WISH LAB

Welcome to WishLab

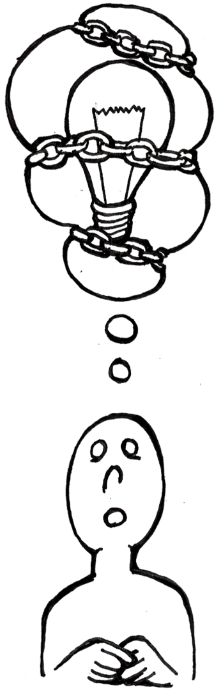
When mass-production fails us, when we desire something more personal and unique, who can we to go with our wishes? For a custom suit or gown we can look up a local tailor. Carpenters will furnish doors and tables to our liking. But where de we go when the objects of our desire involve electronics? Wish Lab specialises in the production of custom electronics that are handmade by a skilled team of artists, engineers and designers.

WishLab aims to promote a new attitude towards electronics production; away from one-size-fits all devices, to tailor made solutions. For this scenario to work we need both tailors and people to tailor for. WishLab creates a space for these two parties to come together.

WishLab workers come from a variety of disciples, with an interdisciplinary approach to making and a keen interest in hacking and re-imagining electronics. Wishes can come from anyone and an important part of the WishLab process is to identify, collect and interpret wishes from people.

This booklet intends to be a resource for all artists, engineers and designers interested in making electronic wishes come true.

Electronic Desires

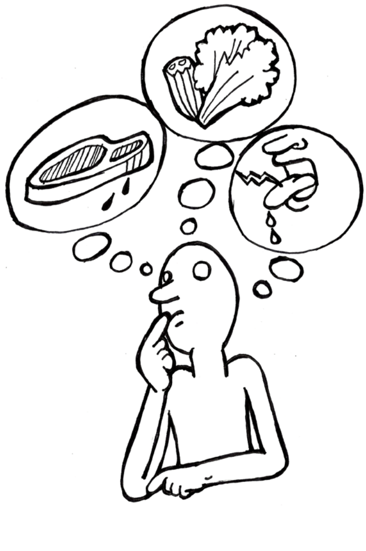


One might expect the hardest part of the wish-making process to be learning electronics in order to build functioning devices. But this is not the case. The trickiest part of realizing wishes is to identify them in the first place and then interpret them in a meaningful way. While we would hesitate to say that there is a *correct* way to interpret a wish, there are definitely strategies to identifying their underlying desires. Once a desire has been identified, one can go about satisfying it.

An electronic desire is an expression of individuality. The electronics industry has steered electronics production towards a one-size-fits-all, standardized production. And we have grown accustomed to this portrayal of electronics. We have come to think that personalising our electronics is about buying skins for our smart phones, putting stickers on our laptops and choosing an operating system. No! Truly personalised electronics come from deep urges and inner cravings that we have learned to suppress. It is very important that we make efforts to unleash our electronic desires and learn to communicate, identify and address them. Only then can we bring about an electronic diversity in a world currently full of uniform solutions.

Unleashing electronic desires is no easy task. Whether our own, our friends or a complete stranger's. We are not accustomed to thinking of electronics as customisable goods. Our perception of electronics is formed by what already exists and we tend to base our desires on what we have seen before.

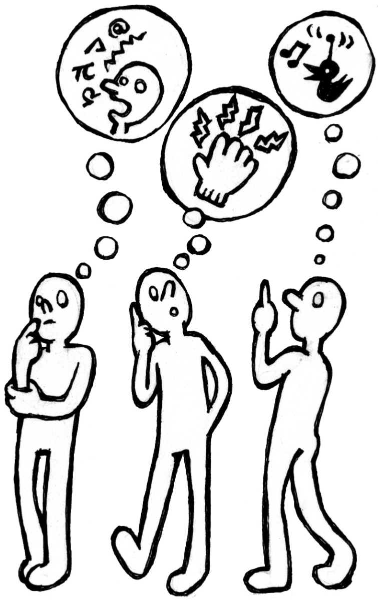
Just like any other desire, some electronic desires make themselves very clear, like the craving for a bloody steak or a fresh green salad. Other times the desire surfaces but can only be vaguely expressed; like the urge to eat something sour or mushy. Even at other times we simply feel uncomfortable and cannot pinpoint a concrete complaint and don't know what to do to make ourselves feel better. Some people keep mood diaries to detect patterns in their lives to help them determine what might be causing them suffering. Similar exercises can be used to help us identify opportunities for electronic desires. Desires often arise in conversation. Desires sometimes manifest themselves as problems. By observing somebody you may become attentive to an obvious problem or difficulty they experience which they could not have identified themselves.



As a WishLab maker, you must be sensitive to identifying electronic desires. You employ strategies such as charting activities, observation and conversation as tools; and of course, your own creativity in recognising opportunities for intervention comes in handy at all times.

Once a desire has been identified and formulated into a wish, whether through a specific request, such as “I want an umbrella that sings in the rain”, or through an observation, such as “my monther always looses the TV remote”, the full picture must be taken into account. An expressed wish is not always the true wish. Sometimes you crave chocolate when really you desire a hug or a hot fire. Somebody might wish for a propellor hat when really they need to be tickled awake in the morning. Underlying desires should always be taken into account,as well as details about the person who expressed the wish. It is not always possible to gather all information but as many details as possible should be taken into account when making a wish come true.

We call the process of of interpreting wishes *Wishstorming*. Wishstorming is a highly creative process and must be taken seriously. Time must be taken to allow ideas to form and be evaluated. Often when interpreting a wish, a solution immediately jumps into mind. These immediate ideas are normally either very good or very bad. The trick is to write them down (always write everything down!) and continue Wishstorming.



WishLab Thinking

Think of electronics as a medium, not a science. Don't make the mistake of thinking that you need to understand everything about electronics before you are able to make electronics. A good and talented painter does not need to know the science behind the pigments in his paint, he will learn a lot about the paint's properties and possibilities through experimentation and being creative with it.

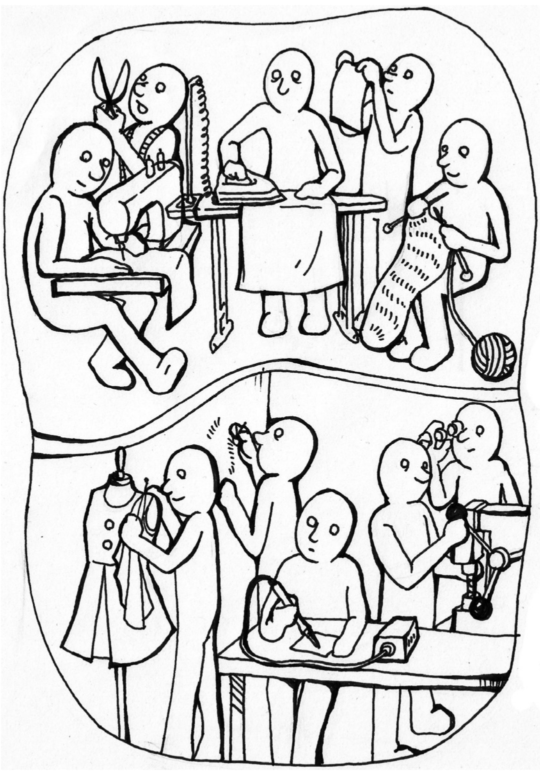
WishLab electronics often build upon surprisingly simple circuits and electrical principles. Besides being skilled craftsman in their own disciplines, WishLab makers have a sound grasp of a few basic electronics principles. They are familiar with a variety of conductive materials ranging from metal wires to conductive fabrics and paints, and are capable of using these materials to build functioning electronics in extremely creative ways.

While the electronics used to make many WishLab wishes come true may be very basic, a great deal of ingenuity comes from conceptual design and creativity. Aesthetics and materiality are important when it comes to making electronic wishes come true.

Lets not forget that while we have the ability to desire the undesirable, electronics do have limitations. Electronic desires might not all be electrically feasible (yet) but in almost all cases there is a creative way to tackle the wish and create something that will address the desire.
While most WishLab makers are not electrical engineers, they are good at working between disciplines and at improvising and collaborating in order to do so.

Whats with all the textiles?

As you continue to read this booklet you'll notice the frequent mentioning of "conductive thread" and "soft circuits". Electronic Textiles (E-Textiles) is a field of electronics that makes connections between engineering and traditional textile crafts disciplies. E-Textiles is a great diving board for jumping to new ideas when it comes to electronics simply because we're not used to thinking of electronics as soft, fabric, coulourful and wearable, and because there are no conventional ways to make; for example, a pillow that talks back when you talk in your sleep. E-Textiles challenges us to come up with new ways of making electronics outside the standardized sytem of mass-production.



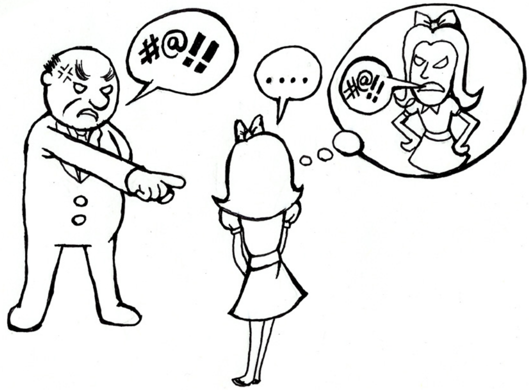
Wishes Come True

At the end of the wish-making process a wish has come true.

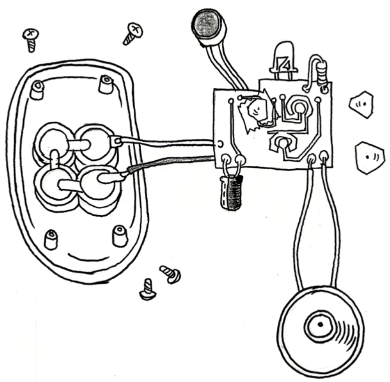
Can you remember the last time you made something? That moment when you were finished and what you had been making was no longer a project but had become a finished piece. The feeling you get from a job well done feels pretty amazing. Showing what you have made to friends or colleagues helps you see your creation through their eyes and further appreciate what you have achieved. When a wish maker has finished making a wish come true, part of the completion process is to hand over the result in person. Handing over wishes is an important step in the making process. It insures that the maker can let go of their creation and see that all the hard work that went into making something is appreciated by the person they made it for.

The following pages show the wish-making process and explain in some detail how certain wishes were made come true.

“I want to swear back in public”



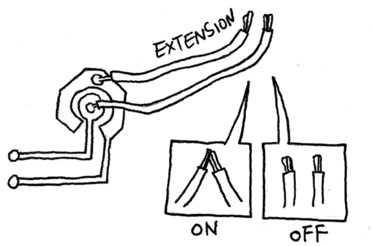
This wish came from a young woman who was upset by a recent incedent where an angry elderly men started shouting and swearing at her for no good reason. She wanted to shout and swear back but she couldn’t.
In response to this expression of frustration, WishLab designed and built The Swearing Brooch. The Sewaaring Brooch will shout back the most unimaginable swearwords you would never dare say out loud. Swearing is triggered by a hidden switch in the shape of a teardrop at the end of a piece of ribbon. The angry old man will never know who is responsible for the horrible words.

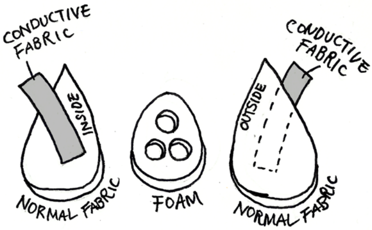


To make this wish come true a “record and playback” toy was hacked and remade into a brooch.

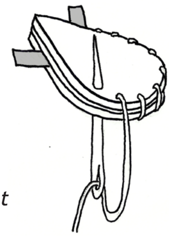
Open up the voice recording toy. It contains a speaker, microphone and main circuit board that contains three buttons. Underneath the push button metal bits is the button circuit; basically two separate conductors which are bridged when you press down the metal bits.

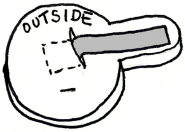
You can hack this button circuit extend the conductive pads by soldering wire to them.Now if you touch the two wire ends together the circuit behaves as if the button is pressed. One of the button triggers to record and the other to playback the recorded sound. We extend both of the buttons with extra wire.



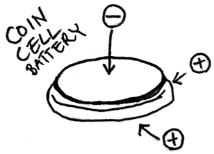


Make the fabric button using conductive fabric as the contacts and perforated foam as the spacer material. The buttons are teardrop shaped and placed at the end of a decorative ribbon that connects them via conductive thread and an wire extention to the button pads on the circuit board.



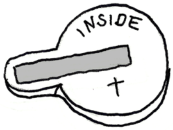


Use neoprene and conductive fabric to construct a tight fitting neoprene pouch for a coin cell battery.



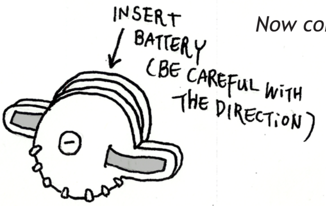
Trace the shape of the coin cell battery on to the neoprene two times. It is better to be tight than loose. Add a tab to the circular shape to use it as connection later. Cut out the shapes.

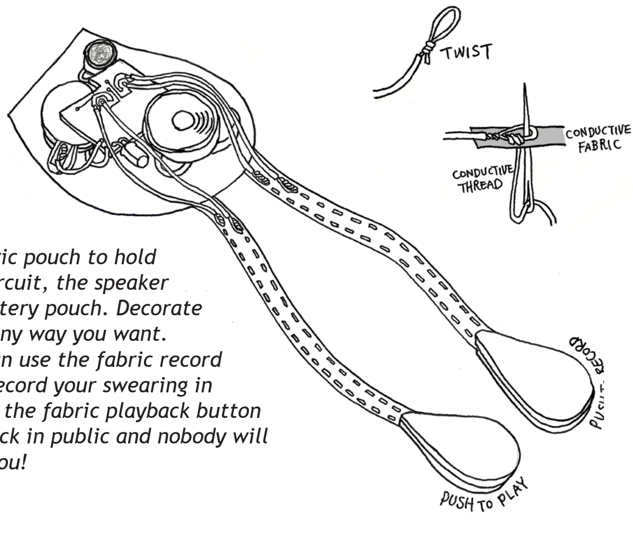
Fuse some fusiible interfacing to two small strips of conductive Make a small slit on one of the neoprene pieces as you can see in the illustration. Take off the backing paper and fuse the thin strip of conductive fabric onto the neoprene, one of them as whole, and the other through the slit as shown in the illustration.



Place the neoprene pieces on top of each other with the conductive fabric tabs facing inside. Sew the edges together leaving space to insert the battery. The slit side faces the negative (-) side of the battery, the other side faces the positive (+) side of the battery.

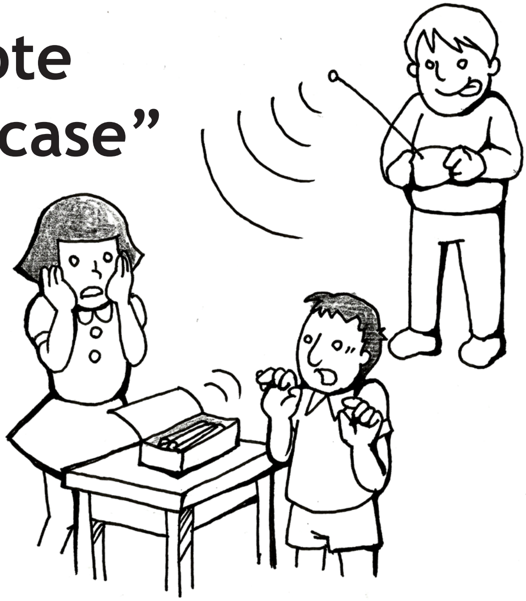
Now connect the battery pouch to the circuit.





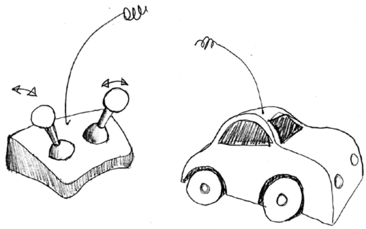
Make a fabric pouch to hold the main circuit, the speaker and the battery pouch. Decorate the pouch any way you want. Now, you can use the fabric record button to record your swearing in private and the fabric playback button to swear back in public and nobody will know it is you!

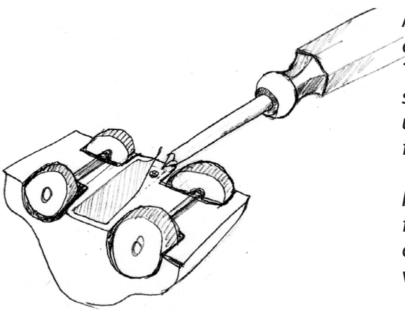
“I want a remote control pencil case”



Submitted by a primary school student, this wish for a remote control pencil case could be interpreted in many different ways. WishLab chose to interpret the wish quite litterally and built a pencil case whose lid can be opened and closed via remote control, allowing the person with the remote to play all kinds of silly tricks on his or her fellow class-mates.

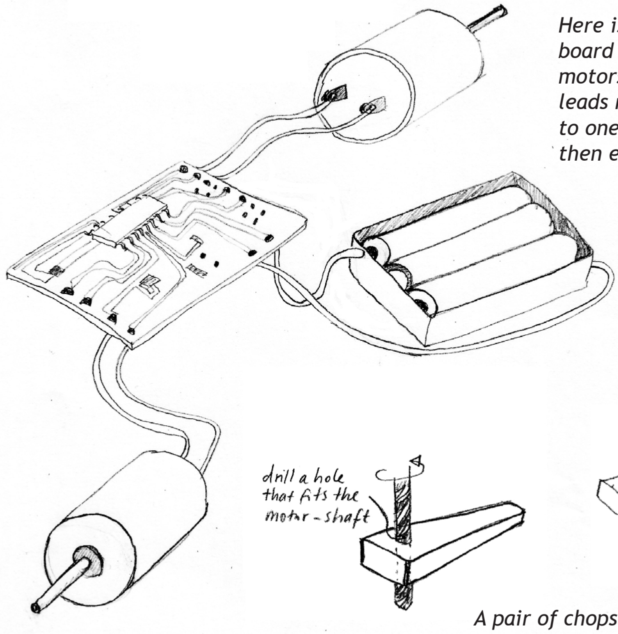
This wish was made come true by hacking a cheap remote control car and re-making the motor mechanism that normally drives the car forwards and backwards to make it open and close the lid of a pencil case.



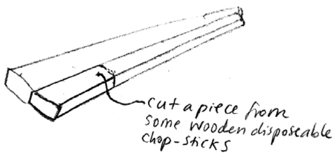


Most electronic toys and gadgets can quite easily be opened up and reverse engineered. The screws on some devices are hidden behind stickers, but once these are located and unscrewed, the casing opens up to reveile the insides.

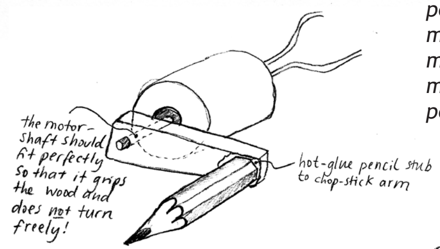
For this project, the remote control was left intact; only the car was opened up and the circuit that receives the remote control signal with the motors attached was removed.

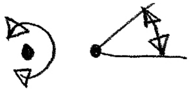


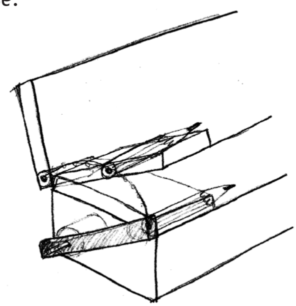
Here is an illustration of the circuit board removed from the car with two motors and battery attached. The leads running from the circuit board to one of the motors were cut and then extended.

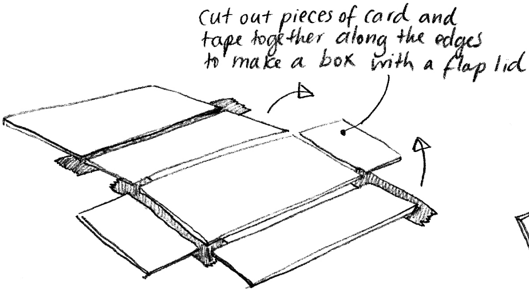


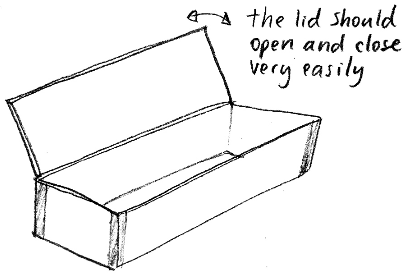
A pair of chopsticks and a short pencil were repurposed into a lever mechanism that turned the rotaional movement of the motor into a linear movement that opened and closed the pencil case.









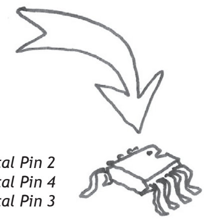


The pencil case was made by cutting pieces of cardboard and sticking them together with tape. The outside was decorated with pens and stickers.

“I want an umbrella that sings in the rain”

Whether this wish was submitted by somebody who really dislikes rainy days or is a fan of “singing in the rain”, we’ll never know.
But the wish was made come true by translating the actual electrical resistance of raindrops into musical notes played through speakers on the umbrella.
With this umbrella, even the most rainy of days are made enjoyable!

To make this wish come true an ATtiny microcontroller was programmed using the Arduino environment and an Arduino board as a programmer. The circuit was made by stitching a conductive copper thread to the fabric of the umbrella and then soldering the components directly to the thread.



Here is a breakdown of the code that was programmed to the microcontroleler:

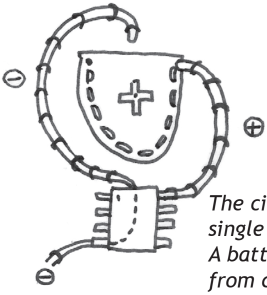
The first part of the code is where we define our variables. Giving names to pin numbers that indicate what function they will have.

Inside the “setup” function we assign the pins of the microcontroller to do different things. Analog pins ADC 1, 2 and 3 will read the electrical resistance of the raindrops and digital pin 0 will play the frequency to the speaker.

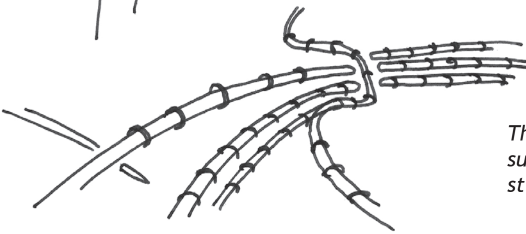
Inside the “loop” function we tell the microcontroller to continuously read the value of the analog input pins. If one of the incoming values is less than a certain threshold, it should take that value, translate it into a note, and play it out through the speaker. The threshold should be a value that can only be reached when a raindrop hits the rain sensor.

The “playNote” function translates our note into an audio signal by pulsing the pin on/off at the frequency of the assigned note.

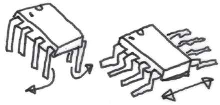
```
#define speakerPin = 0;
#define sensorPin1 = 1; // ADC 1, digital Pin 2
#define sensorPin2 = 2; // ADC 2, digital Pin 4
#define sensorPin3 = 3; // ADC 3, digital Pin 3
#define rainThreshold = 900;

void setup() {  // this is the setup function and is only called once
  pinMode(speakerPin, OUTPUT);
  digitalWrite(2, HIGH); //set internal pull-up ADC 1
  digitalWrite(3, HIGH); //set internal pull-up ADC 4
  digitalWrite(4, HIGH); //set internal pull-up ADC 3
}

void loop() { // this is the loop function and is only called over and
over again
  int sensorValue1 = analogRead(sensorPin1);  // read values coming
from ADC 1
  int sensorValue2 = analogRead(sensorPin2);  // read values coming
from ADC 2
  int sensorValue3 = analogRead(sensorPin3);  // read values coming
from ADC 3
  if(sensorValue1 < rainThreshold) playNote(speakerPin, 760, 400);
  if(sensorValue2 < 900) makeNoise(speakerPin, 1200, 400);
  if(sensorValue3 < 900) makeNoise(speakerPin, 3600, 400);
}

// the playNote function plays the frequency to the speaker
void playNote(unsigned char pin, int frequencyInHertz, long
timeInMilliseconds) {
  long delayAmount = (long)(1000000/frequencyInHertz);
  long loopTime = (long)((timeInMilliseconds*1000)/
(delayAmount*2));
  for (int x=0;x<loopTime;x++) {
    digitalWrite(pin,HIGH);
    delayMicroseconds(delayAmount);
    digitalWrite(pin,LOW);
    delayMicroseconds(delayAmount);
  }
}
```

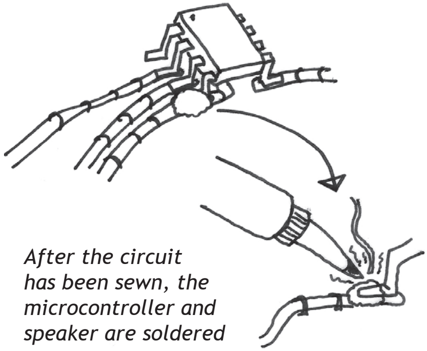


The circuit is powered by a single 3 V coin-cell battery. A battery pouch is made from conductive fabric and sewing the conductive thread leads to either side of the battery.

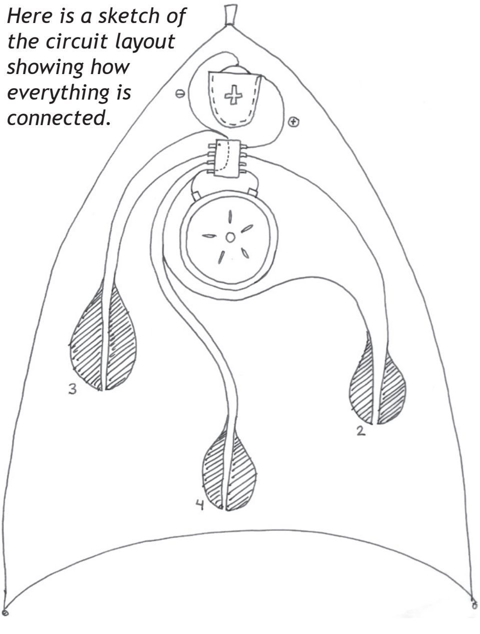


The conductive thread is sewn to the surface of the umbrella using a couching stitch.

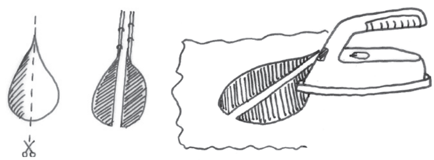




Here is a sketch of the circuit layout showing how everything is connected.



After the circuit has been sewn, the microcontroller and speaker are soldered on.

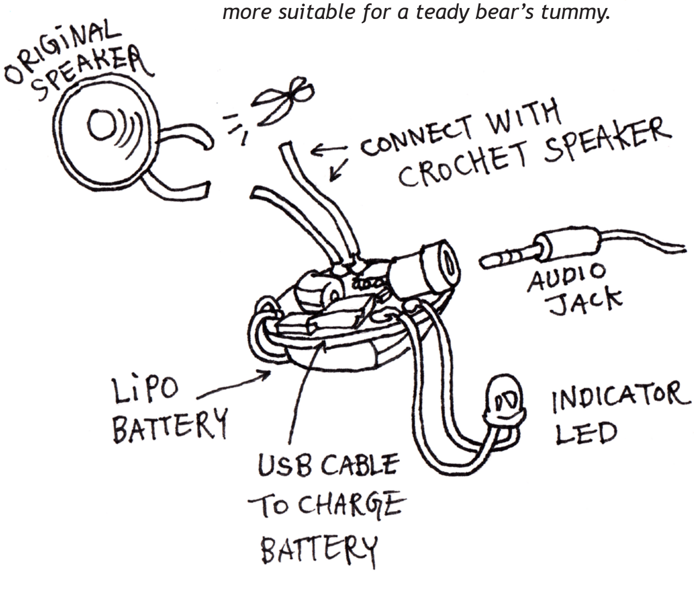


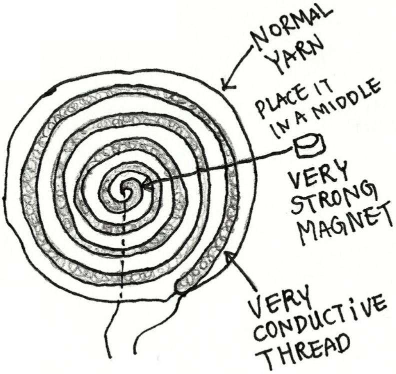
The rain sensor is a raindrop shaped design made from two pieces of conductive fabric that are fused to the surface of the umbrella with a very small gap between. When a raindrop bridges this gap, rain is detected.

“I want a teddy that plays my MP3s”

This wish was submitted to a WishLab by somebody who wanted to lay their head on their teddy bear to listen to their favorite songs. A WishLab member with good sewing and crochet skills took it upon herself to make this wish come true.

To make this wish come true, a cheap portable speaker was hacked upen to re-use the amplification circuit as well as the re-chargeable battery. The wires to the speaker were cut so that the speaker could be replaced by a crochet speaker, much more suitable for a teady bear’s tummy.

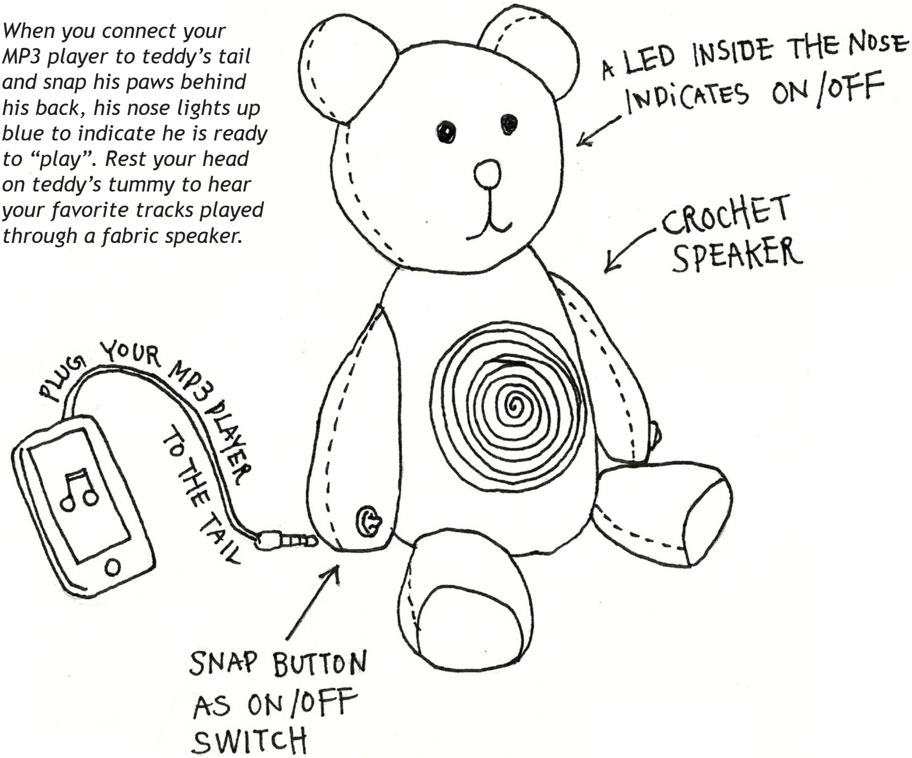




The speaker is crochet from conductive thread with rows of non-conductive yarn seperating the conductive rows so that it forms a spiral as shown in the illustration.

A small but strong magnet is mounted behind the center of the coil. When the audio signal flows through the coil it repells and attracts the coil form the permanent magnet. The crochet speaker coil vibrates as the membrane of the speaker, sending audio waves through the air and into our ears.

When you connect your MP3 player to teddy's tail and snap his paws behind his back, his nose lights up blue to indicate he is ready to "play". Rest your head on teddy's tummy to hear your favorite tracks played through a fabric speaker.

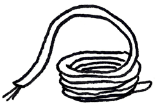


This booklet is accompanied by a kit of materials that are inteded to get you started making wishes come true. The following pages describe what these materials are and show you examples of what you can do with them.

Conductive Materials

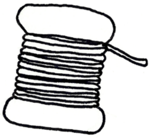
When working with electricity, one obviously needs materials that are conductive to conduct the electricity. Conductive materials come in all kinds of shapes and sizes and can be used in a whole variety of ways to control the flow of electrons to your liking.

Wire



Wire is the most common thing used for making an electrical connection from A to B. Wire comes in various thicknesses and degrees of flexibility. Single core wire is stiffer than wire made from many thin strands (multi-stranded). Wire can be cut, bent, twisted and soldered.

Conductive Thrread

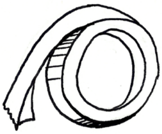


Conductive thread tends to have a higher electrical resistance than wire but can nevertheless be used to sew electrical connections. Softer conductive threads have a synthetic core that has been plated with a thin layer of metal such as silver. The metal layer is normally very thin and the core thread synthetic so that they are not solderable. Stiffer conductive threads are spun from very thin metal wires and can be both sewn and soldered to.

Conductive fabric

Most conductive fabrics are regular fabrics that have been plated with metals such as silver, copper or nickel. The layer of metal on the fabric is normally so thin that you can not achieve a good connection by soldering to the fabric but if you solder at a lower temperature and use a lot of flux it can be possible to make a delicate connection that will need to be reinforced in some way so as not to tear.

Copper Tape



Copper adhesive tape is great for layout out circuits on paper or any other flat, flexible or curved surfaces. Copper tape is highly conductive and solderable. While the adhesive is often also intended to be conductive it is not always possible to make reliable electrical connections simply by overlapping two pieces. Soldering in addition to overlapping is recommended.

Metal Things

Metal beads, snap fasteners/poppers, zippers, saftetey pins, hook and loops.... All things metal can be used in nifty ways to create create such things as pluggable/detachable fabric connectors and tilt switches.

Magnets

Magnets are not only magnetic but also conductive. This makes them another candidate for making detachable electrical connections. Magnetic fasteners can easily be sewn into a circuit using conductive thread. And of course magnets are also magnetic and can be used as such when building your own speakers.

Resistive Materials

Resistive materials are conductive with a high electrical resistance. In most cases their resistance is so high that they are no good at making connections from A to B because they don't let enough power through the circuit to reach the parts that need it. Instead, resistive materials are great for building custom sensors such as sliders and knobs as well as stretch, squeeze and pressure sensors.

Velostat

Velostat is the commercial name for a carbon infused plastic sheet that has a stable resistance across it's surface and a variable resistance through the material. It can be cut and used to make sliders and knobs, and layered between conductors to make pressure sensors. And cut to the right size you can make your own resistors.

Stainless Steel Yarn

A yarn spun from short stainless steel fibers blended with polyester. As the steel fibers are short, electricity can only flow through the few points where they make contact. Compressing the yarn (through stretching or squeezing it) causes the fibers to make better contact and the yarn to become more conductive. This yarn is perfect for knitting and crochet.

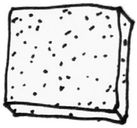
Steel Wool

Steel fibers blended with real wool. The steel fibers only conduct electricity through their points of contact. Compressing the fibers together makes it more conductive. The blend includes real wool so it is great for felting.

Non-Conductive Materials (Insulators)

Just because a material isn’t conductive, that does not mean it is electrically uninteresting. Every circuit relies on non-conductive materials to insulate conductive parts from one another. Besides simply insulating conductors, insulating materials also have interesting properties of their own.

Foam



Polyester foam is porous and squishy and works great as a separation layer between conductors when making soft pushbuttons.

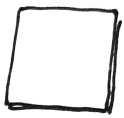
Beads

You can use glass or plastic beads to isolate, decorate or mark conductive thread by simply threading the conductive thread through the bead.

Polymorph (Thermoplast)

Also known as “friendly plastic” or “shapelock” this material comes as white pellets of a plastic that deform at a low temperature (<100°C). Submerging the pellets in hot water causes them to become transparent; indicating that they can be shaped into almost any shape. As the material cools off and hardens it becomes white again. Itcan be reheated as often as needed.

Fusible Interfacing



Also known as “fusible web” or “iron-on”, this translucent white sheet is a fabric glue that melts when heated by an iron and fuses together the materials on either side of it. Most fusible interfacing comes adhered to wax paper so that you can first apply it to one material by ironing on the wax paper side, cut out the shape you desire and then peel away the wax paper and iron the two materials together. Make sure you never iron the glue directly as it will make a mess of your iron.

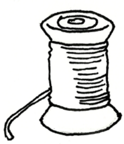
Neoprene

Neoprene is a vulkanized rubber with fabric fused to either side. You can stitch conductive thread inside the material to isolate and protect it.

Felt

Felt is a non-woven fabric that can easily be cut to shape and sewn together.

Sewing Thread



Regular thread is for sewing things together, either by hand or with the machine.

Yarn

Regular yarn, whether wool or synthetic, can be used in combination with conductive materials as in insulator.

Electronic Parts

We’ve selected a few of the most common electronic parts that you might find inside electronics when you open them up.

Coin-cell Battery

Coin-cells are flat, round batteries about the size of a coin. One side of the coin cell is the positive supply and the other negative. They provide 3 volts to power small circuits, microcontrollers or LEDs.

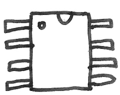
LED

LEDs (Light Emitting Diodes) are special diodes that emit coloured light when powered. There are LEDs available for every colour, even for invisible IR and UV light. The two legs must be connected the right way round for the LED to work.

Transistor

Transistors are the most basic digital component. They have three legs: a “base”, “emitter” and “collector”. When a small current is applied to the base, the transistor will let a larger current flow from the collector to the emitter and so become a digital switch or amplifier.

Microcontroller



Microcontrollers are processors with input and output pins that can run code to do just about anything. They are the brains inside every washing machine, MP3 player, calculator, and printer. Most modern electronics contain at east one microcontroller.

Resistor

Resistors limit the flow of current in an electrical circuit. For example a resistor can be used to reduce the brightness of an LED. Coloured bands indicate the value of each resistor.

Capacitor

Capacitors store small amount of electrical charge and function like tiny batteries, each tuned to a specific value. They a often used in power supply and audio circuits.

Diode

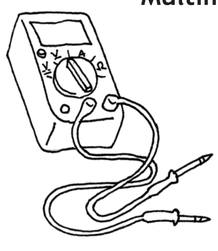
Diodes are “semiconductor” which means they behave like a conductor and an insulter. A diode has two legs, if connected one way the diode is let the current flow like a wire, if connected the other way the diode will block the current like an insulator. This special behavior can be very useful for circuit design.

The WishLab Maker's Toolbox

In addition to the materials included in the WishLab Kit you'll need a few tools to get started. You'd be surprised at how few tools you need to make amazing things. With a screwdriver, a pair of pliers, a needle and some conductive thread you can already repurpose existing electronics to build a variety of new devices. On the other hand there is no limit to how many different kinds of tools you can include in your process to obtain your desired result.

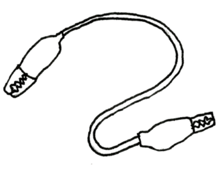
Here are two of our favorite tols for working with electroncis and textiles:

Multimeter



As the name implies, this is a device for measuring multiple things related to electricity. The major things you will end using it for are: measuring continuity (direct electrical connection), measuring amount of resistance between two points and measuring amount of voltage supplied by a battery power supply.

Alligator Clips

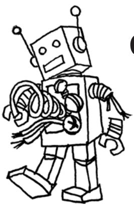


Also known as "crocodile clips". Alligator clips are wires with clip connections at either end. They are great for temporary connections between two points when for testing and debugging your circuits.

When we say that WishLab draws on local materials and resources we don’t mean the naturally occurring resources in a geographic area, but rather the variety of goods available in any surrounding. Discarded toys, used clothing, broken gadgets, free giveaways, anything you can buy in the local shop.

Scrap Electronics

Broken or otherwise discarded electronics are a great resource for functioning materials and parts such as plugs, wires, resistors, motors, LED lights, switches and knobs. Ask around for old cell phones, scanners, electronic toys and gadgets. Check the local scrap yard and second hand shops.



Old Toys

Scavenge your toybox not only for useful materials such as soft toys and rattles but also for inspiration.

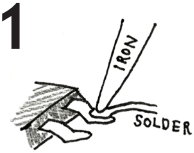
Used Cloths

Cut them up and alter them to suit your project. Old cloths are also a great resource for fabric. Second hand clothing shops are a great way to get small quantities of very specific fabric for cheap.

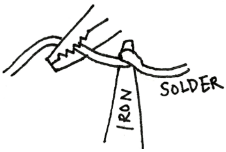
How to solder...

Soldering is a technique of joining metal items by melting solder onto the joint.

1



First apply to solder seperately to the two parts that you want to join.



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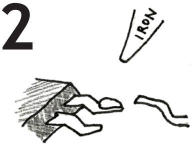
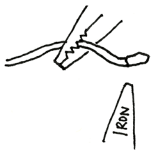
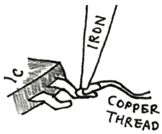


Use the hot tip of a soldering iron to heat up the parts you want the solder to flow on to.

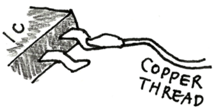


3



Then hold the two parts together and use the soldering iron to re-flow the solder from both parts together.

4

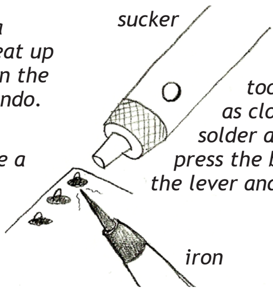


How to desolder...

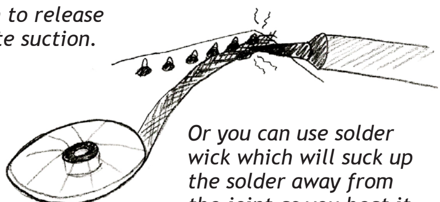
Desoldering is a technique of removing solder from a soldered joint to disconnect parts from one another.

Use the hot tip of a soldering iron to heat up the solder that is on the joint you want to undo.

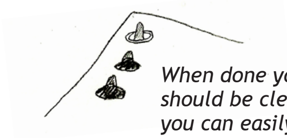
You can either use a de-solder tool to create a suction that sucks away the hot solder.



Push in the lever of the de-solder tool, hold it’s nossel as close to the hot solder as possible and press the button to release the lever and create suction.



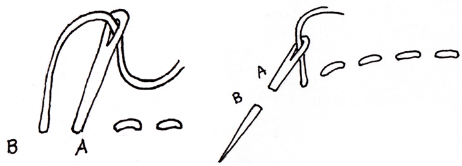
Or you can use solder wick which will suck up the solder away from the joint as you heat it up with the soldering iron.



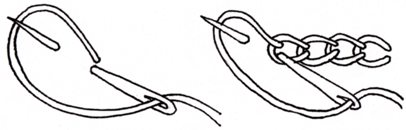
When done your solder joint should be clean of solder so that you can easily seperate the parts from one another.

How to sew...

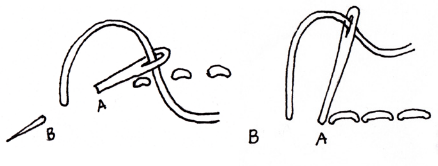
Running stitch



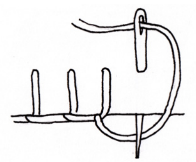
Chain stitch



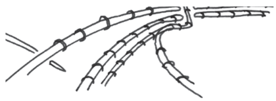
Backstitch



Blanket stitch

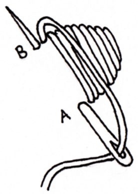


Couching stitch



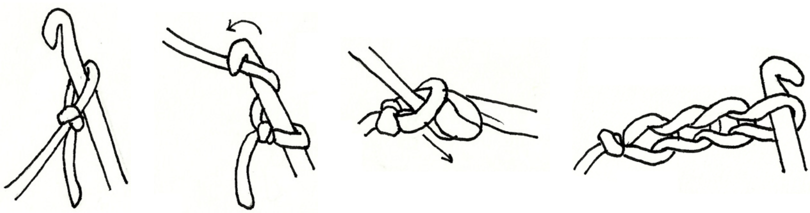
Tent stitch

Fill stitch

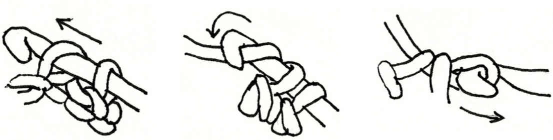


How to crochet...

First row



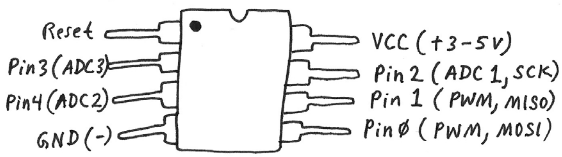
Second row



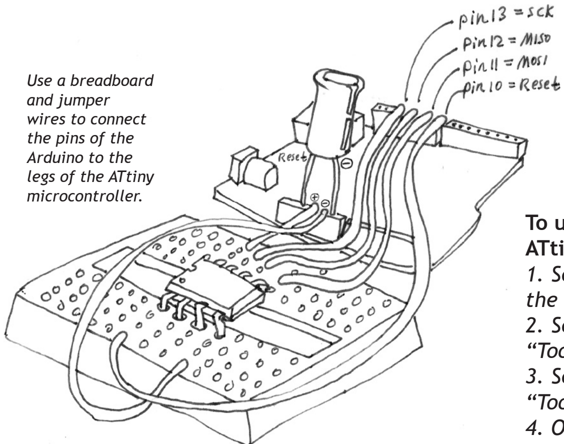
How to program an ATtiny...

The following information is inteded as a quick guide for programming the ATtiny microcontroller with Arduino. ATtinies are microcontrollers with 5 in/out pins amd are small, cheap and relatively easy to program.

To turn your Arduino into an ISP programmer you will need: a laptop with the Arduino software installed, an Arduino Uno or Duemilanove (with an ATmega328), USB cable, ATtiny microcontroller, 10 uF capacitor, breadboard and some jumper wires



To turn your Arduino into an ISP Programmer:
1. Download the Arduino software and install it
2. Download the ATtiny folder and save it in a “hardware” folder in your Arduino sketch folder
3. Restart Arduino
4. Open “ArduinoISP” sketch from “Examples” folder
5. Select “Arduino Uno” or “Duemilanove” from the “Tools > Board” menu
6. Select “/dev/tty.usbserial####” from the “Tools > Serial Port” menu
7. Upload sketch



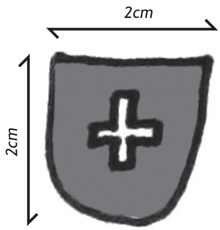
Use a breadboard and jumper wires to connect the pins of the Arduino to the legs of the ATtiny microcontroller.

To use your Arduino ISP to Program an ATtiny Microcontroller:
1. Select “ATtiny45 or 85 (8 MHz)” from the “Tools > Board” menu
2. Select “Arduino as ISP“ from the “Tools > Programmer” menu
3. Select “Burn Bootloader” from the “Tools” menu
4. Open the sketch you want to upload to the ATtiny
5. Upload sketch

Coin-cell Battery Pocket

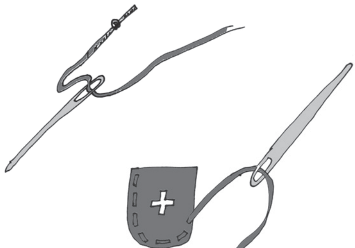
Make a super simple coin-cell battery pocket from stretchy conductive fabric and condcutive thread.

! *The positive and negative contact surfaces on a coin-cell battery are only seperated by a very narrow gap on the bottom side. When making a battery pouch you need to make sure that neither the conductive fabric nor the conductive thread bridges this gap. Bridging the gap with a conductor would result in a short circuit which will drain the battery and cause it to heat up.*

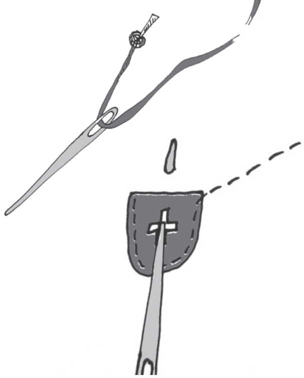


Cut the following shape from stretch conductive fabric.

The + shape in the middle is to indicate that this piece of conductive fabric will be making contact with the positive surface of the coin-cell battery.



Thread a needle with conductive thread and tie a knot in one end. Sew around the edge of the battery pocket and then continue to sew with the thread to the positive lead of your circuit.



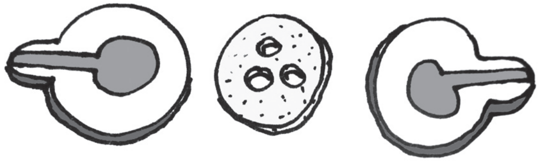
Thread the needle with a new piece of conductive thread and tie a big knot (multiple knots on top of each other) at one end. Stitch right through the center of the + in the battery pocket and then jump out the back about 1 cm away from the conductive fabric pocket as shown in the illustration. The big knot should end up inside the battery pocket and will connect to the negative (-) surface of the battery. With the end of the conductive thread you can sew to the negative lead of your circuit.

! *Your positive and negative leads should never touch when the battery is inside the pocket!*

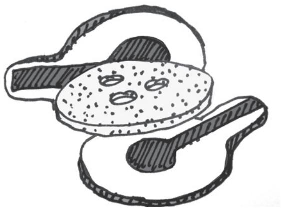
Fabric Pushbutton

Using conductive fabric as the contacts for soft push button and perforated foam as a spacer material, this fabric pushbutton is an extremely basic construction that can be used in many different ways.

Decide on your button shape and cut out two of these shapes from a non-condcutive fabric such as neoprene or felt. You can add tabs to your shape as contact points if fyou like.



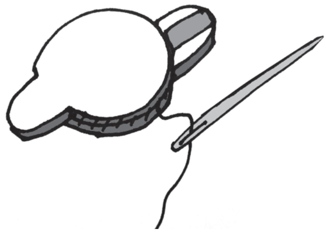
Cut out two pieces of conductive fabric with tabs that reach the edge of your button shape. Fuse these pieces of conductive fabric to your base material.

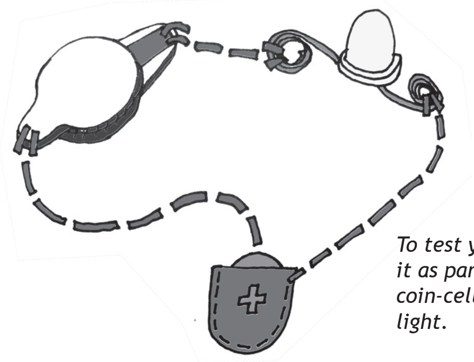


Cut a piece of foam to size so that it covers the conductive fabric but fits inside the button shape. in the center of the foam cut one or more holes.

Layer your materials so that the conductive fabric faces inwards with the perforated foam in between.You can arrange the tabs of your fabric button any which way you want so long as the don't overlap.

Thread a needle with regular sewing thread. Tie a knot in one end and proceed to sew around the edge of your sensor. Be sure to stitch both sides of neoprene together, you do not need to include the foam in your stitch, as it will stay in place.



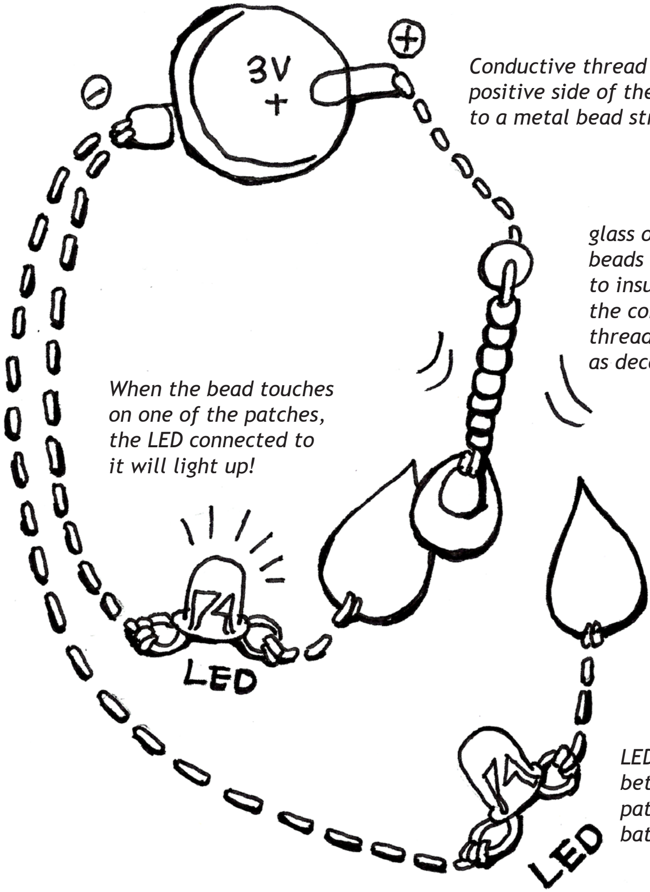


To test your pusbutton you can connect it as part of a simple circuit. Using a coin-cell battery pocket and an LED light.

Beaded Tilt Switch

A super simple tilt switch made from a metal bead strung on the end of condcutive thread, and a patch of conductive fabric nearby.

This sensor is made by stringing a metal bead to the end of a piece of conductive thread. A patch of conductive fabric is fused to the base fabric so that when the metal bead swings to a certain point it makes contact with the patch, closing the switch.



Conductive thread is sewn from the positive side of the battery pouch to a metal bead strung at the end.

glass or plastic beads are used to insulate the conductive thread as well as decorate it.

When the bead touches on one of the patches, the LED connected to it will light up!

In this case two conductive fabric patches shaped like drops are fused to the base fabric on either side of where the metal bead can swing.

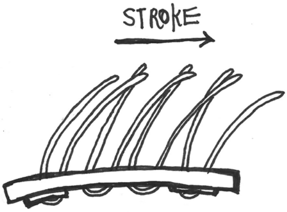
LED lights are sewn in between the conductive patches and the negative battery lead.

Stitched Stroke Switch

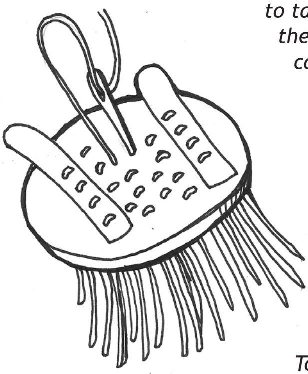
Stitching conductive thread into a neoprene base you can stitch yourself a custom stroke switch. Stroking over the stitched fur causes the hairs of both contacts to touch, closing the switch.

On the peice of neoprene fuse two pieces of conductive fabric to the back side. The distance between the two pieces represents the gap that the conductive fur will need to bridge when stroked.

When you stroke over the fur, from one side to the other, the conductive threads from one side should touch the center ones, and these in turn should touch those on the other end.



Thread the needle with conductive thread, feel free to take the thread double or quadruple. Stitch into the neoprene from the top side (the side without conductive fabric), but don't pull the thread all the way through. After stitching cut the thread at desired fur length, roughly 2cm. Repeat 5 or 6 times. Each time the conductive thread should penetrate all the way through the neoprene and make contact with the conductive fabric fused to the reverse side.

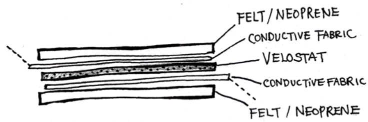


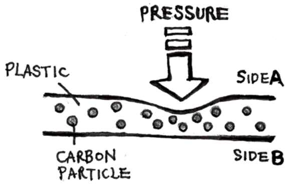
To complete the sensor add some non-condcutive fur by stitching with a non conductive thread. Stitch fur until the sensor is dense and the conductive fur contacts are isolated from one another, yet make contact when stroked.

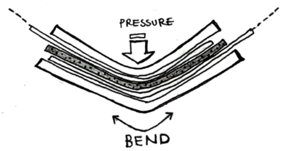
Neoprene Bend Sensor

This sensor is constructed by layering conductive and piezoresistive materials. Velostat is a piezoresistive plastic film that reacts to pressure with a decrease in electrical resistance. The sensitivity of this sensor can be adjusted by controling how large the conductive areas on either side of the Velostat are.

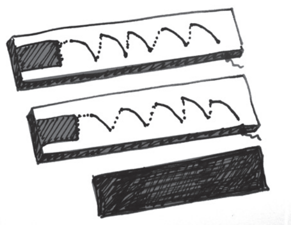
To make a bend sensor with a good range the conductive area should be minimized to just a few points of overlap. To achieve this the contacts on either side of the Velostat are stitched into neoprene as diagonal lines so that when they are sandwitched together they cross and only overlap in one point.

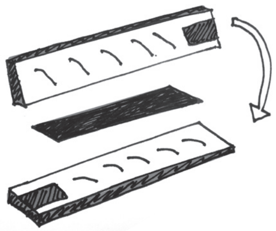




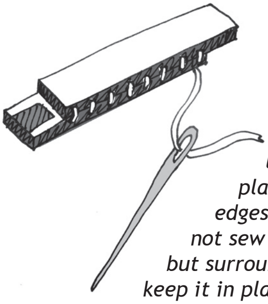


Cut two same size strips of neoprene. Thread the needle with conductive thread and tie a knot in one end. Stitch into the neoprene, exposing the thread in diagonal stitches as shown in the illustrations. Finish sewing the conductive thread by connecting it to a patch of conductive fabric at one end of the neoprene strip. This will make contacting the sensor easier.





Layer a piece of Velostat in between the two pieces of neoprene, with the conductive stitches facing each other. The conductive fabric tabs should be on opposite ends. Make sure the conductive thread and the conductive fabric on either side never touch directly, only through the Velostat.



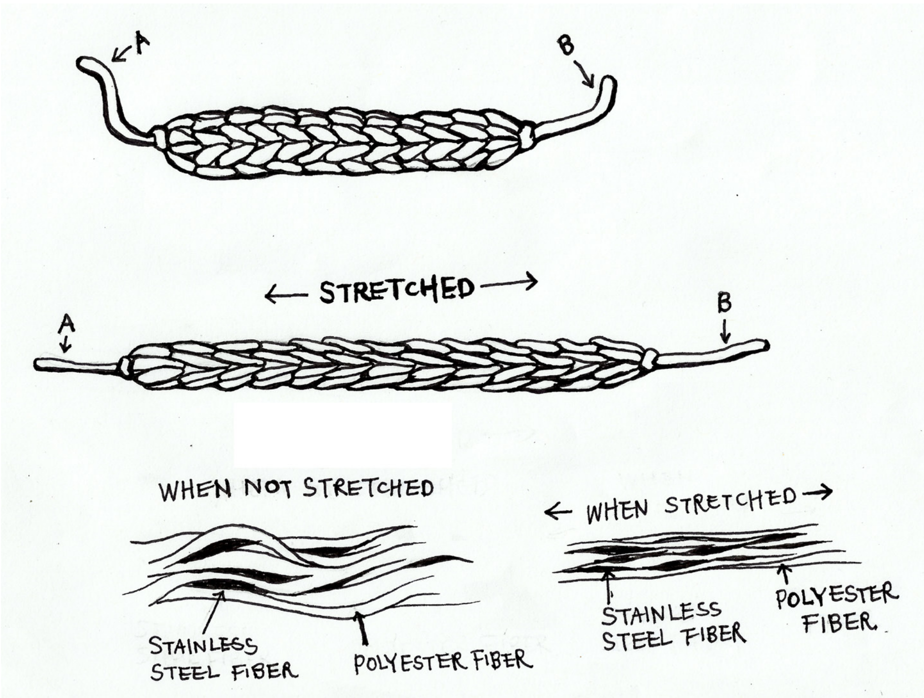
Thread the needle with regular sewing thread. Holding the layered materials in place, stitch around the edges of the neoprene. Do not sew through the Velostat, but surround it with stitches to keep it in place.

To test your finished sensor, connect either end to a multimeter set to measure resistance (Ohm). As you bend or pressure the layers of the sensor together, the resistance should decrease. Depending on the construction of your sensor, the values should range from 2K Ohm to 200 Ohm.

Knit Stretch Sensor

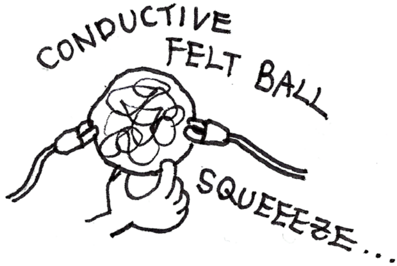
Stainless steel yarn is perfect for knitting or crochetting stretch sensors. The yarn is spun from a stainless stell and polyester yarn blend, making it conductive, but with a very high electrical resistance. When in a relaxed state the individual conductive fibers are not touching much, but when compressed through pressure or stretch, the steel fibers in the yarn make better contact and it becomes more conductive the more it is compressed. We can use this property of the yarn to sense stretch or pressure.

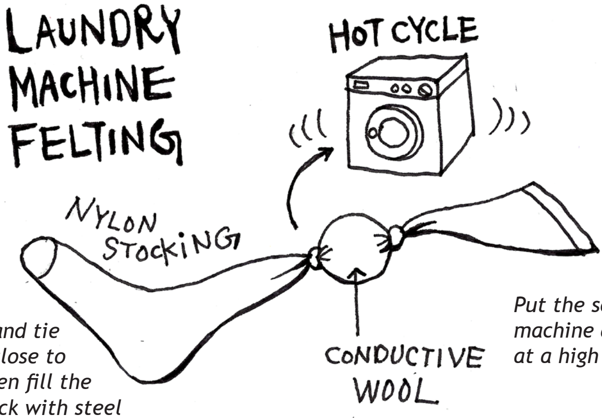
A single strand of yarn can already be used as a stretch or pressure sensor. But you can knit or crochet the yarn into any shape you like to make it more stretchy or squishy and giving you some feedback when manipulting the material.



Felted Pressure Sensor

When wool fibers are stimulated by friction and lubricated by moisture, they lock to each other and are “felted”. You can felt steel yarn into a conductive felt ball as it contains natural wool. This felt ball will act as pressure or squeeze sensor as it gets more conductive when the steel fibers are compressed.



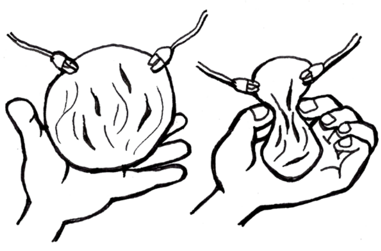


Take a sock and tie a knot in it close to the heel. Then fill the leg of the sock with steel wool fibers and tie another knot at the other end to form a ball shape as shown in the illustration.

Put the sock in the washing machine and wash with soap at a high temperature.

After washing, remove the felt from inside the sock and it shoudl have felted itself together into a nice ball.

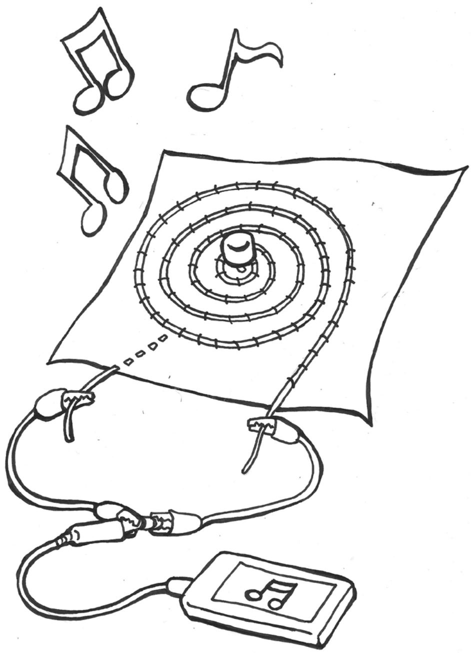
To test your finished sensor, connect either end to a multimeter set to measure resistance (Ohm). As you squeeze or pressure the ball, the resistance should decrease.



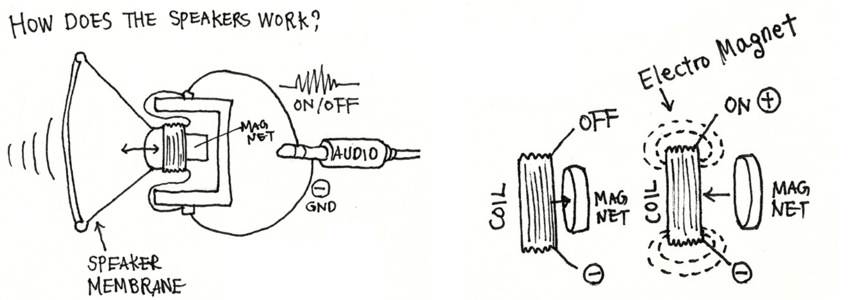
CONDUCTIVE WOOL BALL

Embroidered Speaker

Before embroidering your own speaker, it's probably not a bad idea to understand how a speaker works. One good way to understand is to take apart an existing speaker.



When you look inside a speaker you will see tha it is made up of: a plastic membrane, a very tightly wound coil of very thin wire (magnet wire/enameled wire) and a magnet. The speake has two contacts, and theseare connected to either end of the wire coil. The wire may look like it is uninsulated and thus all touching, but in fact the wire is insulated, forcing the electricity to flow through the whole coil to reach the other end. The flow of electricity through the coil creates a magnetic field arounc the coil, making it an electromagnet. This magnetic field fluctuates with the frequency of the audio signal. Every time the signal is low the coil looses it's magnetic field and is not attracted to the permanent magnet, every time the audio signal is high, electricity flows and the coil is attracted to the permanent magnet. Thus the coil and the magnet are constantly repelling and attracting each other very very quickly. Because the coil is connected to the plastic membrane every time it moves (repel/ attract), it moves the membrane and the membrane moves air, creating the sound waves that our ears can hear.



An embroidered speaker will work the same way, but instead of winding the coil around a cylinder it is embrdoiered on to fabric. The strength of the speaker depends on a few things: the strength of the electromagnet (conductivity of the coil, how many turns the coil has…), the material of the membrane (stiff vs. soft), the strength of the permanent magnet, and the amount of power running though it.

Thank you for reading!

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