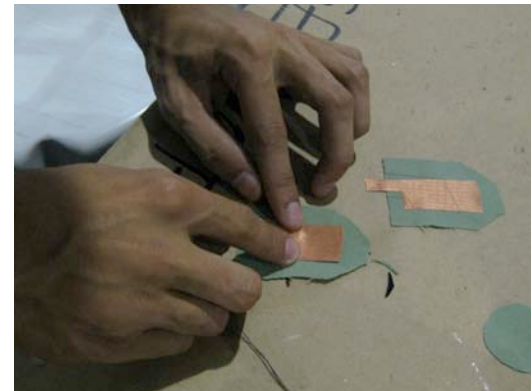
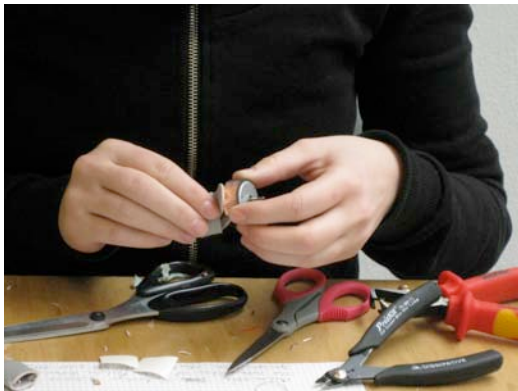


Handcrafting Textile Sensors from Scratch



Materials

Conductive

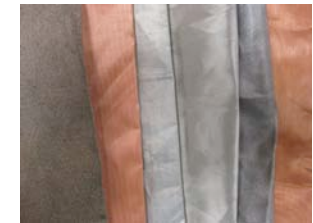
- Stretch conductive fabric - Silver plated Nylon
- Conductive thread - 117/17 2ply silver plated Nylon
- Conductive thread - 234/34 2ply silver plated Nylon
- Metal beads

Conductive with high resistance (resistive)

- Resistive thread - 66 Yarn 22+3ply 110 PET
- Resistive yarn - Polyester and Inox steel fiber
- Velostat/Linqstat - Carbon impregnated Polyethylene film

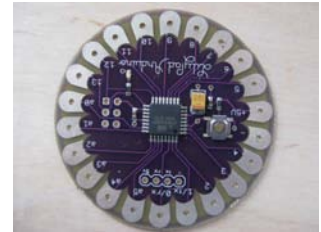
Non-Conductive (isolating)

- Neoprene - 1.5mm with polyester jersey fused to both sides
- Felting wool
- Foam
- Fusible Interfacing - "Iron-on"
- Anti-fray or Fabric glue



Tools

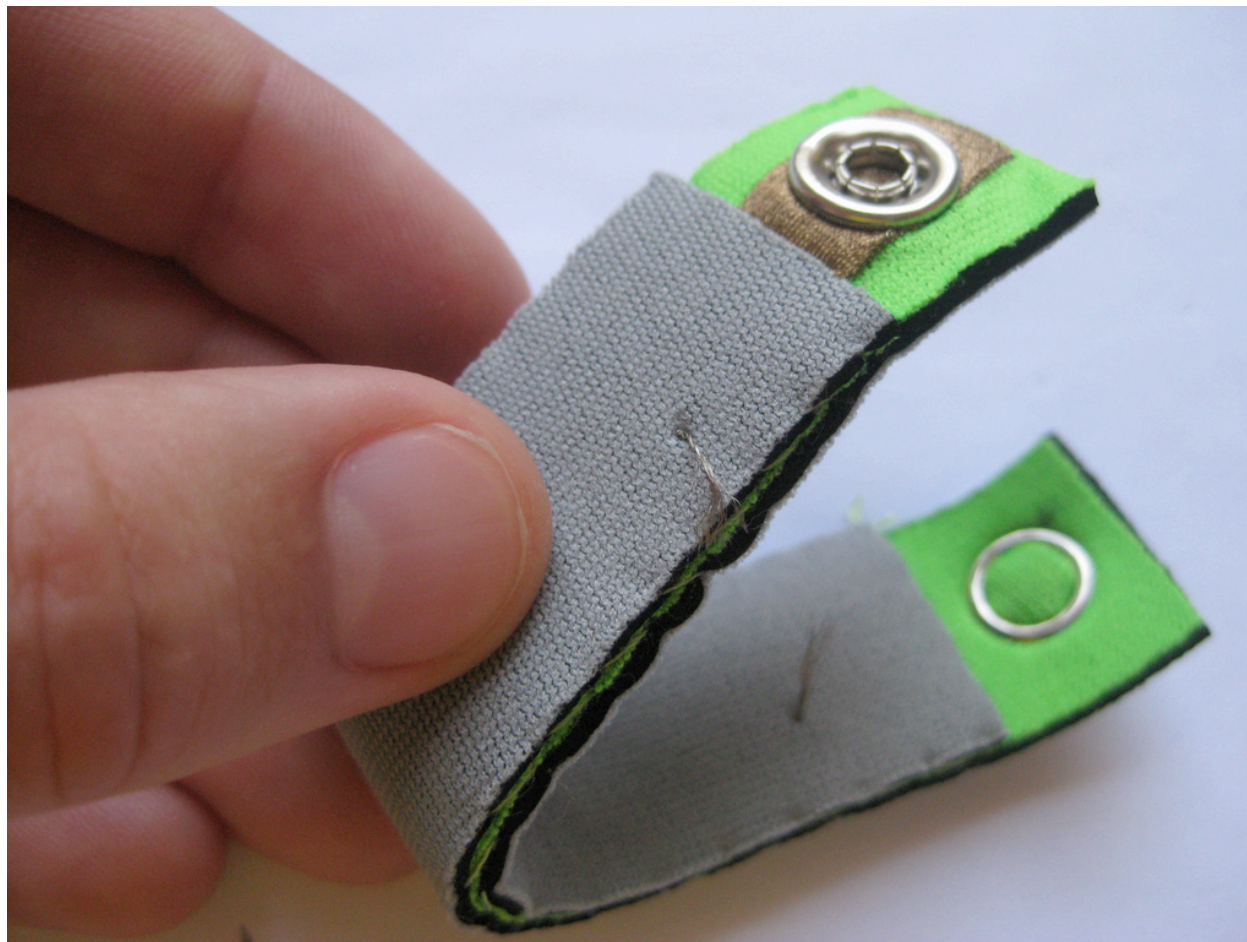
- Sewing needles
- Knitting needles
- Crochet hooks
- Circular knitting machine
- Spool knitter
- Needle felting tool
- Needle felting mat
- Hole maker
- Iron
- Multimeter
- LilyPad Arduino Mainboard
- LilyPad sewable LEDs



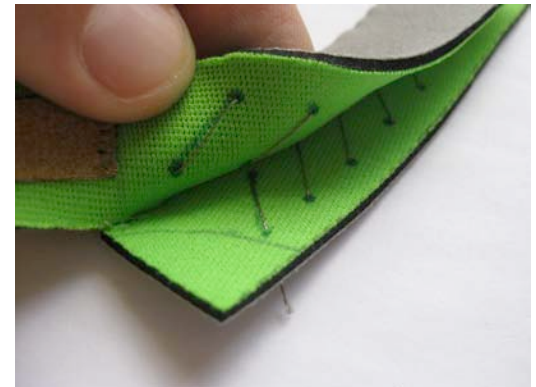
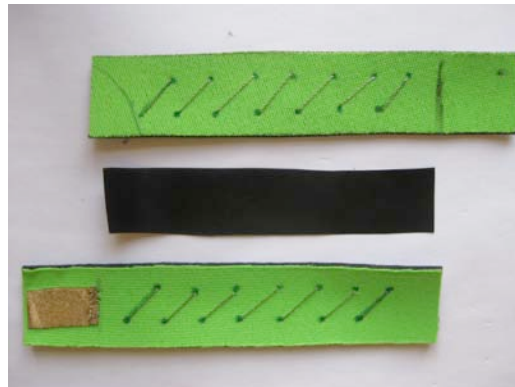
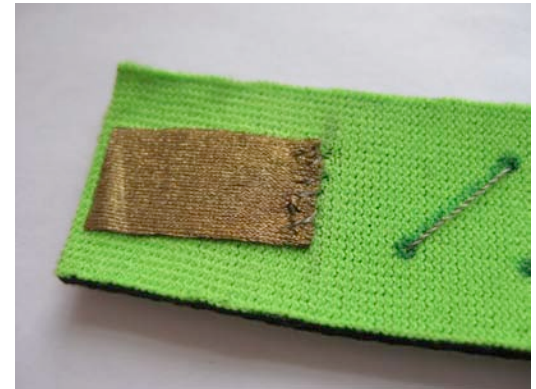
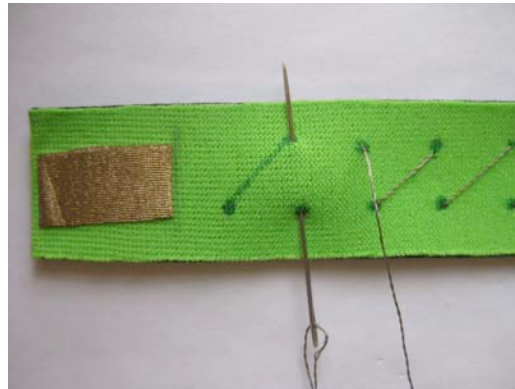
Textile Sensors

- Fabric Button
- Pressure Sensor
- Pressure Sensor Matrix
- Bend Sensor
- Tilt Sensor
- Fabric Potentiometer
- Crochet Potentiometer
- Stroke Sensor
- Knit Stretch Sensor

Bend Sensor



Bend Sensor

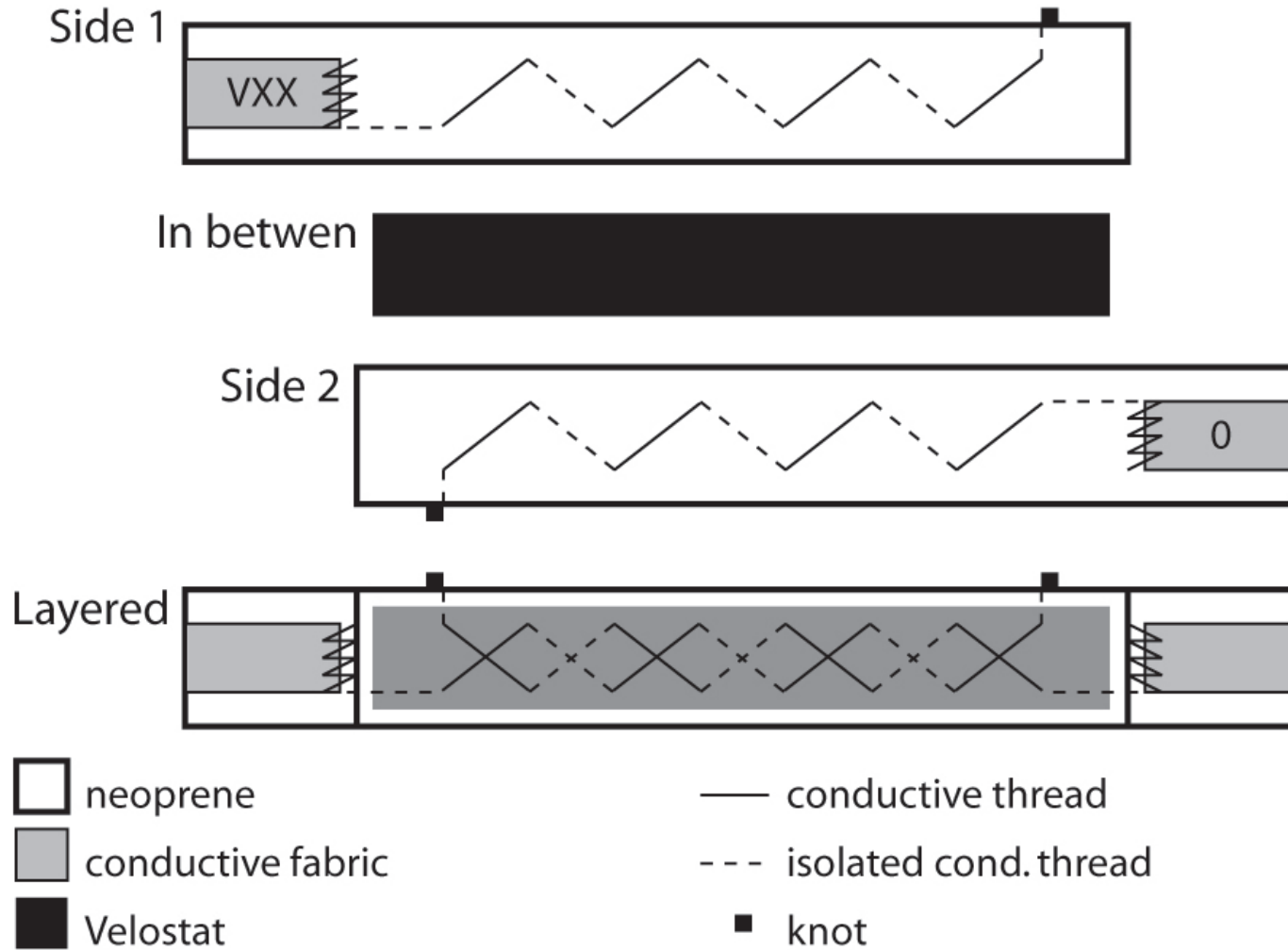


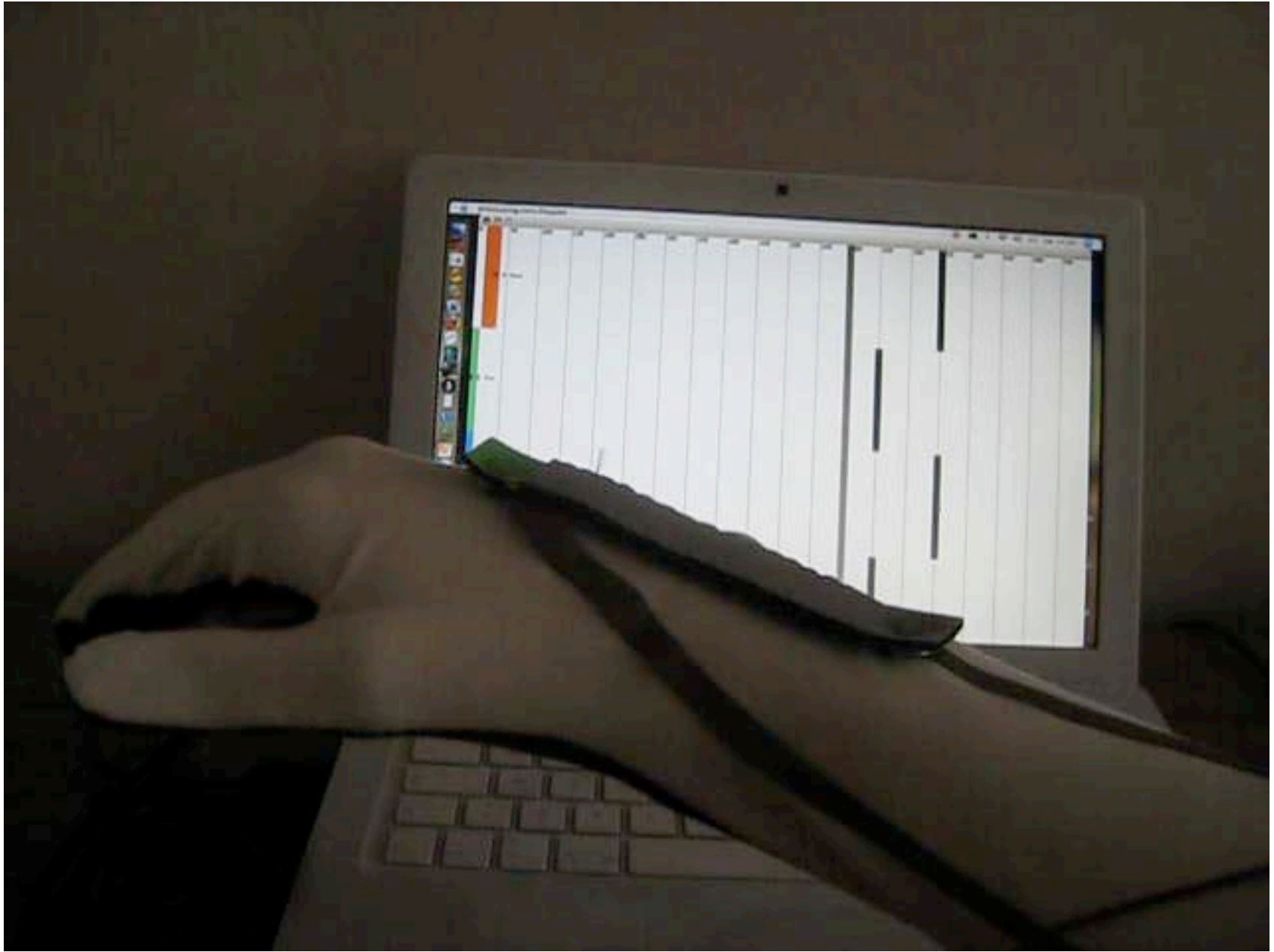
MATERIALS

- Neoprene
- Conductive thread
- Stretch conductive fabric
- Fusible interfacing
- Velostat

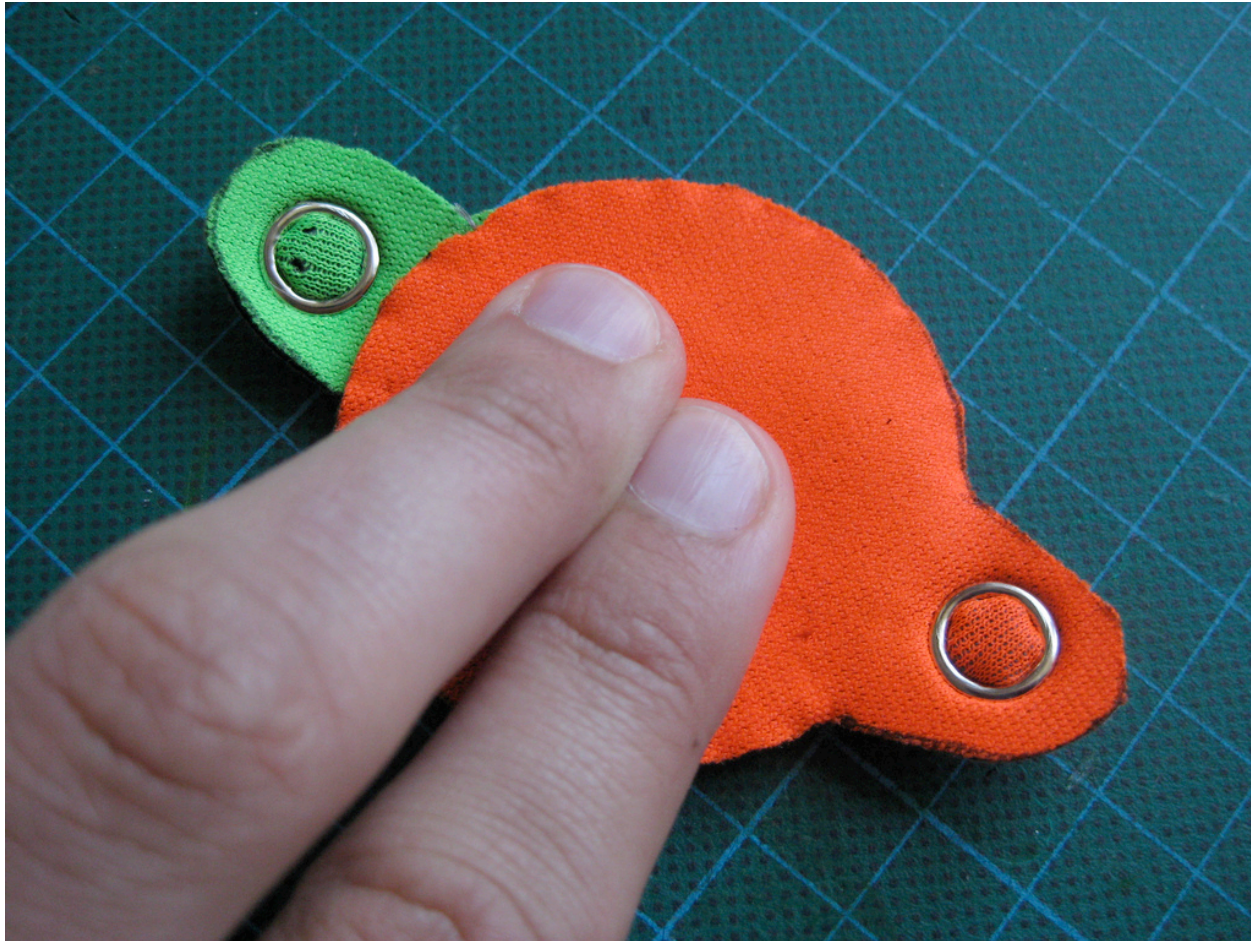


Bend Sensor

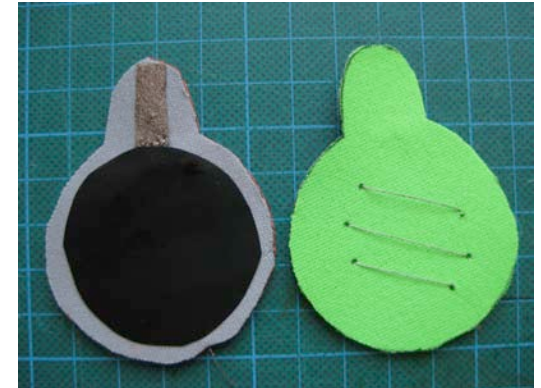
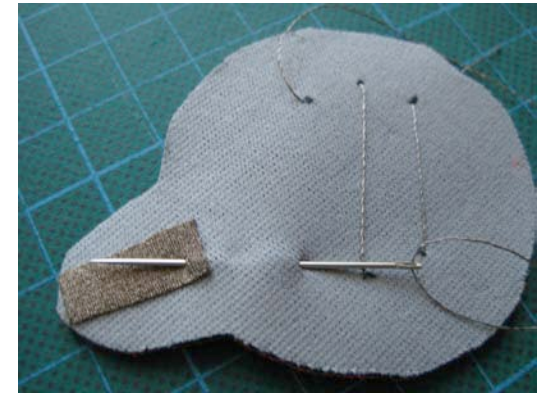
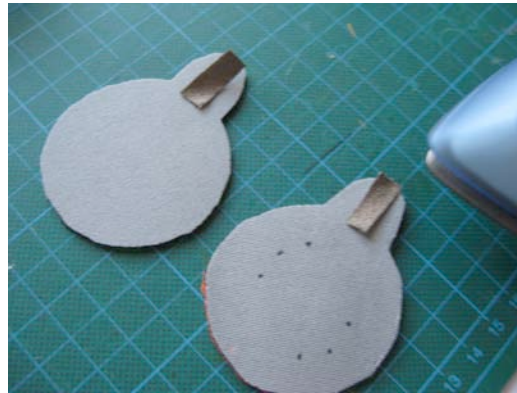




Pressure Sensor

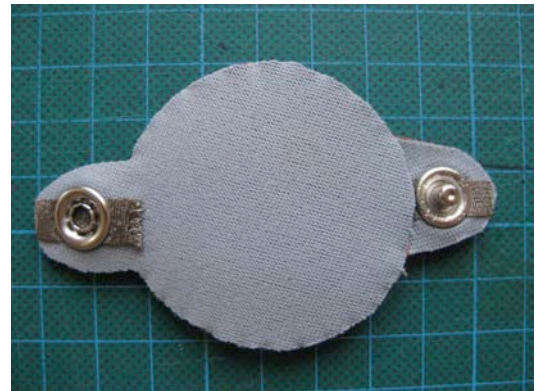


Pressure Sensor



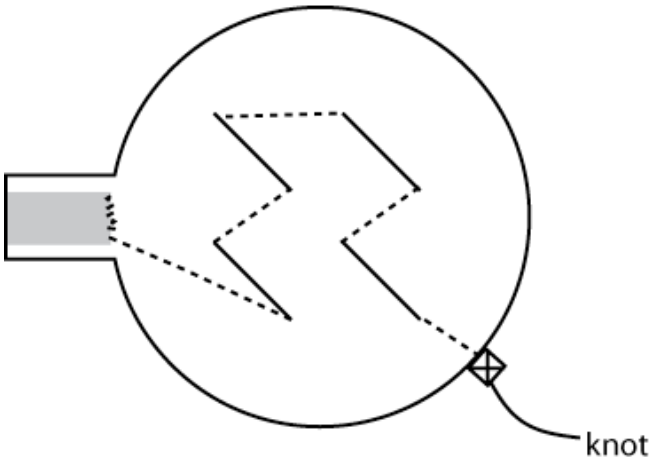
MATERIALS

- Neoprene
- Conductive thread
- Stretch conductive fabric
- Fusible interfacing
- Velostat



Pressure Sensor

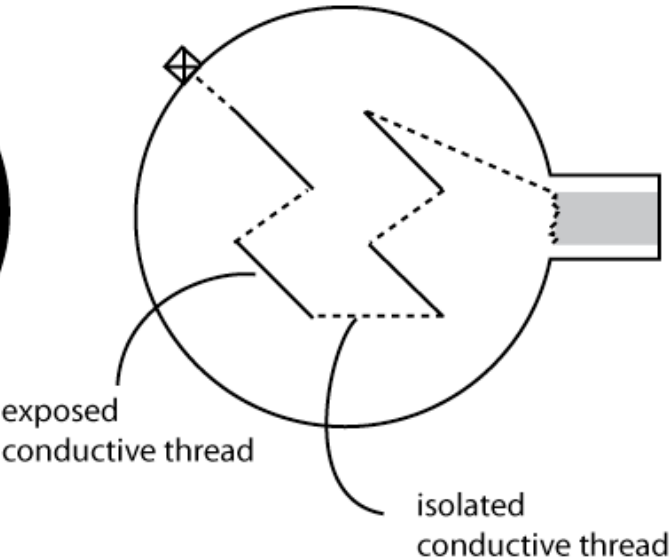
SIDE A



IN BETWEEN

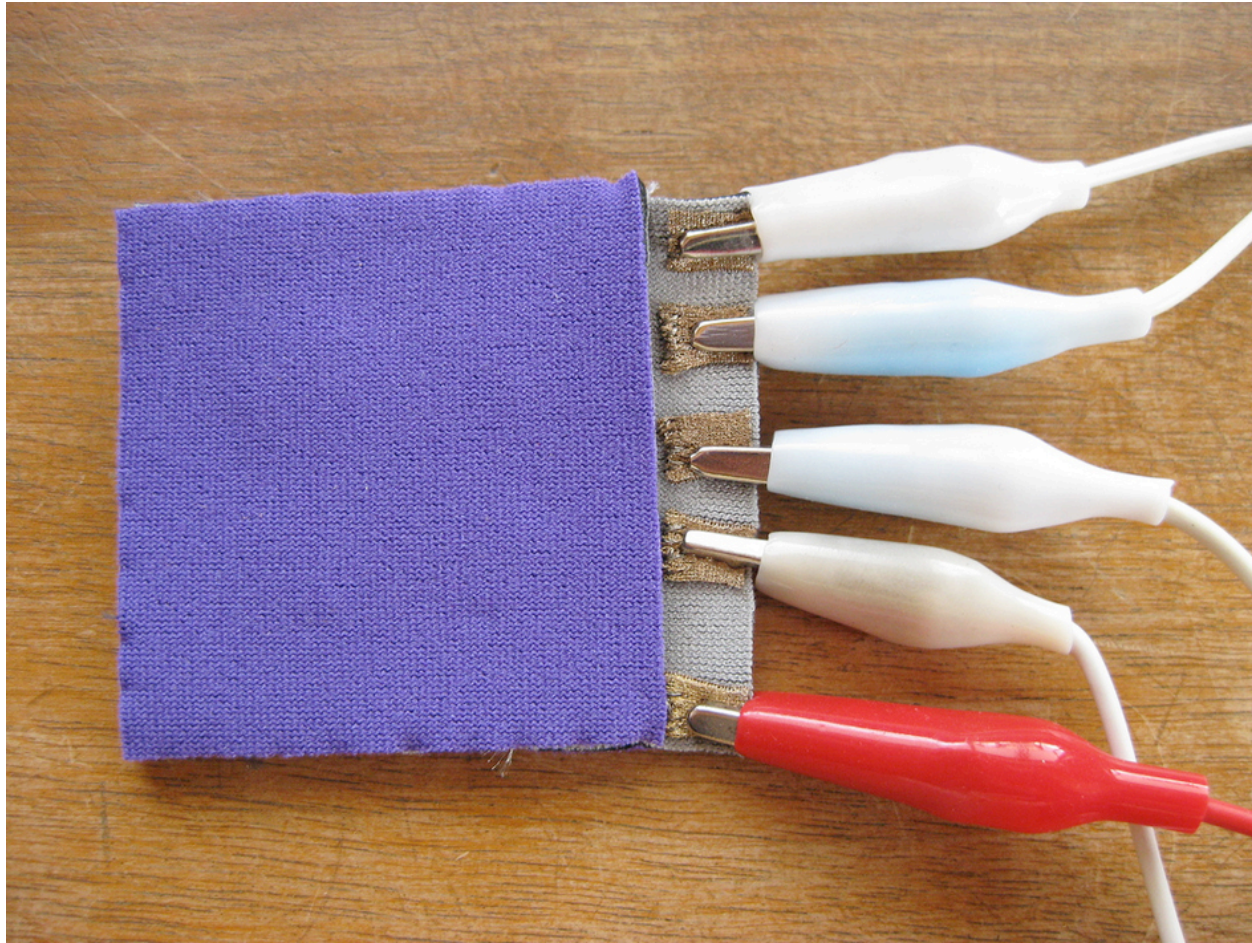


SIDE B

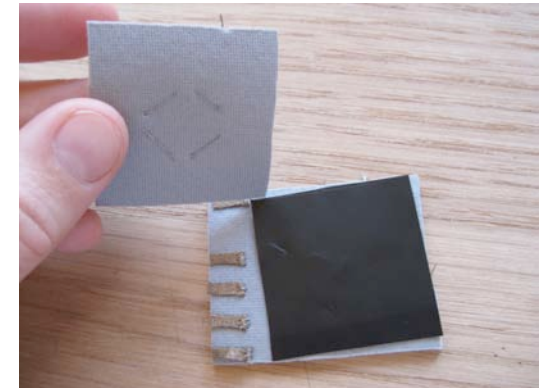
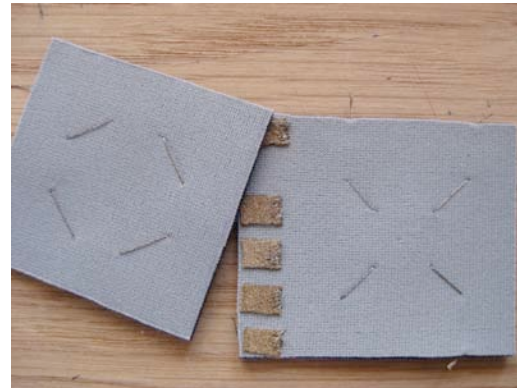
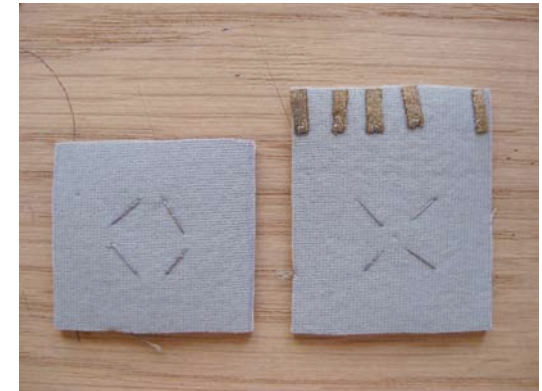
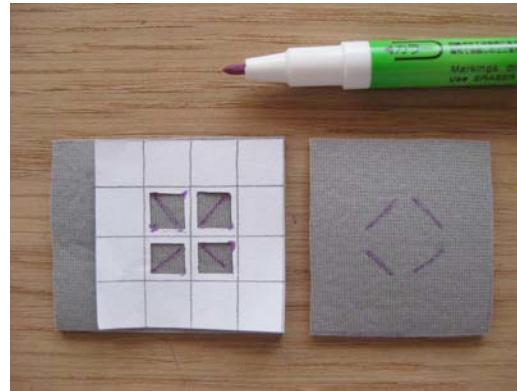




Pressure Sensor Matrix



Pressure Sensor Matrix

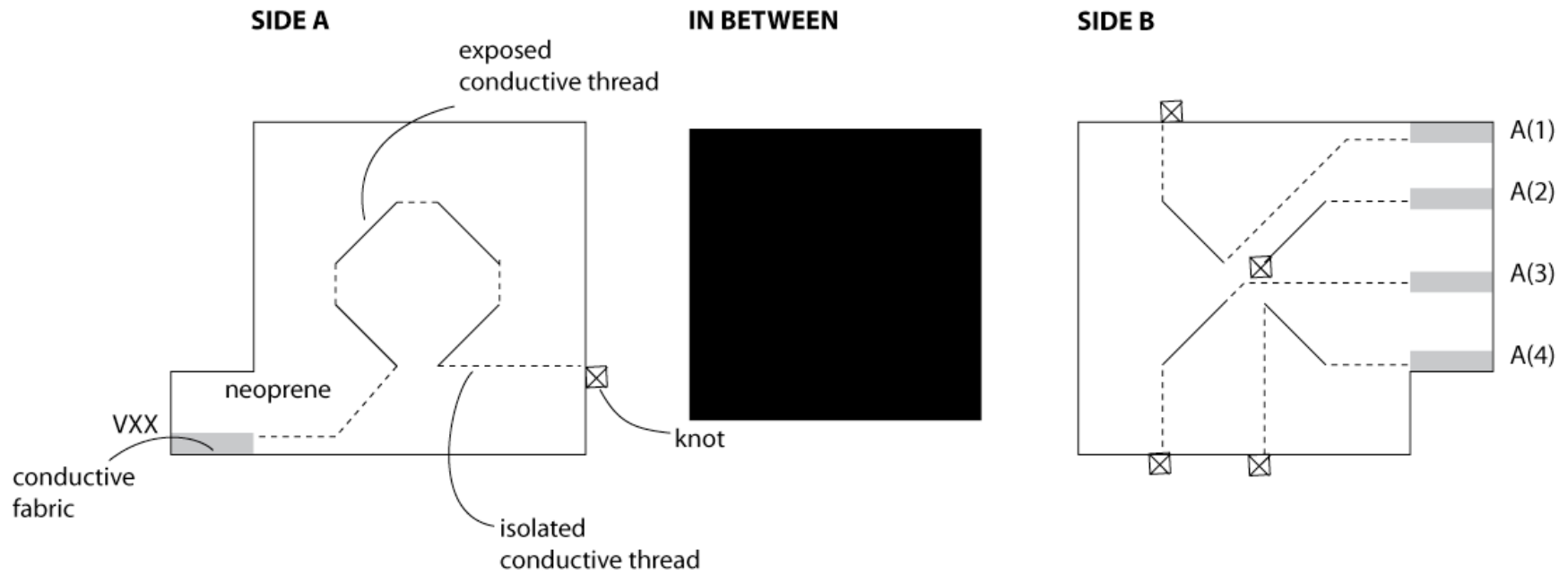


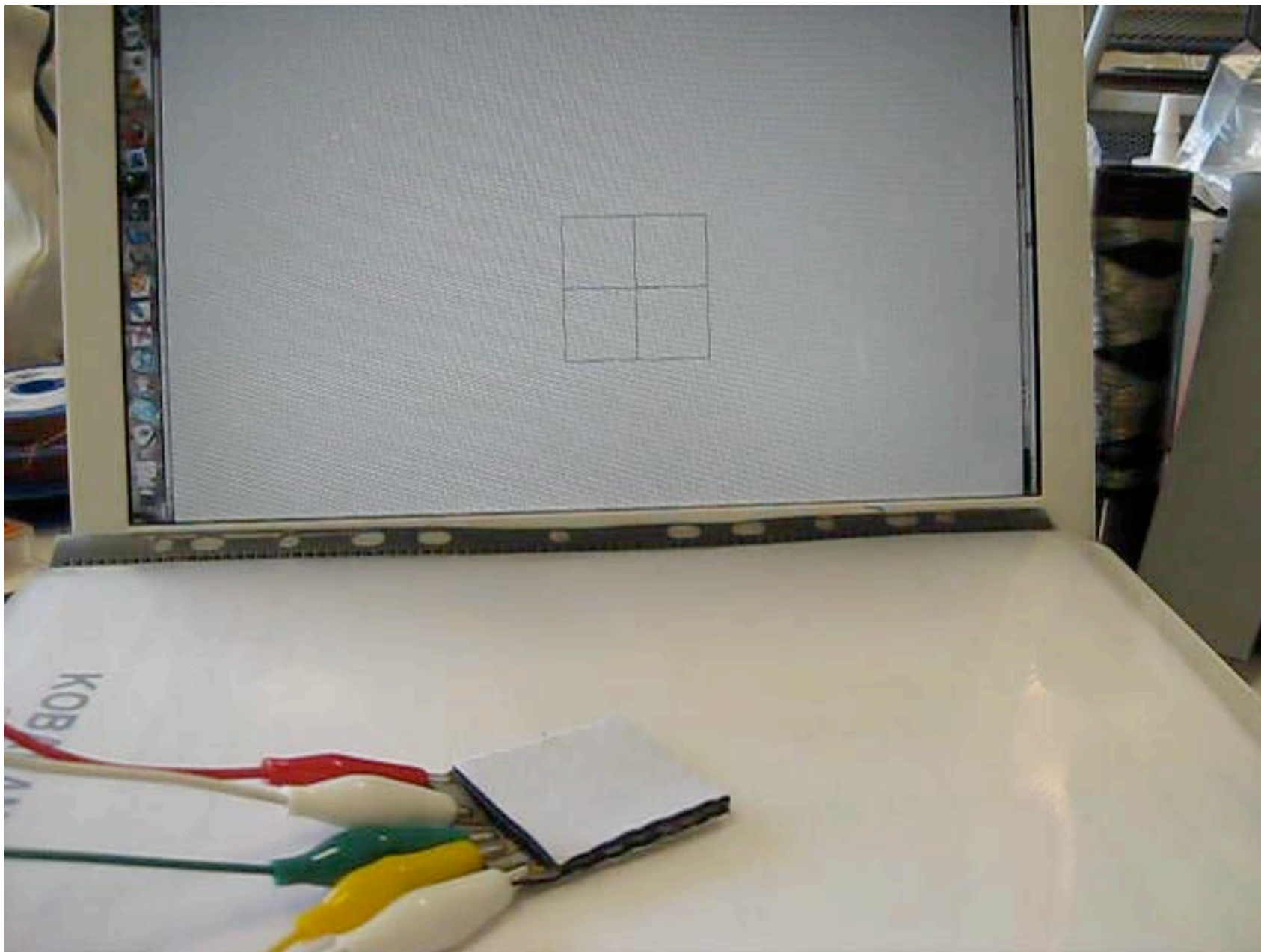
MATERIALS

- Neoprene
- Conductive thread
- Stretch conductive fabric
- Fusible interfacing
- Velostat



Pressure Sensor Matrix





Tilt Sensor



Tilt Sensor

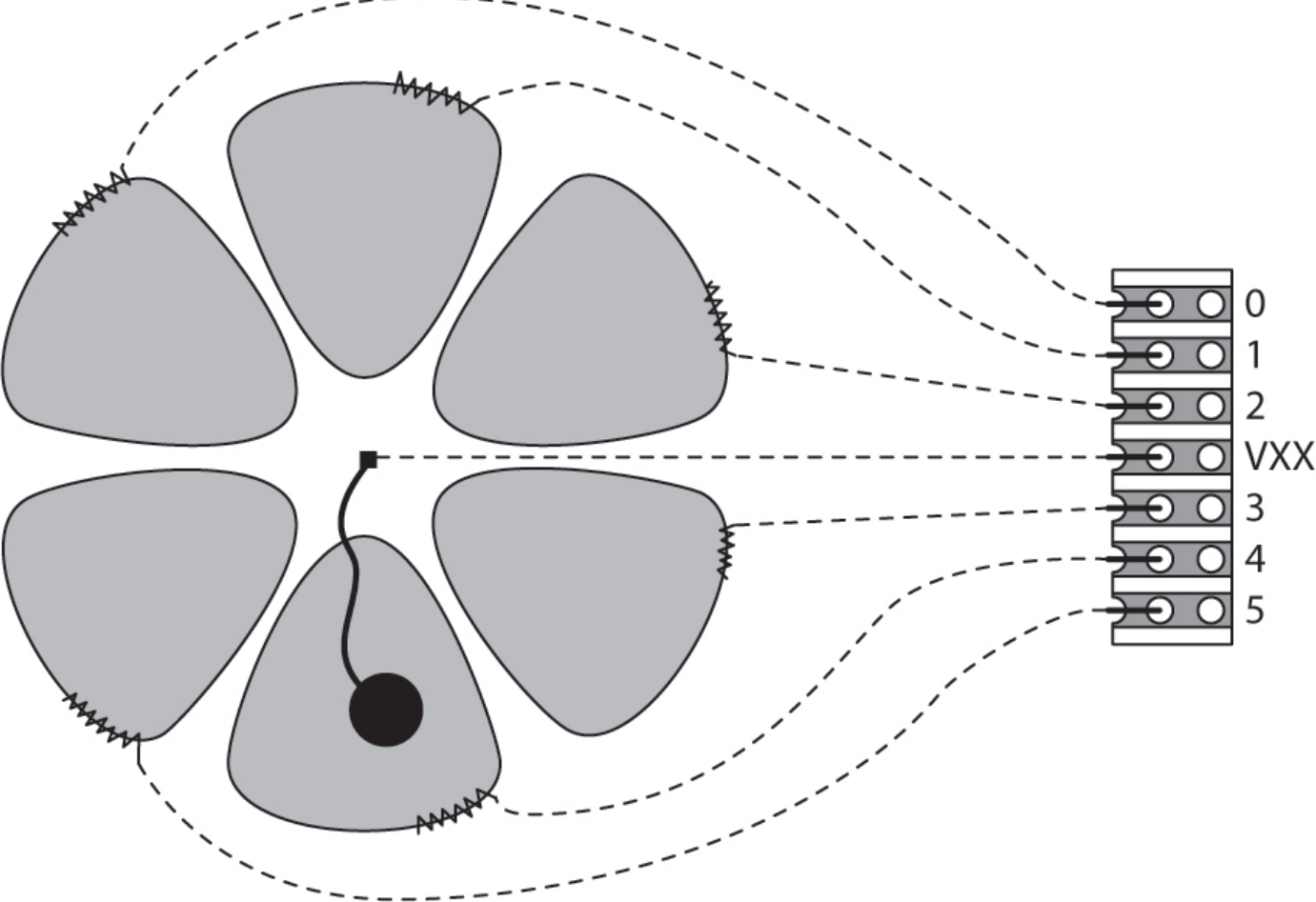








MATERIALS

- Neoprene
- Stretch conductive fabric
- Conductive thread
- Metal bead
- Stretchy fabric glue



Tilt Sensor



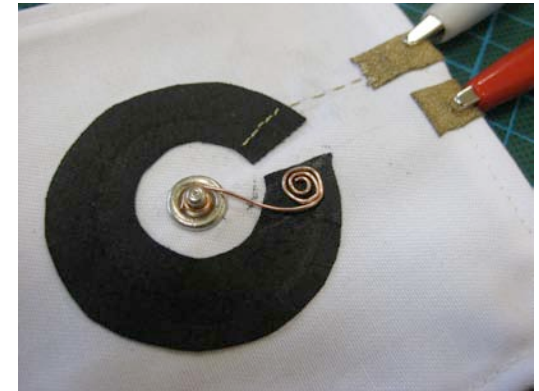
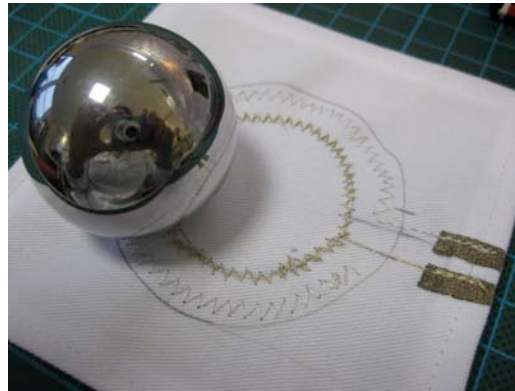
-  conductive fabric
-  metal bead
-  knot
-  conductive thread
-  double cond. thread
-  isolated cond. thread



Fabric Potentiometer



Fabric Potentiometer

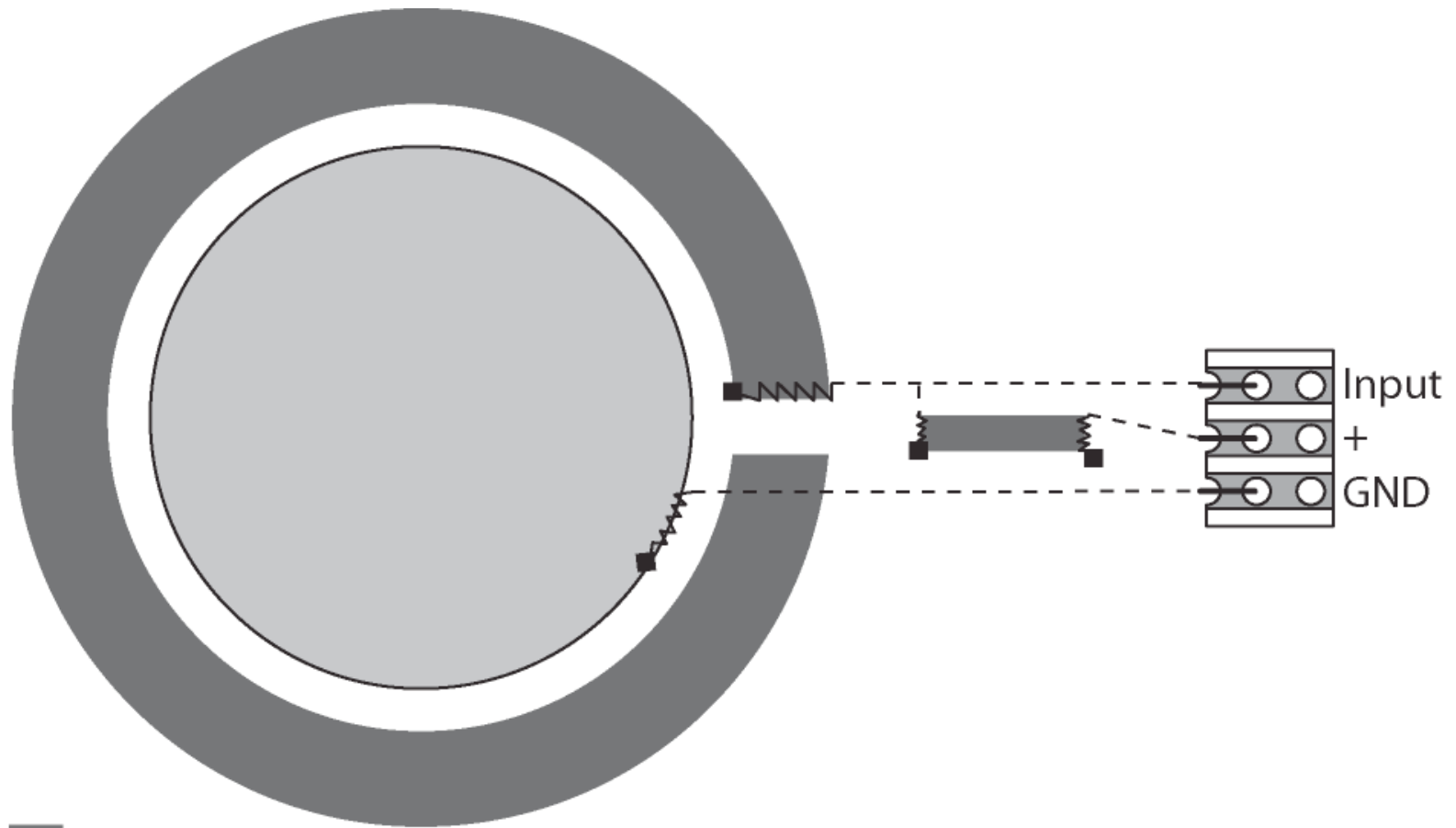


MATERIALS

- Neoprene
- Conductive thread
- Stretch conductive fabric
- Resistive fabric
- Fusible interfacing



Fabric Potentiometer

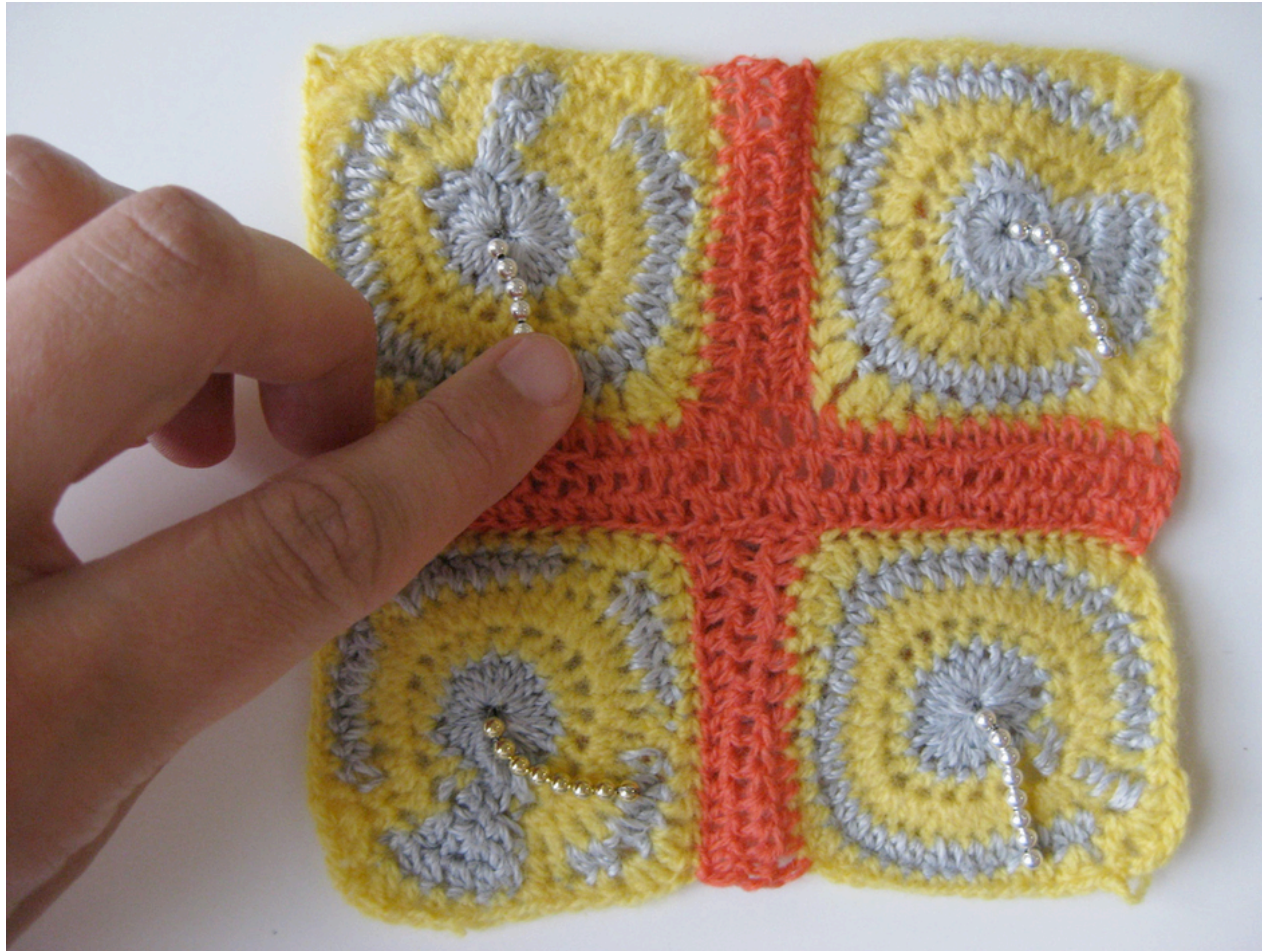


- resistive fabric
- conductive fabric
- knot

- conductive thread
- double cond. thread
- - - isolated cond. thread



Crochet Potentiometer



Crochet Potentiometer

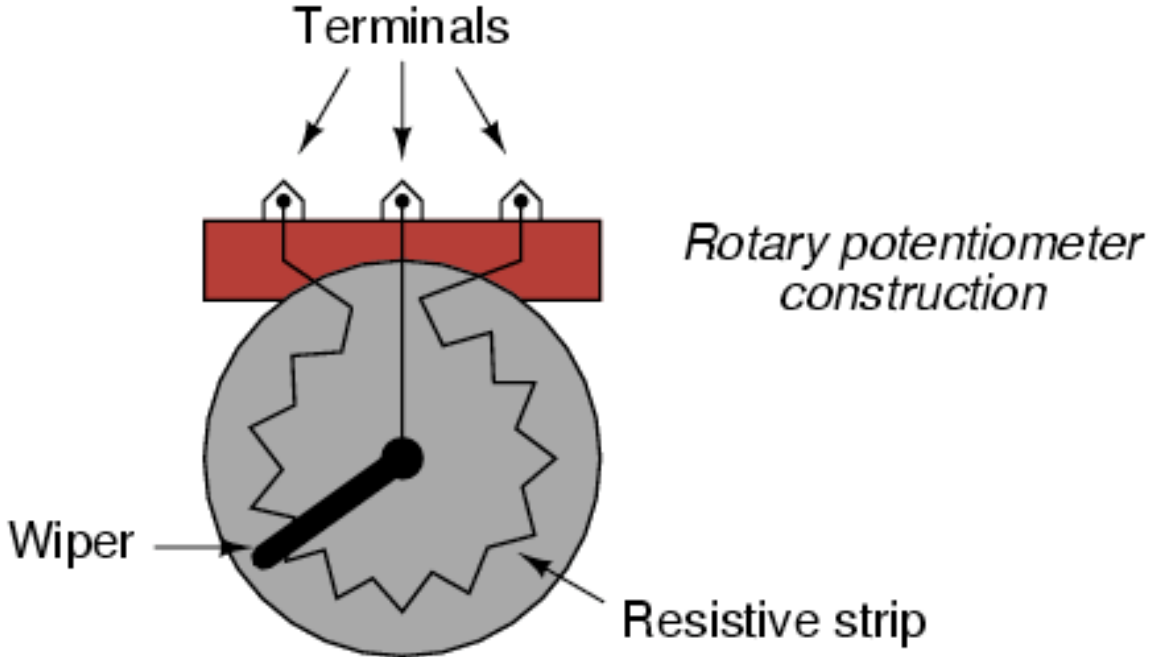


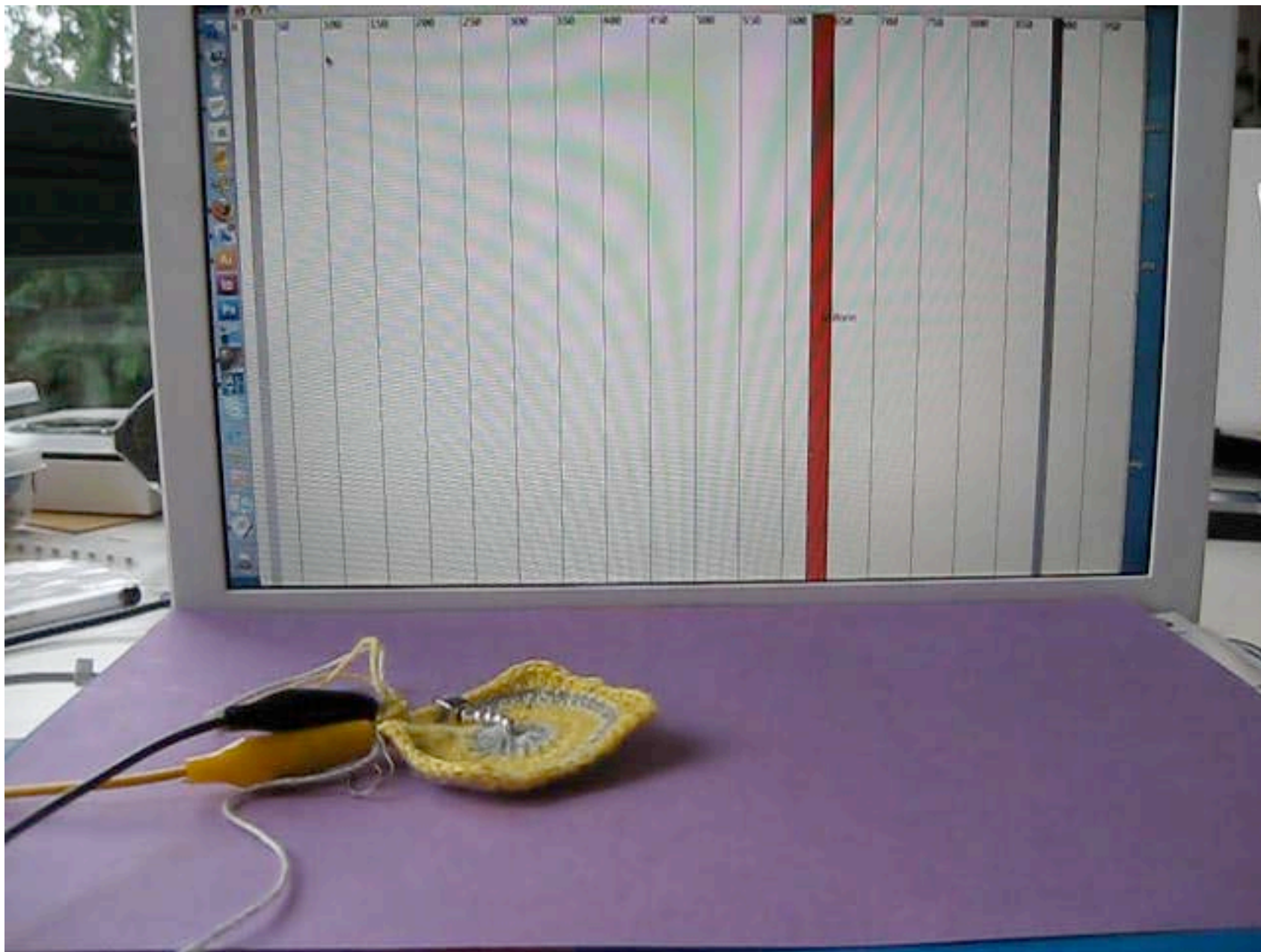
MATERIALS

- Resistive yarn
- Regular yarn
- Conductive thread
- Metal bead



Potentiometer





Stroke Sensor



Stroke Sensor

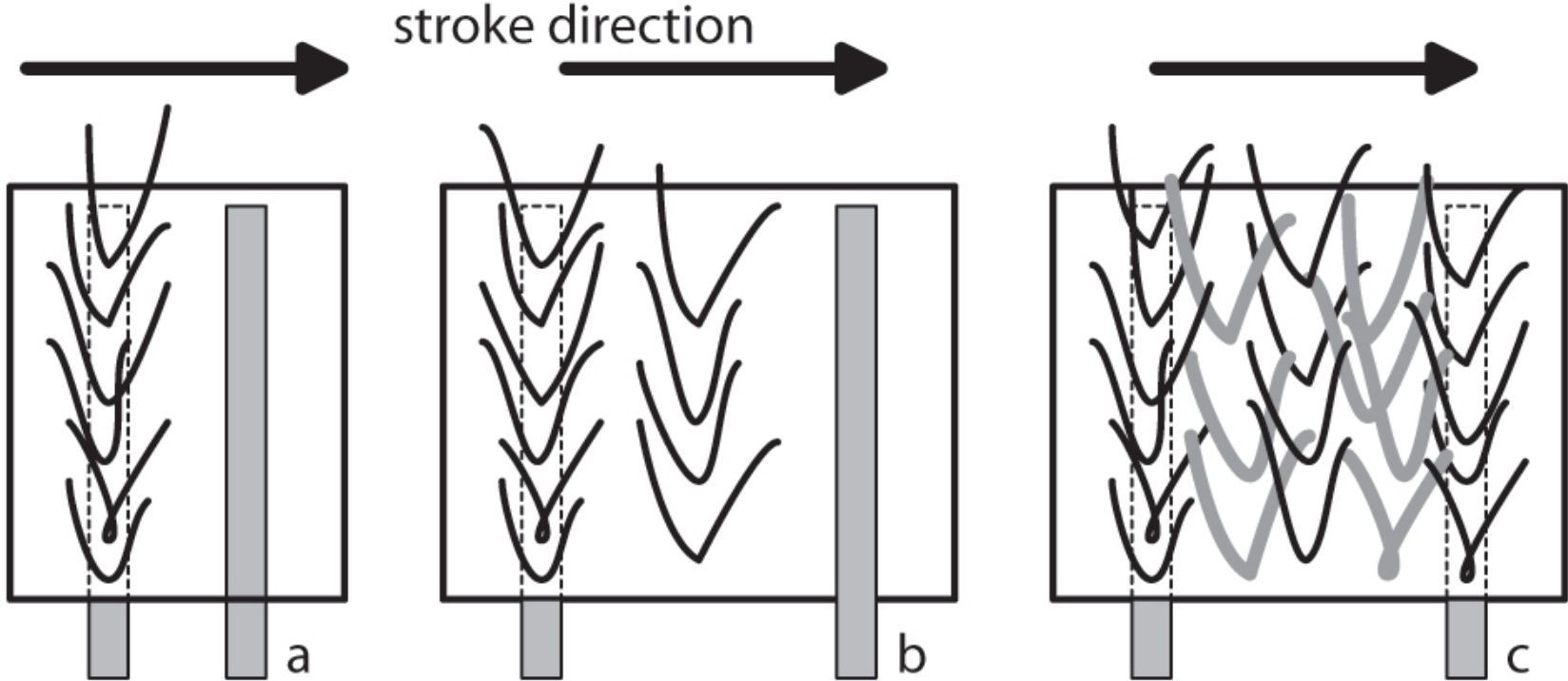


MATERIALS

- Neoprene
- Conductive thread
- Resistive thread
- Conductive fabric
- Fusible interfacing



Stroke Sensor



□ neoprene

■ conductive fabric

— conductive thread

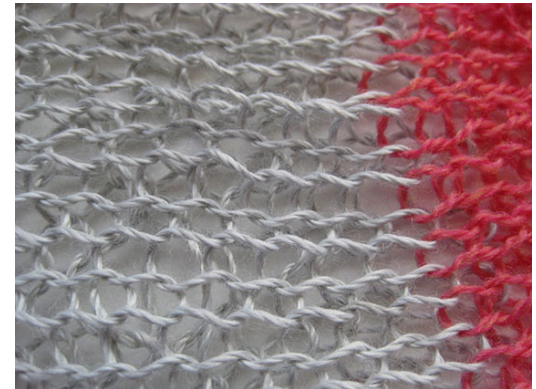
— non-conductive or resistive thread

Stroke Sensor - VIDEO

Knit Stretch Sensor



Knit Stretch Sensor

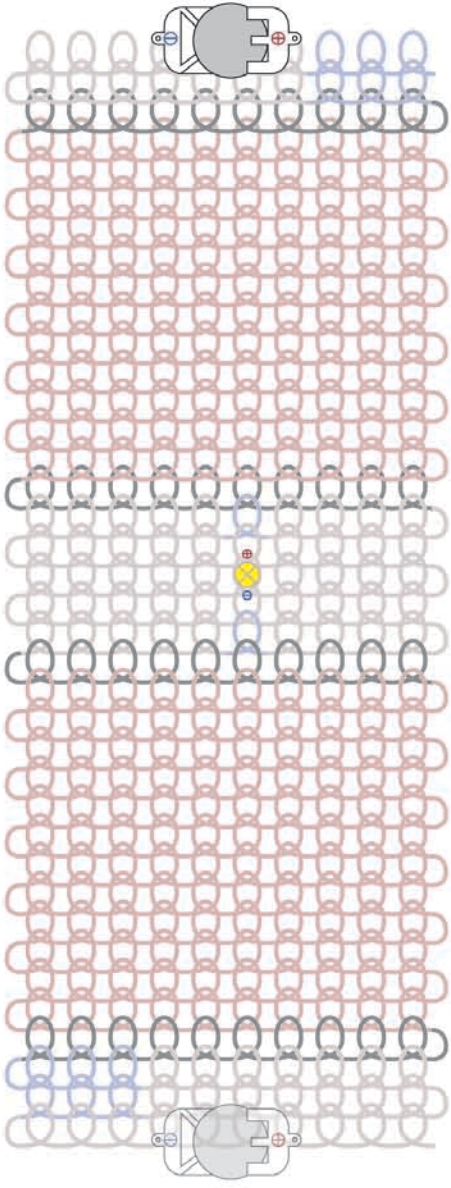
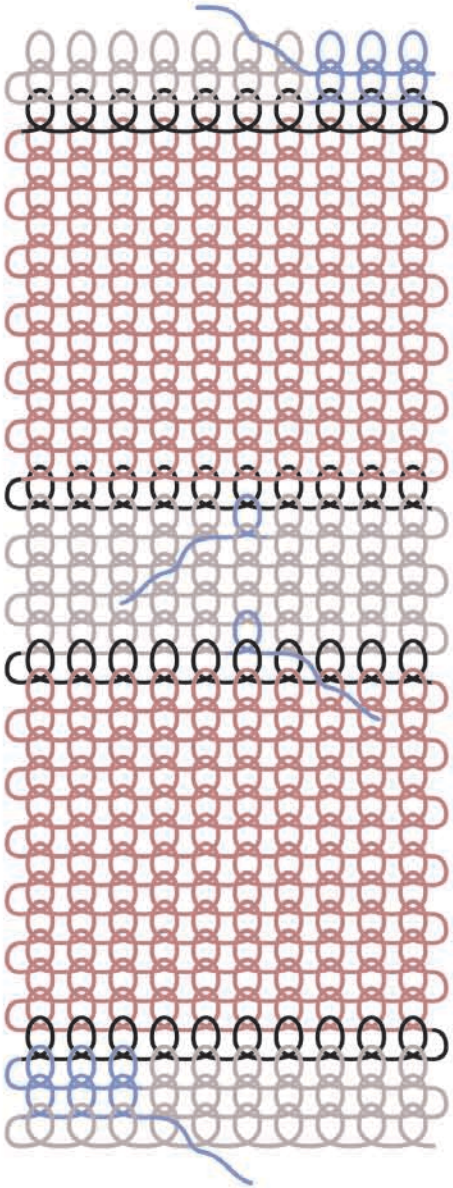


MATERIALS

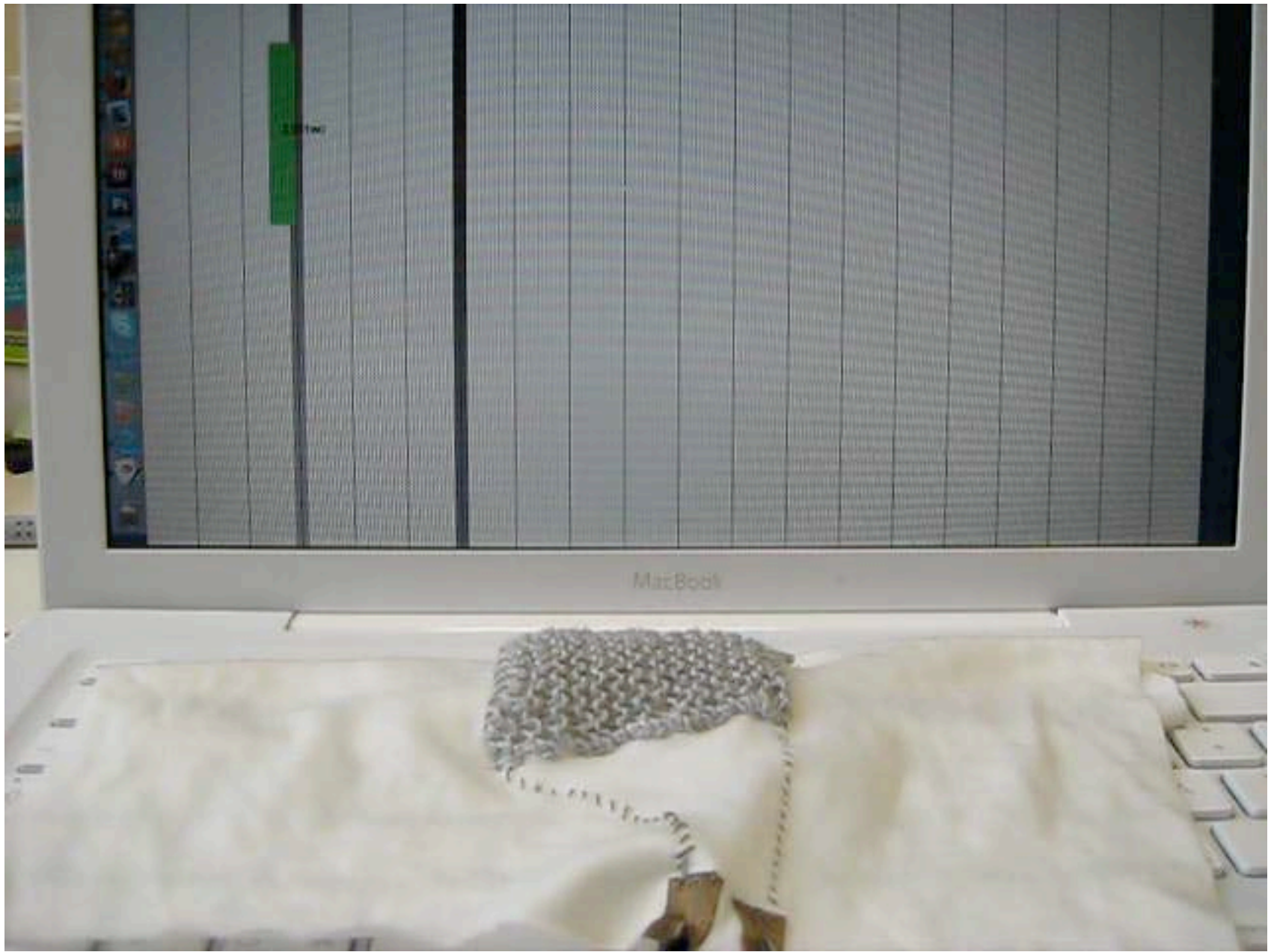
- Resistive yarn
- Regular yarn



Knit Stretch Sensing Bracelet



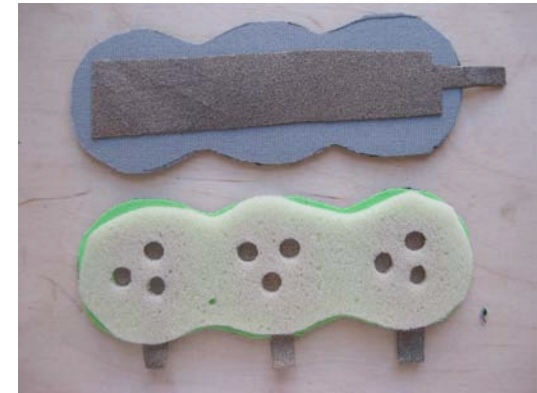
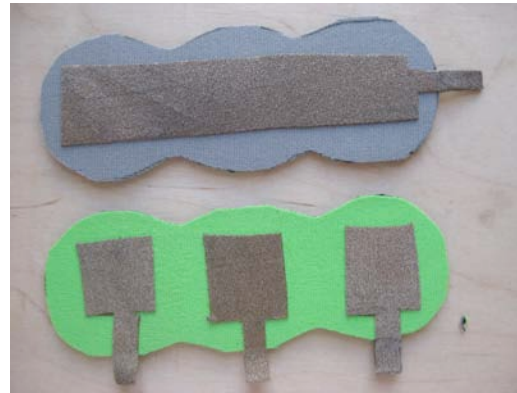
- regular yarn
- resistive yarn
- conductive thread
- regular yarn + resistive yarn
- regular yarn + conductive thread
- regular yarn + resistive yarn + conductive thread
- LED light
- Battery holder



Fabric Button

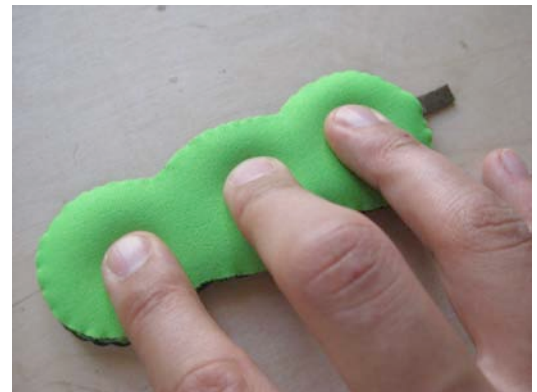


Fabric Button

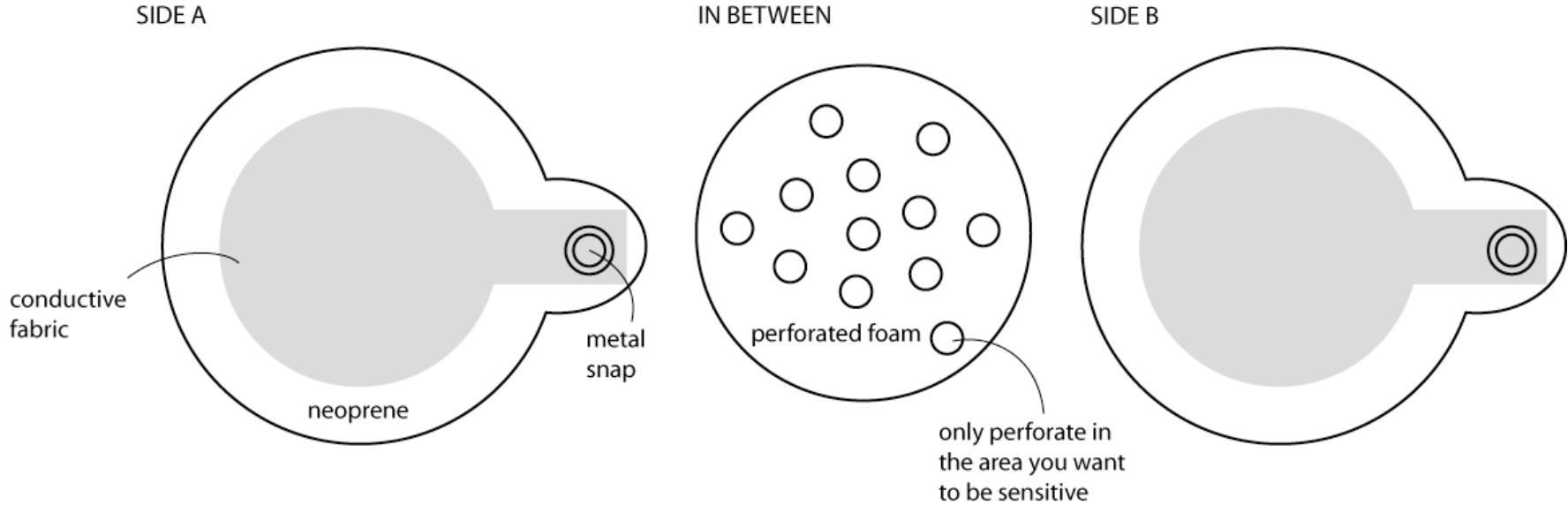


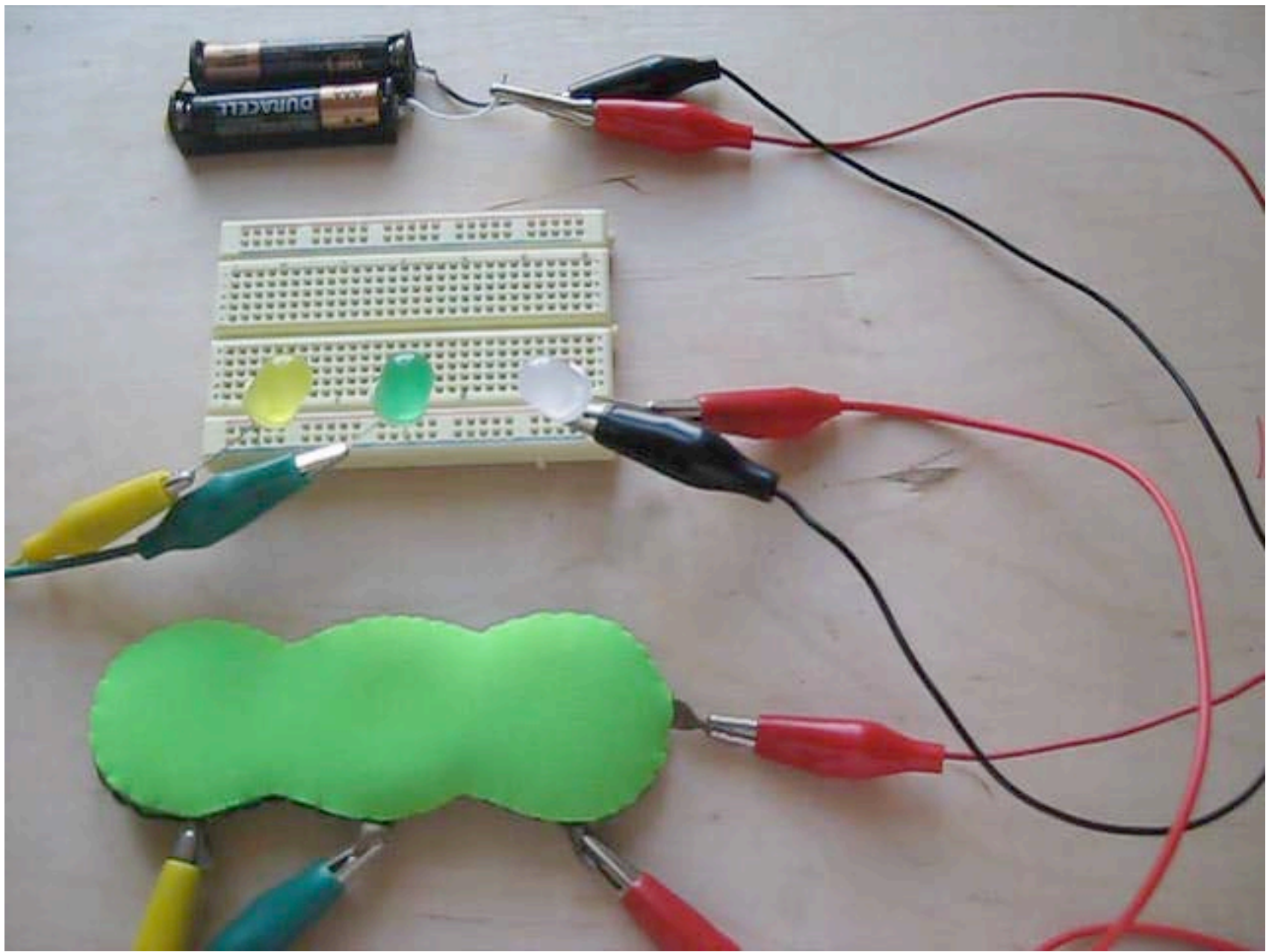
MATERIALS

- Neoprene
- Stretch conductive fabric
- Fusible interfacing
- Foam

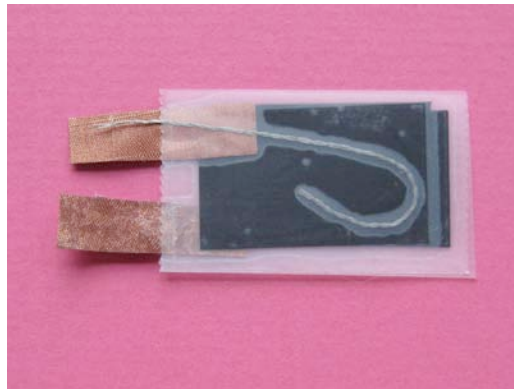
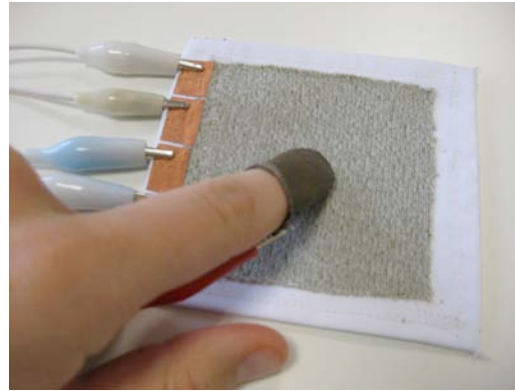


Fabric Button





More Sensors...



www.instructables.com/member/Plusea

The screenshot shows the Instructables member profile for Plusea. At the top, there is a navigation bar with the Instructables logo (a hand with circuit traces) and the word "instructables" in a white box. To the right of the logo are links for Home, Explore, Answers, Community, and Submit. A user profile picture and the text "You" are visible in the top right corner. Below the navigation bar is a search bar and a line graph showing activity over time from January 2008 to May 2009. A secondary navigation bar lists various categories: All, Art, Craft, Food, Games, Green, Home, Kids, Life, Music, Offbeat, Outdoors, Pets, Ride, and S.

The main content area is titled "member : Plusea" and includes a "subscribe" button. Below the title, there are links for "Instructables" with an RSS icon, and sorting options: "sort by: recent | views | name | rating". A pagination indicator shows "1-12 of 32" and a "next" button.

On the left side of the profile, there is a profile picture of Plusea, a woman with dark hair and bangs. Below the picture are three buttons: "Send Me a Patch", "Private Message Me", and "Subscribe to Me". Below these buttons, the name "Plusea" is displayed, followed by her location "Brooklyn, NY", her web site "http://www.plusea.at", and her membership date "Member Since: Jun 8, 2007". A "MEMBER STATS" section shows "Instructables: 32" and "Subscribers: 115".

The main content area displays a grid of featured projects, each with a "FEATURED" label in the top left corner and a caption below the image:

- Sensitive Fingertips**: A hand with red circuit traces on the fingertips.
- Stickytape Sensors**: A piece of yellow sticky tape with a sensor component.
- Neoprene Bend Sensor IMPROVED**: A blue neoprene strip with a sensor component.
- Limpet Push-Button**: A small, round, textured button with a red LED light.
- Time Sensing Bracelet**: A blue bracelet with a sensor component.
- Tilt Sensing Bracelet**: A white bracelet with a sensor component.
- Pressure Sensor Matrix**: A purple fabric with several white sensor components.
- Solar Necklace T-Shirt**: A yellow t-shirt with a solar panel and a necklace.

HOW TO GET WHAT YOU WANT

- EXAMPLE PROJECTS
- WORKSHOPS
- ACTUATORS
- CIRCUITS
- COMMUNICATION
- CONNECTIONS
- POWER
- SENSORS
- TRACES
- CONDUCTIVE MATERIALS
- NON-CONDUCTIVE MATERIALS
- TECHNIQUES
- TOOLS

- >> SENSORS
- BEAD TILT SENSOR
- CONSTRUCTED STRETCH SENSORS
- CROCHET PRESSURE SENSOR
- SENSOR
- CROCHET TILT POTENTIOMETER
- FABRIC BEND SENSOR
- FABRIC BUTTON
- FABRIC POTENTIOMETER
- FABRIC PRESSURE SENSOR
- FABRIC STRETCH SENSORS
- KNIT CONTACT SWITCH
- KNIT TOUCHPAD
- KNITTED STRETCH SENSORS
- PAINTED STRETCH SENSOR
- PRESSURE SENSOR MATRIX
- SIMPLE FABRIC PRESSURE SENSORS
- STICKYTAPE SENSORS

SENSORS

Sensors

CROCHET PRESSURE SENSOR



Here is the crochet pressure sensor. The main principle is same as regular pressure sensor. Instead of conductive fabric or thread, I used conductive yarn from Schoeller, Nm 50/2 60/40 Pes/Inox @ Euros 65.00/kg (25,000 metres/kg). Since this yarn is very thin, it is mixed with normal yarn and crochet, which is what you can see [...]

Sensors

CROCHET TILT POTENTIOMETER



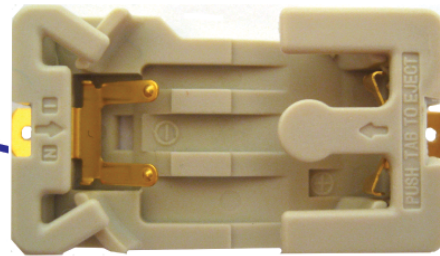
Combination of tilt sensing and potentiometer using regular wool and conductive wool from Schoeller.

Sewable LED Light



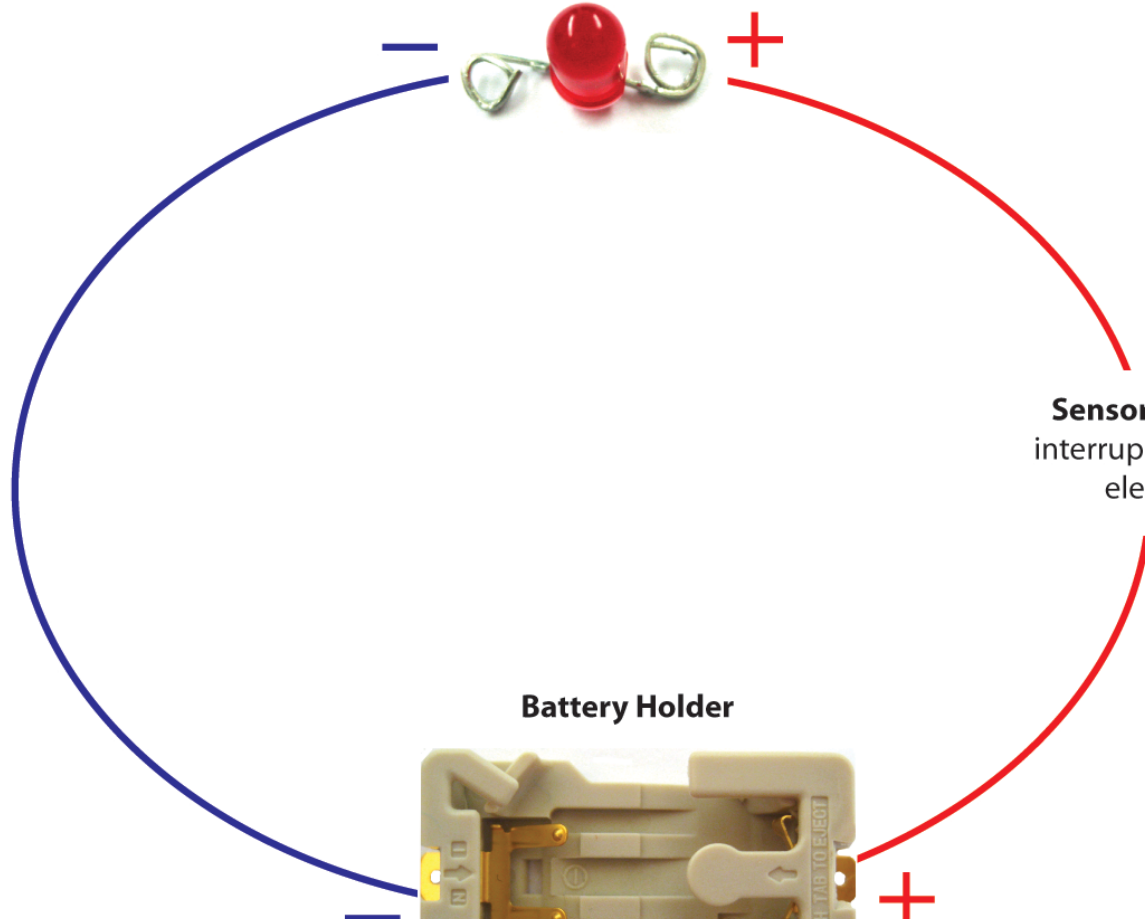
Sensor or Switch
interrupts the flow of
electricity

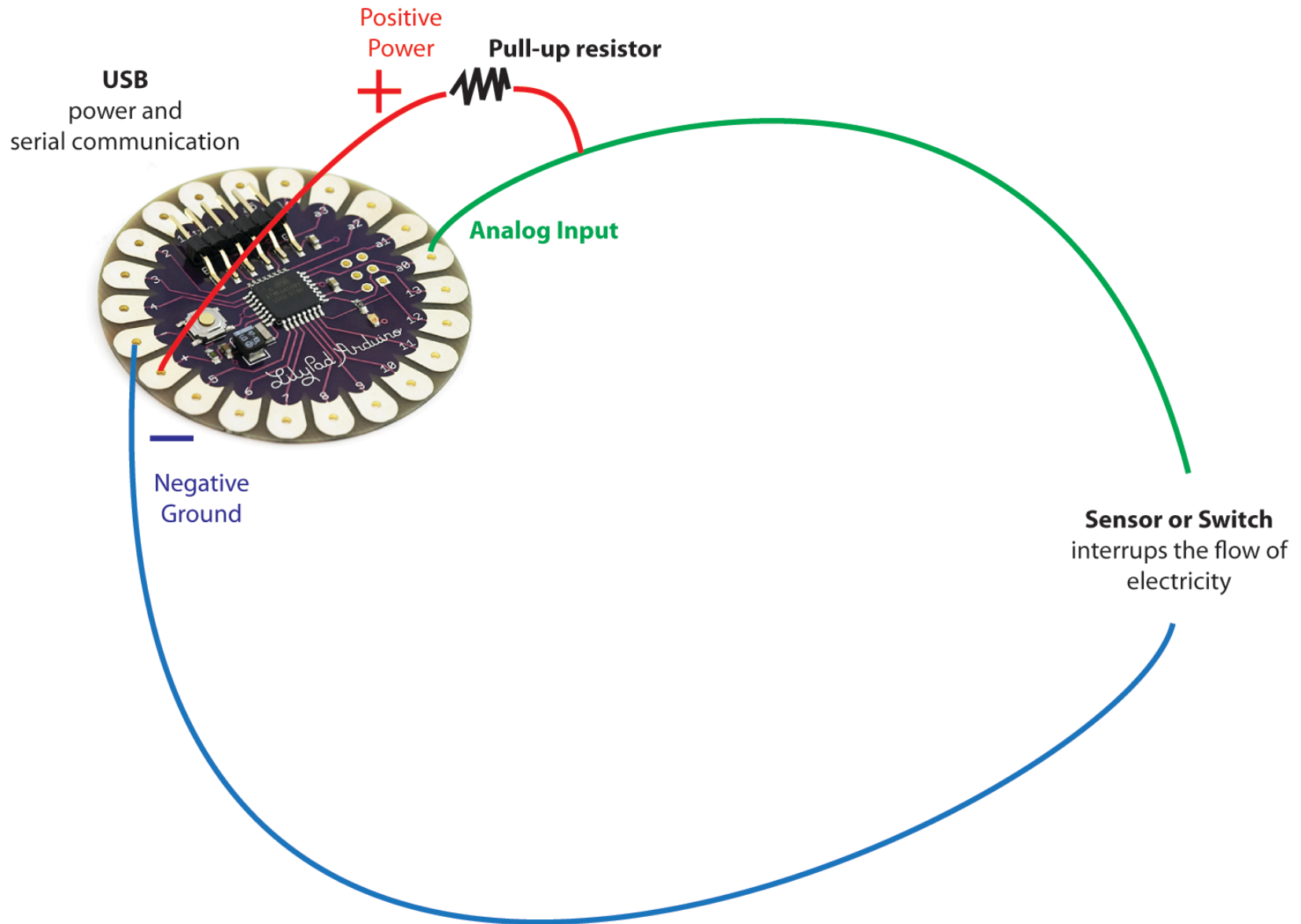
Battery Holder



Negative
Ground

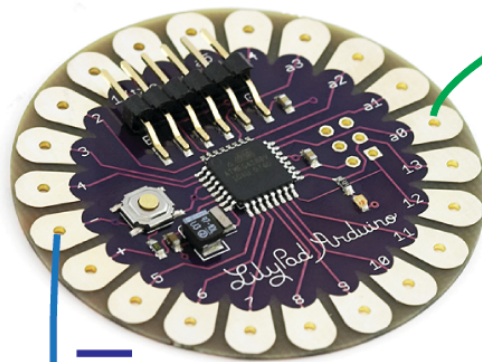
Positive
Power





USB
power and
serial communication

**Use internal
pull-up resistor!!!**



Analog Input

**Negative
Ground**

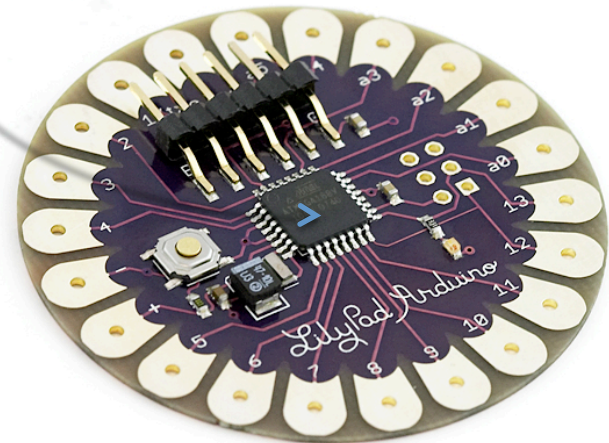
Sensor or Switch
interrupts the flow of
electricity

Arduino LilyPad

```
Blink | Arduino 0017
Blink §
int ledPin = 13; // LED connected to digital pin 13

// The setup() method runs once, when the sketch starts
void setup() {
  // initialize the digital pin as an output:
  pinMode(ledPin, OUTPUT);
}

// the loop() method runs over and over again,
// as long as the Arduino has power
void loop()
{
  digitalWrite(ledPin, HIGH); // set the LED on
  delay(1000);                // wait for a second
  digitalWrite(ledPin, LOW);  // set the LED off
  delay(1000);                // wait for a second
}
1
```



Processing

```
Graph_1AnIN | Processing 1.0.9
Graph_1AnIN serialEvent thresHolding thresholdGraph
/*
 * By Hannah Perner-Wilson, www.plusea.at
 *
 * IMPORTANT: Scroll down to set your thresholds!
 */

import processing.serial.*;

// definition of window size
// you can change the size of the window as you like
// the thresholdGraph will be scaled to fit
// the optimal size for the thresholdGraph is 1000 x 400
int xWidth = 1200;
int yHeight = 800;

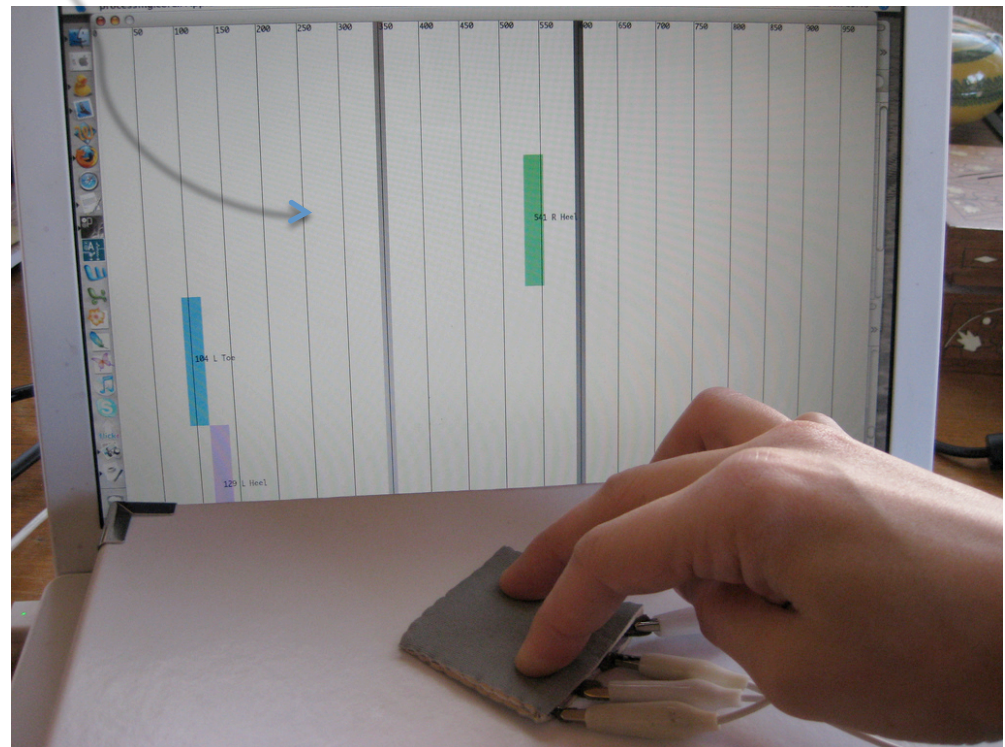
// xPos input array, using prefix
int[] xPosArr= {0};

//
int[] messageArr= {0};

// Arrays for thresholding
int[] threshMax= {0};
int[] threshMin= {0};

// variables for serial connection. portname and baudrate are user specific
Serial port1;

//Set your serial port here (look at list printed when you run the application)
String V3 = Serial.list()[0];
String portname1 = V3;
int baudrate = 9600;
```



Links

Download Arduino programming environment from:

>> www.arduino.cc

(Install FTDI drivers, included in download)

Download Processing programming environment from:

>> www.processing.org

Download Arduino and Processing code for Graph:

>> www.arduino.cc/en/Tutorial/Graph

Thank you

plusea@mit.edu

www.plusea.at

www.hlt.media.mit.edu

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[2194](#) [862](#) [460](#) [905](#) [02-LDR20](#) [02-LDR21](#) [02-LDR22](#) [02-LDR23](#) [1008](#) [1020](#) [1031](#)