An Introduction to E-Textiles

Class Logistics

In this class, students learn to create active and responsive textiles embedded with microcontrollers, electroluminescent wire, muscle wire, pneumatics, and/or electronics. This course provides an overview of the field, the current state of the art in e-textiles, and the possibilities and difficulties that arise from merging electronics with flexible materials. We do expect students to have basic circuit making and hand sewing skills in this class. We won't cover programming in this Micro - that can be learned in the Arduino Micro!

Instructors

Olivia Robinson (orobinso@andrew.cmu.edu)

Jet Townsend (jetboy@cmu.edu)

Teaching Assistant

Sarika Bajaj (sarikab@andrew.cmu.edu)

Class Website

https://courses.ideate.cmu.edu/99-360/s2018

Class Logistics

Class 1: 02/16 Instructor: Olivia Robinson

Discussion Topic: Electronic Components and Textiles

Lab: Gemma Microcontroller Sampler

Class 2: 02/23 Instructor: Jet Townsend

Discussion Topic: Electroluminescent Wire

Lab: EL Wire Sampler

Class 2: 03/02 Instructor: Olivia Robinson

Discussion Topic: Textiles and Movement

Lab: Pneumatics/Muscle Wire Explorations

Final Project due 03/09

Proposal Option: You will create a proposal for a project that utilizes techniques or concepts covered in the class. Should include: sketches, write up of materials, techniques and concepts used.

Skill Investigation Option: You will learn a new textile skill and create a sample to show what you have learned. Should include: photos of your sample, what resources and guides were used, and possible applications.

Format of Micro

- 1:30-4:30pm class time
- 4:30-6:30pm lab time
- Demo and discussions (3 hrs)
- Open Lab (2 hrs)
- Deliverables: Sample booklet and project
    - Due one week after last class

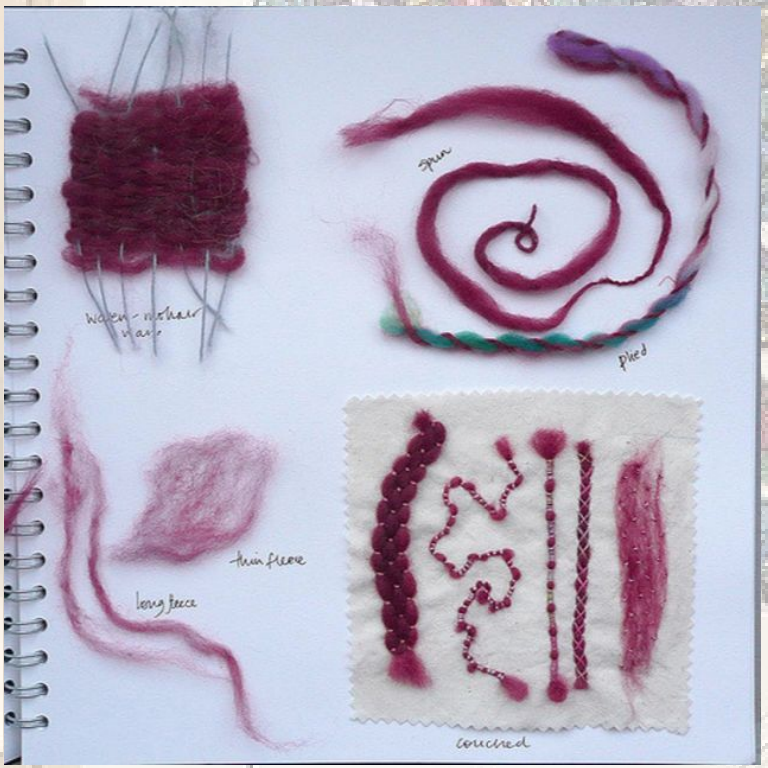
IDeATe Gallery Website:

http://ideate.xsead.cmu.edu/gallery/courses/ideate-e-textiles

Sign up early!! (new registrations are approved manually)

Sample Book

- Collection of different techniques and samples that can be used a reference tool
- 1” binder + plastic sheets



Project

For the final project, students will further investigate a skill covered or create a project proposal that incorporates techniques from the class.

http://ideate.xsead.cmu.edu/users/sign_in

Due: one week after our last class

IDEATE gallery documentation

Proposal Option: You will create a proposal for a project that utilizes techniques or concepts covered in the class. This project could be for another class or be for personal inquiry. Make sure to include:

- Sketches
- Write up of materials
- Techniques and Concepts used

Skill Investigation Option: You will learn a new textile skill and create a sample to show what you have learned. This skill could be one that we discussed in class (but did not cover in a demo) or one for personal inquiry. Make sure to include:

- Photos of your sample
- What resources and guides used
- What materials used
- Possible applications

What are *E-textiles*?

- Textile materials embedded with digital and electronic components
- Textiles that can react to environmental stimuli
- e-textiles, soft circuits, wearable tech, wearable electronics...

Smart textiles are fabrics that have been developed with new technologies that provide added value to the wearer.

“ **Wikipedia**

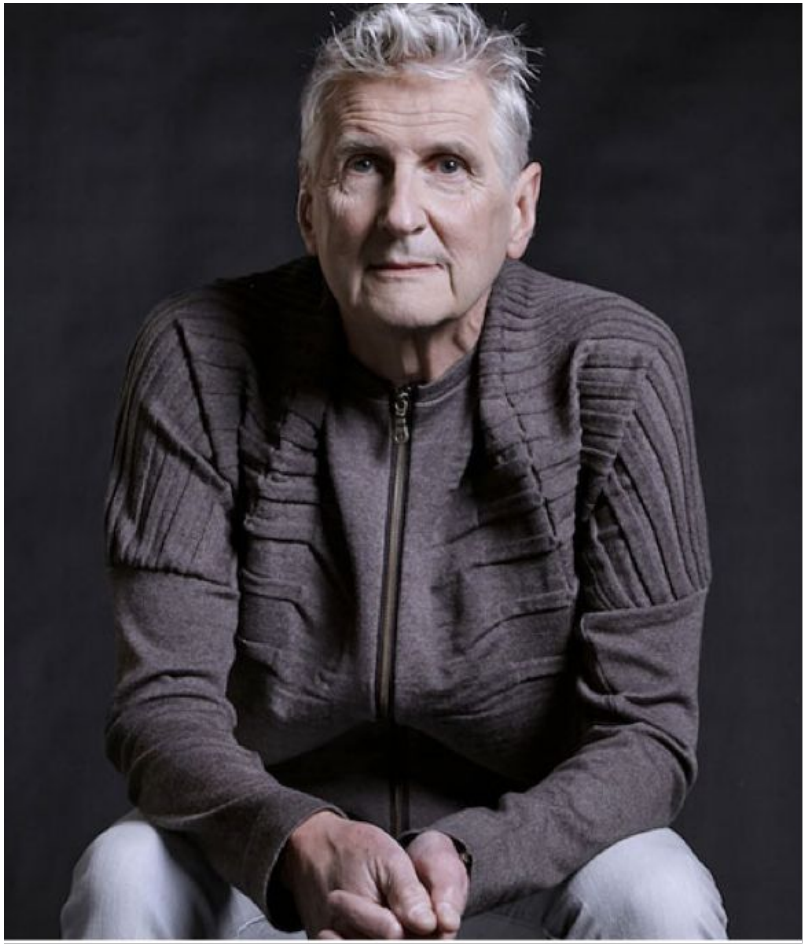
What makes smart fabrics revolutionary is that they have the ability to do many things that traditional fabrics cannot, including communicate, transform, conduct energy and even grow.

Pailes-Friedman
Pratt Institute

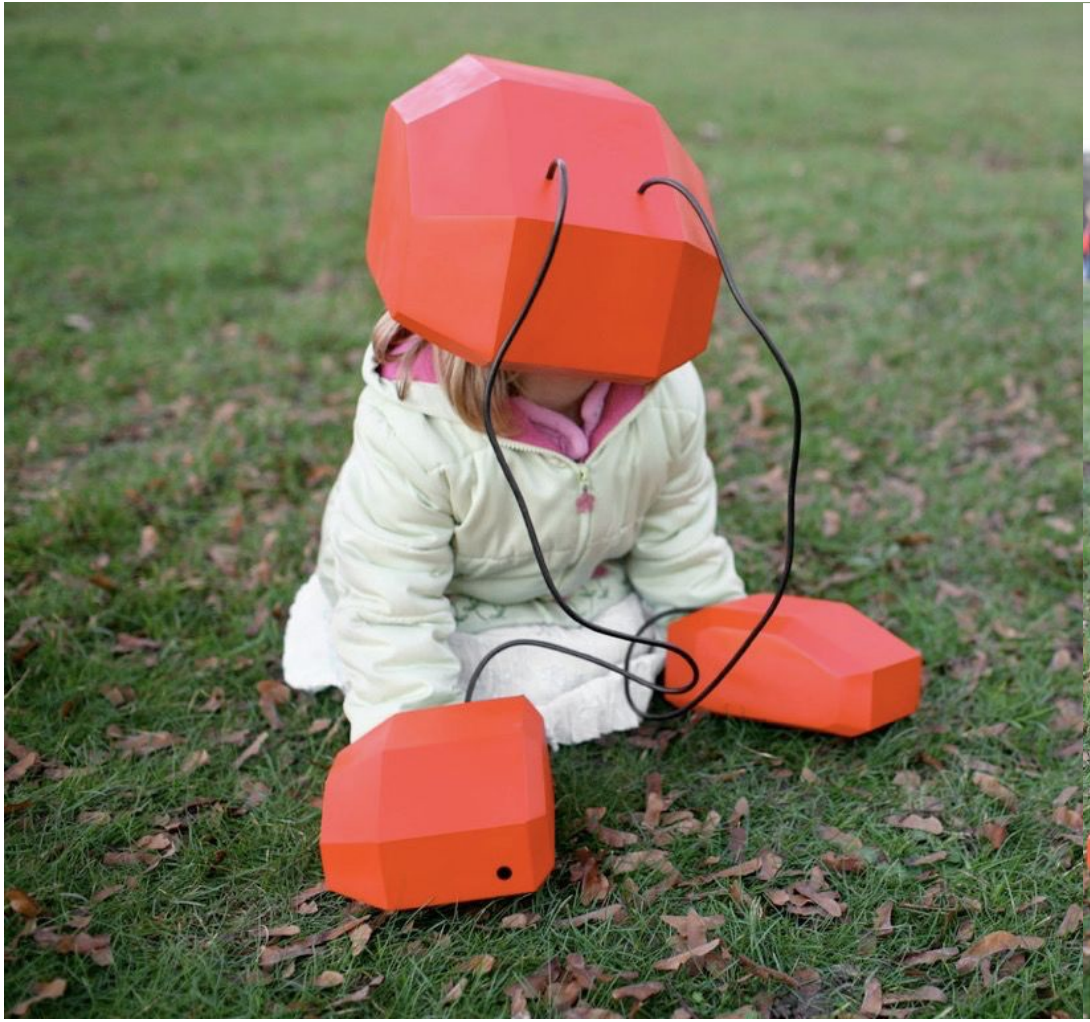
Spider Dress

Nike’s Self Lacing Shoes

Medical Textiles



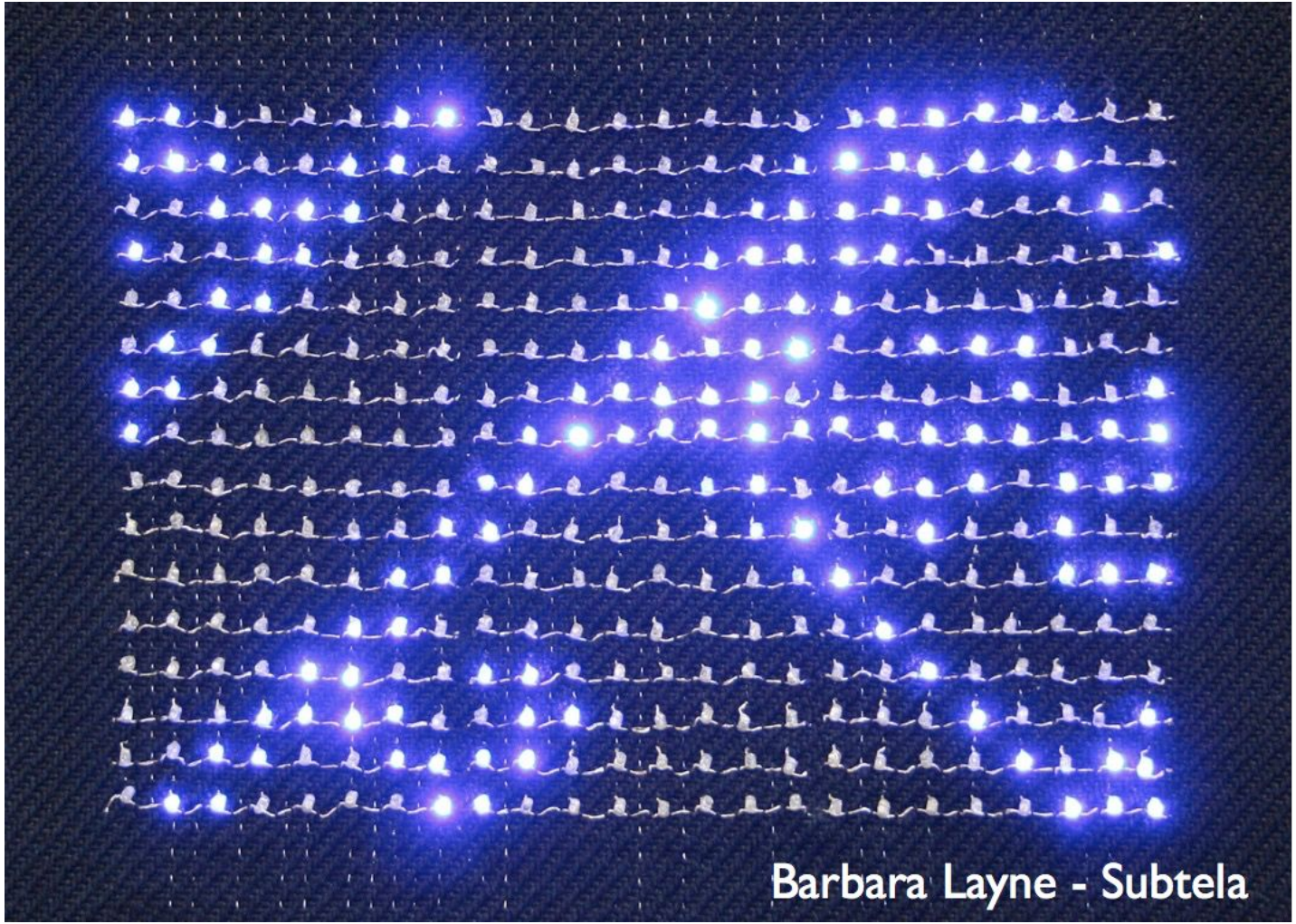
Pauline von Dongen

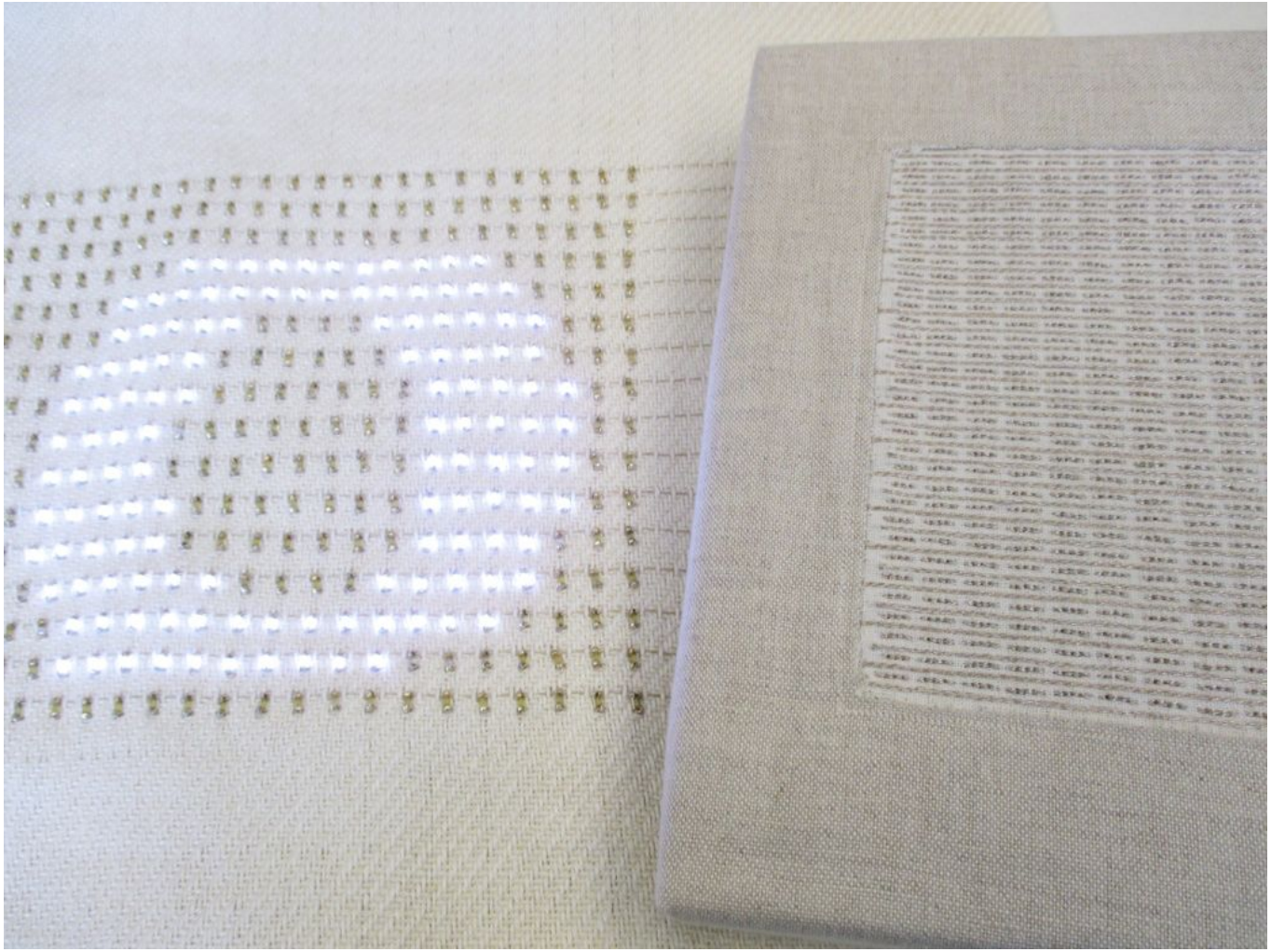


Chris Woebken
Kenichi Okada

Jen Liu

Jen Liu


Barbara Layne - Subtela

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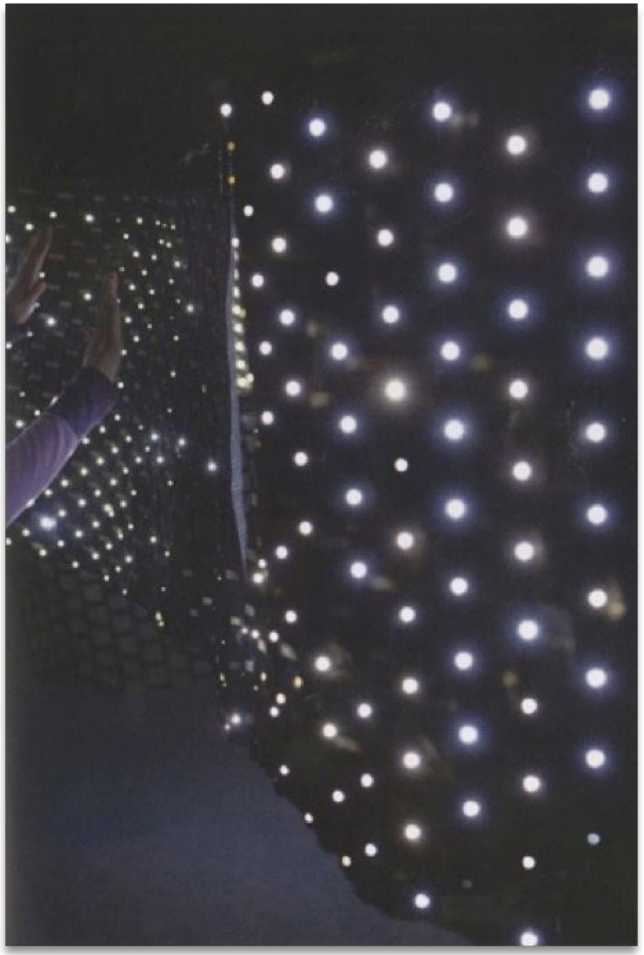


Zane Berzina

Haley Profita + Microsoft Research: Lightwear

For Seasonal Affective Disorder

Cute Circuit + EasyJet: Engineer uniforms for airplanes

Sharewear by Di Mainstone

https://vimeo.com/55216258

How to get started...

Electronics + Textiles ≠ E-Textiles

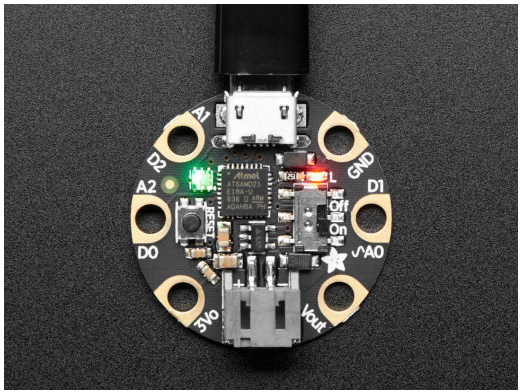
Both systems must be carefully designed simultaneously in order to succeed. This includes planning ahead of time to determine:

1) How the electronic system will be attached to the fabric
2) Where the power system and circuit boards will be stored
3) Whether the fabric is strong enough to support this extra weight
4) How is the circuitry affected when interacting with the body

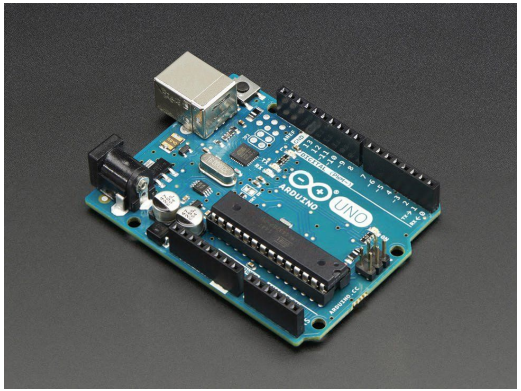
Fabrics stretch, Circuits don't (currently).

The constant struggle with E-Textiles is figuring out methods to ensure that the circuits integrate well with the fabric. If the circuitry does not have enough support then the circuitry will break; at the same time, if the fabric is too structured to support the circuitry, then it will be uncomfortable to use.

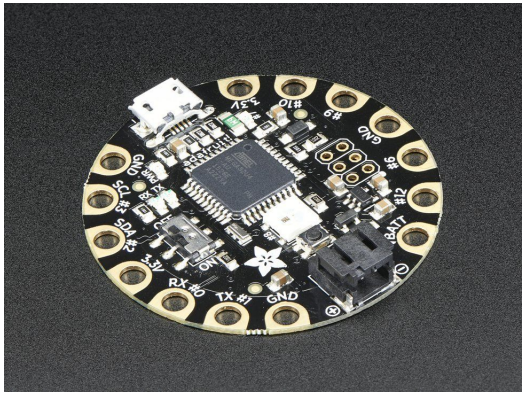
Some Wearable Microcontrollers!



Gemma

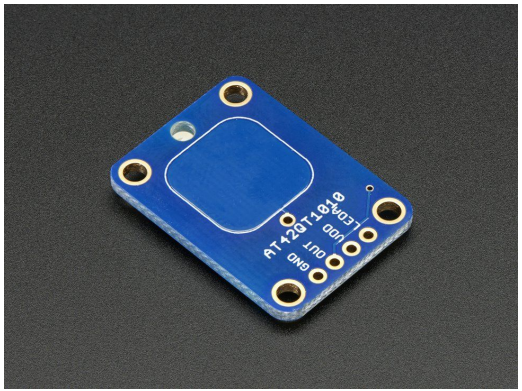


Arduino



Flora

Some Common Sensors!



Capacitive Touch

IMU

Pulse Rate

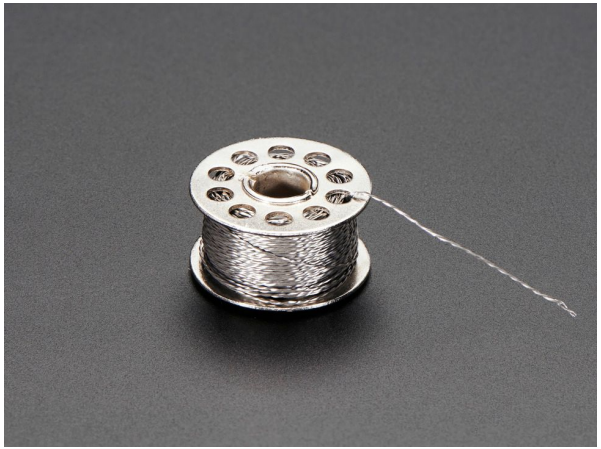
Homemade Sensors

from top left:
stroke sensor,
knit/crochet sensor,
soft push button,
pom pom switch,
fabric potentiometer

Kobakant: HOW TO GET WHAT YOU WANT

Plusea / Hannah Perner-Wilson

Some Path Making Connections

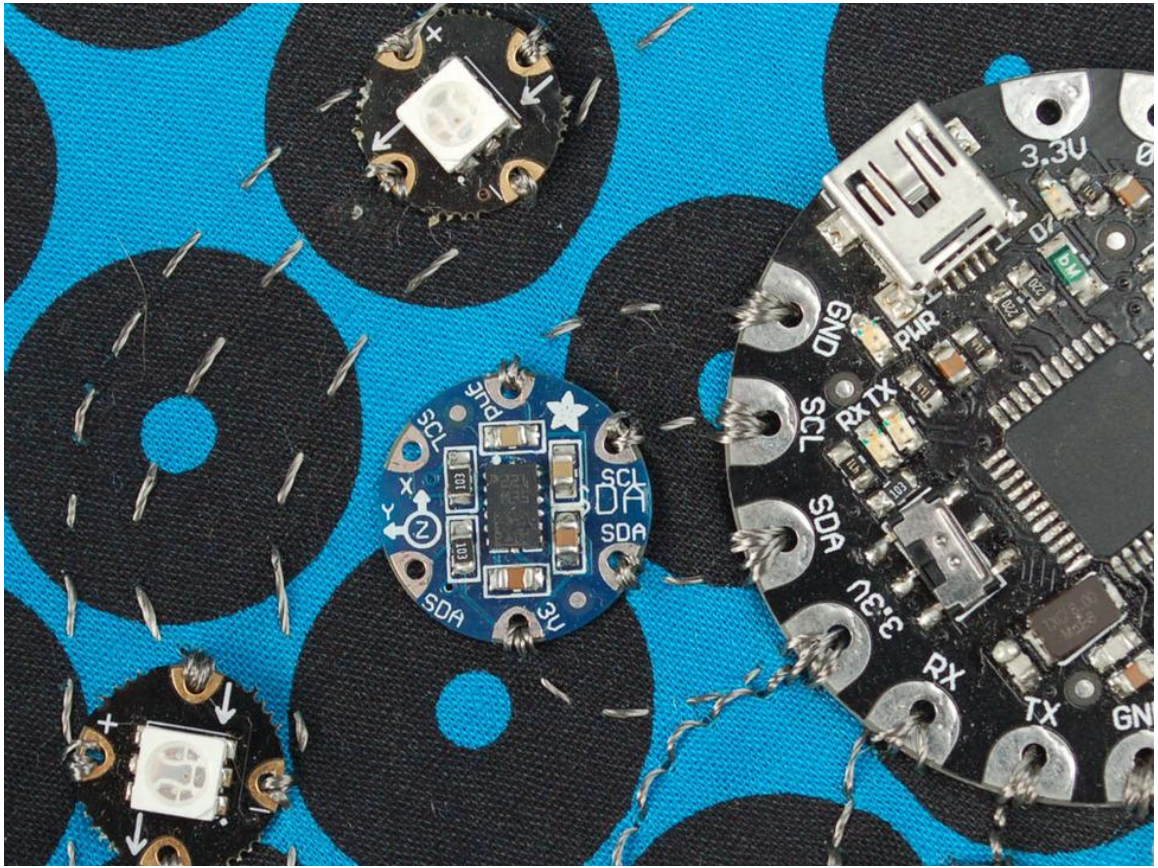


conductive thread
(stainless steel / silver)

conductive fabric
(wide variety!)

conductive ink
(drawing/printing)

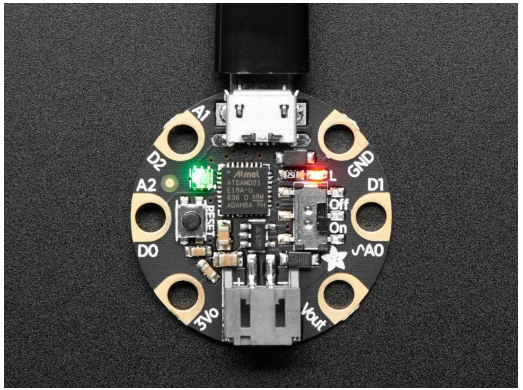
Sewn Connections



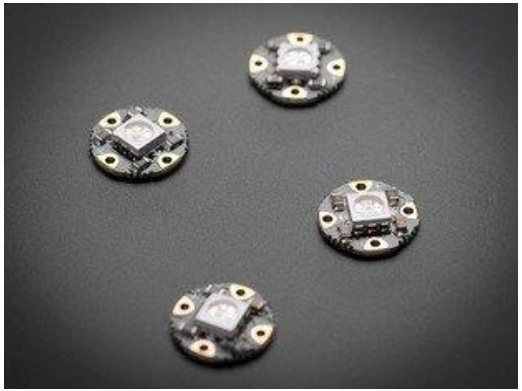
Great for basic circuitry.

Not great for circuitry that needs to send data.

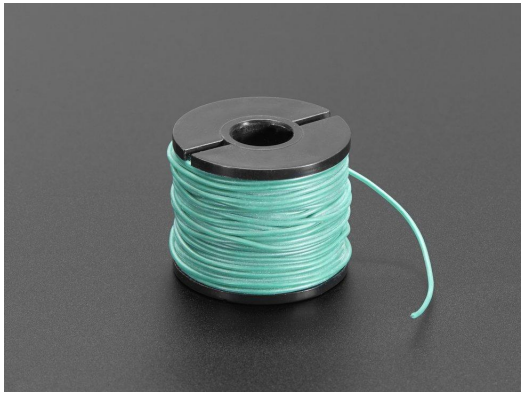
What we will use Today!



Gemma

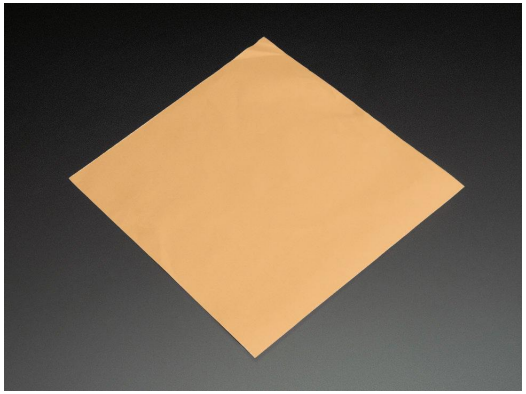


Neopixels



Silicone Wire

USB Battery Pack



Copper Fabric

Other items:
Regular thread, hand sewing needle, hot glue

Soldering Equipment

Soldering Station

Soldering Iron

Solder

Helping Hands

Soldering Stand

Tip Cleaner

Solder Pump

Desoldering Braid

Safety

- Never leave a hot soldering iron unsupervised.
- Put soldering iron in stand when not in use.
- Use “helping hands” to hold components and wires when soldering.
- Work in a well ventilated space and/or use a fume extractor.
- Always wash your hands after handling solder and electronic components.
- Keep workspace clean and clutter free.
- Wear eye protection as an extra precautionary measure.

Technique

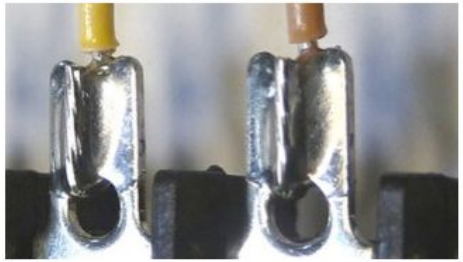
Temperature: Around 600 degrees+ for leaded solder. 700 degrees+ for lead-free solder.

A good solder joint should take no longer than 2-3 seconds to form. If it takes longer, raise the soldering iron temperature.

Keep the soldering iron tip clean and coated with a thin layer of solder (“tinned”).

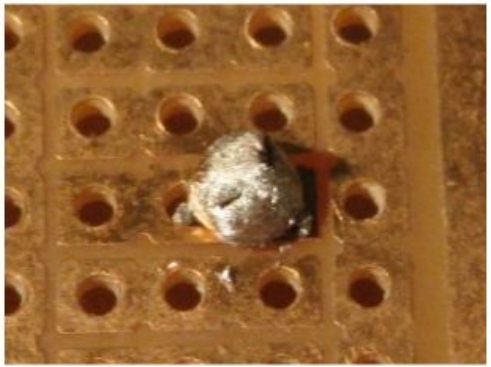
Apply heat to the joint to be soldered and allow solder to flow over it.

A good solder joint



A good solder joint will be bright and silver (unless you use lead-free solder) and not use too much solder.

A bad solder joint



A bad solder joint will be grey and gritty and/or use too much or too little solder.
These are often referred to as "cold" solder joints.

Hands On

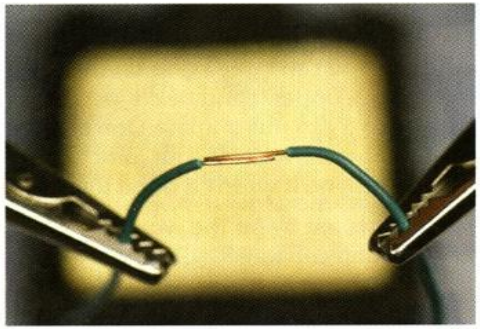


Figure 3-40

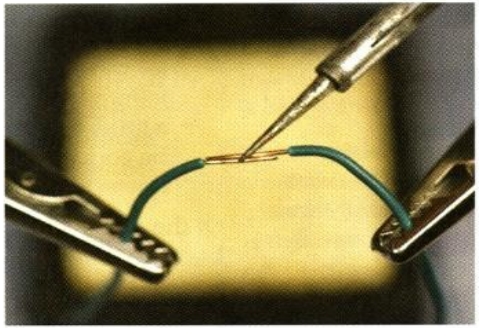


Figure 3-41

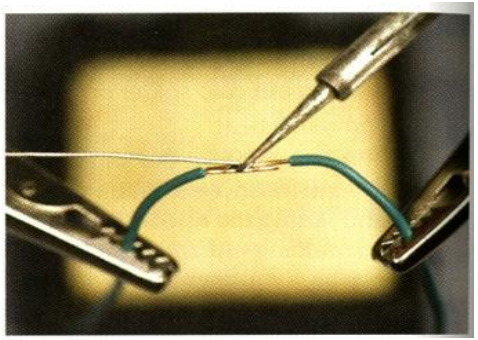
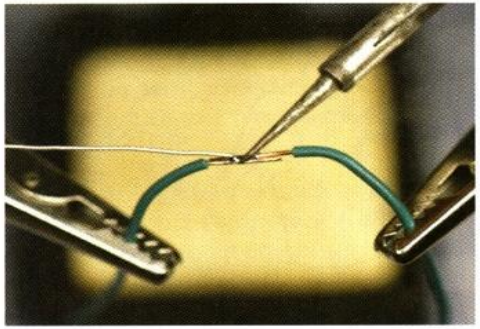
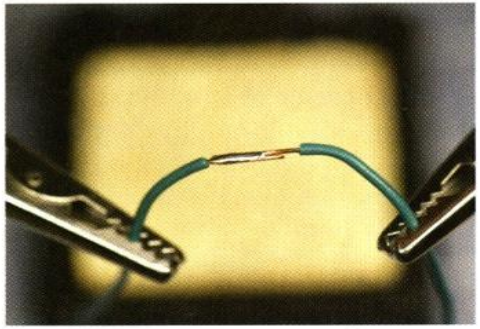


Figure 3-42

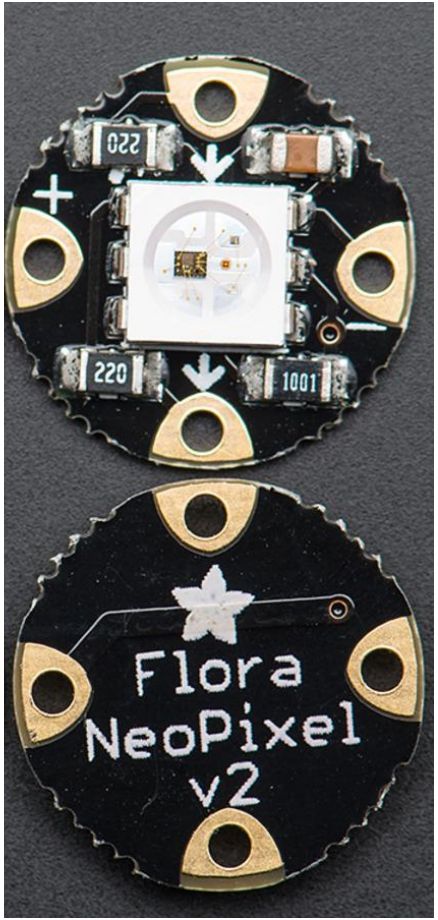




Steps:

1. Lay your items out & draw a to scale drawing of your plan
2. Cut wires to the appropriate size to go between components
3. Solder wires onto 1 of the neopixels.
   a. Solder two black wires to GND.
   b. Solder two red wires to +5VDC
   c. Solder one yellow, green or blue wire to Din (arrow pointing inward) and one to Dout (arrow pointing outward).
4. Solder this neopixel to your Gemma.
   a. Connect the black wire to GND
   b. Connect the red wire to Vout
   c. Connect the Din wire on the neopixel to D1 on the Gemma.
5. TEST to make sure it works! Test after adding each neopixel.
6. Solder on another neopixel to the string you have already started. If you will be adding more neopixels eventually, also solder on an extra black wire to GND, an extra red wire to +5VDC, and a wire to Dout. Test!
7. Solder on the wire that will go to Gemma's A2 (your capacitance pin).
8. TEST everything again!
9. Hot glue or sugru the areas where the wires connect to the boards.

Neopixel Layout



Demo Time