KOBA Winter School of Wickedfabrics

January 21-25 2019, KOBA Schneiderei für Elektronische Textilien, Berlin

We have been running our KOBA E-Textile Tailorshop for one year now. During this time we’ve been refining our skills in some of the most basic techniques like making hard-soft connections and detachable parts. But we have also been confronted with learning bespoke tailoring skills in taking a customer’s ideas from concept to robust artifact.

Before closing shop, we want to offer a workshop to pass on these skills to a group of interested people. This swatchbook is part of our week-long KOBA Winter School of Wickedfabrics.

KOBAKANT

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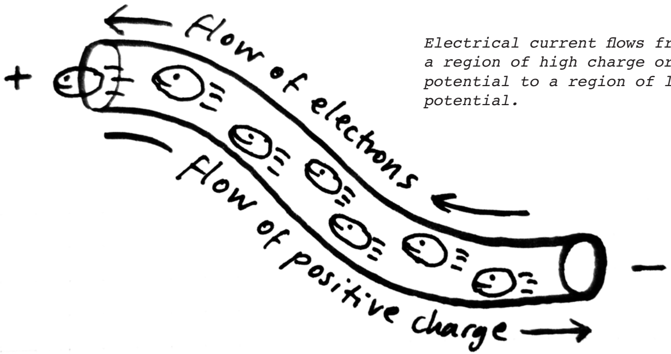
www.kobakant.at

www.howtogetwhatyouwant.at

Things are never so simple. We are surrounded by complicated structures and ambiguous situations. Something that seems wonderful may contain a harmful side on the other end. Trying to do good, can end up bad. Yet, we can not give up. We live in a wicked world filled with wicked problems… with a wicked fabric in our hands.

Electricity

-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-e-



Electrical current flows from a region of high charge or potential to a region of low potential.

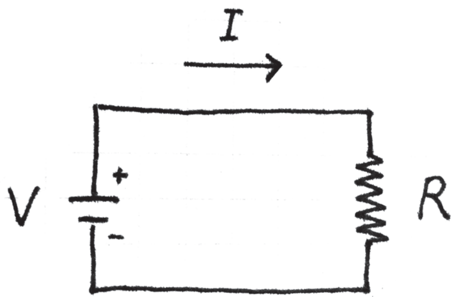
WATER ANALOGY

If we compare electricity to water flowing through a pipe, then:
Voltage is the water pressure,
Current is the stream of flow of water,
Resistance is the valve.

Voltage (V) - is electrical pressure or force. Sometimes referred to as potential. Voltage drop is the difference in voltage between the two ends of a conductor through which current is flowing.

Current (I) - is the quantity of electronics passing a given point. The unit of current is Ampere.
1 Amp = 6,280,000,000,000,000,000 electronics passing a point in one second.

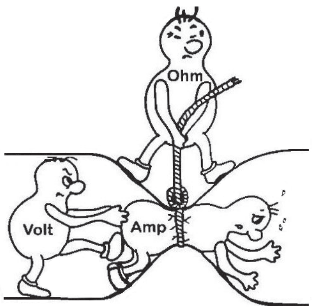
Resistance (R) - conductors are not perfect, they resist the flow of current to some degree. the unit of resistance is the Ohm (Ω).



OHM'S LAW

$$V = I \times R$$

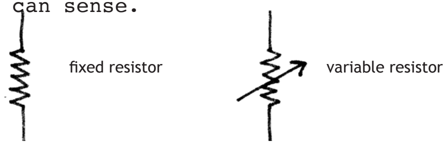
A potential difference of 1V will force a current of 1A through a resistance of 1Ω



Reading resistance

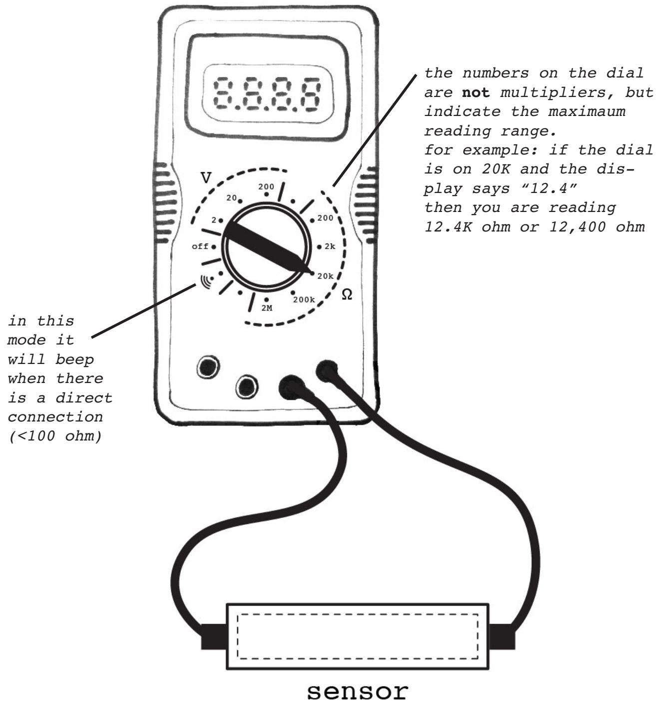
fixed resistors, variable resistors, multimeter

The analog sensors we will construct in this workshop all work as **variable resistors**, meaning their electrical resistance changes under the circumstances of what they can sense.



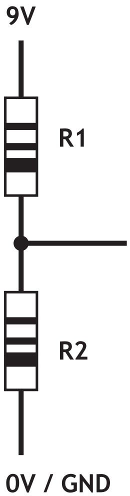
A **voltage divider** allows us to convert resistance into voltage. Connect two resistances in series, apply a voltage across them and measure the voltage at the point inbetween them: V(out)

Using Ohm’s law you can calculate how much voltage will be at V(out).
If one of these resistors were to vary their resistance, V(out) would also vary.

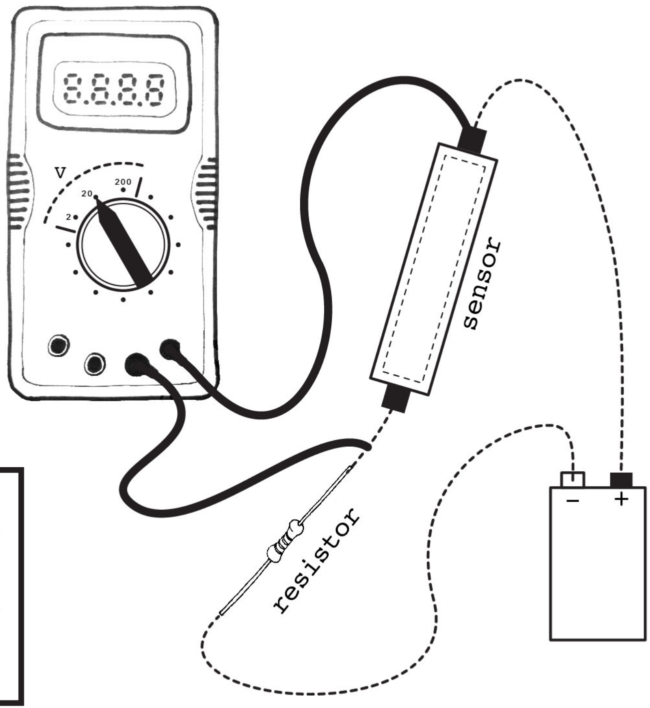


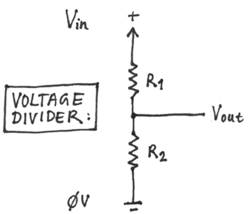
Making a voltage divider

voltage divider, analog sensor



you will measure voltage divided by the ratio of the two resistor. for example, if R1 is 100 ohm, and R2 is 50 ohm, you will measure 3V here





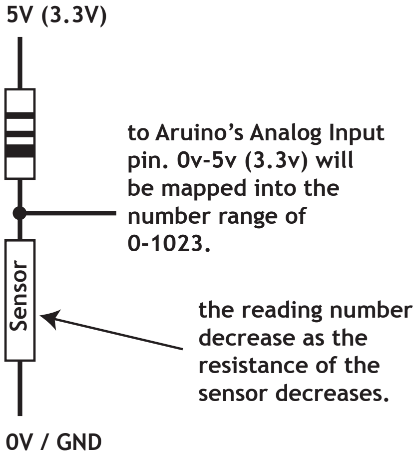
Ohm's Law: $V = I \times R$

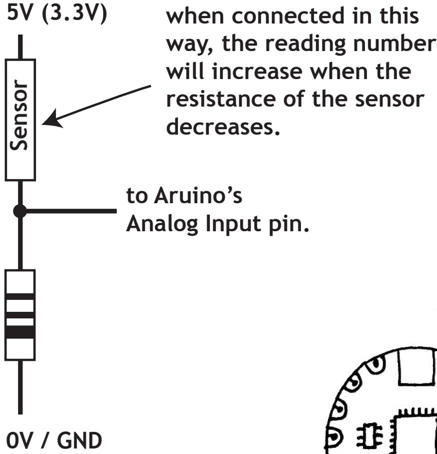
$$V_{in} = I \times (R_1 + R_2)$$

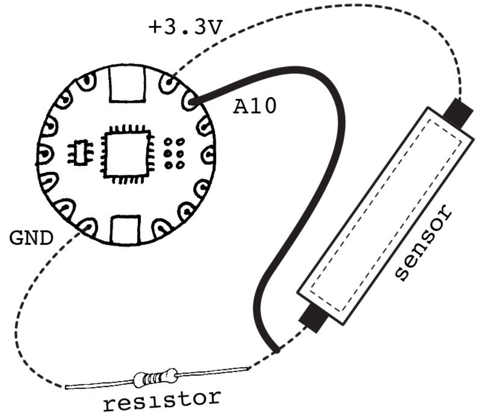
$$V_{out} = V_{in} \cdot \left(\frac{R_2}{R_1 + R_2} \right)$$

Reading analog sensors with an Arduino

voltage divider, analog sensor, arduino

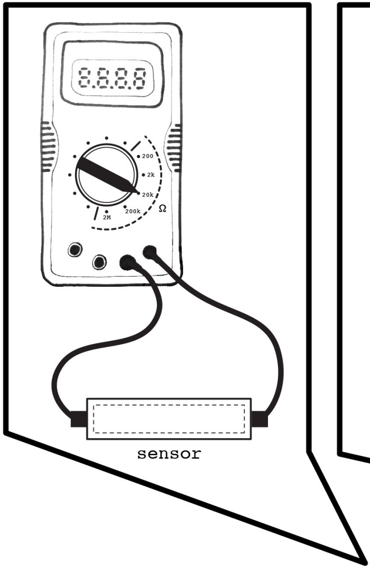




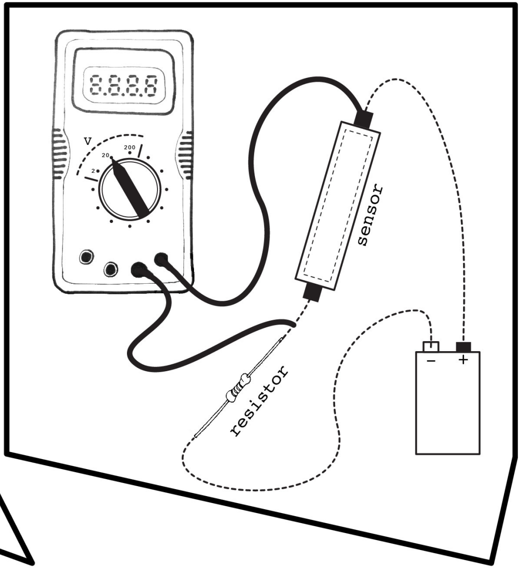


Worksheet

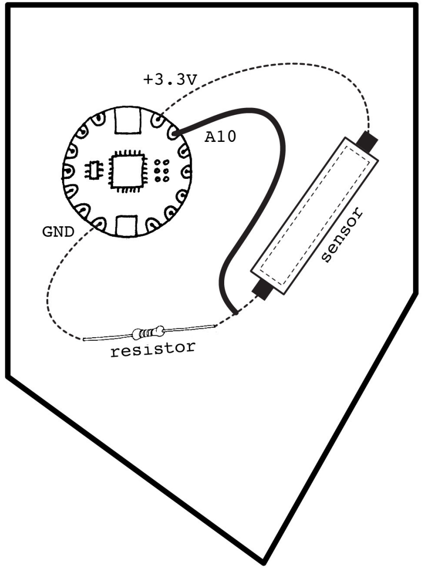
sensor's resistance range



sensor's voltage range



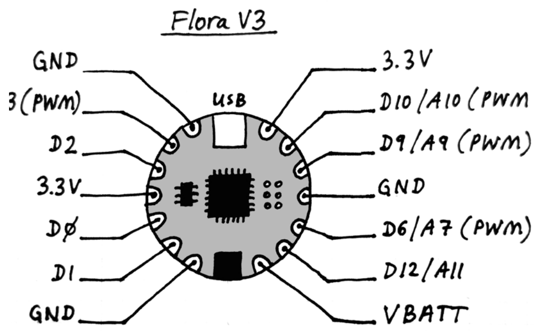
sensor's 10bit ADC range



sensor	max Ω (resting)	min Ω (activated)	mean Ω (resistor)	max V (resting)	min V (activated)	max ADC (resting)	min ADC (activated)

Arduino

microcontroller programming



STRUCTURE

void setup() { . . . }
The setup function is called when a sketch starts.
It will only run once after each powerup or reset of the Arduino board.

void loop() { . . . }
loops consecutively, allowing your program to change and respond.

SERIAL COMMUNICATION

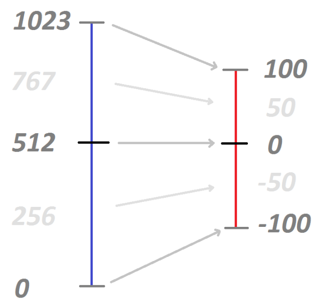
Serial.begin(speed);
Sets the data rate for serial data transmission.
speed: in bits per second (baud)

Serial.print(val);
Prints data to the serial port as human-readable ASCII text.
val: the value to print - any data type

MATH

constrain(x, a, b);
Constrains a number to be within a range.
x: the number to constrain / a: the lower end of the range / b: the upper end of the range
returns: the constrained value

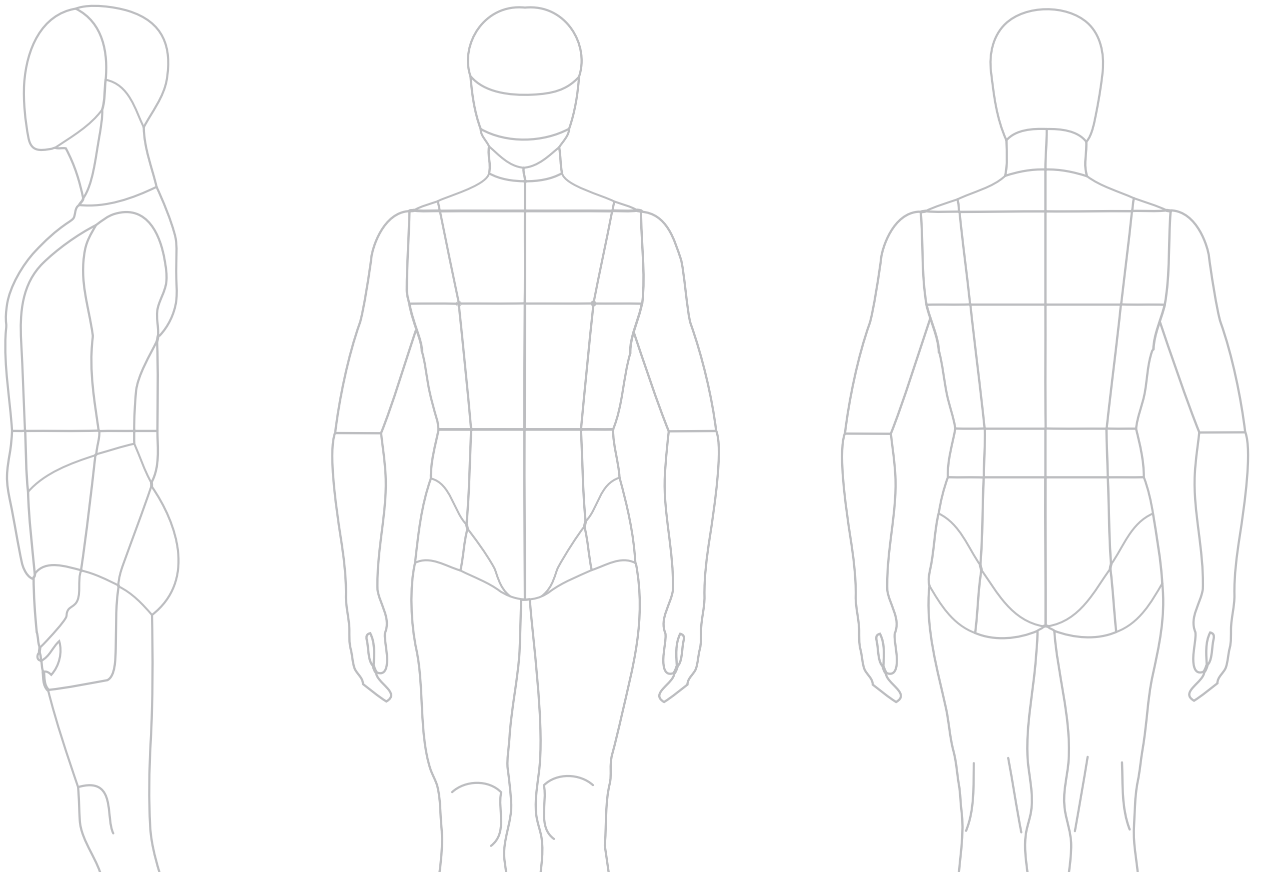
map(value, fromLow, fromHigh, toLow, toHigh);
Re-maps a number from one range to another.
value: the number to map
fromLow, fromHigh: the lower and upper bounds of the value's current range
toLow, toHIGH: the lower and upper bounds of the value's target range
returns: the mapped value



I/O	DIGITAL	ANALOG
READ	**digitalRead(pin);** *returns: HIGH or LOW*	**analogRead(pin);** *returns: 10bit analog reading between 0 - 1023 (ADC resolution)*
WRITE	**digitalWrite(pin, HIGH or LOW);** *writes: HIGH (3V, 5V) or LOW (0V or GND)*	**analogWrite(pin, [0-255]);** *writes: 8bit PWM duty cycle between 0(always off) - 255(always on)*

Design Sketch

draw your design and sketch your circuit layout



Meet the Materiarls

not all conductive materials are equal

We know very little about the origin of the materials we are working with.

Where do the raw materials come from?
How are they manufactured?
Can we recycle them?

Most conductive fabrics, threads and yarns are a blend of a conductor (metal, carbon or an inherantly conductive polymer) and non-conductive synthetic or natural fiber. This blending is done at the level of plating, coating, doping and spinning, as well as weaving and knitting.
Intertwining materials at this level makes it hard to sperate them again. Unfortuantely there is near to no information about how to recycle these materials, how to prolong their life-time or even how to properly dispose of them.

When working with these materials, we can try to bring about change by:

- **taking care** to produce as little waste as possible.

- **considering** design solutions that use less material.

- **re-useing** our leftovers.

- **designing for longevity**, make things that will last and that can be repaired when broken!

- **being curious**, finding out as much information as possible about the materials we are using & wearing.

- **demanding information**, contacting suppliers as well as our local waste/recycling facilities and asking them to provide us with information about how to recyle the materials we use.

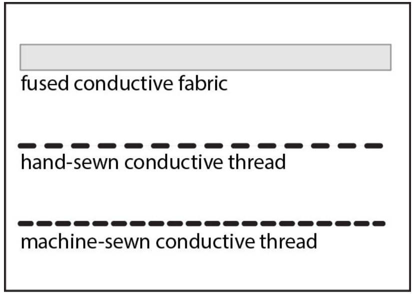
Conductive Traces

traces **2019**

Samples of different conductive materials making traces across fabric.

Materials: base fabric, conductive threads, conductive fabrics, fusible interfacing

Techniques: fusing, hand-sewing, machine-sewing, embroidery



Tilt Switch

digital sensor **2019**

Contact Switch detects if two contact points are touching or not. By extending one of the contact points with conductive thread and metal bead with weight, you can create a sensor that detects tilting direction. The metal bead swings with gravity and touches with open contact as it gets tilted.

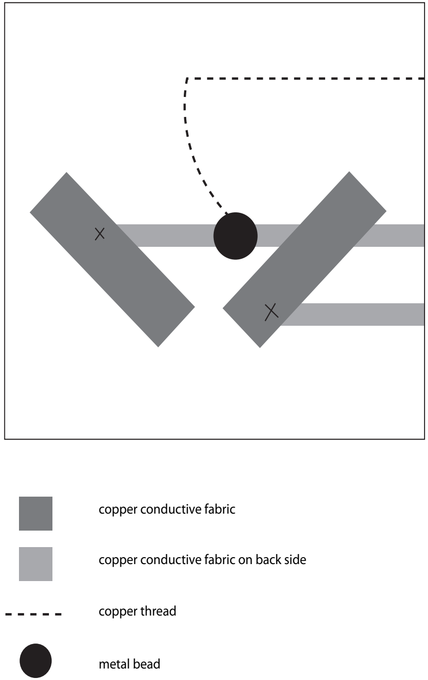
Materials: cotton fabric, copper thread (Karl-Grimm), copper conductive fabric, fusible interfacing, metal bead, galss/plastic bead

Tools: scissors, iron, sewing needle

Techniques: fusing, sewing

Tilt Sensor:

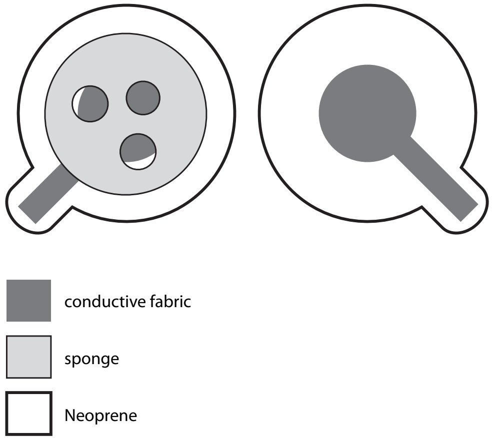
>> http://www.kobakant.at/DIY/?p=201



Fabric Push Button

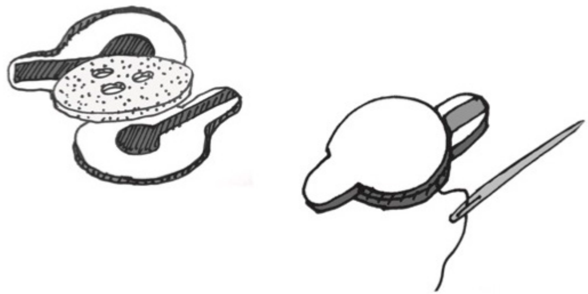
analog sensor 2019

Push button is one of the simplest form of sensors. It is a contact switch separated with a spacer. You can use any conductive material such as conductive fabric and thead to make two contact point separated with spacer made out of sponge, felt or any squishy material. You can make several holes on the spacer material if needed. Make sure the two contacts are not touching unless pressed.



Materials: neoprene (or other fabric), stretch conductive fabric (or non-stretch, depending on previous listed fabric), fusible interfacing, foam, thread

Tools: Scissors, hole maker, cutting mat, sewing needle,iron



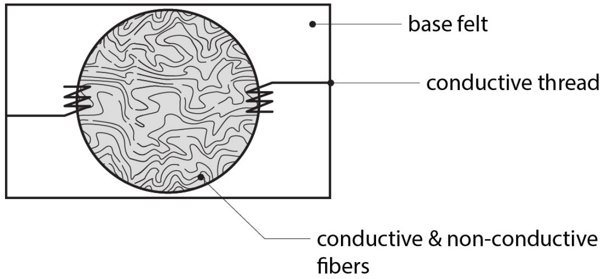
Fabric push button:

>> http://www.kobakant.at/DIY/?p=48

Felt Squeeze Sensor

analog sensor **2019**

Conductive wool (80% wool, 20% stainless steel) felted onto base synthetic felt material with needle felting technique. The sensor reacts to pressuring and squeezing of the wool.



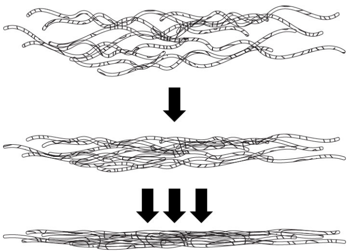
Materials: conductive wool (80% wool, 20% stainless steel) Bekaert, non-conductive wool roving, conductive thread, base felt

Tools: felting needle, scissors, sewing needle

Techniques: needle felting, sewing, cutting

Needle felting conductive wool:

>> http://www.kobakant.at/DIY/?p=3089



Knit/Crochet Stretch Sensor

analog sensor **2019**

Conductive yarn knit into tubular knit with 4 needle knitting mill. It lowers its resistance across the two end as it gets stretched.

Materials:

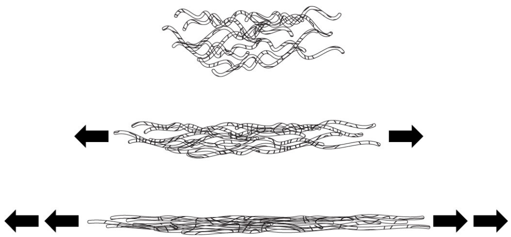
Plug and wear Conductive yarn (polyester 80% Stainless steel 20%), non-conductive yarn

Tools: knitting mill, crochet hook, scissors

Techniques: knitting with 4 needle knitting mill

Circular knit stretch sensors:

>> http://www.kobakant.at/DIY/?p=2108

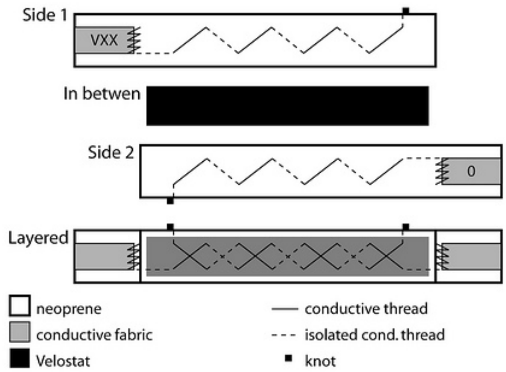


Neoprene Bend Sensor

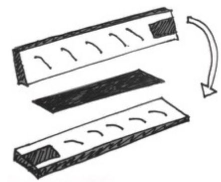
analog sensor **2019**

This bend sensor actually reacts (decreases in resistance) to pressure, not specifically to bend. But because it is sandwiched between two layers of neoprene (a thick, sturdy material), pressure is exerted while bending, thus allowing one to measure bend (angle) via pressure.

You can make this sensor with any piezoresistive material, such as velostat, eeonyx non-woven or eeonyx stretch as middle material.



Materials: neoprene, conductive thread, piezoresistive material (velostat, eeonyx non-woven or eeonyx stretch), conductive fabric (silver stretch), fusible interfacing

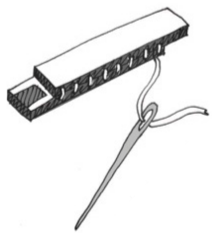


Tools: scissors, sewing needle, iron

Techniques: cutting, fusing, layering, sewing

Neoprene Bend Sensor:

>> http://www.kobakant.at/DIY/?p=20



Heavy Weight Pressure Sensor

analog sensor 2019

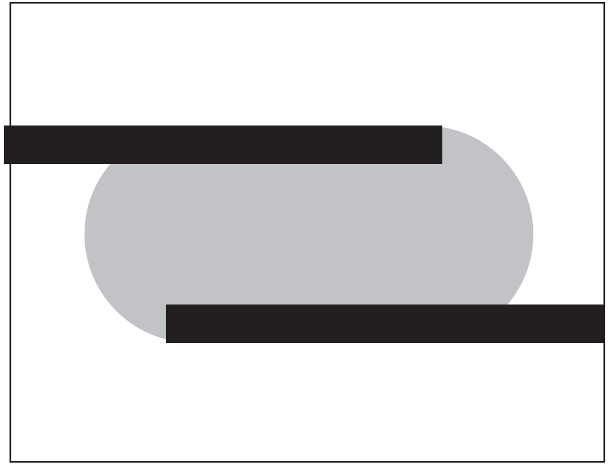
Eeonyx non-woven fabric coated with 20K ohm/sq reduces its resistance when pressure is applied across the material. Compare to other piezoresistive materials, this particular material reacts to larger pressure. This is perfect when you want to detect heavy weight pressure such as human weight.

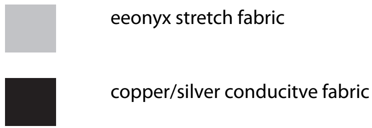
When designing pressure sensor, you can sandwich the eeonyx with electrodes like neoprene bend sensor, or you can place the electrodes side by side to measure the resistance across the material.

Materials: Eeonyx non-woven (20K ohm/sq), copper fabric, fusible

Reference:

Resistive sensors>> http://www.kobakant.at/DIY/?p=5689



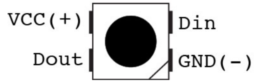


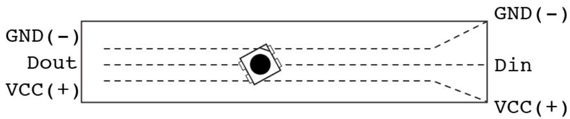
DIY LED Strip

WS2812 addressable LED 2019

Three lines of conductive thread are machine-sewn to a strip of fabric. The center conductive line is cut/interupted where the LED should be placed, to create seperate connections for Data-in and Data-out. The LED is positionied at an angle so that it's pads line-up with the thread and then it is soldered in place.

WS2812
Neopixel pin-out





Materials: Karl-Grimm solderable conductive thread, WS2812 addressable LED, solder, base fabric strip

Techniques: sewing, cutting, soldering

Couching LEDs

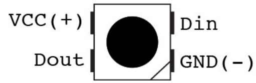
WS2812 addressable LED **2019**

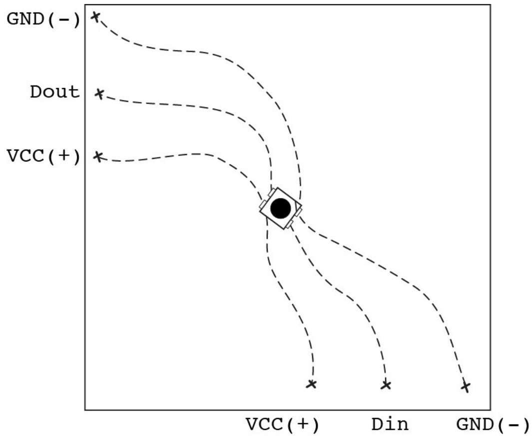
The SMD LEDs are soldered directly to the conductive thread. After soldering all the LEDs the thread, it is then fastened to the fabric using couching technique.

Materials: Karl-Grimm solderable conductive thread, WS2812 addressable LED, solder, base fabric

Techniques: soldering, cutting, sewing

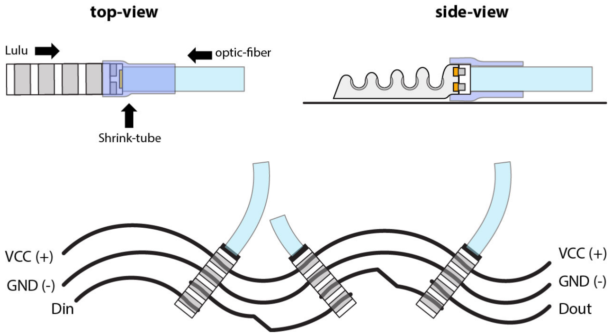
WS2812
Neopixel pin-out



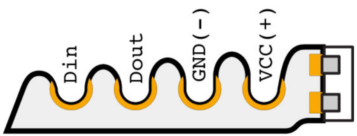


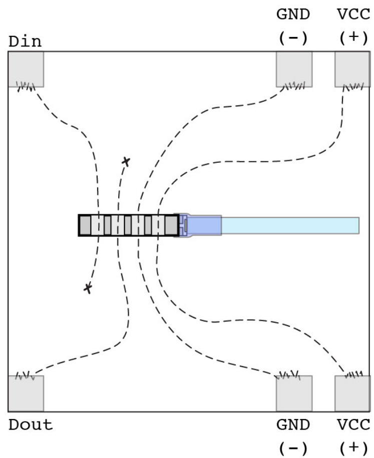
Lulu

WS2812MINI addressable LED + optic-fiber **2019**



Lulu pin-out
WS2812MINI

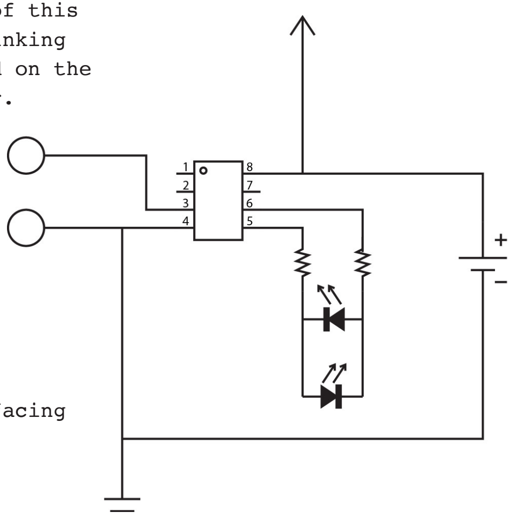


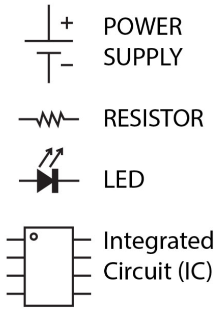


ATtiny Circuit

ATtiny 45/85 microcontroller 2019

This swatch is your chance to make a textile or flexible breakout board for the ATtiny 45/85 microcontroller.
You must plan out your own veresion of this simple circuit that controlls the blinking speed of two charlieplexed LEDs based on the reading from a skin-resistance sensor.





Materials:

ATtiny 45/85 microcontroller (IC)

SMD or through-hole LED

Coin-cell battery

(Resistors or resistive thread)

Copper tape and kapton

Conductive fabric with fusible interfacing

Conductive thread

Single-core wire

Protoboard

Natural fiber base-fabric

ATtiny 45/85