# MAS.S63: Design for DIY Manufacturing

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MIT Media Lab
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diymanufacturing.mit.edu

# Today

- Introductions
- Manufacturing: Past, Present, Future
- Class Overview
- Artisanal Technology (Leah)

# Goal

- From mass production to do-it-yourself (DIY) manufacturing.
- Focus on electronic devices.

# Means

- Digital fabrication technology and services.

# Possibilities

- New business models.
- New forms, materials, and aesthetics.
- Personalization and customization.

# Analogy: Internet startups.

- You can do it yourself.
- Lots of them.
- It doesn’t have to appeal to everyone to succeed.

# Products of Digital Fabrication

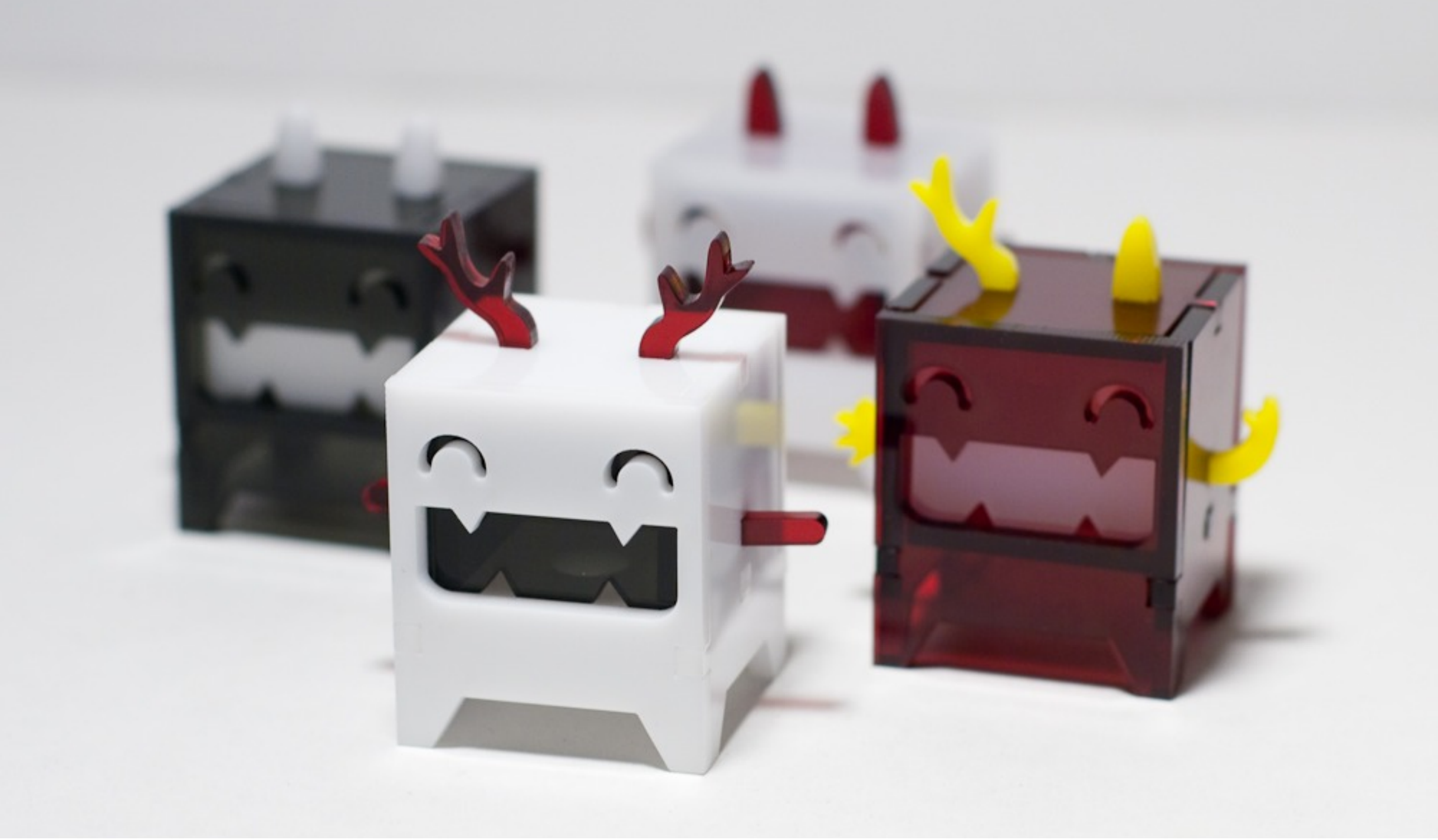

# WoodMarvels

Laser-cut or CNC wooden toys.
$30 to $230



# Carla Diana: “Directives”

Laser-cut wooden furniture
$185 to $315



# Drownspire: Vambits

Laser-cut acrylic toys
$15

# cunicode: 30 days 30 cups

3D-printed ceramics
$45

# Nervous Systems

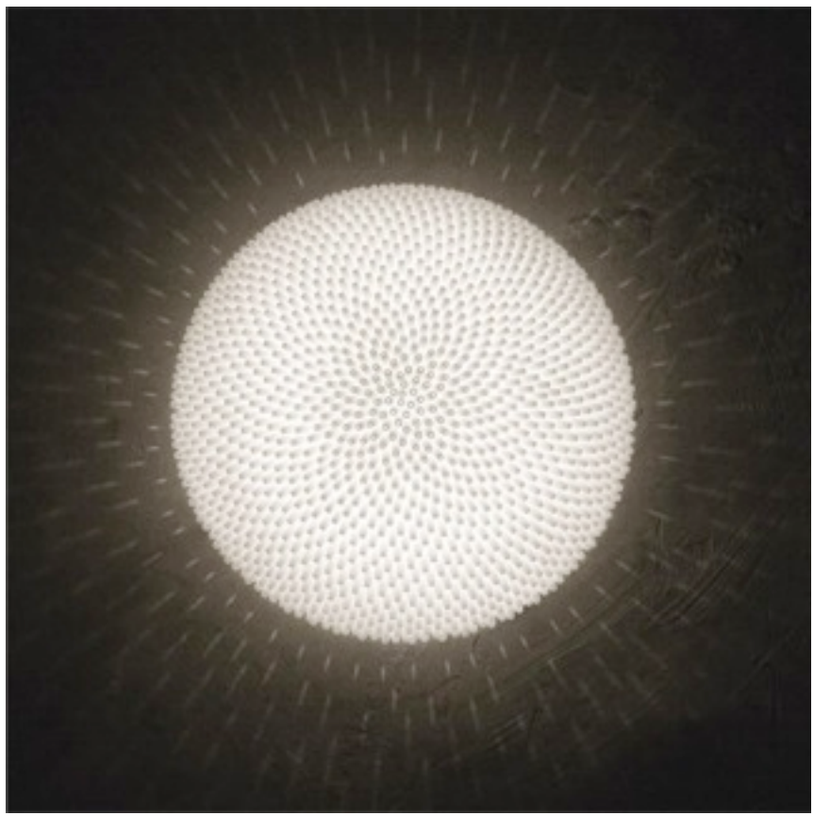
3D-printed nylon & etched metal
$25 to $75

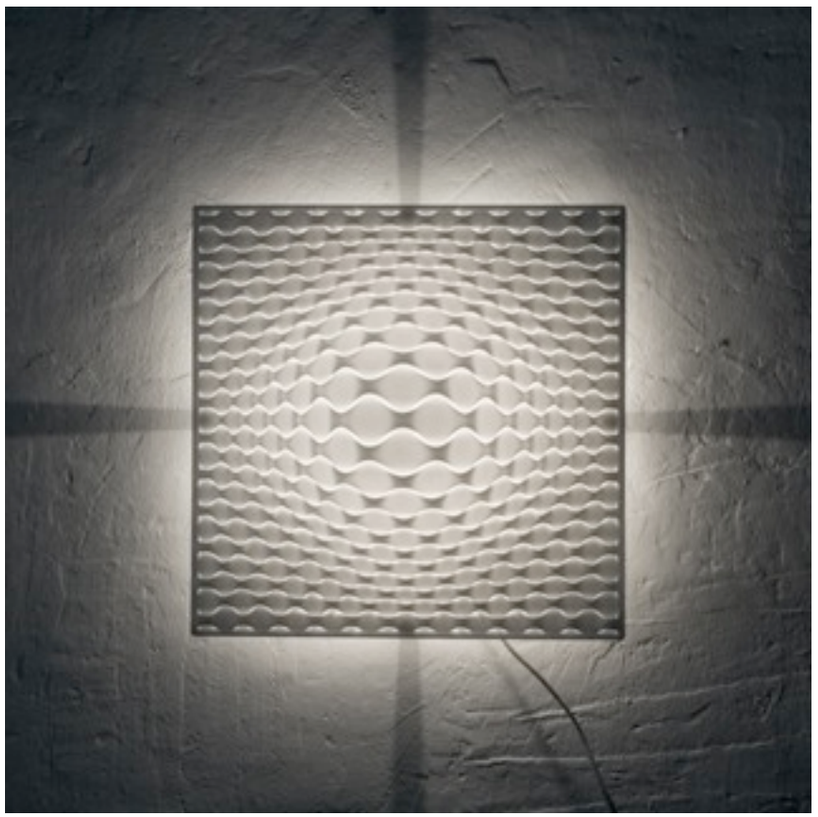

# Diana Eng: Laser Lace Tee

Laser-cut t-shirt
$68

# WATDesign: ZER00:00

Circuit board and components
$40 (originally)





# Freedom of Creation

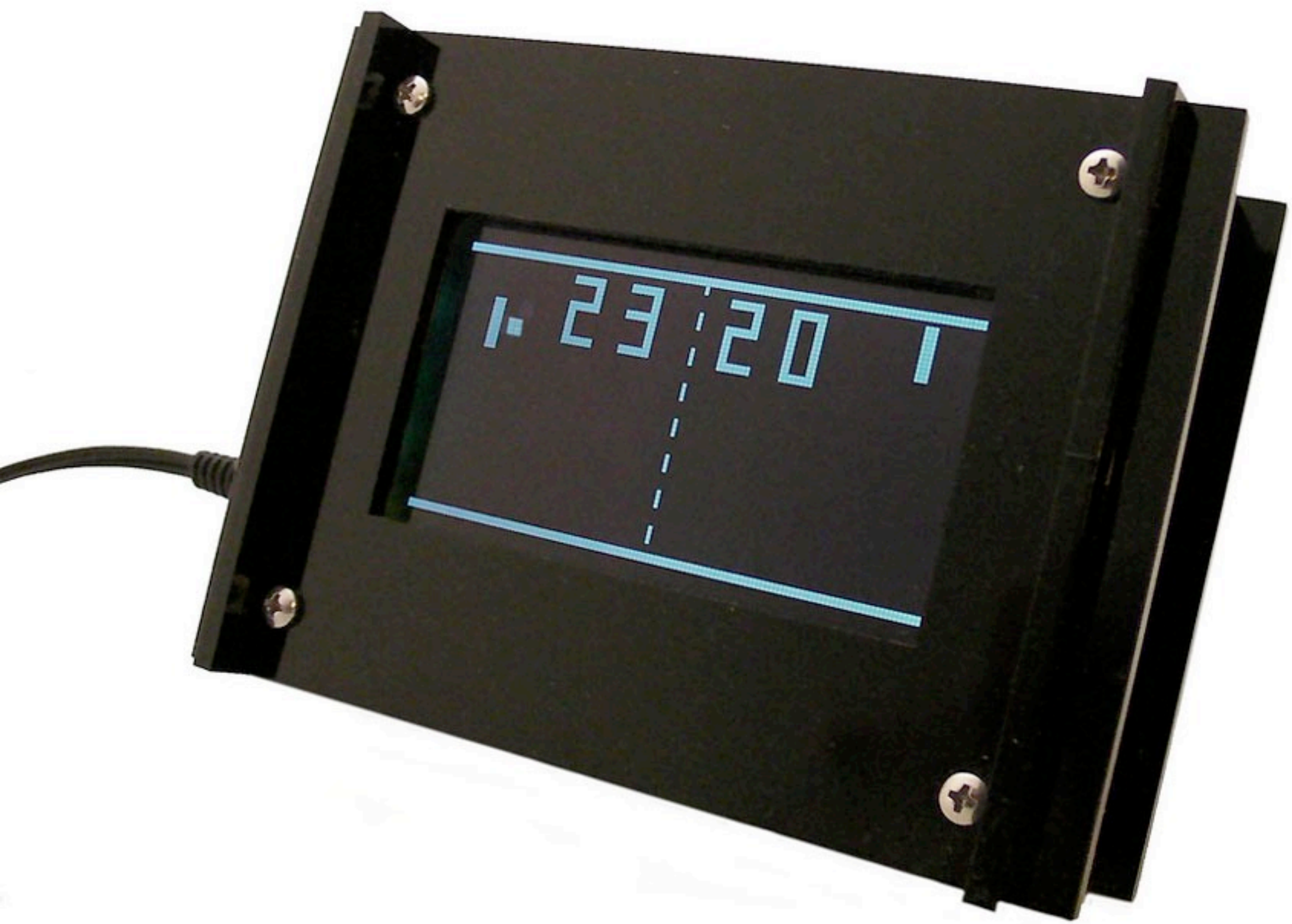
3D-printed (SLS) lamps
$450 to $800

# Fluid Forms: Streets Clock

Laser-cut wood or acrylic
$200

# SketchChair

Software / CNC wood
$150 to $200

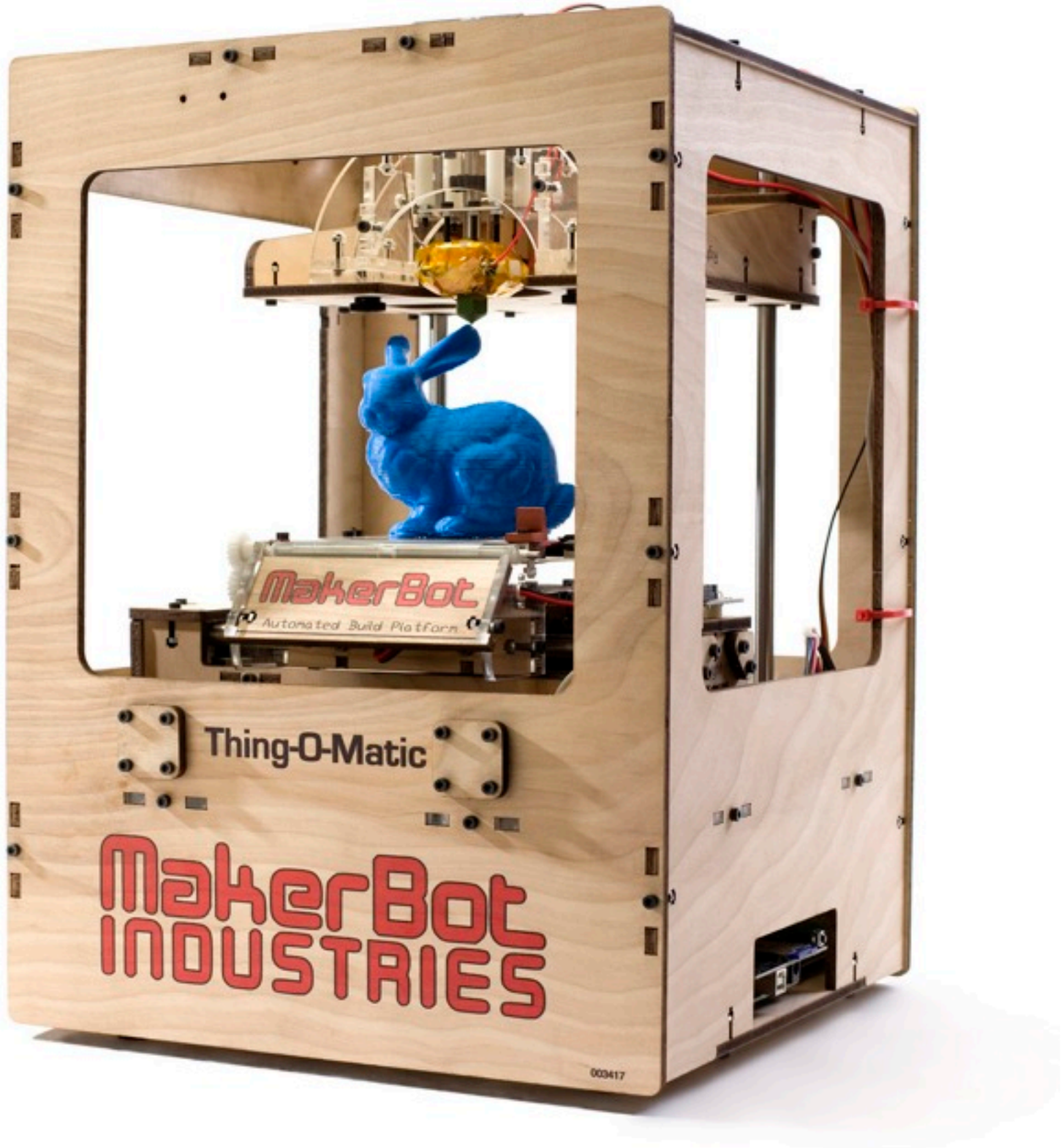



# Adafruit: MONOCHRON

Electronics + laser-cut acrylic
$80

# Adafruit: iNecklace, iCufflinks

CNC-milled aluminum + circuit
$75 / $128




# MakerBot 3D Printer

Laser-cut wood + electronics
$1100 to $1750

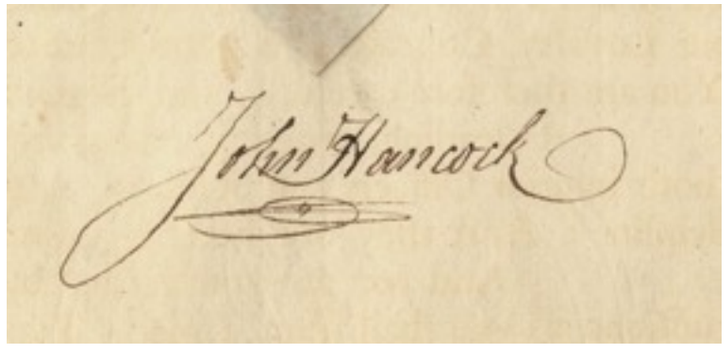
# Turtle Shell Racer

3D-printed parts + electronics
$100 + DIY 3D printing

# Three Epochs

- Craft
- Mass Production
- Digital Fabrication

# Example: Money






"These monetary examples illustrate three paradigms of visual identification, essentially related to three different ways of making things. The signature, the banknote, and the credit card: when objects are handmade, as a signature is, variability in the processes of production generates differences and and similarities between copies, and identification is based on visual resemblance; when objects are machine-made, as a banknote is, mass-produced, exactly repeatable mechanical imprints generate standardized products, and identification is based on visual identicality; when objects are digitally made, as are the latest machine-readable or chip-based credit cards, identification is based on the recognition of hidden patterns, on computational algorithms, or on other nonvisual features."
–Carpo, *The Alphabet and the Algorithm*

# Craft

# Attributes

- Engagement in all aspects of design and production
- Individual variation (on a type)
- Connection w/ materials
- Individual effort and risk

# Mass Production

# Attributes

- Division of labor / specialization
- Control and standardization
- Machines and tooling
- Assembly line
- Capital

# Commodity

"The labor of the private individual manifests itself as an element of the total labour of society only through the relations which the act of exchange establishes between the products, and, through their mediation, through the producers.... It is only by being exchanged that the products of labour acquire a social uniform objectivity as values, which is distinct from their sensuously varied objectivity as articles of utility.... By equating their different products to each other in exchange as values, they equate their different kinds of labor as human labor."

—Marx, *Capital: A Critique of Political Economy*

# Pre-Cursors to Mass Production

- Media
- Separation of design and production
- Mechanization of labor

# Opposing Tendencies

- Efficiency and ideal forms.

- Styling, variation, and subjectivity.

“All possible valences of an object... are reduced by design to two rational components, two general models – utility and the aesthetic – which design isolates and arbitrarily opposes to one another....  Utility is separated from the aesthetic... then they are ideally reunited and all contradictions are resolved by this magical operation.”
—Baudrillard, *For a Critique of the Political Economy of the Sign*

# Business Model

- Large investments (capital)
- Big companies
- Specialized labor

# Examples

- Siftables
- Snif Tag
- Topobo
- Cubelets
- etc.


# Kickstarter

- Crowd-funding
- Letting you become a company
- Direct engagement w/ audience

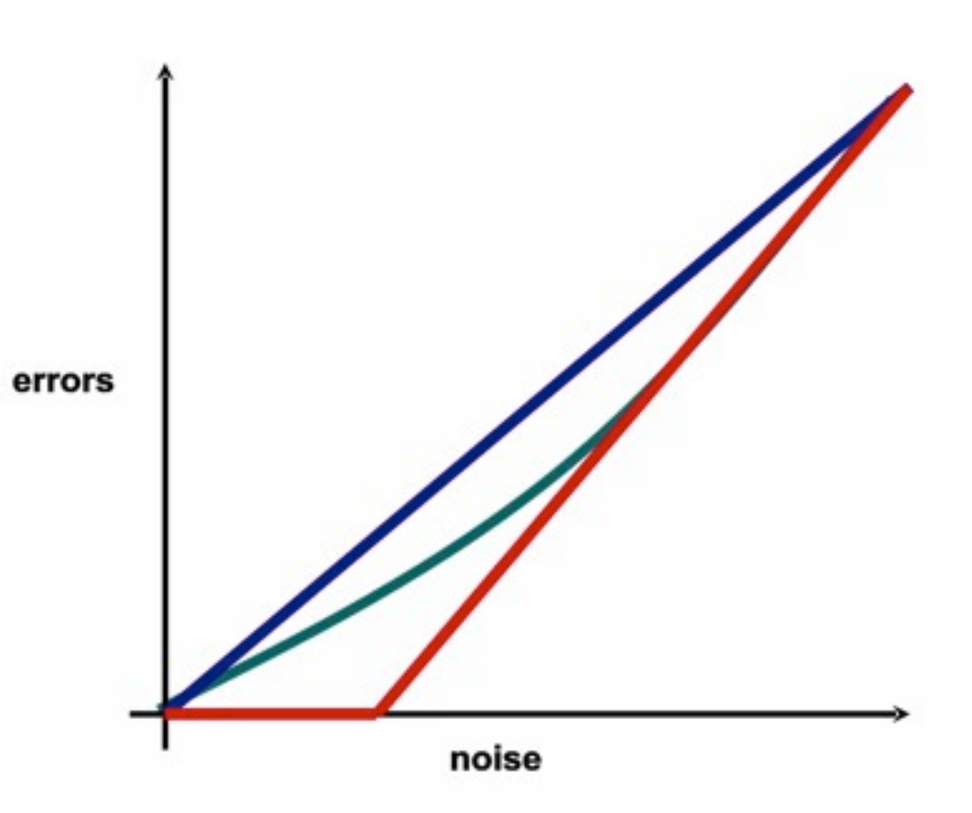
# Digital Fabrication

# Attributes

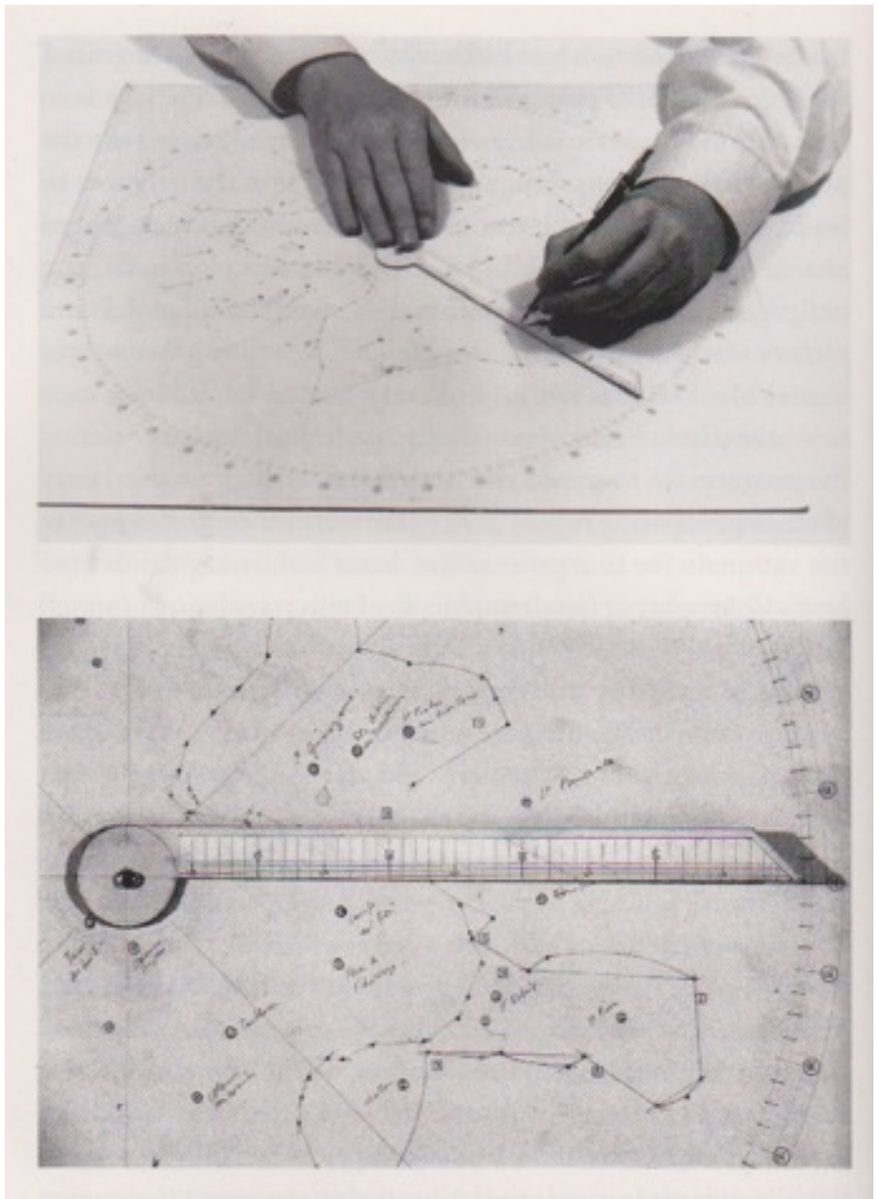
- Digital file to physical object
- Freedom from tooling
- Fewer restrictions on form
- Algorithmic + parametric variation

# Digital

- Shannon’s error curve




- Alberti’s digital maps



# CAD/CAM
# Computer-Aided Design & Manufacturing

- Complicated process

- Digital craft

Reference: *Abstracting Craft* (McCullough)

# Technologies (Media)

- Printed circuit board (PCB) fabrication
- Laser cutter
- 3D printer (various materials)
- Computer-numeric controlled (CNC) router
- etc.

# Online Services
# “You press the button, we do the rest.”

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- Ponoko: laser-cutting, 3D printing, CNC routing
- Shapeways: 3D printing
- Advanced Circuits (and many more): PCB fabrication

# Distribution Models

- Kits (e.g. IKEA, Adafruit)
- Artisanal production
- Out-sourced production
- Distributed production

# Business Model (proposed)

- Small (one or a few people)
- Unified (involvement in the whole process)
- Meaningful

# Need for Collaboration

- Designers
- Engineers

# Do-It-Yourself

- Greater opportunity for customer involvement and understanding.
- Flexibility in customization and production.

# Open-Source Hardware

- Direct relationship between digital and physical enables sharing.
- New opportunities for collaboration and customization.

# Course Structure

# Format

- Studio model: hands-on work w/ relevant lectures and sections.
- Developing product over the course of the semester.
- Teams of one or two.

# What the class is not.

- MAS.863: How to Make (almost) Anything
- 2.009: Product Engineering Processes
- MAS.834: Tangible Interfaces
- Intro to Rhino, Arduino, ...

# Pre-Requisites

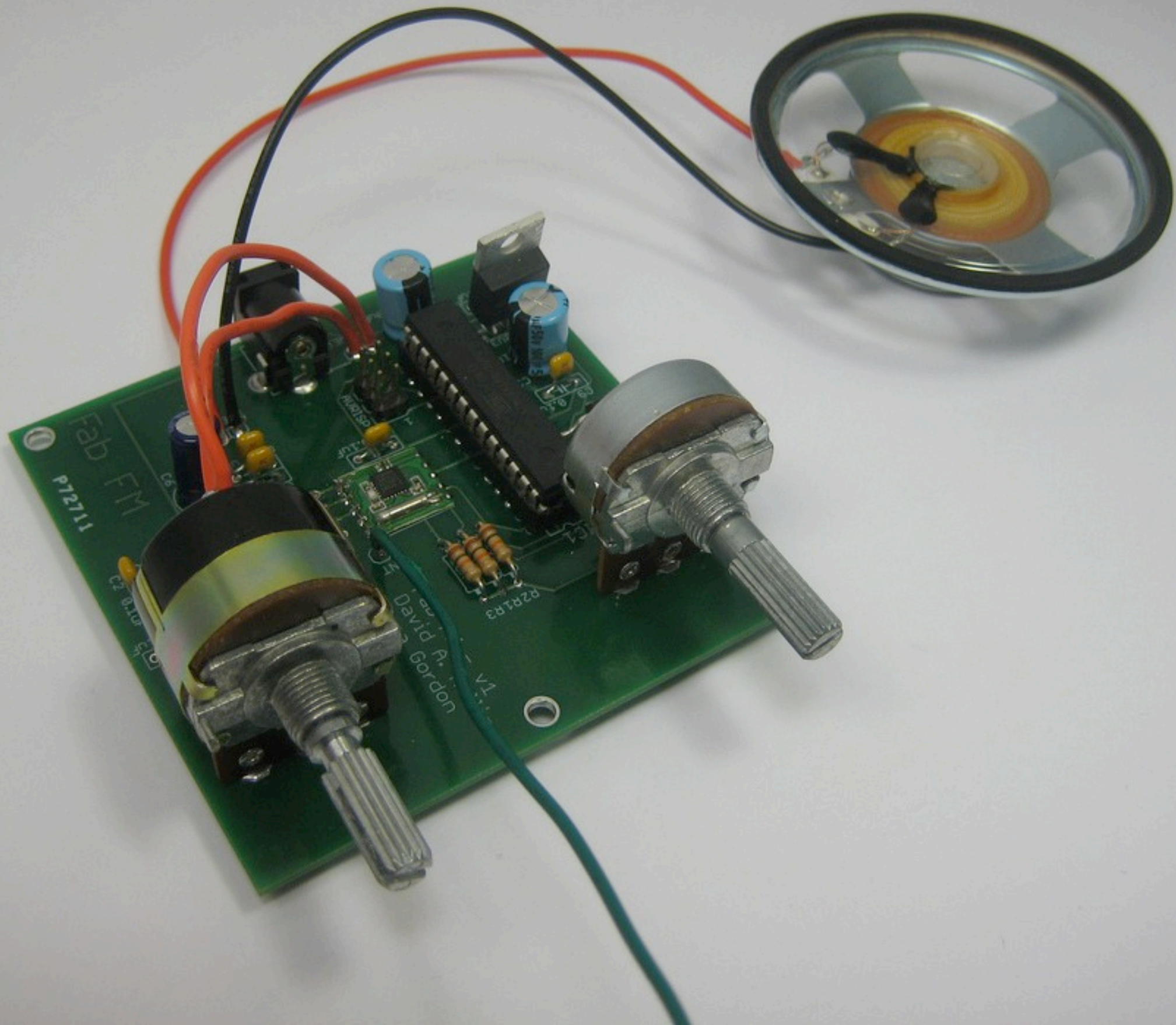
- Knowledge of 3D modeling, electronics, or programming.
- Willingness to learn the others.
- An idea for a product (by next week).

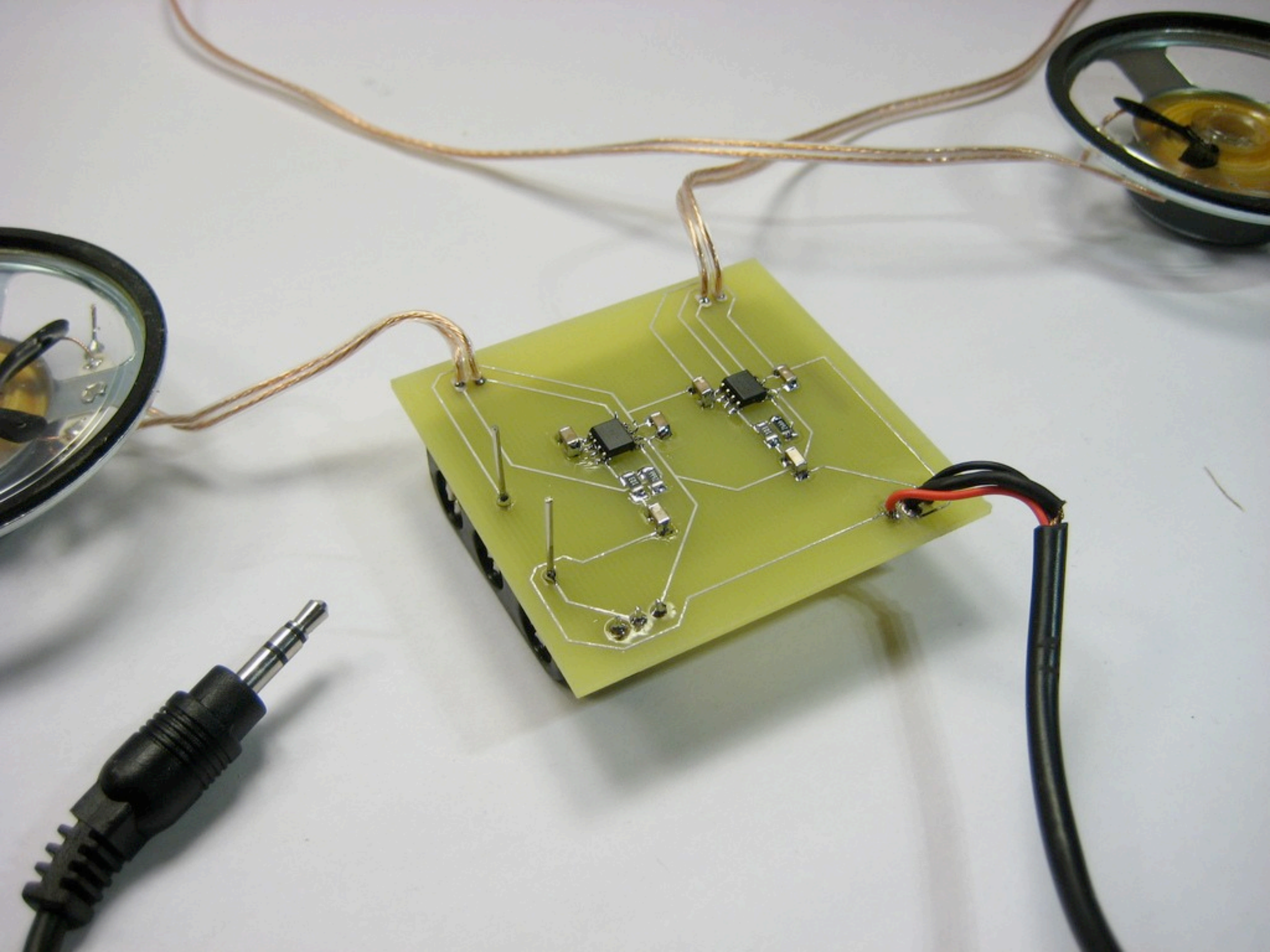
# Scope

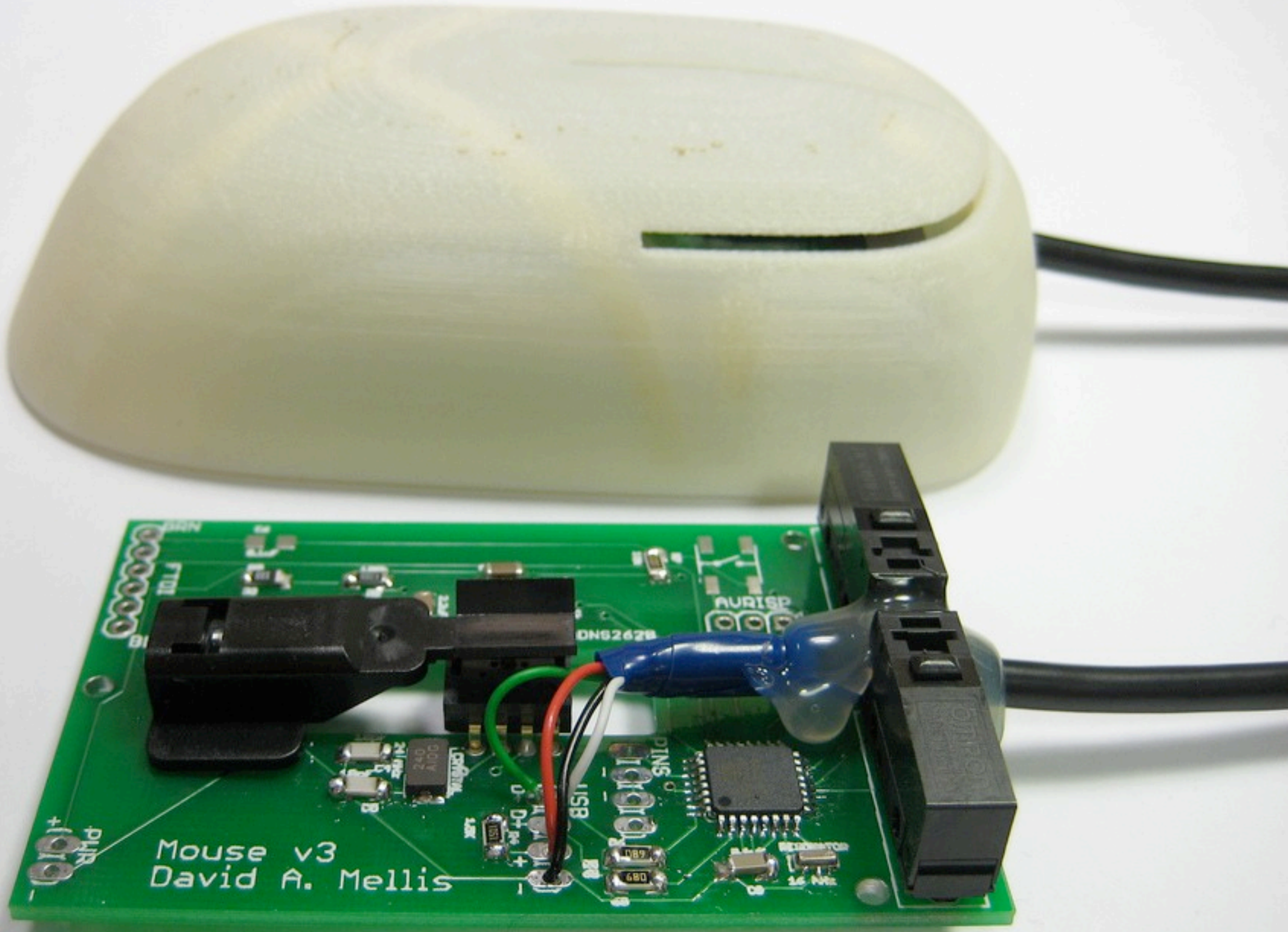
- Electronic device.
- Circuit board + fabricated enclosure.
- Diverse materials.
- Designed function and form.
- Doesn’t have to be novel.

# Examples (from my thesis)


KERALA


Fab FM
P72711
David A. Gordon




Mouse v3
David A. Mellis
AVRISP
DN62628
PINS
USB
16 MHz

# Schedule

- First half of semester: making a working, attractive prototype.
- Midterm Critique.
- Second half of semester: refining the product, figuring out how to make another 100 (or 10 or 1000).
- Final Critique.

# Assignments (first half of the semester)

- Sketch (design on paper) of the product.
- Reverse engineering an existing device.
- Quick-and-dirty functional electronic prototype.
- 3D model of the device.
- Laser-cut prototype of the enclosure.
- Working, attractive prototype for midterm critique.

# Format (continued)

- First half of class: review / critique of student work.
- Second half of class: lecture on relevant topic.
- Weekly assignments, to be uploaded to course website.
- Sometimes: sections on particular skills.

# Budget

- ~$100 per team (i.e. not much).

# Application Process

- Go to the course website: diymanufacturing.mit.edu
- Fill out linked survey by tomorrow at 5 pm.
- We'll let you know on Sunday.

# Assignment for Next Week

- Design your product on paper.
- Sketch the form.
- Decide on the functionality and interface.
- Read Lewis Mumford, “From Handicraft to Machine Production”

# Next Week

- We'll review your designs.
- We'll see who's in the class.
- You can decide who to work with (again, teams of one or two).
- Panel from the other instructors.

# Thank you.

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