MakerWear

EARLY EXPLORATIONS OF WEARABLE CONSTRUCTION KITS FOR CHILDREN

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SEP 25, 2016

HCIL Human Computer Interaction Laboratory
makeability lab
COMPUTER SCIENCE UNIVERSITY OF MARYLAND
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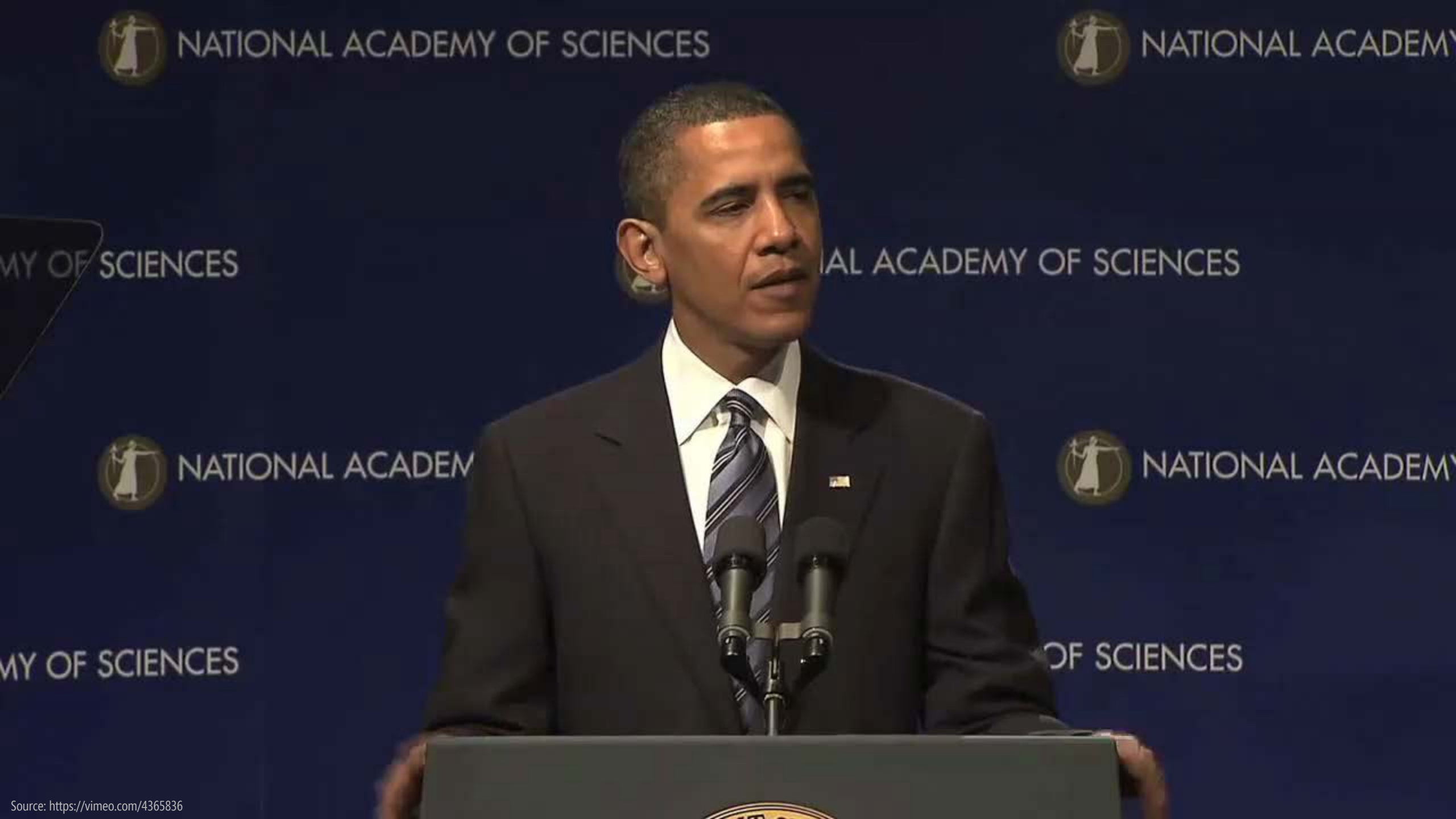


Source: https://vimeo.com/4365836

"...to be **makers of things**, not just consumers of things."

President Barack Obama

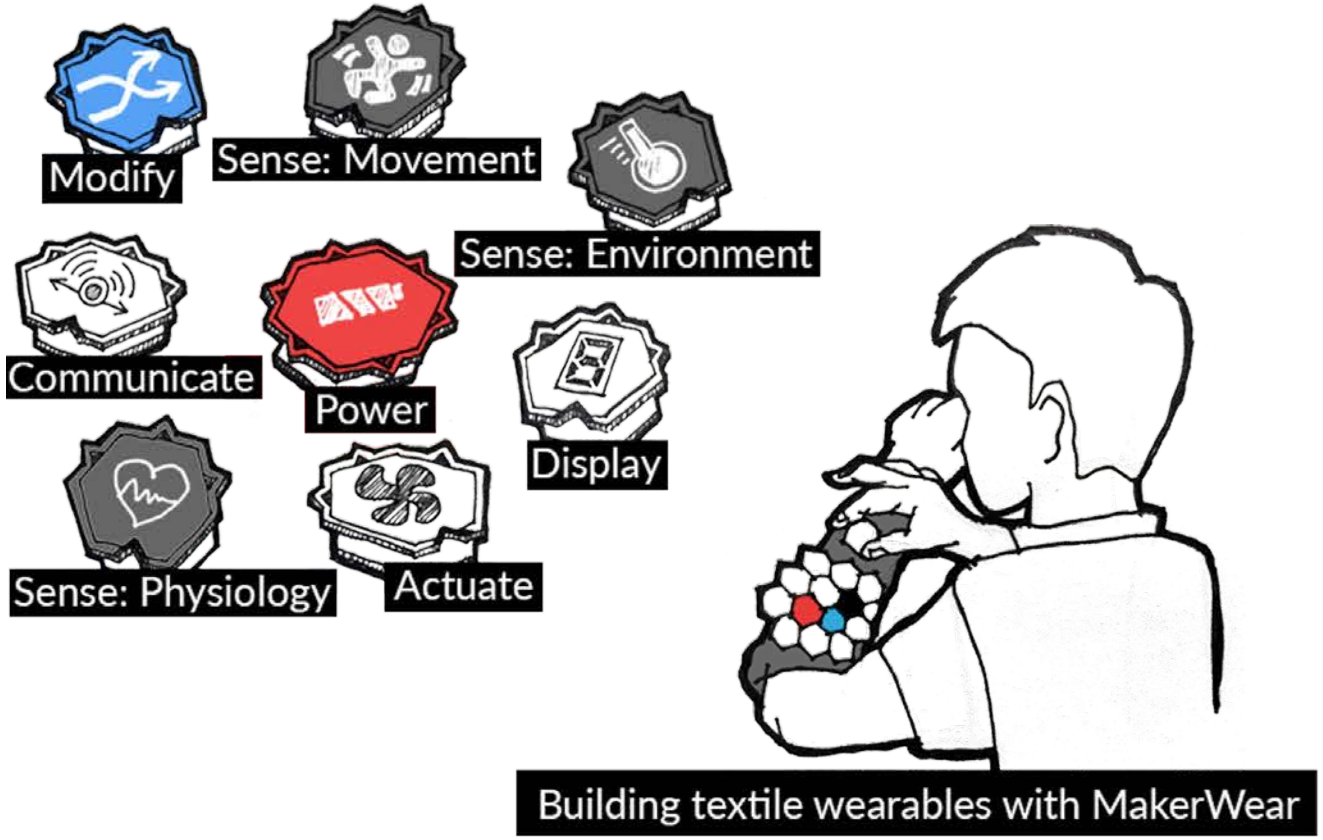
Remarks to the National Academy of Sciences, 2009

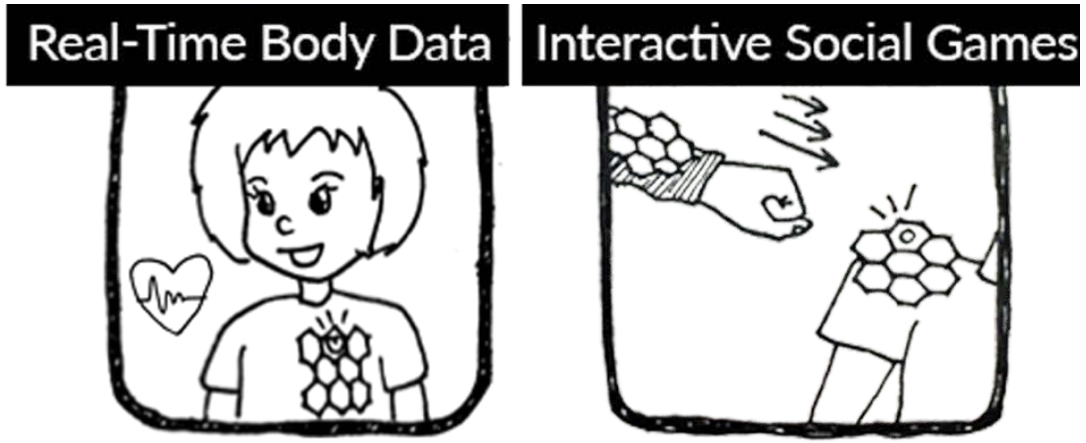
Source: https://www.whitehouse.gov/the-press-office/remarks-president-national-academy-sciences-annual-meeting

Research Vision

MakerWear

A new construction kit aimed at **enabling children** to **design** and build their own **interactive wearables**.





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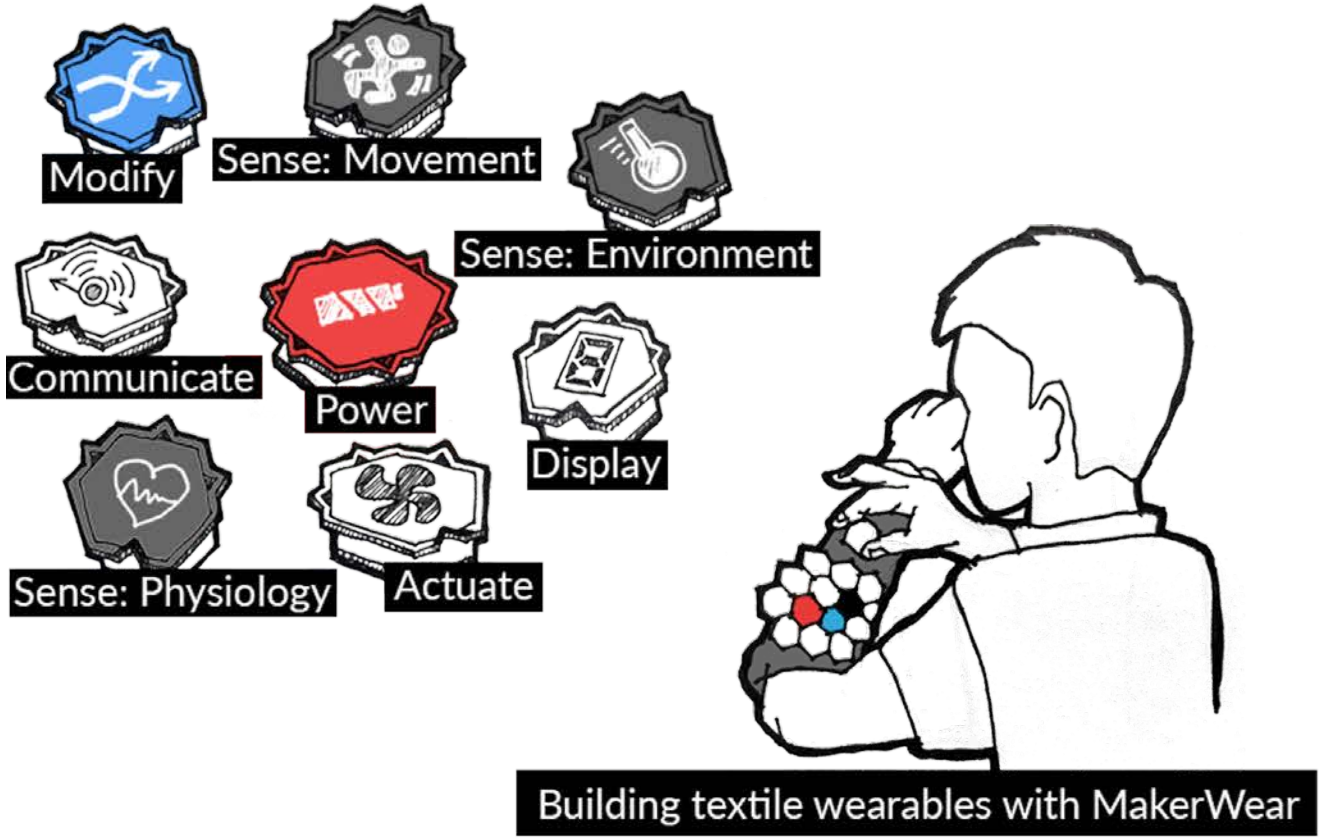
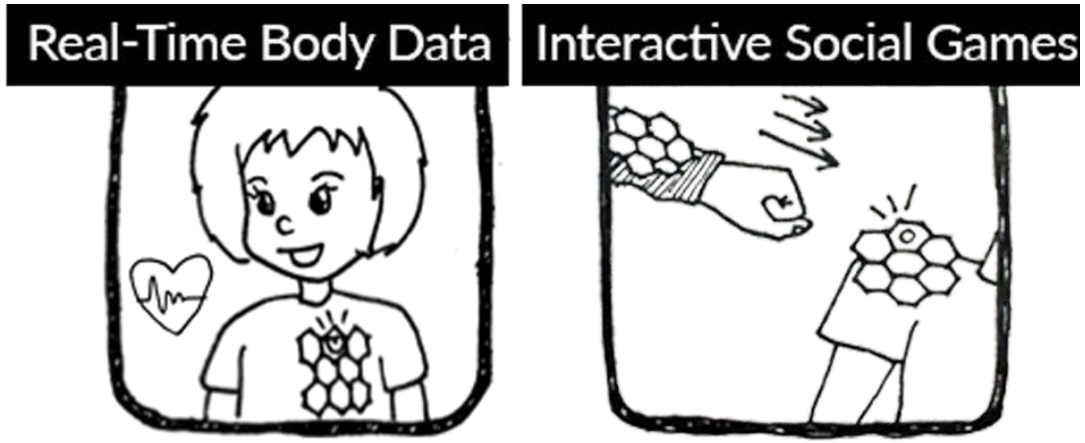
A new construction kit aimed at **enabling children** to **design** and build their own **interactive wearables**.

With only a **few components**, children can build a **wide range of designs**...





Research Vision

MakerWear

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With only a **few components**, children can build a **wide range of designs**...

MakerWear Examples

Design Inspirations

Design Inspiration

Light-Up Shoes

Children love light-up shoes

Interactive

Responsive

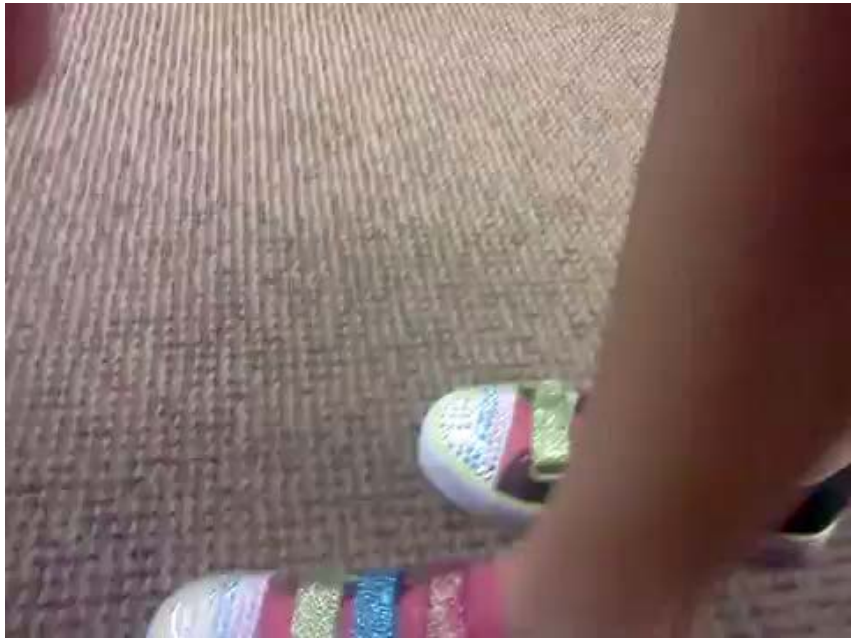
Expressive

Fun

Not modifiable

Not extensible

Not programmable



Design Inspiration

Fashion Customization

Children enjoy customizing their clothing, & collecting and sharing designs

Not interactive

Not programmable

Design Inspiration

LilyPad Arduino

Incredibly successful e-textile microcontroller platform.

Open-ended

Programmable

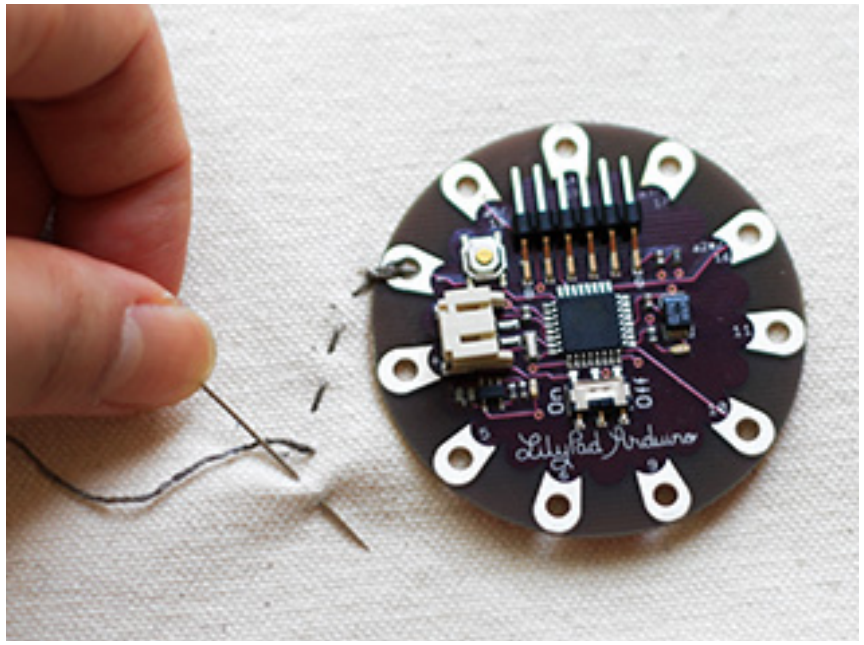
Wearable

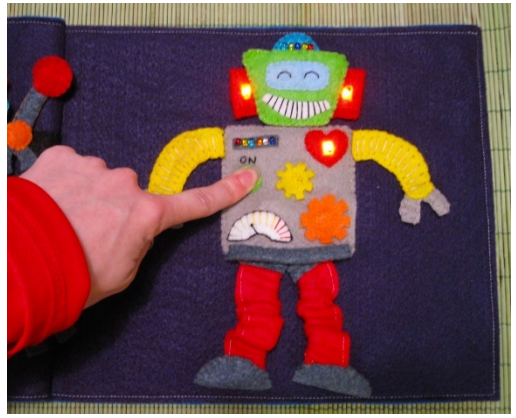
Not designed for children

Requires sewing

Requires programming

Requires basic electronics





Source: Buechley *et al., CHI'08, DIS'10*

Design Inspiration

BodyVis

E-textile shirt for visualizing live physiological data

New platform for health and science learning

Fully responsive and interactive

Source: Norooz *et al., IDC'13, CHI'15*

Design Inspiration

BodyVis Provoked Curiosity

Children constantly asked "**how does it work**" and wanted to **explore the "insides"** of the BodyVis shirt. This was unexpected!

Construction Kits

Construction Kit Definition

> Construction kits—like LEGO or Erector Sets—are **creative platforms** that enable users to **design** and **create things** through **interworking components**.

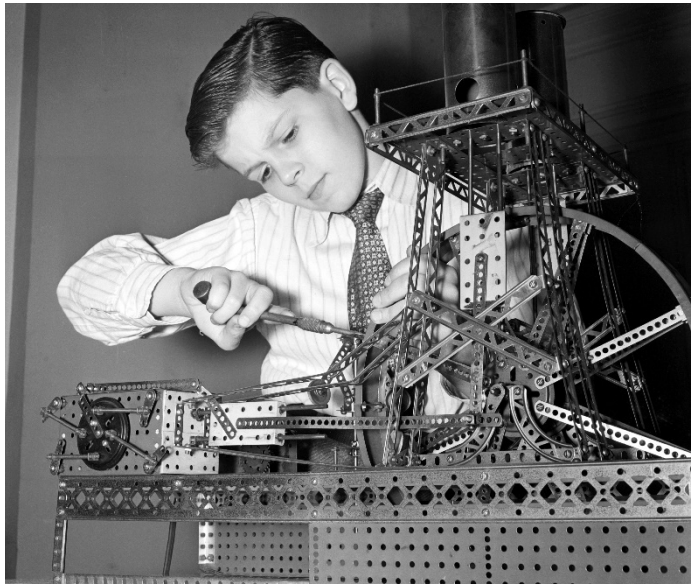
Based on definition by: Resnick, M., & Silverman, B. Some reflections on designing construction kits for kids, *IDC'05*

Construction Kit History

Source: Resnick, M. Behavior Construction Kits. *Commun. ACM '93*

Construction Kit History

1st Generation Kits
Allowed children to build structures (*e.g.,* towers, buildings)



2nd Generation Kits
Allowed children to build mechanisms (*e.g.,* pulleys, working ferris wheels, cars with gears)

3rd Generation Kits
So-called digital-physical kits allow children to build interactive behaviors (*e.g.,* a car that follows a light)

Source: Resnick, M. Behavior Construction Kits. *Commun. ACM '93*

Digital-Physical Construction Kits

Robotics (*e.g.*, Cubelets)

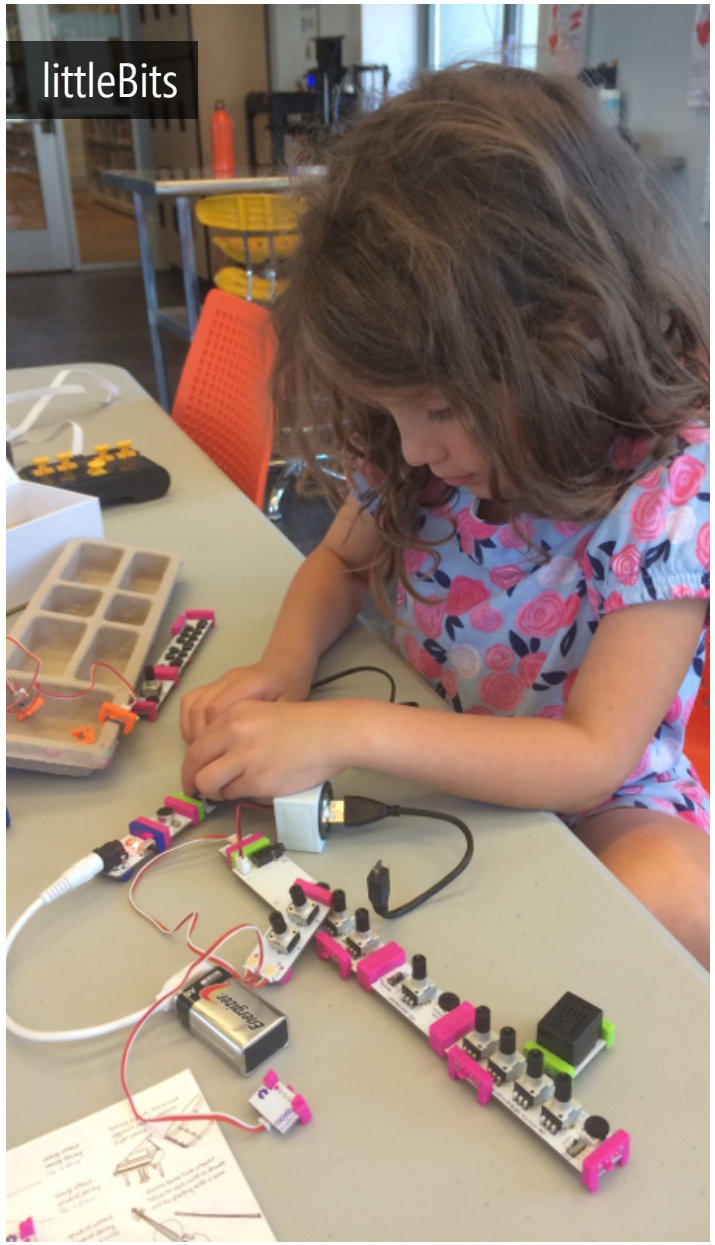
Electronics (*e.g.*, littleBits, SAM)

Circuits (*e.g.*, LightUp)

Often programmable

Modular

Snappable (typically magnetic)



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Construction Kits

Modular Robotics Cubelets

Sensors

Light Sensor

Distance Sensor

Temperature Sensor

Actions

Rotating Wheels

Flashlight

Speaker

"Think"

Inverse

Maximum

Threshold

Other

Battery

Pass Through

Blocker

Cubelets

Modular
Snappable
Emergent behavior
Rapid prototyping
Highly iterative

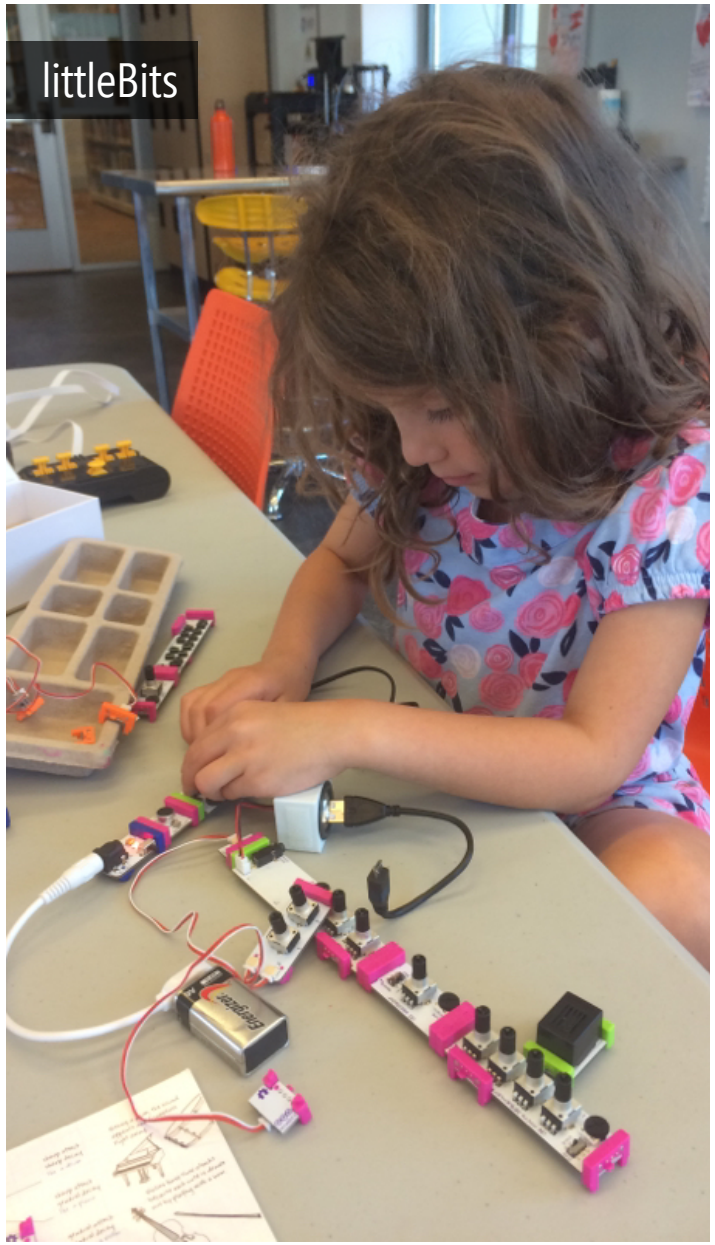
Digital-Physical Construction Kits

Designed & used in static spaces

Not wearable

Not intrinsically shareable

Children not designing for the self, their changing contexts



Clothing is a Unique Design Context

Constructions are wearable &, thus, inherently social, mobile, & always available

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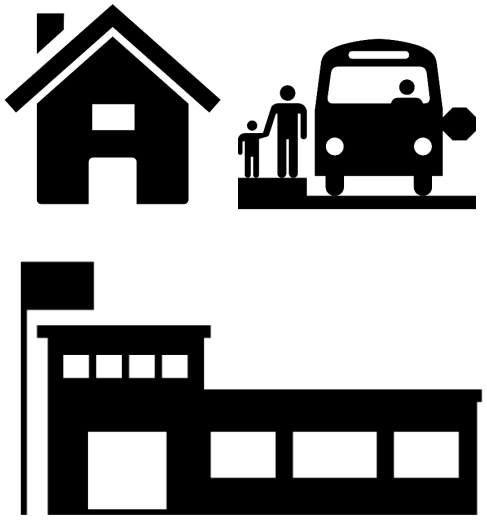
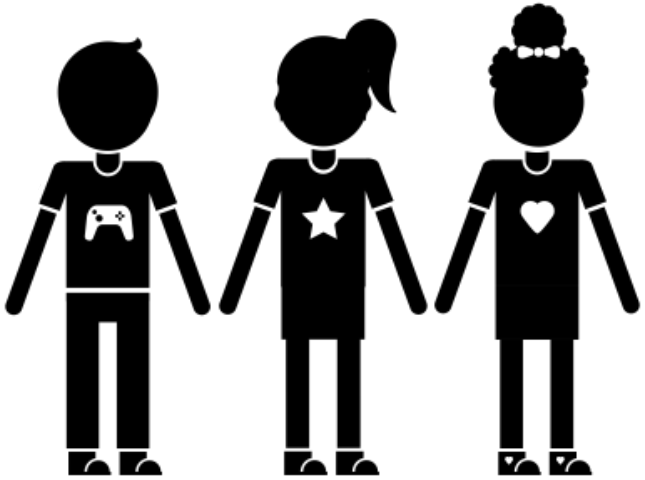


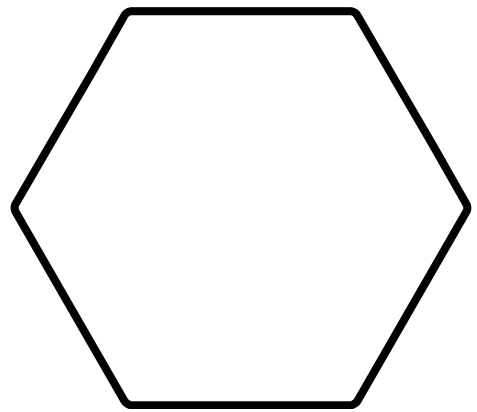
Changing environments

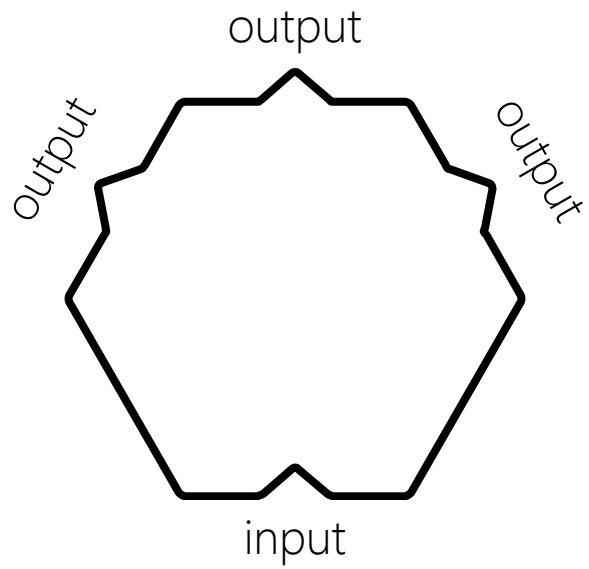


Social Interactions

Daily Life

MakerWear Design

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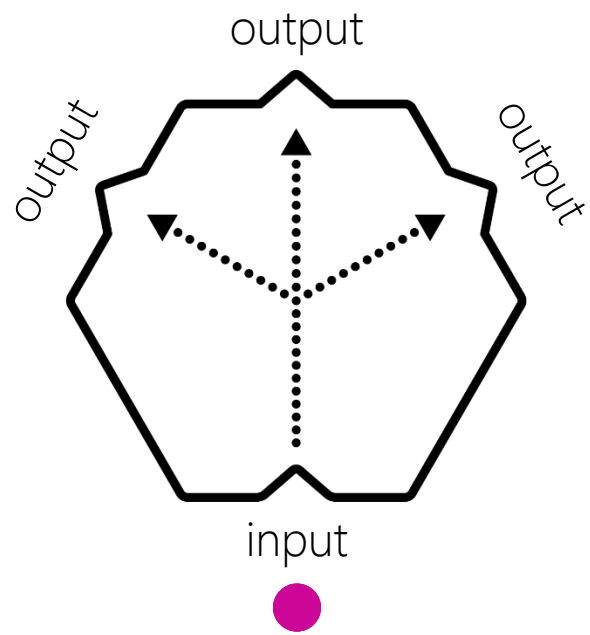
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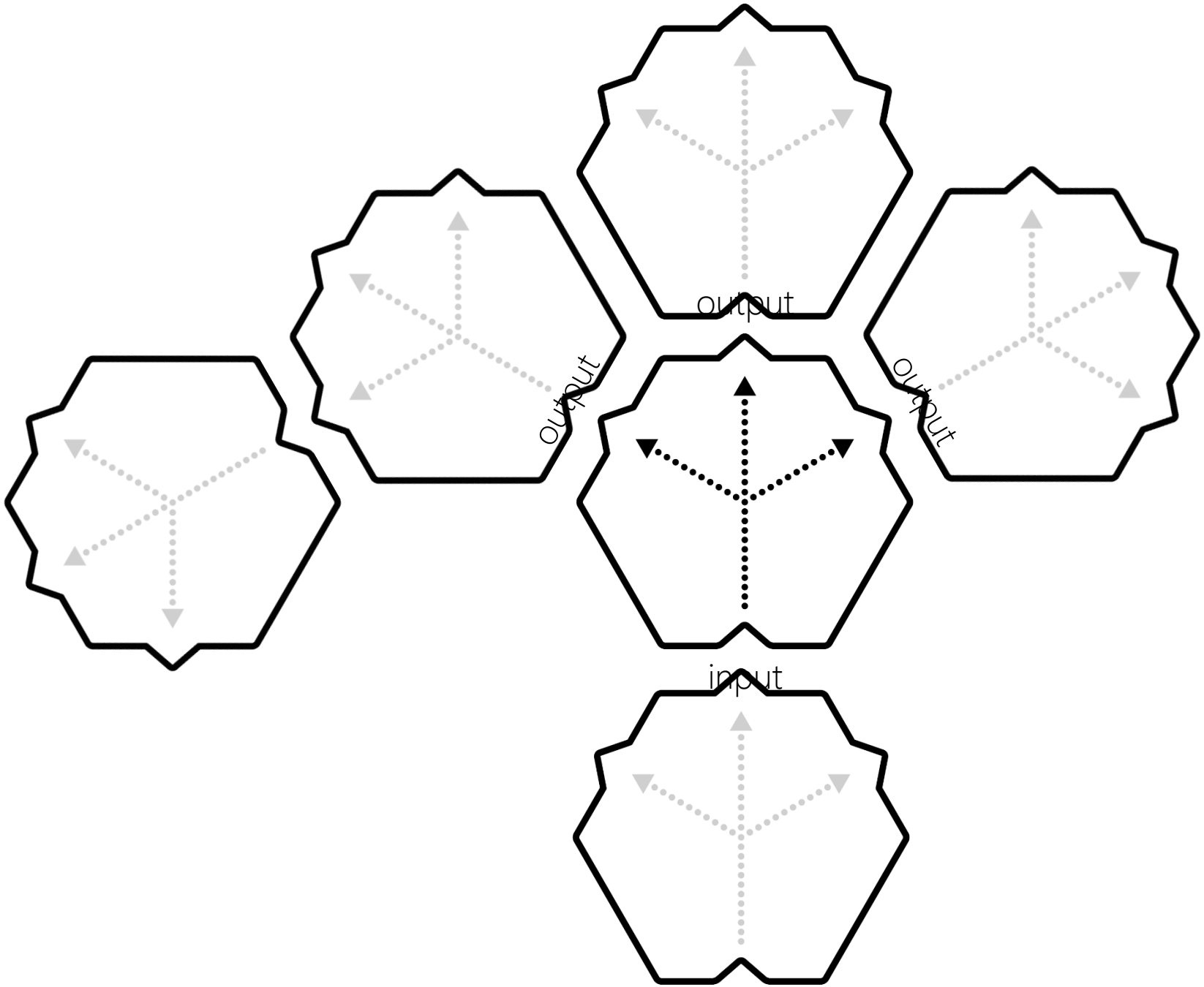
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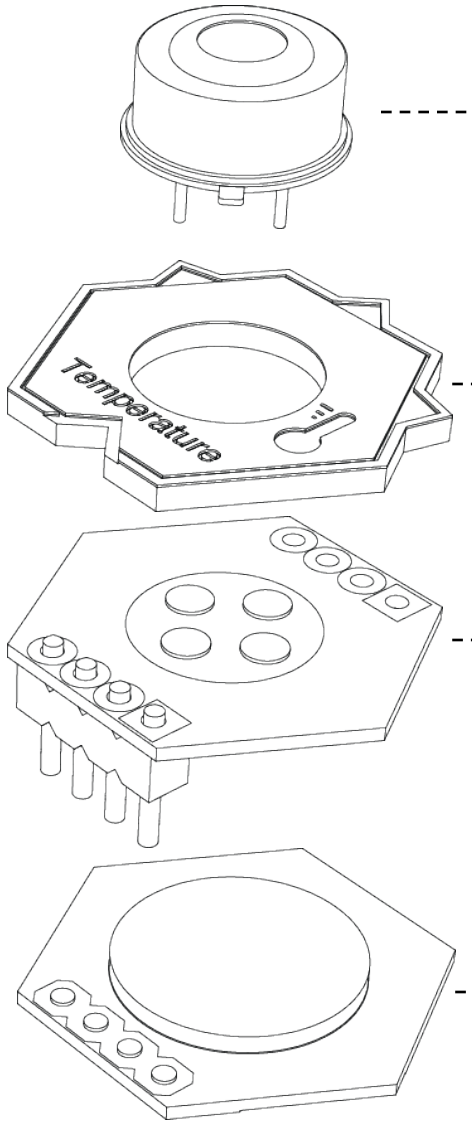
Module Layers



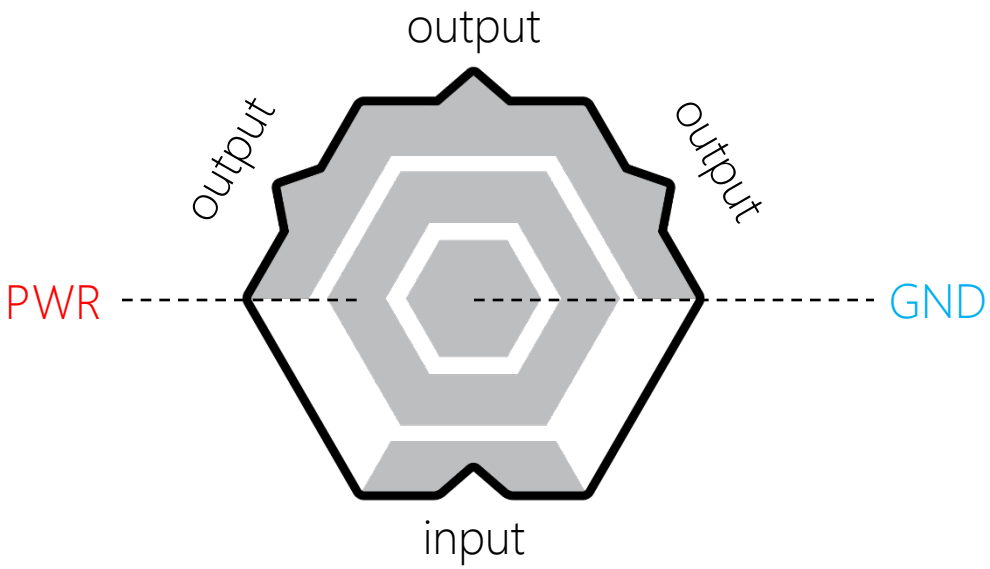
Sensor

Layer Three
Laser cut cover: Module icon & label

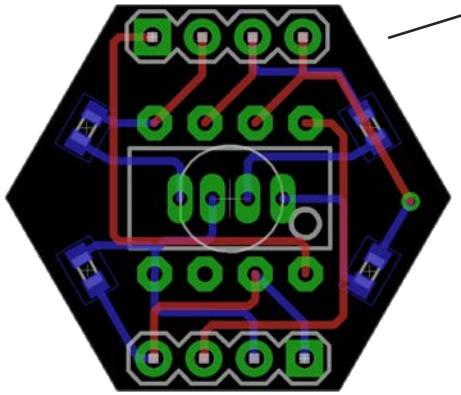
Layer Two
Electronics, Connection to bottom layer.

Layer One
Magnet, Spring Contacts

Module Layer One



Module Layer Two



Custom PCB with pre-programmed electronics for given module

Module Layer Three

Laser cut top shows iconography & label representing module behavior

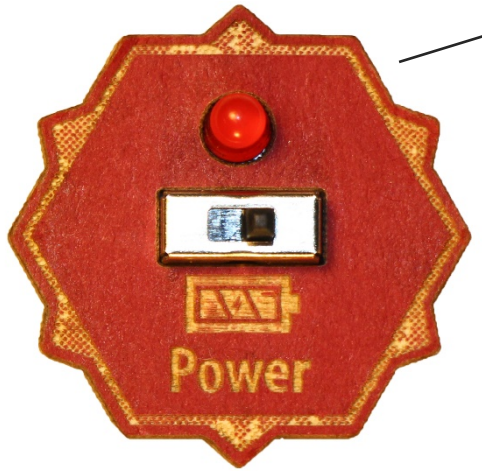
Example Module: MultiColor Light

Example Module: Inverter

Example Module: Distance Sensor

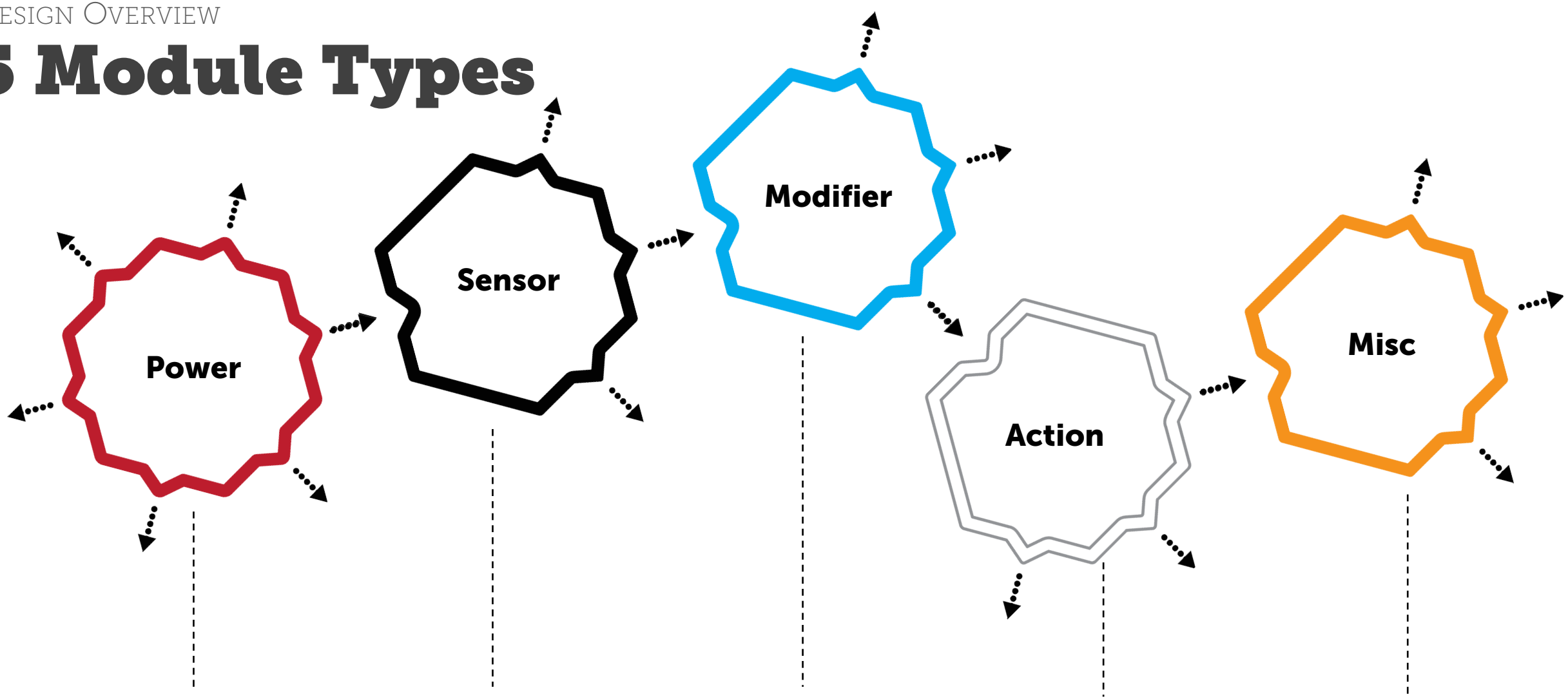
Example Module: Power

Example Module: Power



Power module has **six outputs** instead of three

5 Module Types



provides power to all connected modules

Senses and translates physical phenomena into analog signals

Transforms analog signals into other types of analog signals

Translates analog signals into perceptual forms

Miscellaneous modules: Wire, Bridge, & DIY

Module Library

Sensors **Actions** **Modifiers** **Power & Misc**

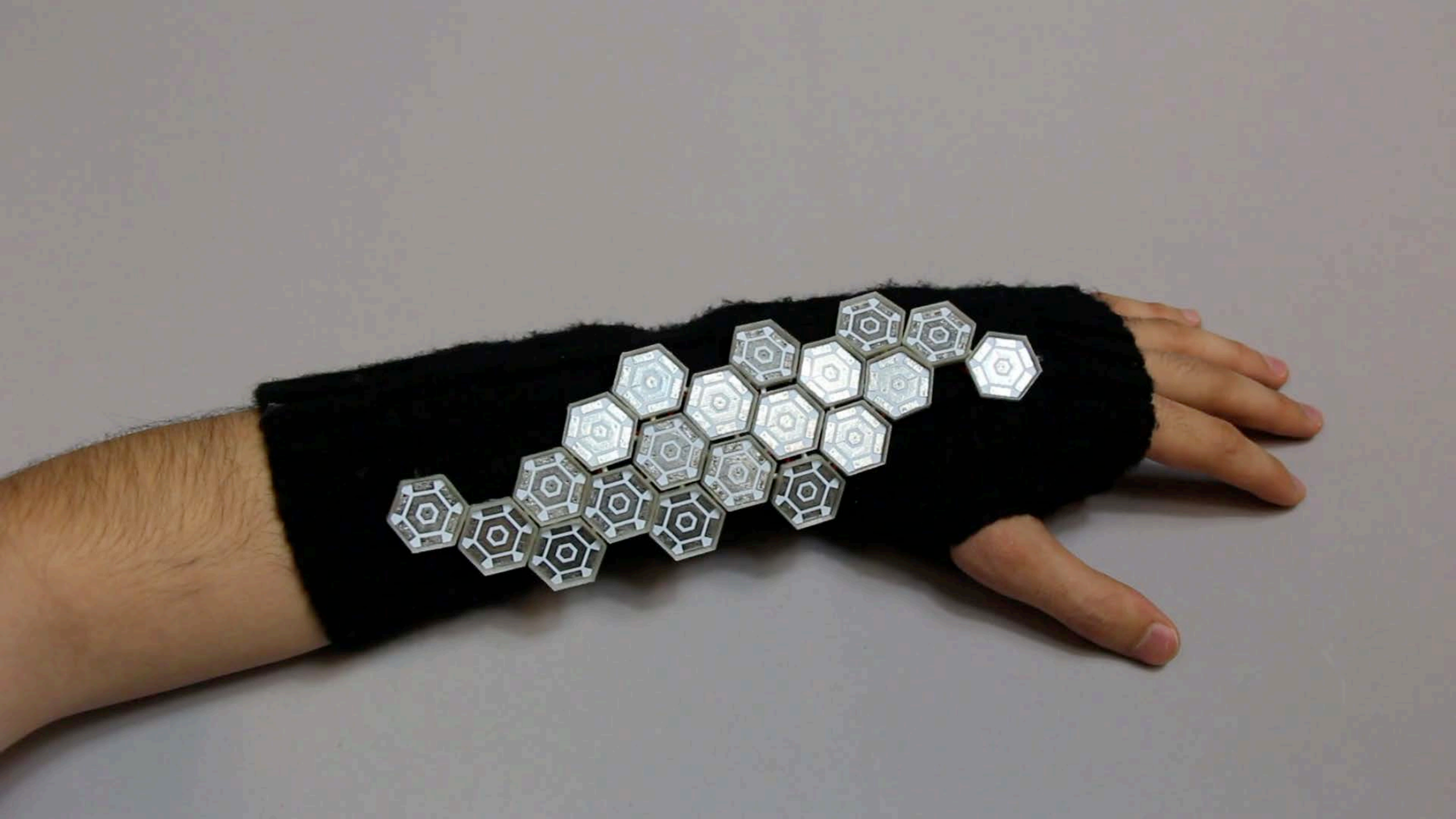
Socket Meshes

Attachable Patch

Vest

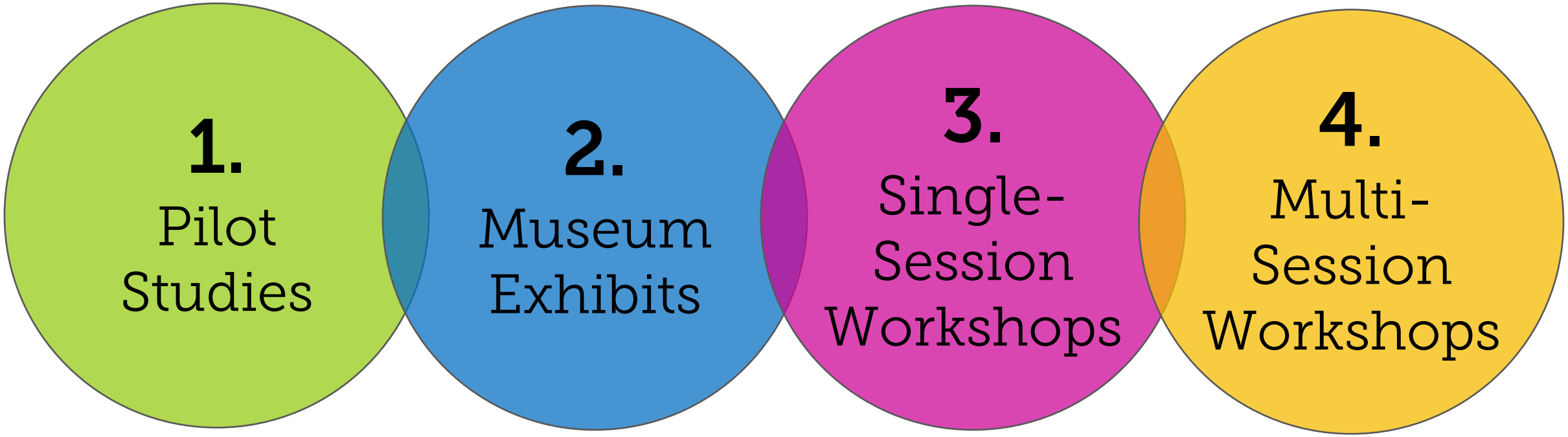
Hat & Scarf

Demo!



Evaluation

MakerWear Studies



EVALUATION

Workshop Structure

Four-day workshop with 19 children, ages 5-11 split into three age groups.

Each day children learned about working with different modules and ended with a **design challenge**.

On day 3 and 4, they worked on a final project and presented it.

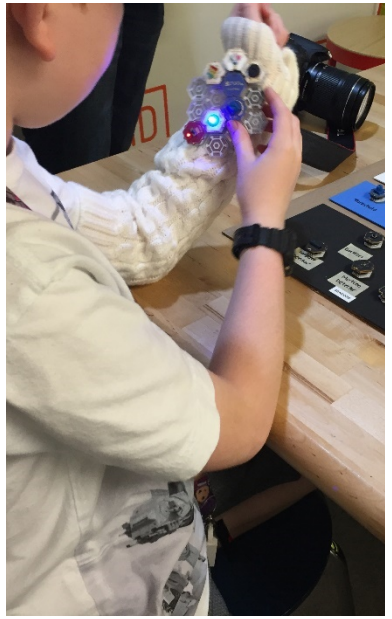
Preliminary Findings

MakerWear Design Process

How do children build with MakerWear?

How Children Make With MakerWear

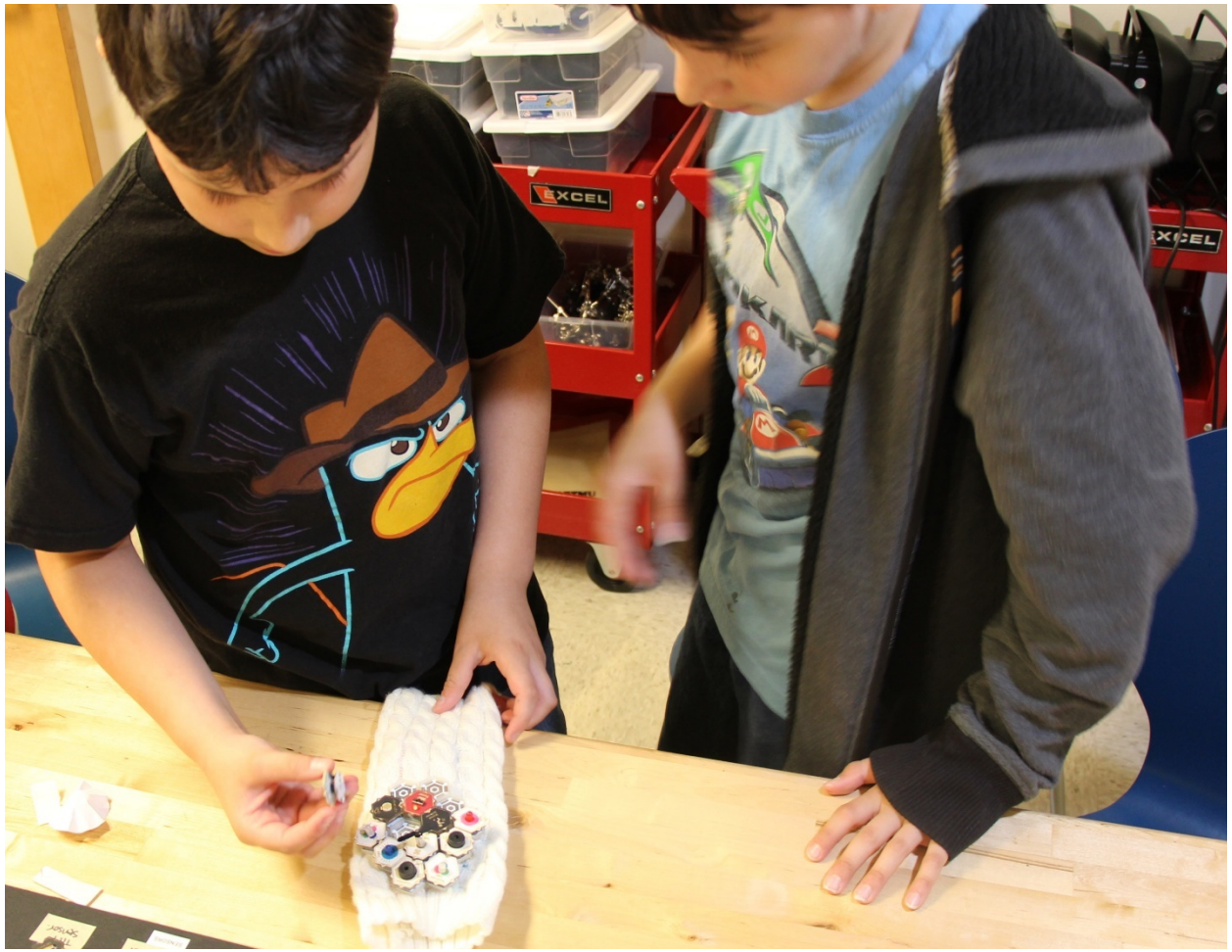
Two styles: (i) work on **table or floor** and switch to wearing for testing; (ii) **build** & **test** while **wearing**



How Children Make With MakerWear

Two styles: (i) work on **table or floor** and switch to wearing for testing; (ii) **build** & **test** while **wearing**

about **half** of the children worked **collaboratively** with a friend, collectively brainstorming and designing.



How Children Make With MakerWear

Two styles: (i) work on **table or floor** and switch to wearing for testing; (ii) **build** & **test** while **wearing**

In museum exhibit, about **half worked collaboratively** with a friend, collectively brainstorming and designing.

In some cases, parents would **co-make** with child.

MakerWear Creations

Workshop Desing Challenges

Dance Freeze

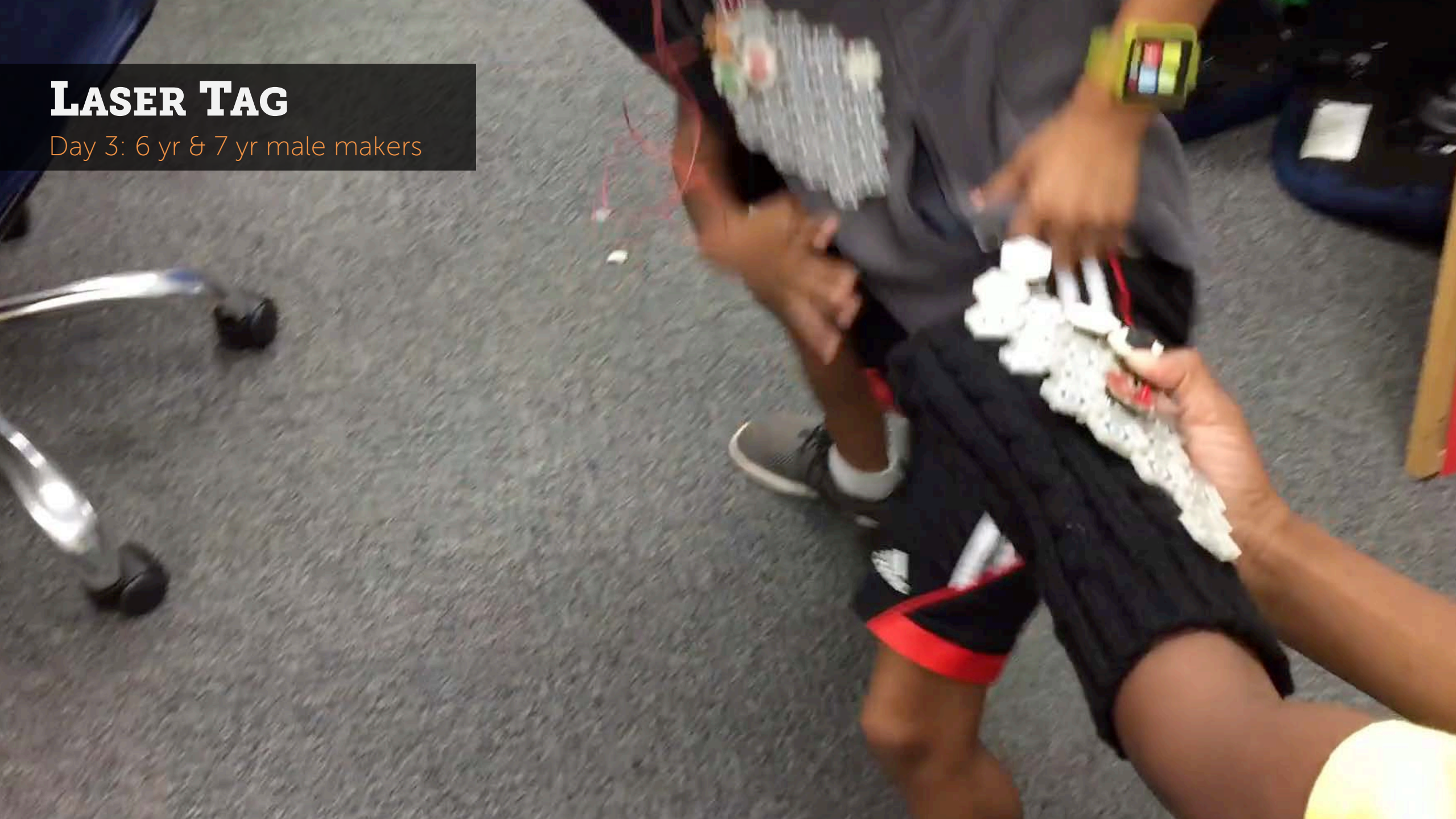
Day 2: 11 yr old male maker

Buzz Lightyear

Day 2: 11 yr old male maker

Laser Tag

Day 3: 6 yr & 7 yr male makers



MakerWear Creations

Workshop Final Projects

Wrecking Ball

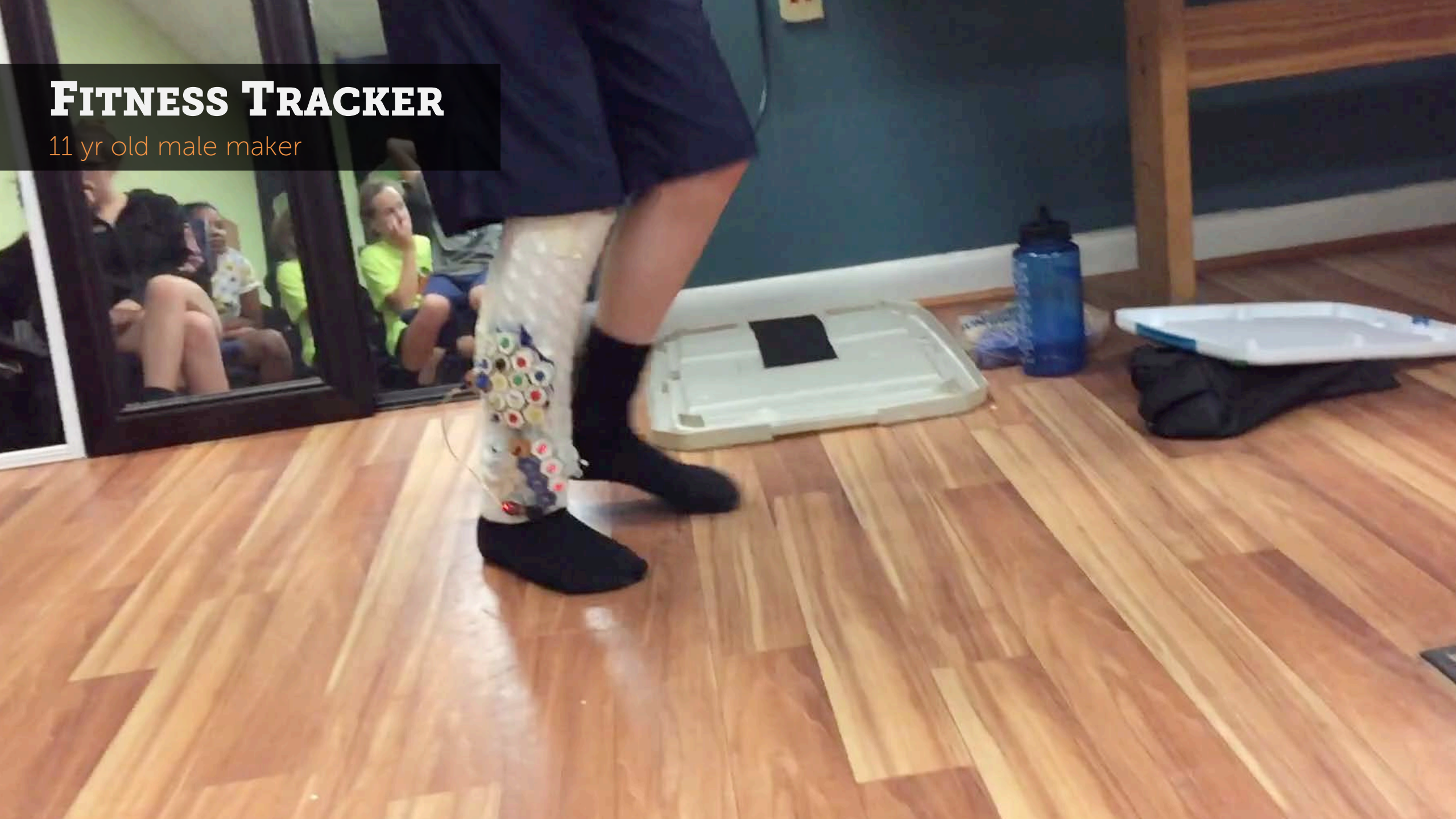
6 yr old male maker

Smart Lacrosse Stick

9 yr old female maker

Pokémon Doppelgänger

9 yr old male maker



Fitness Tracker

11 yr old male maker

MakerWear Creations

Unexpected Things!

Custom Light Oscillator

Male child maker (~8 yrs old)

Custom Light Oscillator

Male child maker (~8 yrs old)

Digital Watch

11 yr old male maker

Digital Watch

11 yr old male maker

MakerWear Creations

Children Explanations

Explaining Threshold Modifier

Male child maker (8 yrs old)

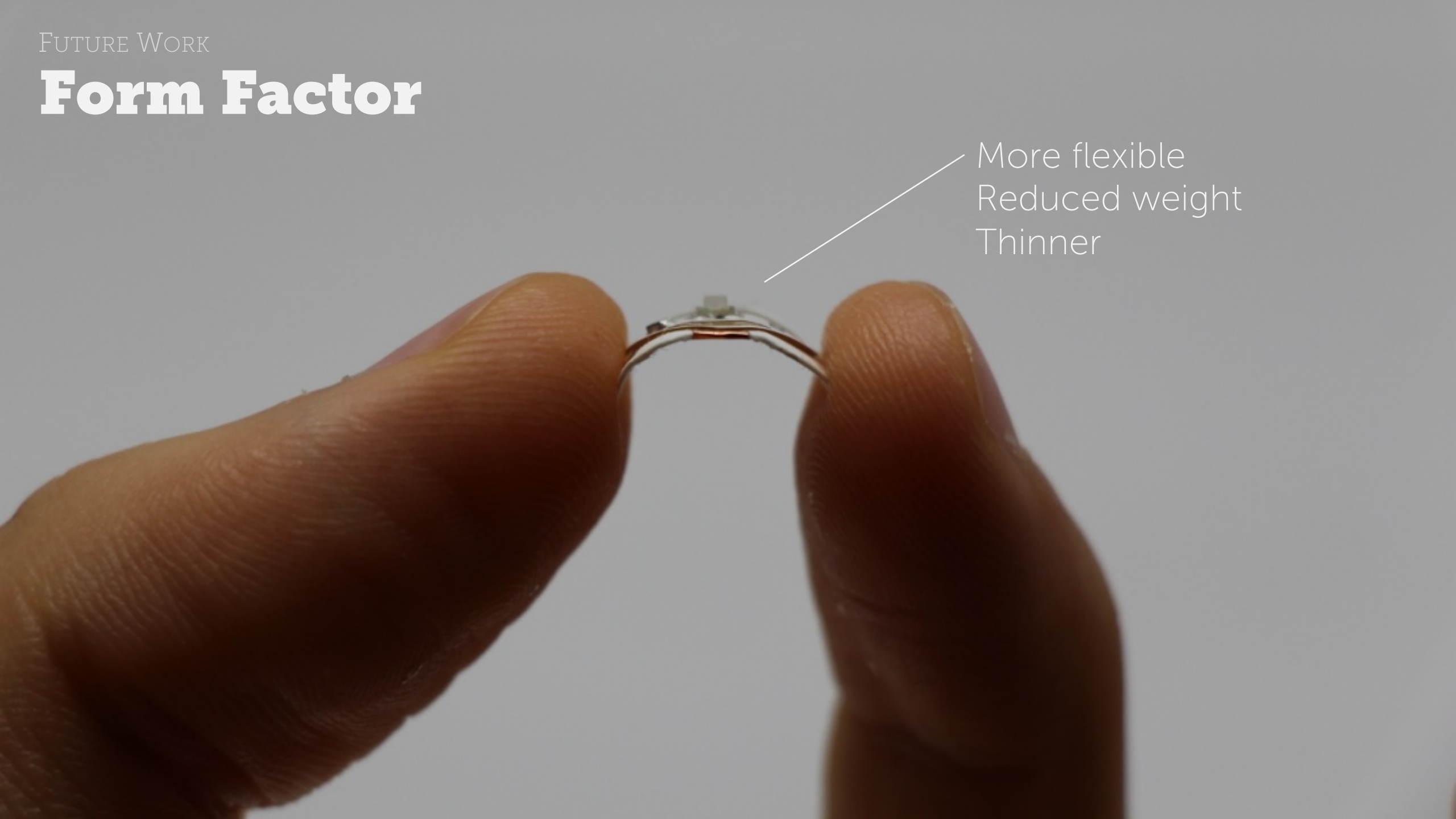
Explaining Threshold Modifier

Male child maker (8 yrs old)

Future Work

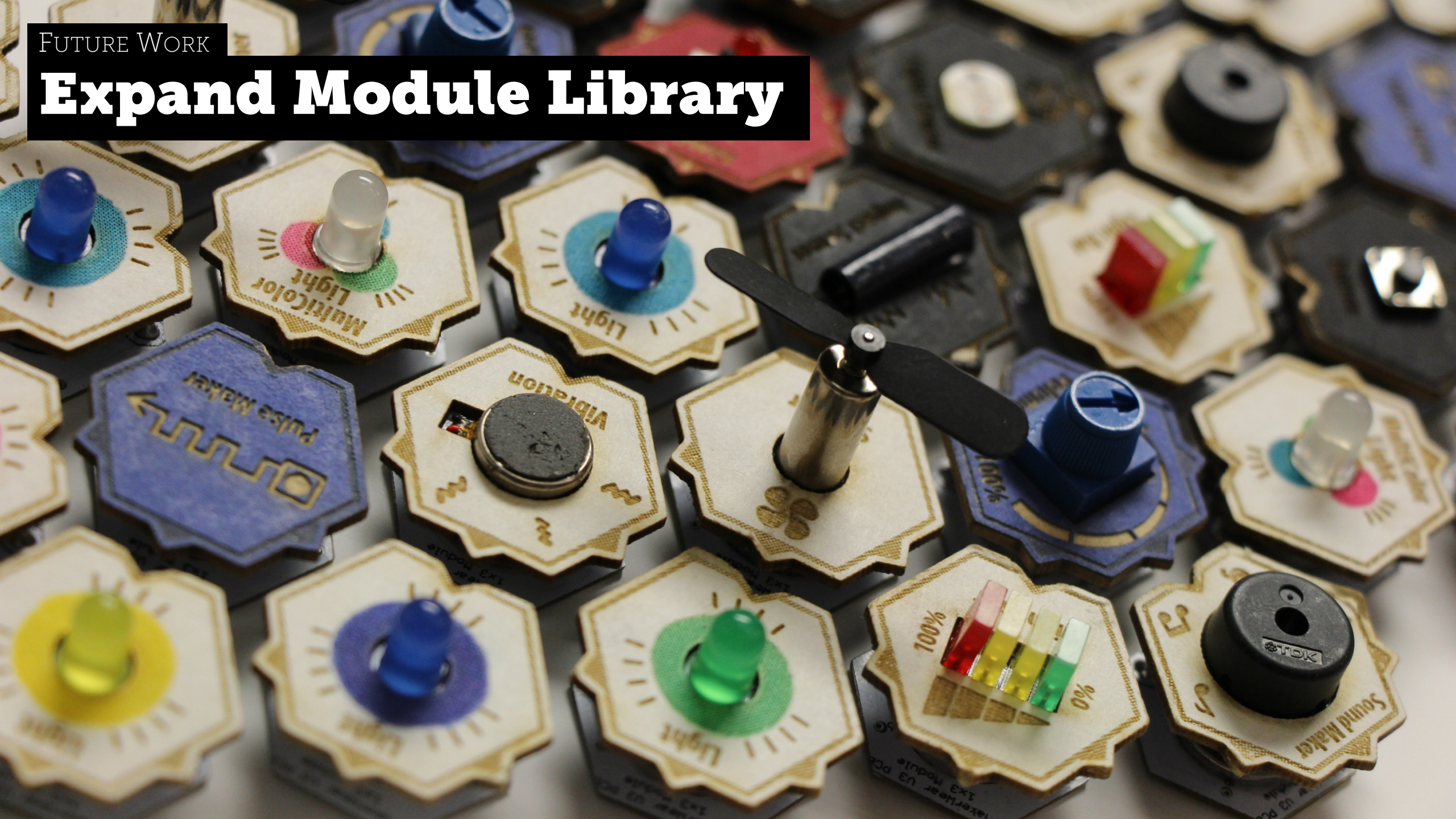
Future Work

Form Factor



Future Work

Expand Module Library



Future Work

Expand Module Library

Greater emphasis on unique aspects of wearability: social, environmental, movement

Wireless Programming Interface

Modules will be wirelessly programmable via a custom tablet programming interface

Tickle
https://tickleapp.com/

SAM Labs
https://samlabs.com

In Summary

MakerWear

A new construction kit aimed at **enabling children** to **design** and build their own **interactive wearables**.

A compelling pathway to engage children in **STEAM-related** activities

A new way for children to **think about** and **develop electronics/code**

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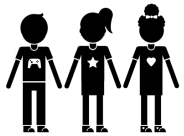

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Children
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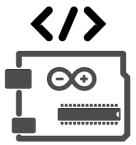

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