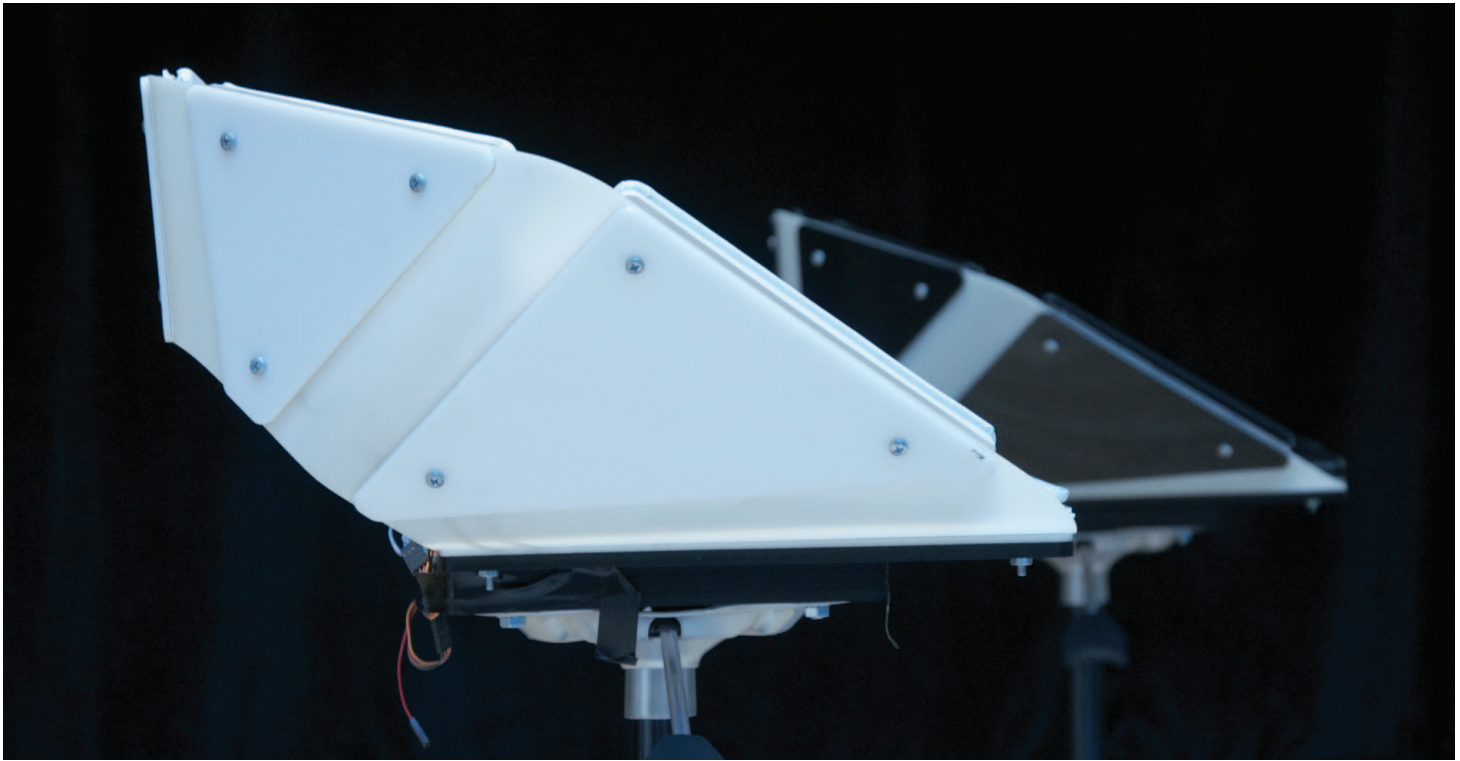




InForm Synergetics

Dimitris Papanikolaou
Doctoral Candidate Harvard GSD
MSc MIT Media Lab
MSc MIT Design Computation SAP

design | research | teaching portfolio



BodyPods

Tags: tangible media, interaction design, human factors, furniture design

Video: <https://vimeo.com/102900472>

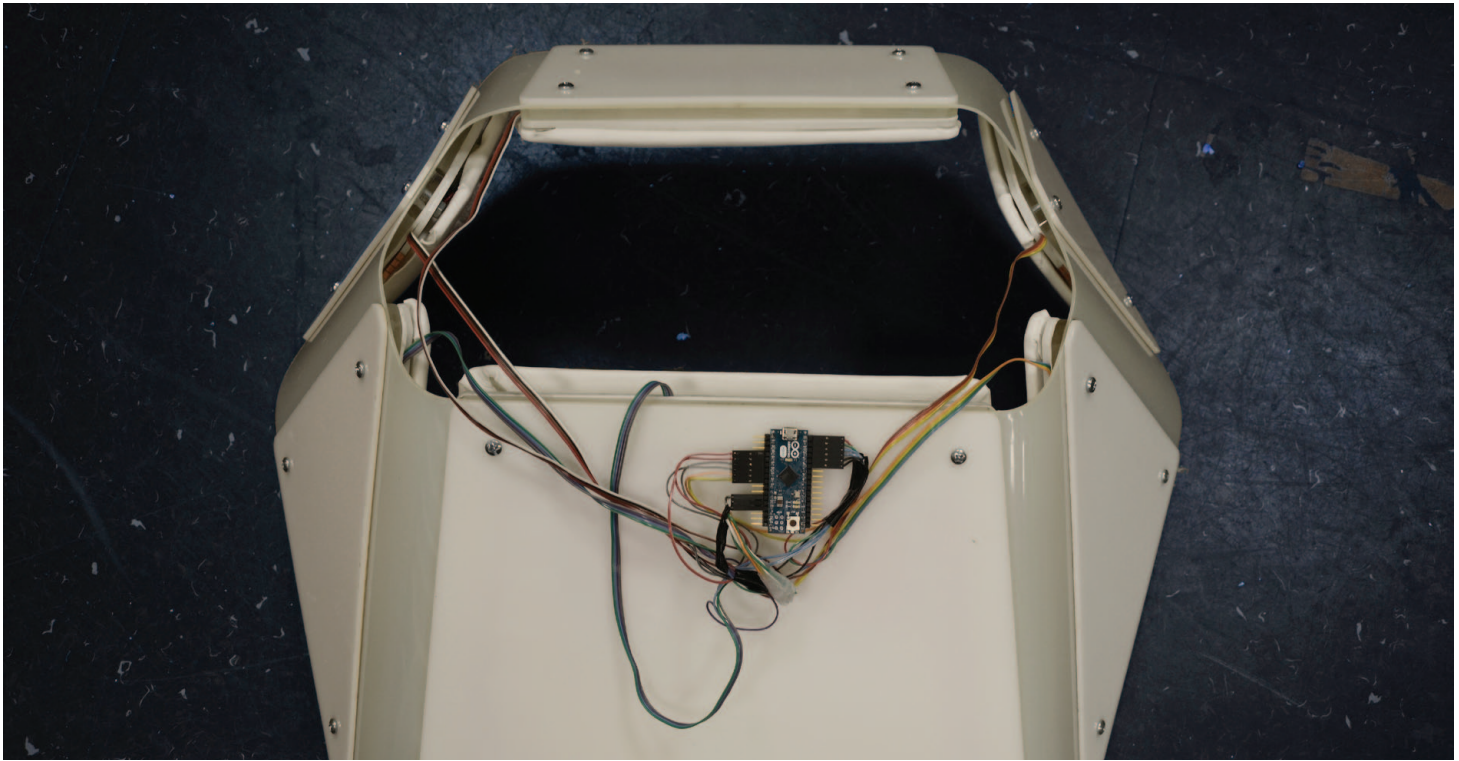
Microsoft Research, Computational User Experiences group, Redmond, MA, 2014

People sharing the same space but having different time schedules often perceive each other's presence through the implicit traces their interactions with physical objects leave behind. BodyPods are multi sensory seats that emotionally connect remotely located people by sensing, exchanging, and visually expressing their "bodyprints" as live gestural expressions through the Internet. Analogous to a footprint, a bodyprint manifests a person's

sitting posture as a distribution of the pressure that their body and limbs exert against the cushions of the seat. When a person sits on one BodyPod, his/her bodyprint is reflected on the pads of the other BodyPod through color and light.

(With A.J. Bernheim Brush and Asta Roseway, Microsoft Research).

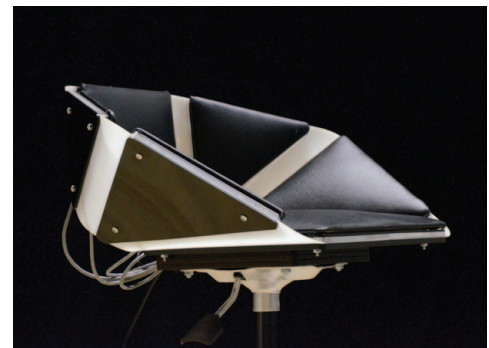
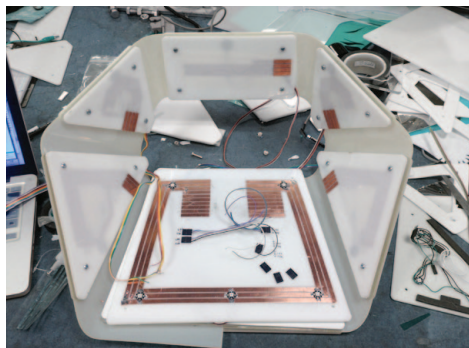
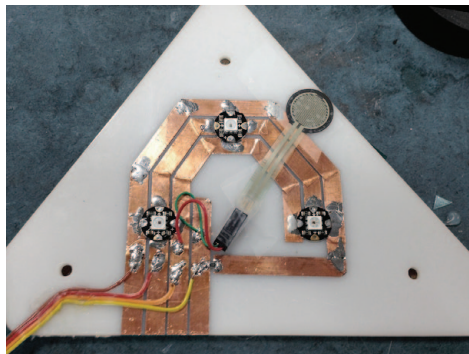
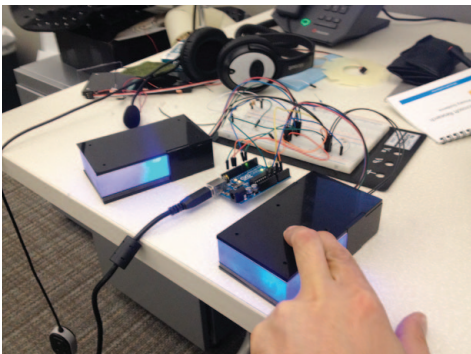


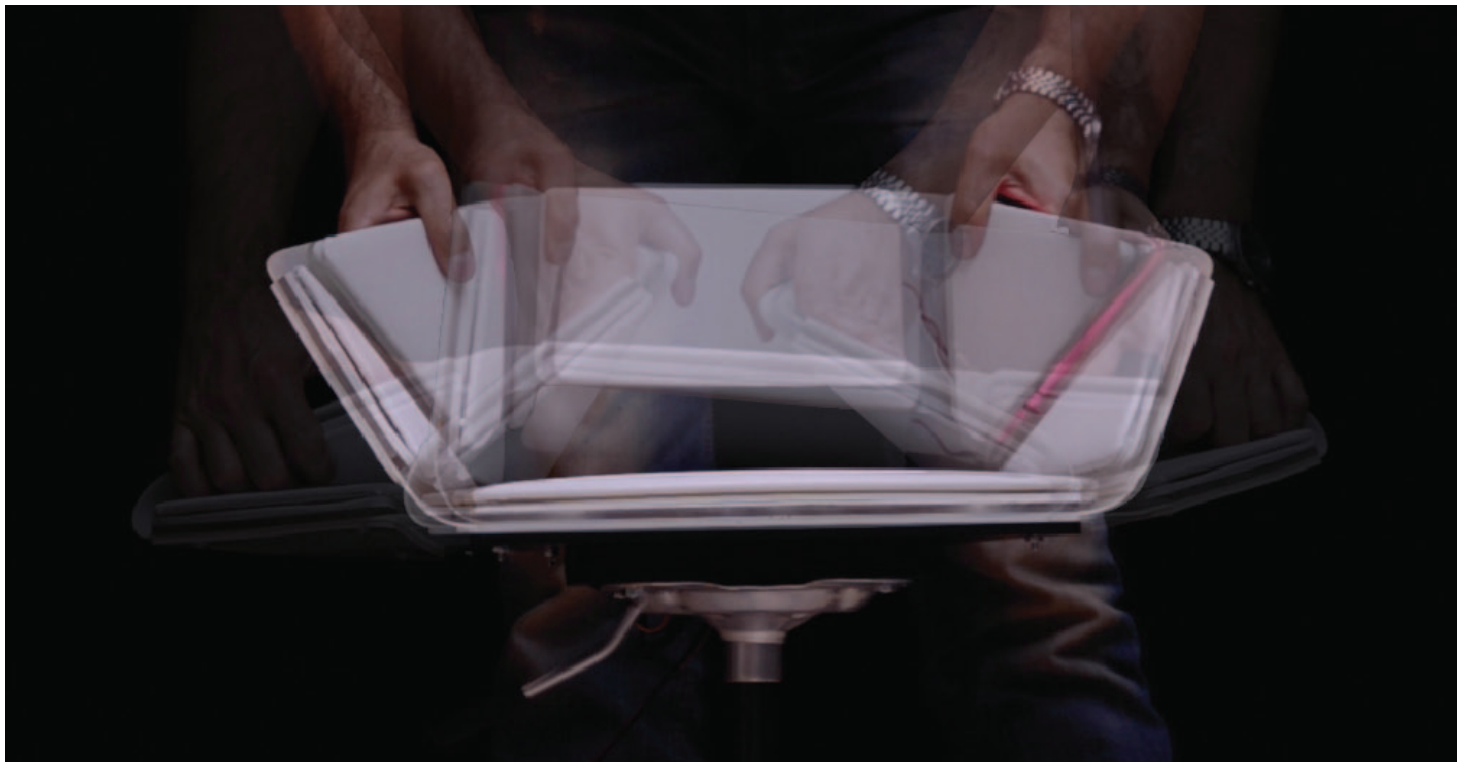


Fabrication

Each BodyPod consists of a flexible substrate with six pressure-sensing pads that adjust itself to the human body's anatomy. Each of the six pads contains an FSR pressure sensor and an array of RGB LEDs. The pads connect to a microcontroller under the seat's base which sends the data to a computer. Multiple computers can connect through the Internet allowing BodyPods to remotely share data. Through the server, the sensors of each BodyPod's pads map to the LEDs of the corresponding pad of the paired BodyPod. The

geometry of the seat can be tailored to the anatomy of the body, allowing the sensors to be placed closer to the body parts that are used as reference points. This decreased the number of required sensors and simplified the computational complexity of their signal analysis. A parametric CAD model in Rhino/Grasshopper was used both for kinematic/collision analysis and for customizing seats to different body types.

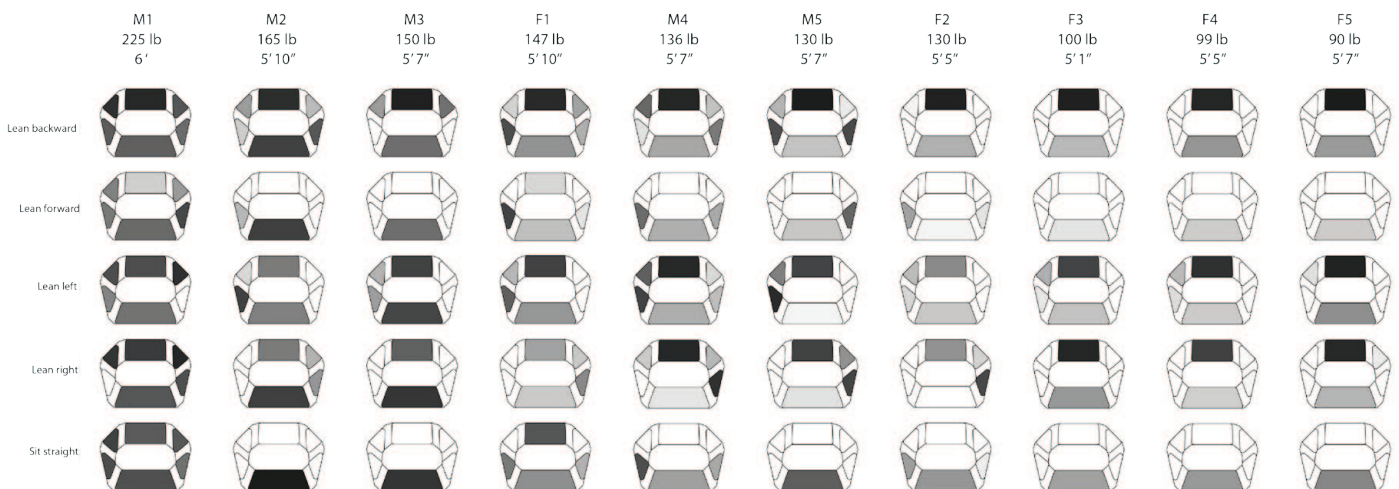
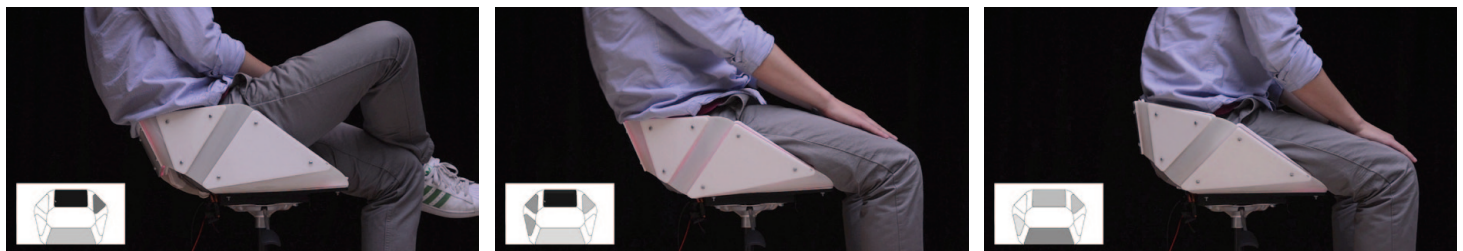


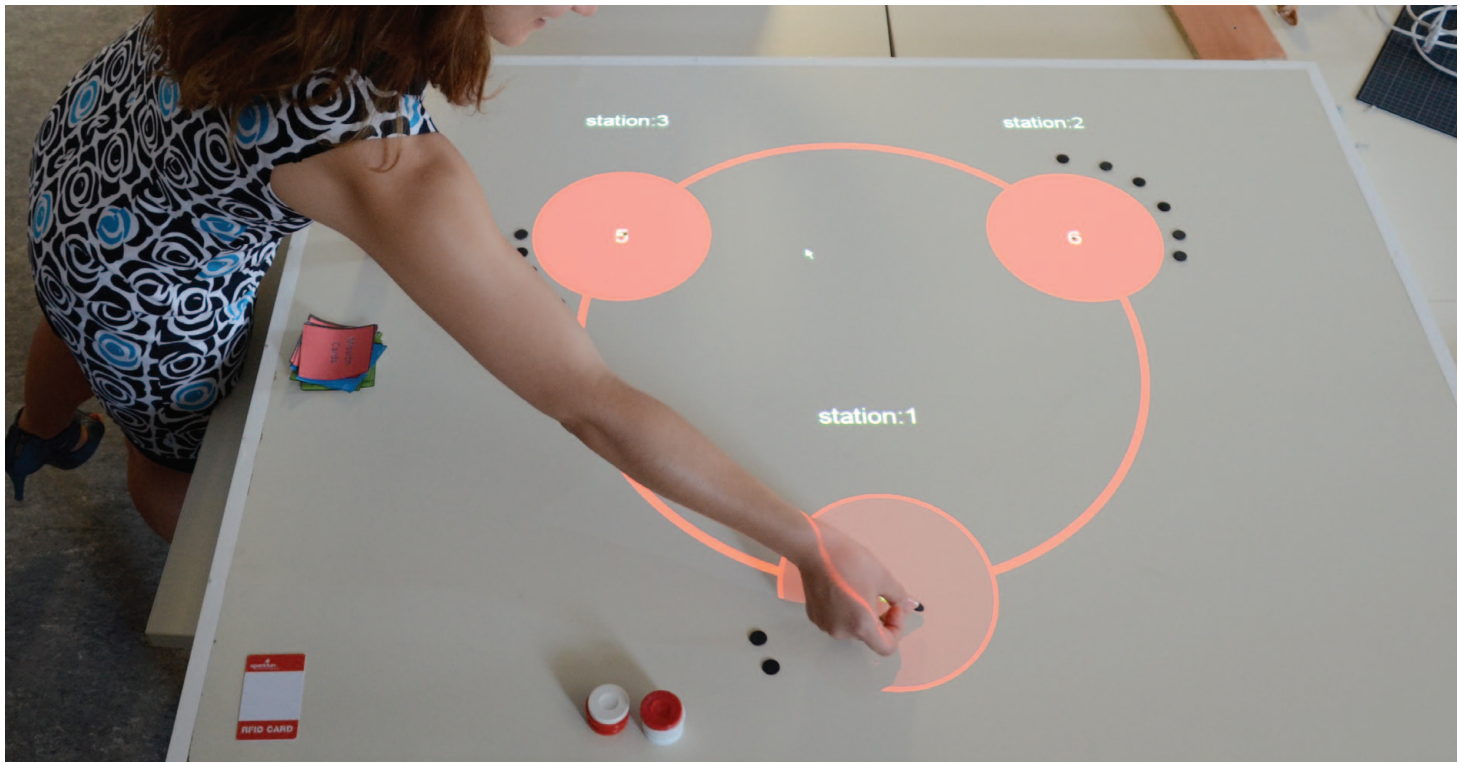


Interaction & Control

BodyPods have firm, comfortable grip, and respond smoothly to body movements. We conducted a 10-person user study gathering both qualitative and quantitative data from various sitting postures (Sit Straight, Lean Left, Lean Right, Lean Forward, Lean Backward, etc). Results show that BodyPods are highly accurate in capturing 8 postures and 2 torso

rotations (clockwise, counterclockwise). Such movements can be useful in applications in tangible or bodily gestural interfaces, musical instruments, game controllers, medical devices, and more. Future areas of research include social experiments as well as the development of learning algorithms for training BodyPods to recognize postures from bodyprint data.



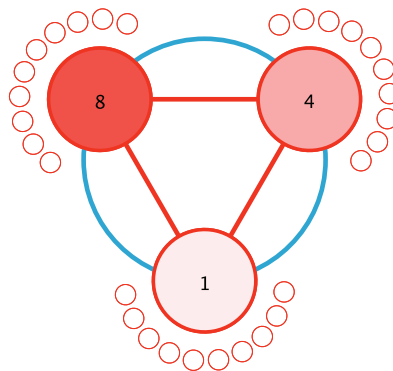
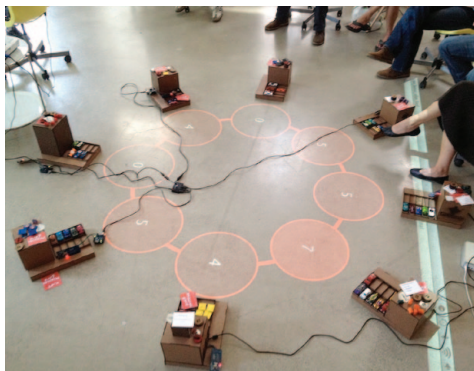
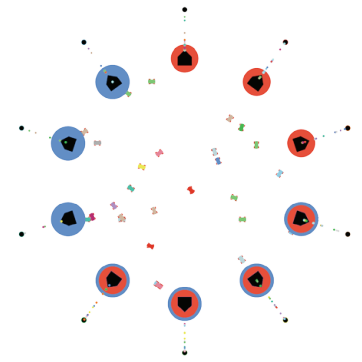
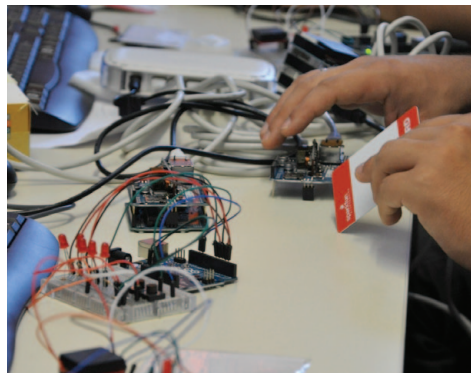
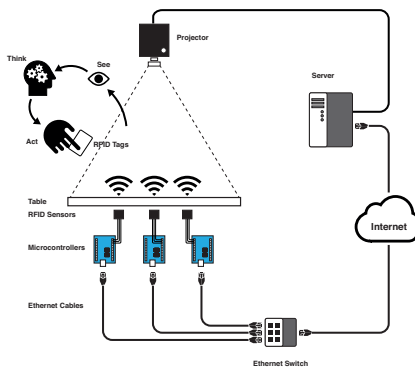


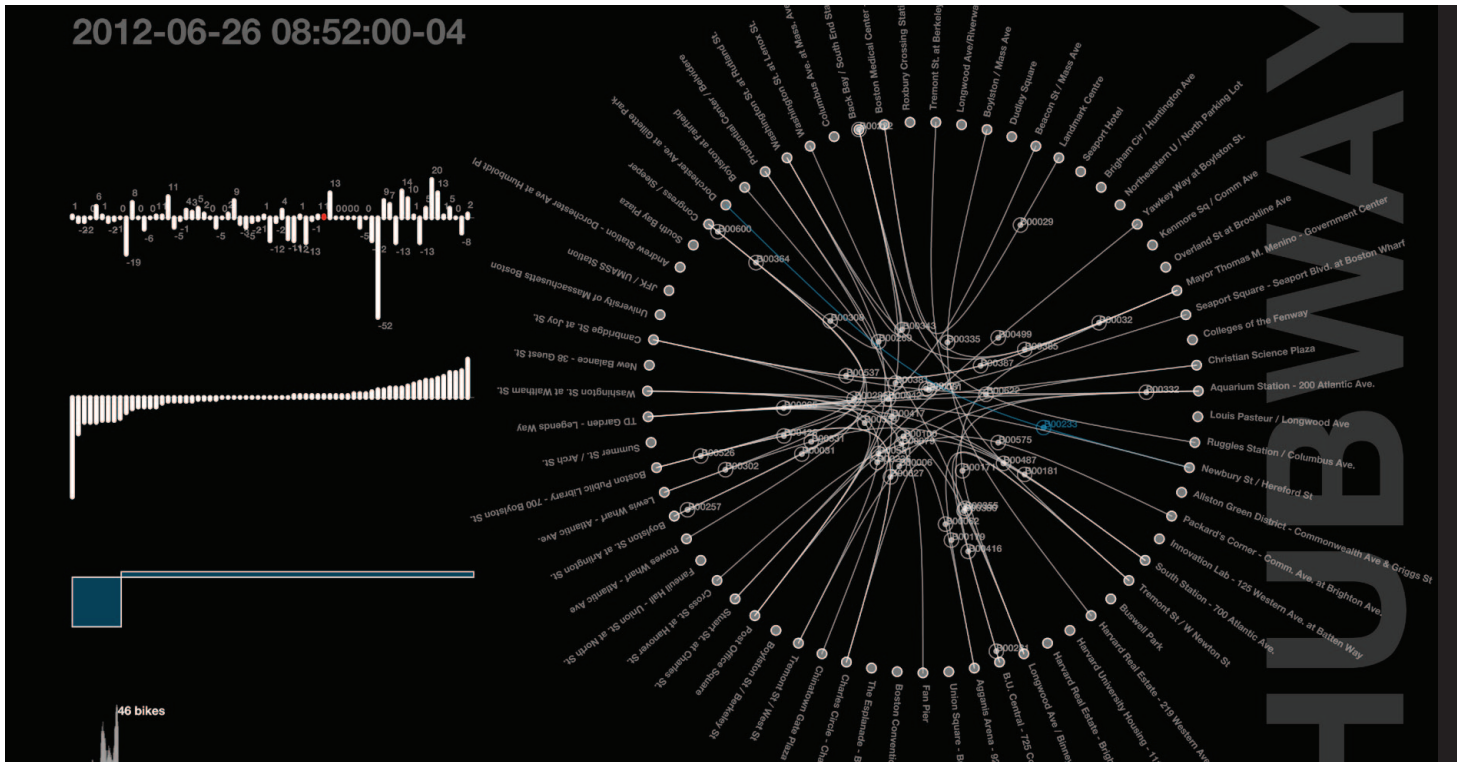
Cloudcommuting Game

Tags: interaction design, education, strategic games, electronics
MIT Media Lab & Harvard GSD, 2012

An interactive strategic board game and educational tool that explores decision making and self-organization in dynamically priced resource allocation networks. Two players complete origin-destination missions by relocating their pawns between stations. Players can choose between a fixed-priced and a variably-priced transportation option. A third player (the computer) controls the pricing of picking up and dropping off at the stations based on demand and supply. Players have limited time and money resources, there-

fore they must choose the optimum combinations to win. The game uses an array of RFID sensors to track pick-ups and drop-offs. Sensors send messages to a central computer through the Internet each time a player picks up or drops. The computer updates a pricing visualization scheme, which is then projected back to the surface of the game, influencing the decisions of the players.



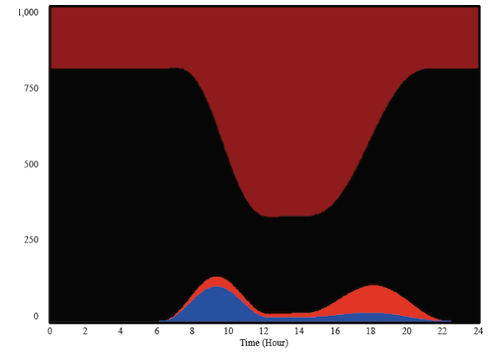
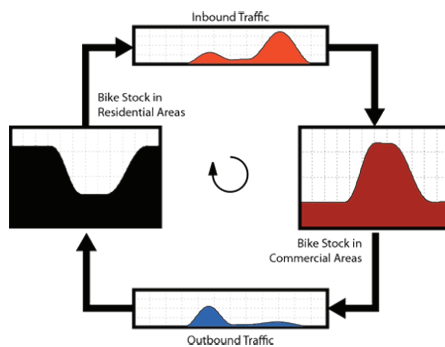
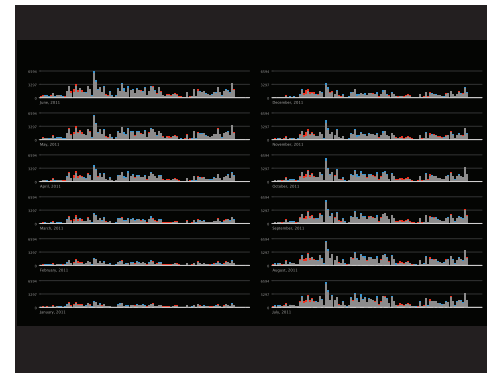
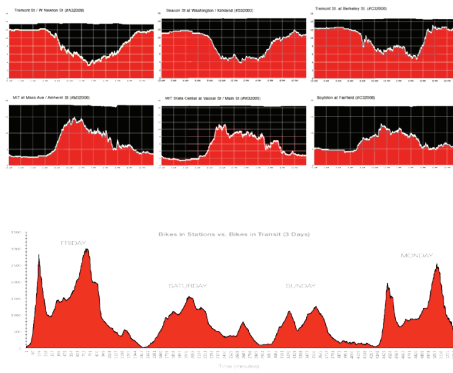
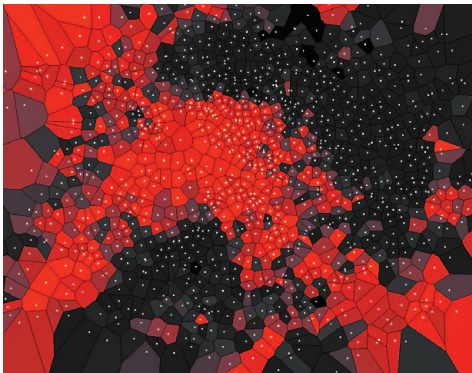


Bike Sharing Dynamics

Tags: bike sharing, economics, data visualization, system dynamics, computer simulation
 Harvard GSD, 2011 - 2013

A cost-benefit analysis of the bike sharing industry that compares the marginal operational costs based on trucks, employees, infrastructure capacity, and rebalancing rate, to the marginal revenues based on usage fees and utilization rate. A stock-flow model in system dynamics simulates ridership, costs and revenues, as a function of the trip pattern, number of trucks, work shifts, and operation time windows and can be used to find the

combination of the above parameters that maximizes ridership for a given pattern of trips. Case studies included Boston, Washington DC, and Paris, combining publicly disclosed datasets with original data from web scraping methods and personal interviews (with Prof Jose Gomez-Ibanez, HKS, Prof Spiro Pollalis, Harvard GSD, and Prof Hans Pfister, Harvard SEAS).



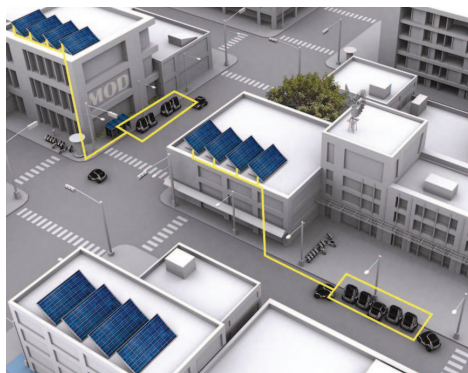


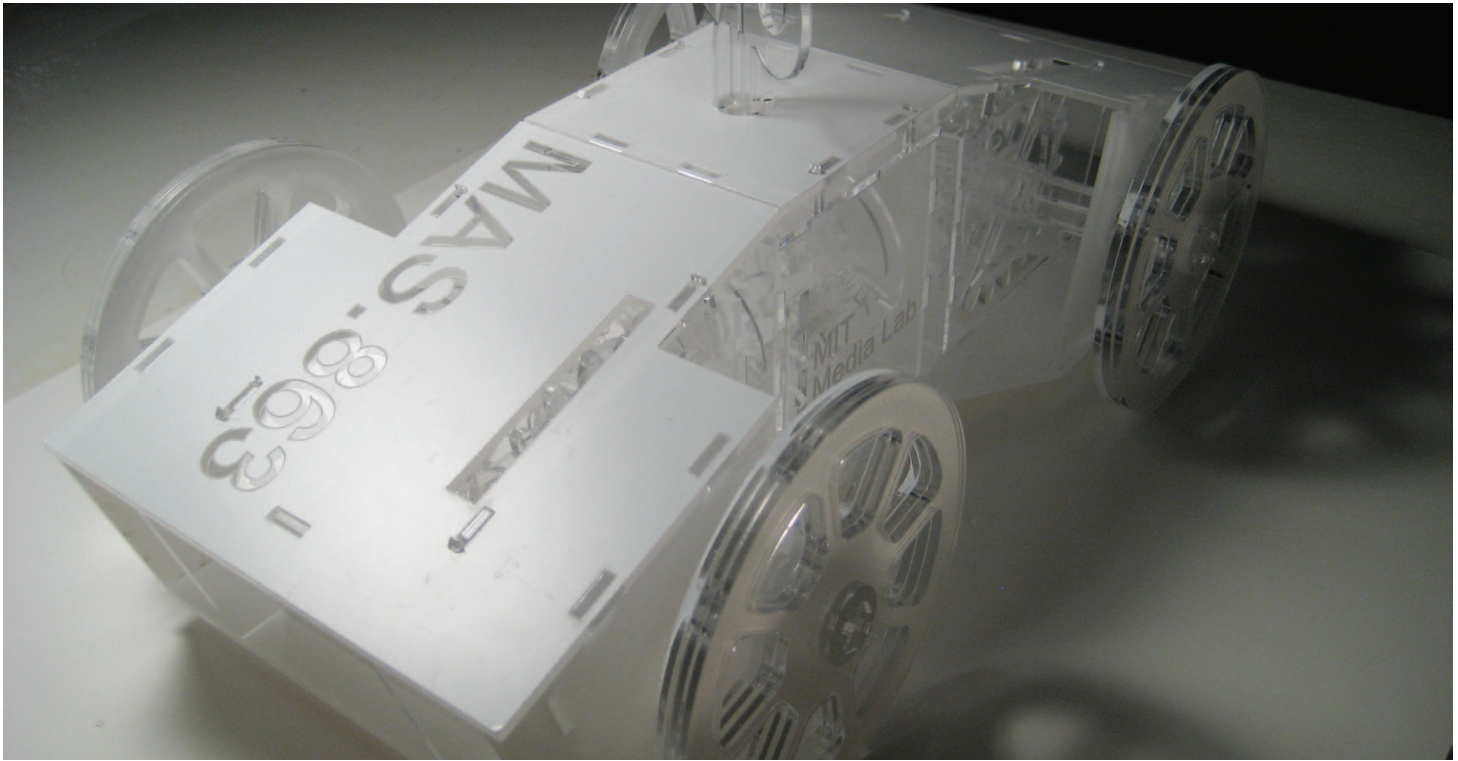
Mobility on Demand (MoD)

Tags: Smart Cities, Intelligent Transportation, Vehicle Sharing
 Smart Cities & Changing Places groups, MIT Media Lab, 2008 - 2011

Mobility on Demand (MoD) systems utilize lightweight electric foldable vehicles, networks of rapid charging stations, and intelligent fleet management systems providing personal point-to-point mobility while solving the public parking problem. We developed three vehicles: the City Car (now HIRIKO), the RoboScooter, and the GreenWheel bicycle. All vehicles deploy drive-by-wire technology and plug-n-play in-wheel, electric motors that integrate suspension, steering control, and breaking within the wheel's hub-space. This

allows the main chassis to fold to minimize urban footprint. MoD systems incorporate: smart grid technologies, smart fleet management, and vehicle-to-grid (V2G) technology. MoD started as collaboration with General Motors and Schneider Electric and continued with Denokinn. **(best invention of year 2007 , TIME magazine; \$100K Buckminster Fuller Award, 2009 - with Prof William J. Mitchell, and Kent Larson, MIT Media Lab).**



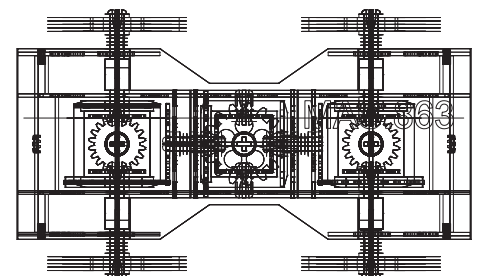
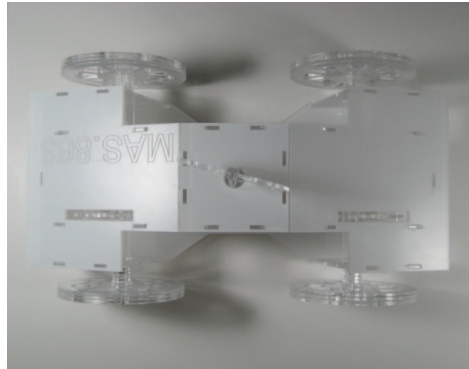
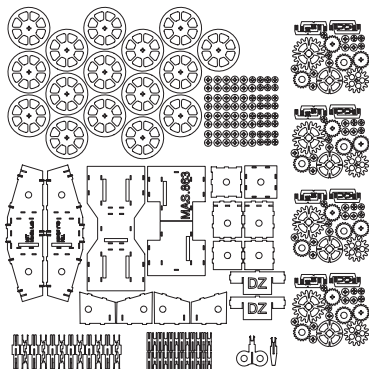
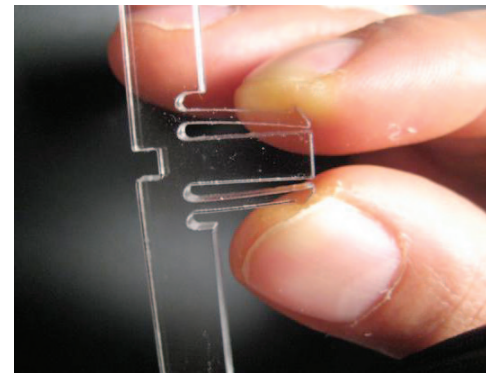
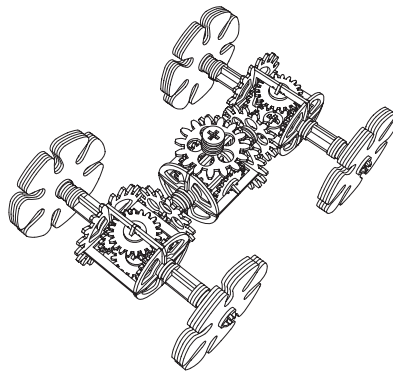
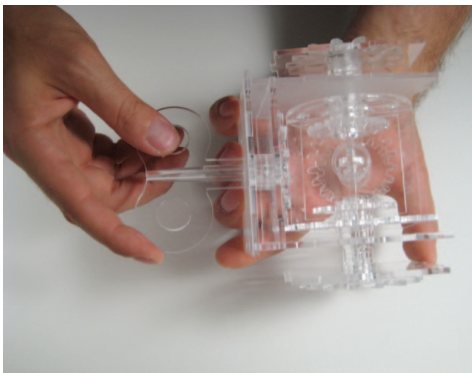


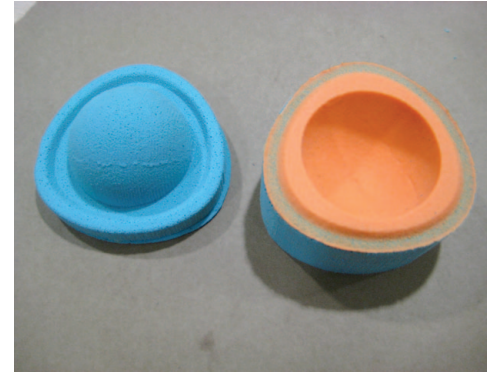
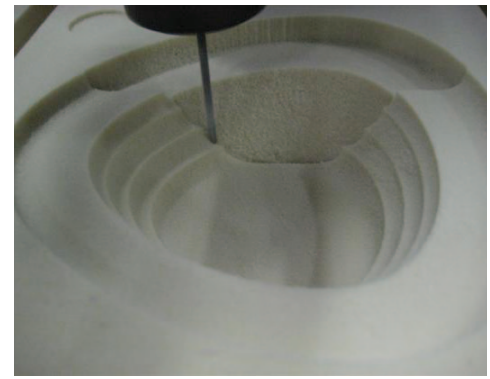
FabCar

Tags: toy product design, mechanical assemblies, fabrication, DIY
MIT Media Lab, 2010

A DIY toy-car made in a laser cutter and manually assembled with snap fit flexure joints that bend and spring back to install parts and prevent disassembly. No adhesives or fasteners required. Fabcar uses 3 differentials gears to unevenly distribute torque to each of the four wheels based on their individual resistances. Torque applied to the main shaft is transmitted

through the central differential to the front and back differentials and from there to each of the four wheels. The design consists of 234 parts that can be cut in a laser cutter and manually assembled easily with no skills. Fabcar has been showcased in Guatemala by MIT Prof Meejin Yoon as example of cross-disciplinary design work. Part files available upon request.





Colorcos ▲

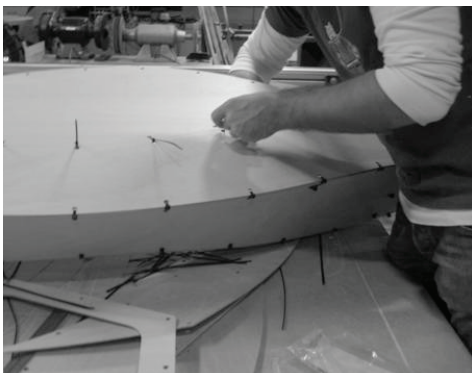
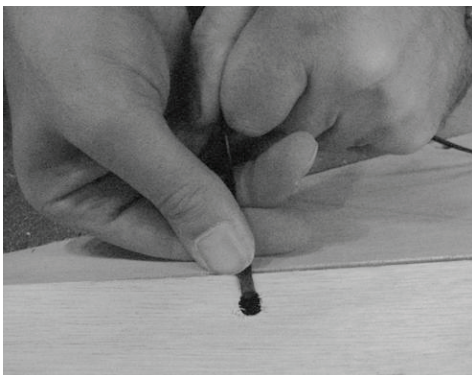
Tags: product design, fabrication, molding, casting, plasitcs
MIT Media Lab, 2010

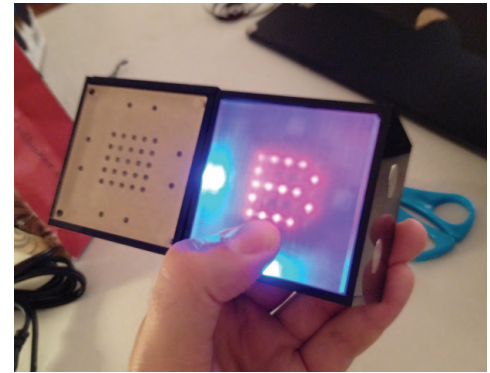
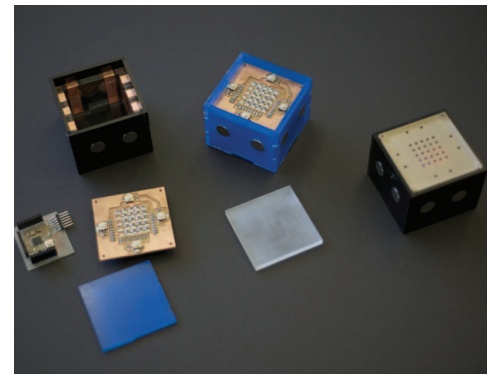
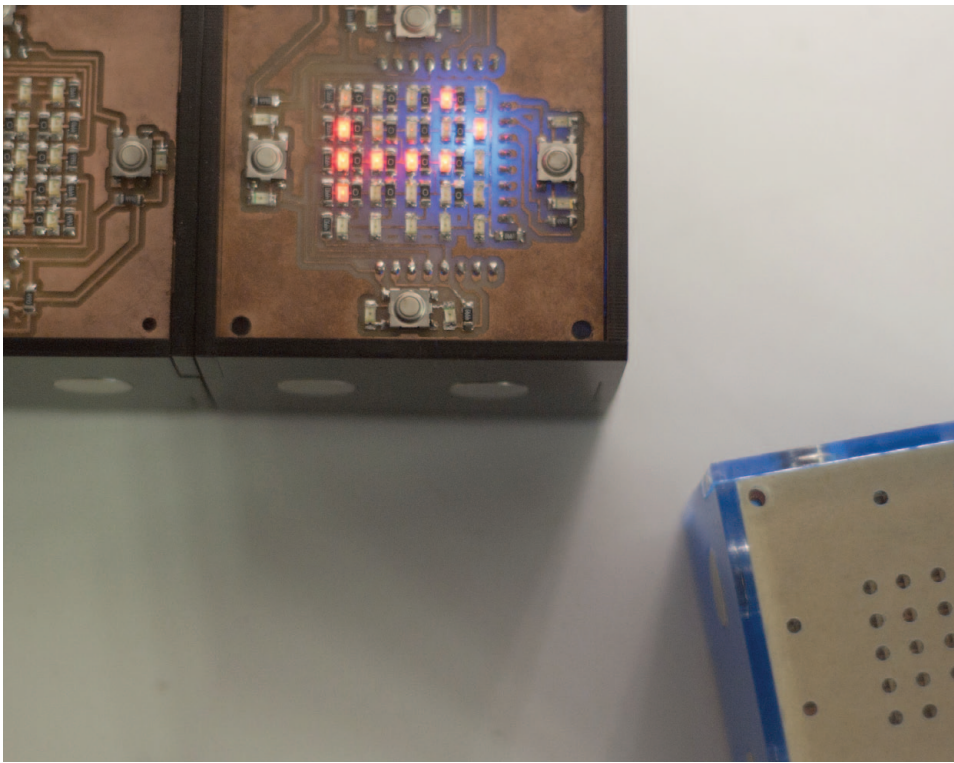
A study for developing low-cost colorful plastic consumer products. Colorcos consist of 3 parts that are casted in Smooth-Cast® 325 liquid plastic in two-part rubber molds that are in turn casted from OOMOO® 30 silicon rubber in molds that were milled in high-density rigid foam in the ShopBot.

▼ StitchYak

Tags: fabrication, CNC, folding, stitching, 3D modeling
MIT Media Lab, 2010

A lightweight, low-cost and easy to assemble, stitch-and-glue whitewater kayak chassis made from 1/8 marine plywood and zip-ties. StitchYak design has a highly efficient structural form, following the principle of synclastic surfaces. StitchYak is milled in a ShopBot, and can fit in two 4x8 ft. plywood sheets.





Cubes ▲

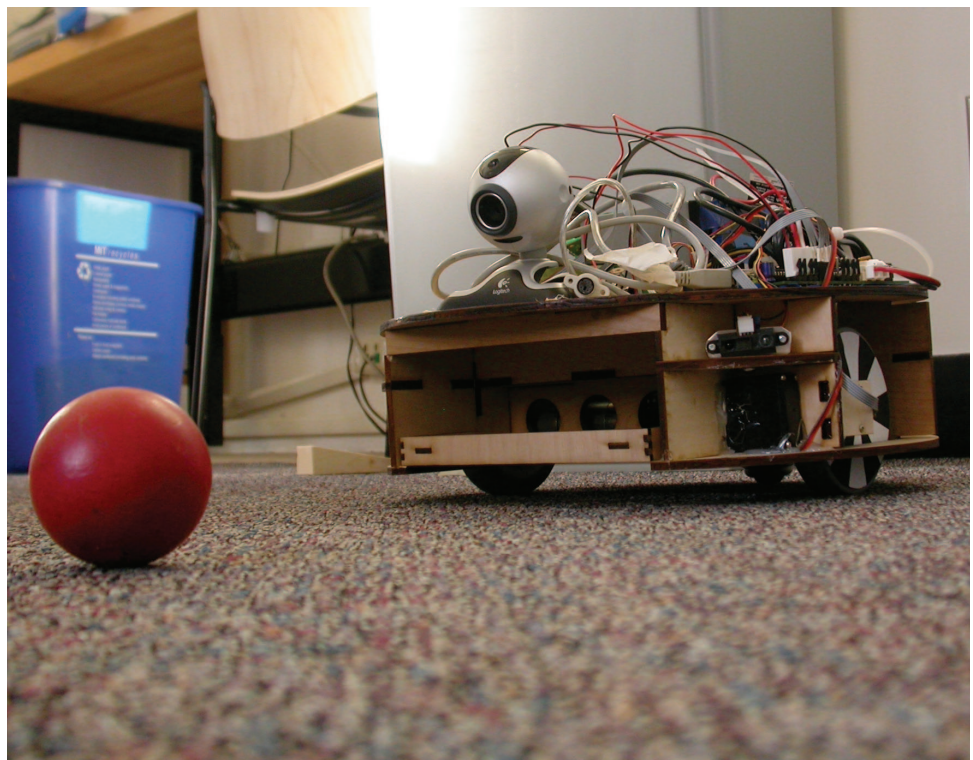
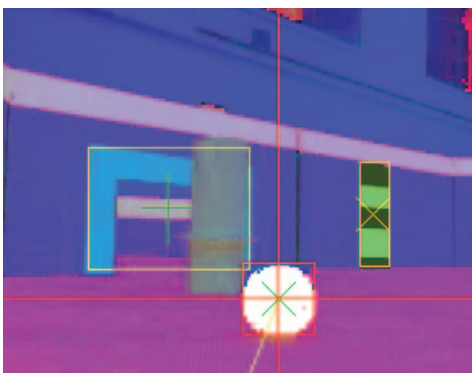
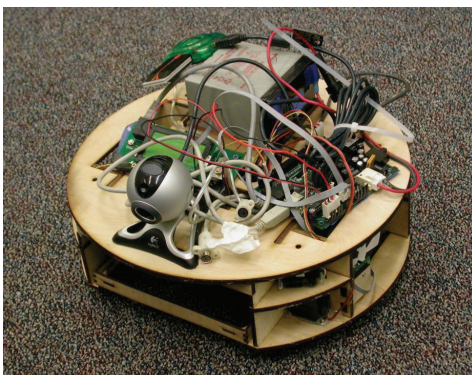
Tags: digital electronics, internet zero, communication networks, assemblies
MIT Media Lab, 2010

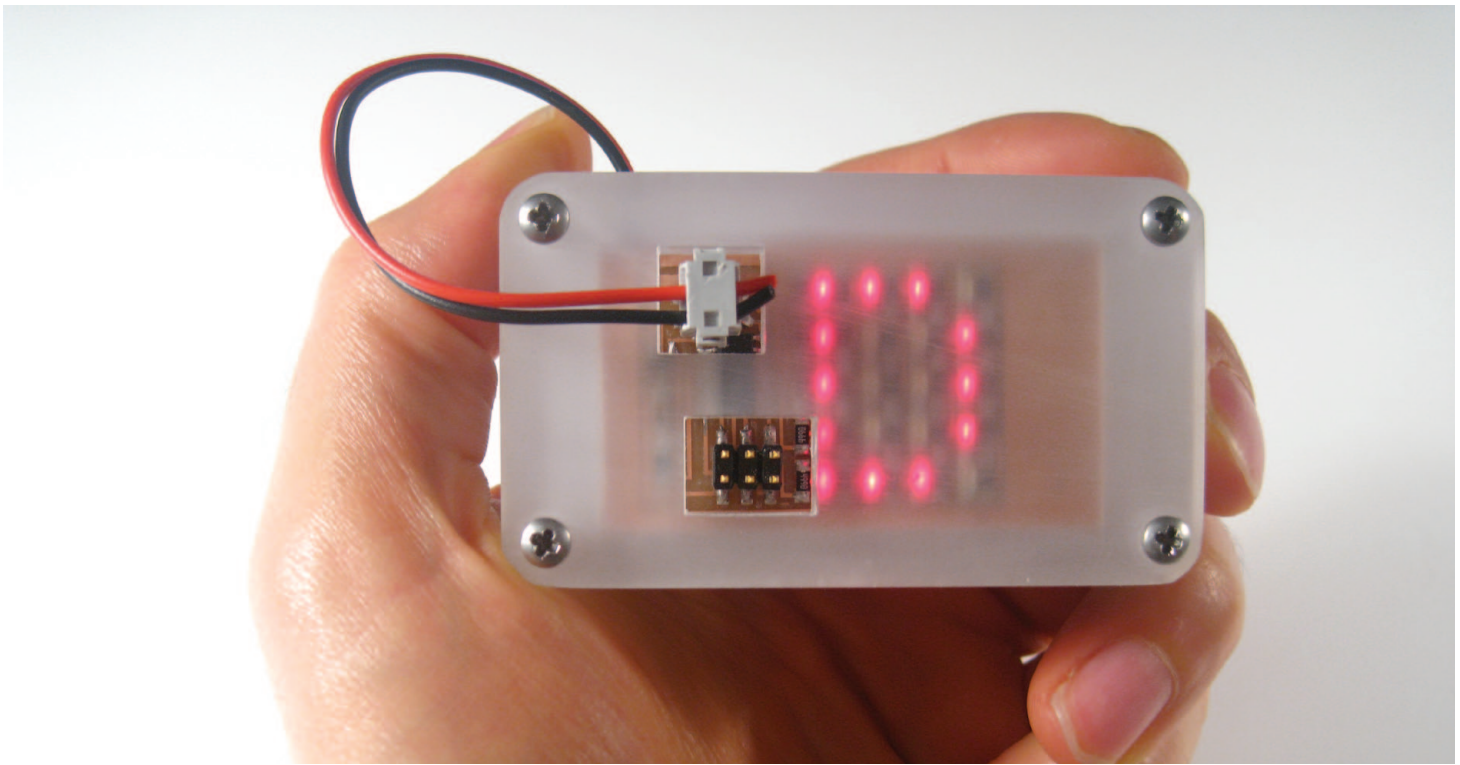
Magnetically snappable interactive blocks that can be assembled and create distributed communication networks. Each block has a LED matrix for output, a touchpad for input, made from acrylic surface supported on four button switches, and uses four pairs of TX/RX magnetic contact pads to both snap and communicate with neighboring blocks. Polycubes can be used as a self-guided assembly kit: an assembly sequence can be boot-loaded in a root block. (with Prof Neil Gershenfeld, MIT Center for Bits and Atoms)

▼ MASLAB

Tags: robotics, computer vision, artificial intelligence
MIT, 2007

An autonomous programmable robot that is capable of navigating into a labyrinth using a web cam and computer vision; avoid obstacles using infrared (IR) proximity sensors; locate, collect and carry red balls; and finally score points by passing the balls through special doors. MASLAB (Mobile Autonomous Systems Laboratory) is MIT's most intense IAP robotics competition (with Si Li and Rachele Villalon, MIT).





DeesPlay ▲

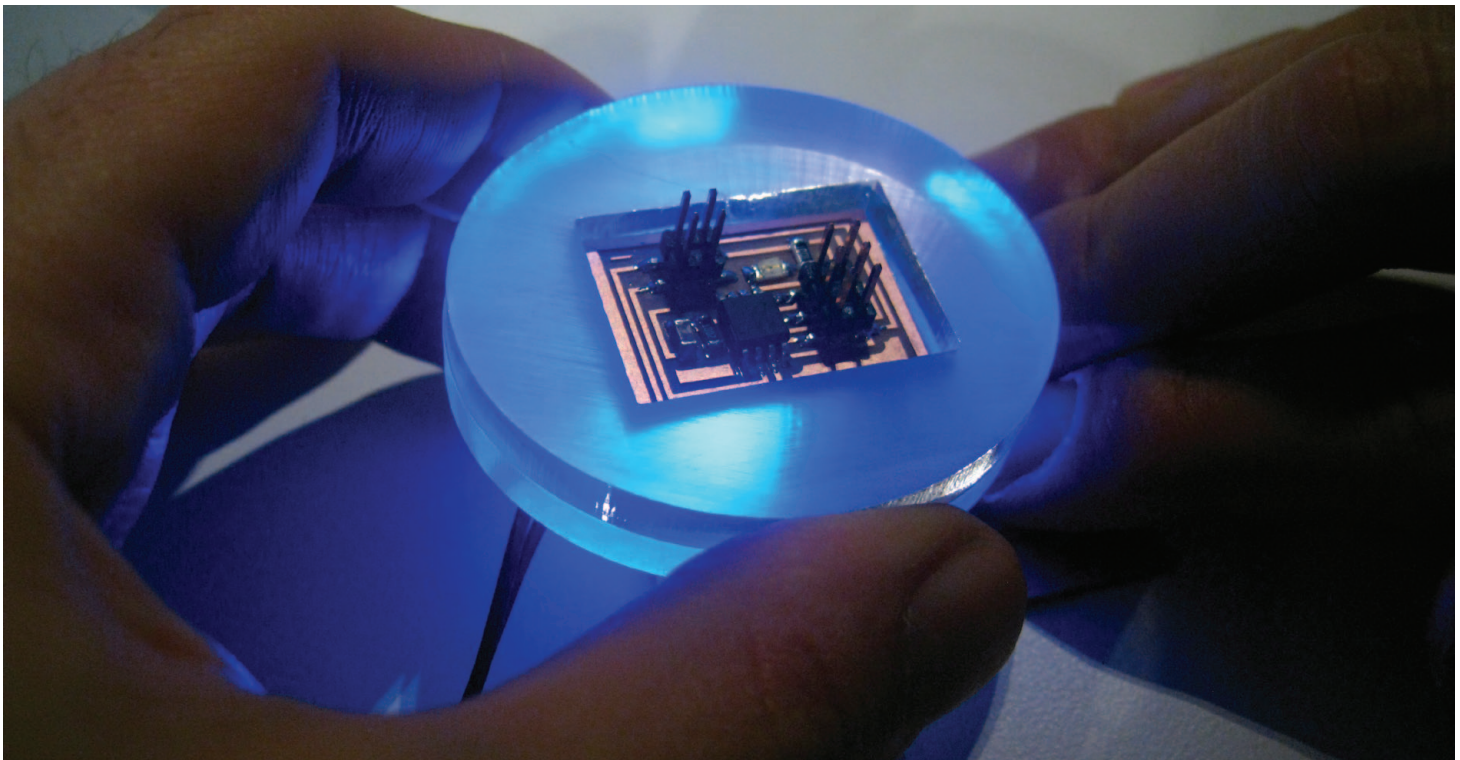
Tags: communication design, digital electronics, DIY product design
MIT Media Lab, 2010

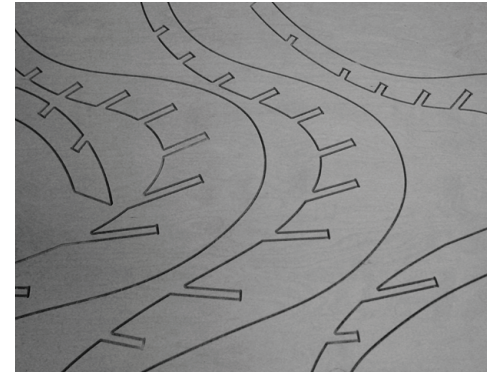
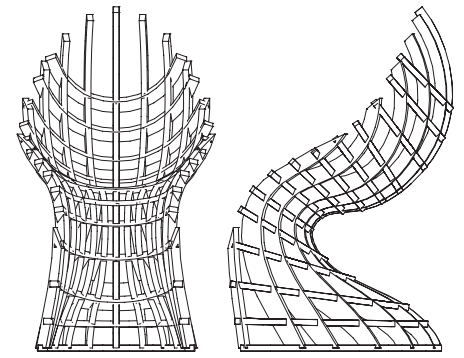
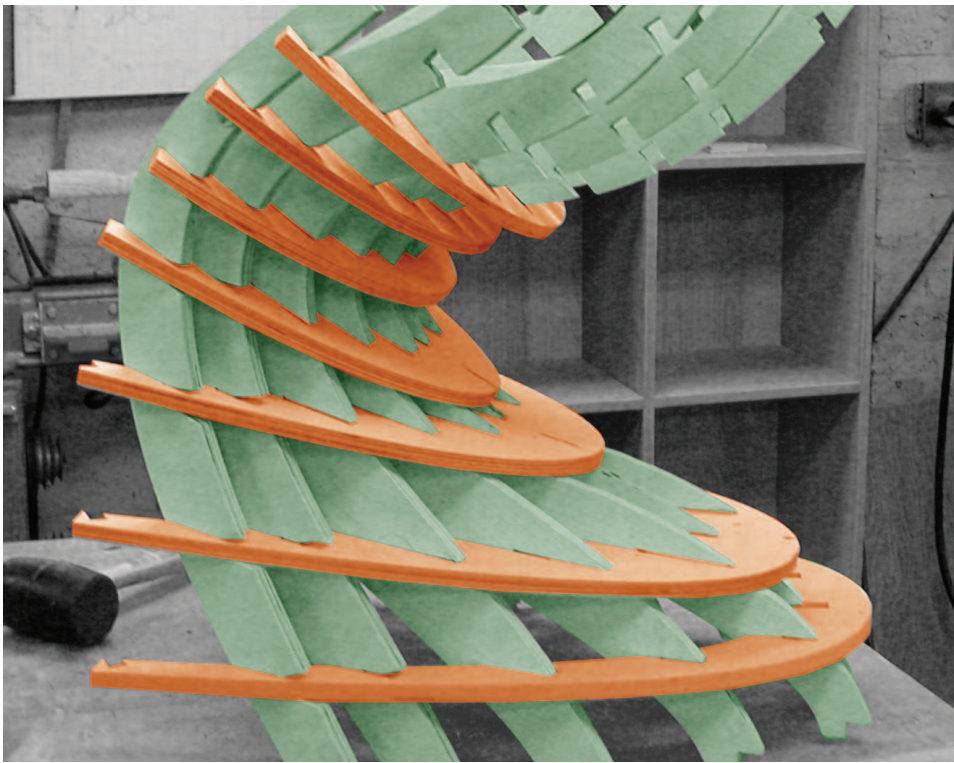
A low-cost programmable personal device for storing, carrying, and displaying messages to people. A custom-made 5x5 LED matrix display consists of Light Emitting Diodes (LEDs) and is controlled by an ATtiny44 microcontroller chip. The LED display uses Charlieplexing, a method that utilizes the tri-state capability of microcontrollers to reduce the amount of required Input/Output pins to only 5 for controlling 30 LEDs

▼ Talking Tiles

Tags: interaction design, digital electronics, communication networks
MIT Media Lab, 2010

Wired translucent tiles that can communicate and transmit light-coded messages serially through a simple TX/RX communication protocol. Each Talking Tile has a unique ID address that can be called by a central controlling computer. Talking Tiles can be used as a low-cost sensor network application for interactive art projects. A computer can periodically request sensor measurements from each talking tile by calling its individual ID.





FabSeat ▲

Tags: digital fabrication, CNC, product design, parametric design, assemblies
MIT, 2006

Fabseat is a built-to-order, fully customizable, and affordable chair that employs digital design & fabrication techniques for production. fabseat is an assembly of custom interlocking planar parts from various materials. Customers can parametrically adjust the design, and send it for fabrication. Customizable parameters include size, proportion, color, and material (with Prof Larry Sass, Joshua Lobel, Magdalene Pantazi)

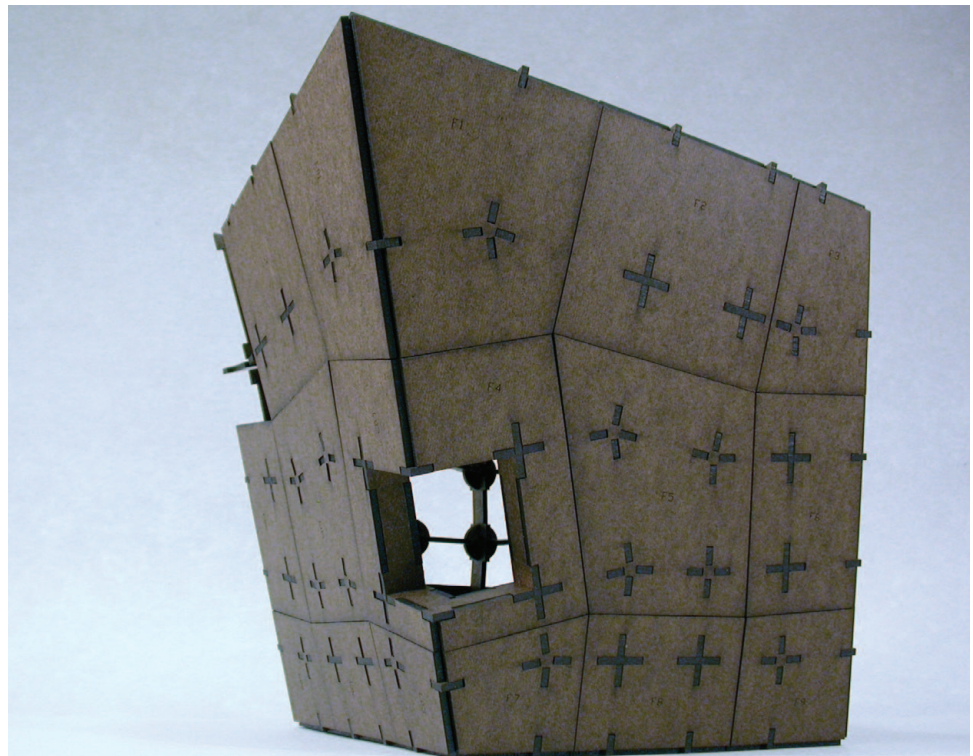
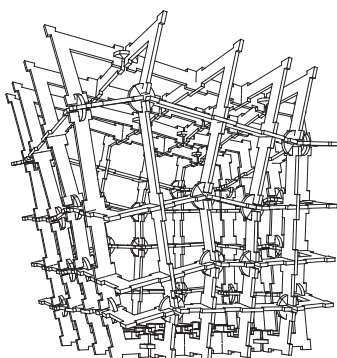
▼ FabHouse

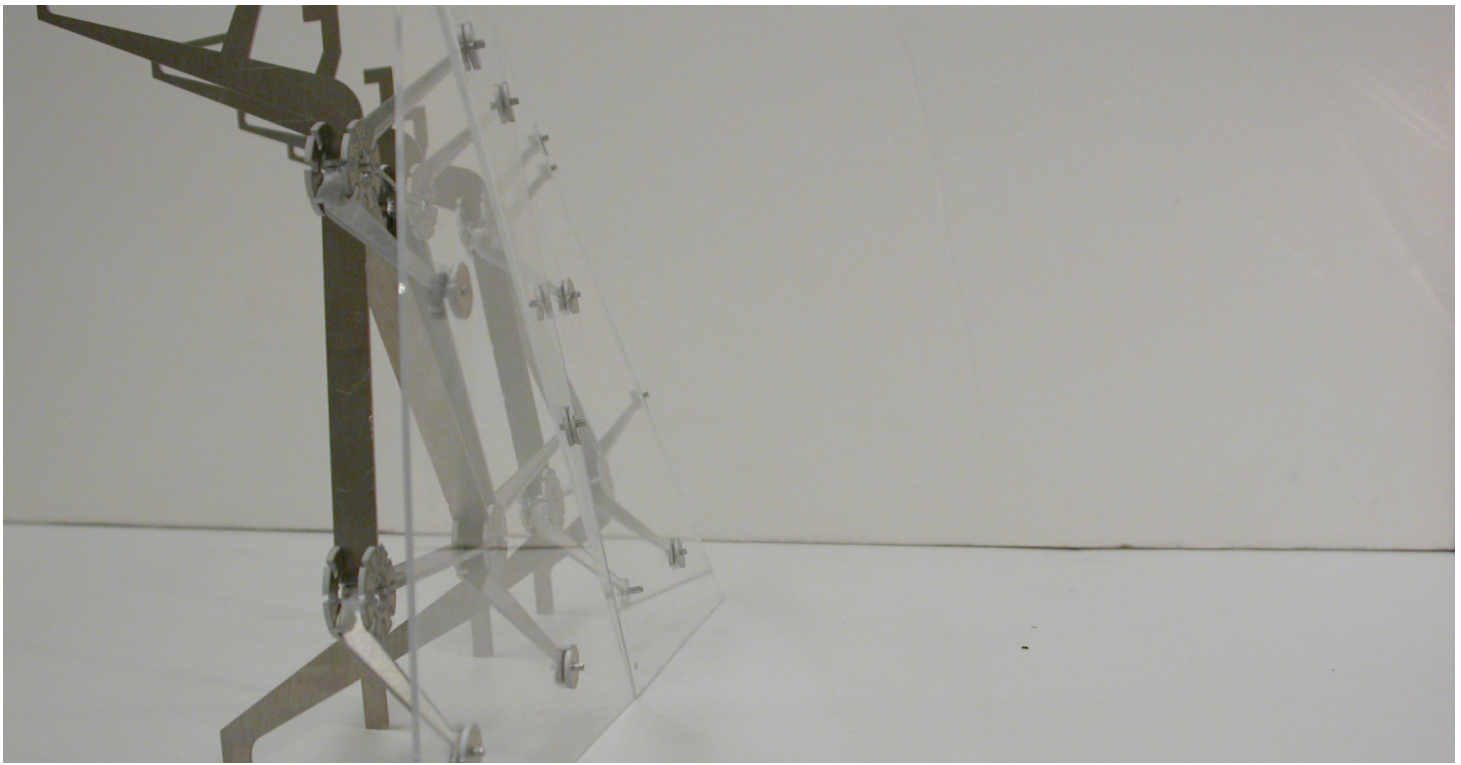
Tags: digital fabrication, CNC, architecture, structural grids, parametric design, assemblies
MIT, 2007

This project advanced a method to digitally fabricate irregular structural envelopes from plywood (demonstrated by MIT at NYC MoMA's Home Delivery exhibition) by retaining grid continuity across adjacent walls while maintaining perpendicularity of connected parts. This technique allowed standardization of joints and facilitated assembly (With Prof Larry Sass, MIT, and Dr Dennis Shelden, Gehry Technologies).



MIT FabHouse (Photo by T. Carrigan)



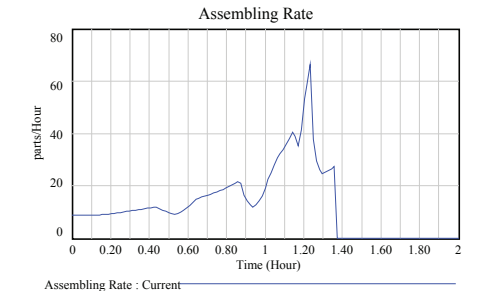
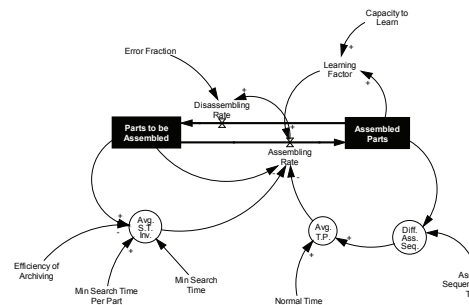
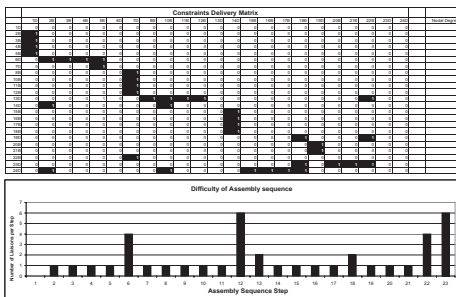
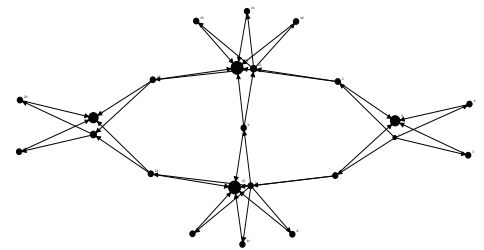
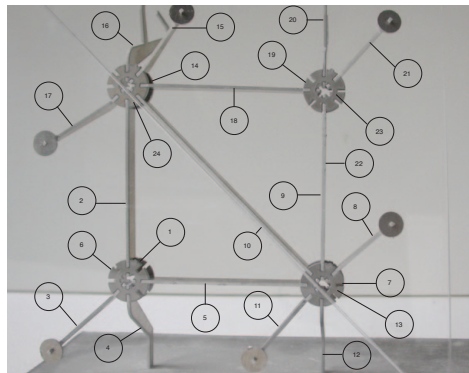
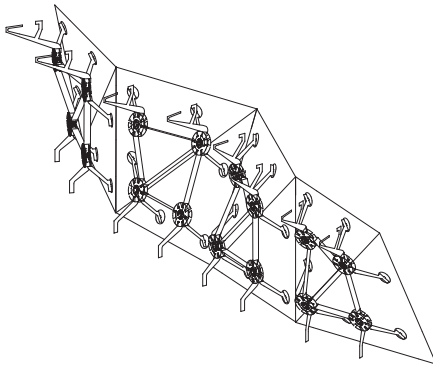


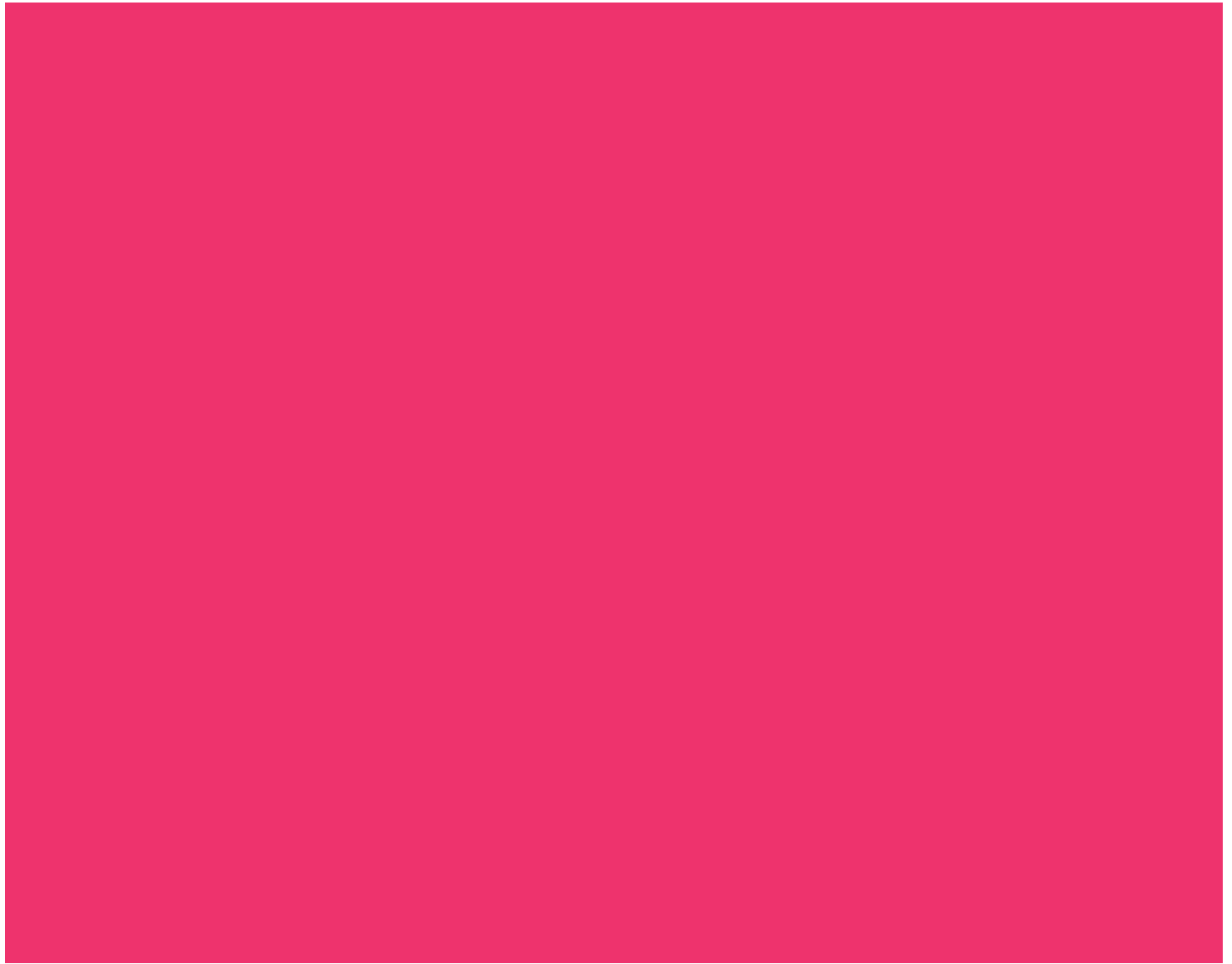
Planar-part Assembly Assessment

Tags: network theory, mechanical assemblies, liaison graph, assemblability assessment
MIT, 2008

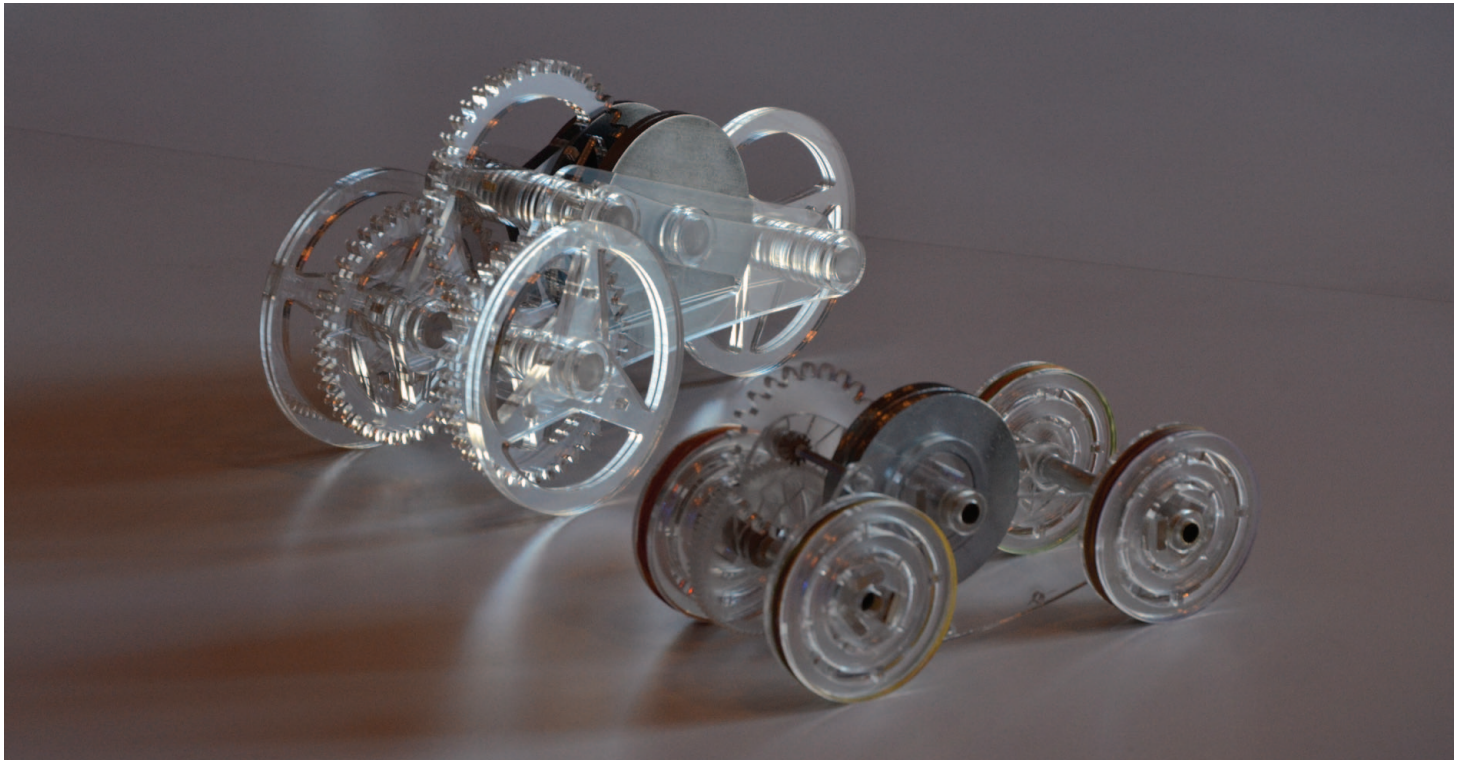
Why certain geometric models can be assembled while others cannot, and why can't such problems be perceived during early design stages with traditional CAD tools? CAD models represent the final state of the assembly but not the process of putting parts together. Designers and builders use physical mockups to test constructability but with significant losses in time, cost, and clarity of understanding the solution to the geometrical problem. My SMArchS thesis developed a rule-based method that used graph theory

and network analysis to identify incompatibilities in free-form designs of interlocking planar-part assemblies. Furthermore a simple system dynamics model to simulate the assembly sequence and estimate the expected time and effort for materializing a design. This work addressed analytically a complex problem that so far designers mostly approached empirically. (With Prof Larry Sass, MIT, and Dr Dennis Shelden, Gehry Technologies).





Selected Teaching

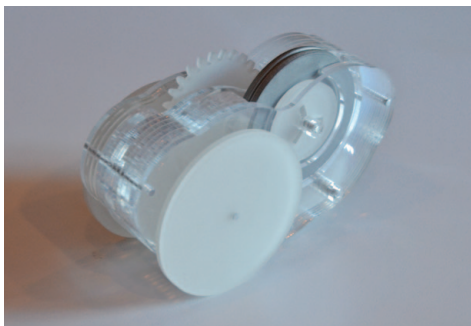


DIY [Toy] Product Design II: Mechanical Assemblies

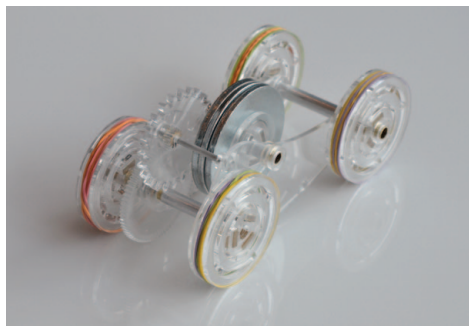
Tags: teaching, mechanical assemblies, toys, product design, DIY
 Harvard GSD, 2014
 Role: Instructor and course developer

This hands-on course explores design, fabrication, and assembly of mechanically actuated toy cars for the DIY community. Working in teams of two, students design, fabricate, and assemble toy cars consisting of multiple functional parts (wheels, chassis, gears, etc.) that use flywheels to store kinetic energy and use it for propulsion. Toys must be designed for laser cutting fabrication and easy manual assembly with no adhesives or fasteners. Students explore flexure joints and Design For Assembly (DFA) techniques

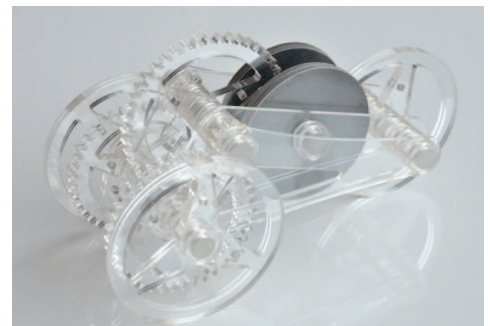
to easily install parts. Each student in a team develops a subassembly, negotiating with his/her teammate about how their subassemblies will interlock and transfer energy. Students learn fundamentals of parametric and computational CAD modeling using Rhino and Grasshopper, and C# programming language. Furthermore they learn how to design gears to transfer torque, basic principles of Design for Assembly (DFA), and physics to calculate gear ratios, as well as size and weight of their flywheels.



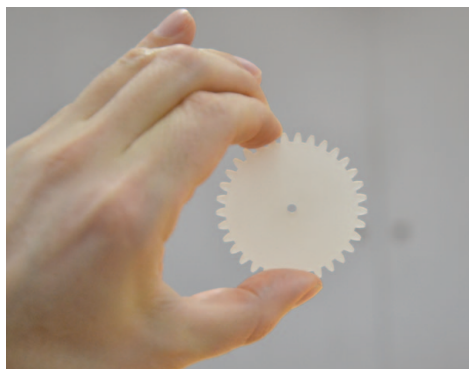
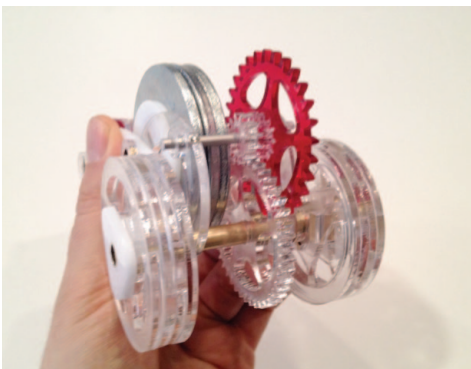
Work by Sarah Bolivar and Tara Ebsworth



Work by Saurabh Mhatre and Sourav Biswas



Work by Elizabeth Wu and Jifey Ou



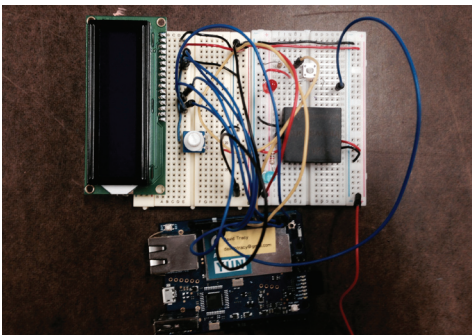


Rethinking P2P Urban Mobility Systems

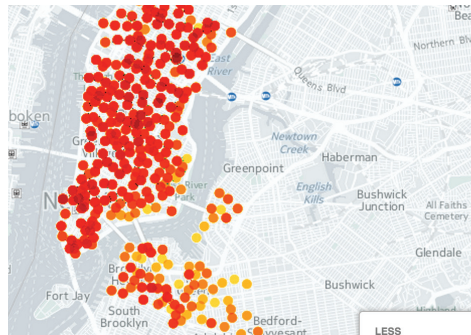
Tags: teaching, urban mobility, smart cities, data visualization, interactive telecommunications
 NYU ITP, 2014
 Role: Instructor and course developer

This course introduces the theory, underlying technologies, and operational complexities of intelligent mobility on demand (MoD) systems using NYC City Bike sharing program as a living laboratory. The first half of the course studies the current operational and economic limitations of MoD systems from a systems theory perspective. Students working with data visualization and computer simulation methods exploring how trip patterns, fleet sizing, and truck rebalancing affect system performance during economic

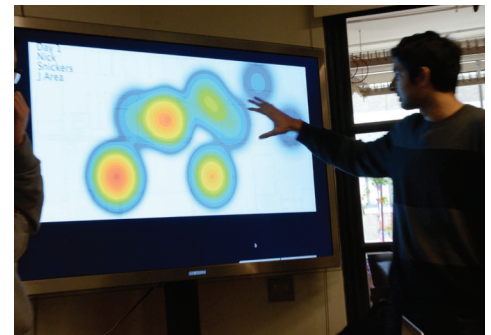
equilibrium. The second half explores new models of collective intelligence for self-organizing MoD systems using digital media and social computation. Students learn how information technology, social mechanisms and game theory can leverage self-organization by designing, prototyping, and playing an interactive game experiment. Lectures cover topics on information and communication technology, data visualization, systems theory, game theory, mechanism design, physical computing, and interaction design.



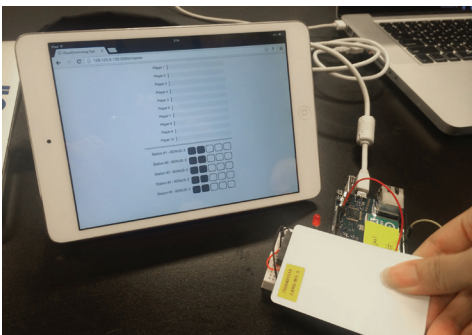
RFID sensor prototyping test (student work).



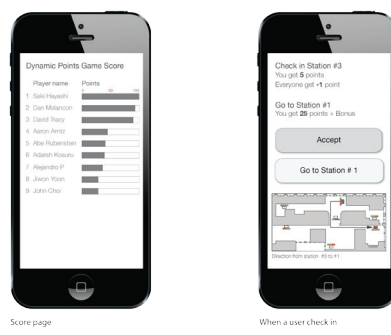
Real-time data visualization of NYC (student work).



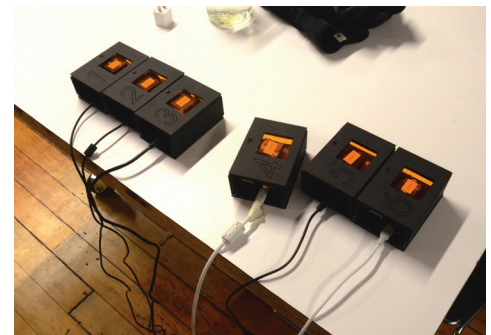
Visualization of a game experiment (student work).



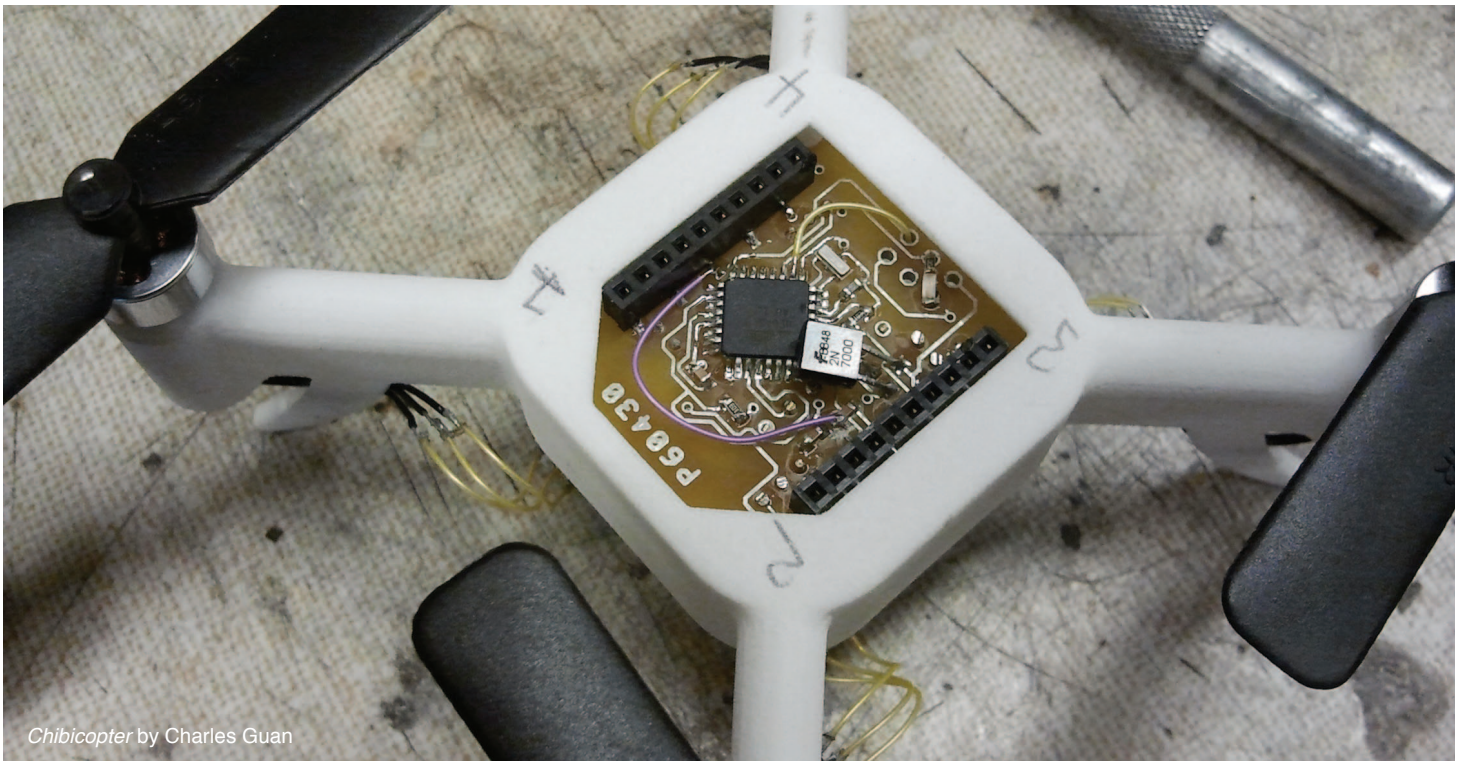
Connecting sensors to tablets (student work).



Mobile device user interface design (student work).



Interconnected sensor nodes (student work).



Chibicopter by Charles Guan

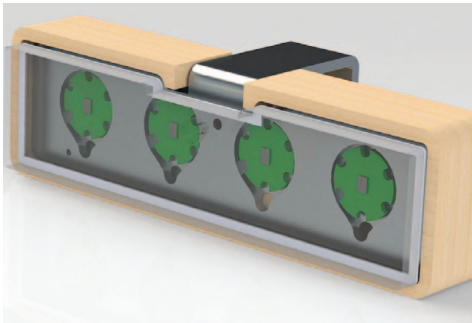
MAS.S63 Design for [DIY] Manufacturing

Tags: teaching, student work, electronics, interaction design, product design, DIY
MIT Media Lab, 2012

Role: Co-Instructor and course co-developer

This class explored the possibilities for the do-it-yourself (DIY) manufacturing of electronic products using digital fabrication processes like laser cutting, CNC milling, and 3D printing; open-source electronic hardware; and computer-aided design (CAD) programs. Furthermore the course provided a platform for rethinking the DIY industrial ecology. Each student designed, developed, and prototyped an electronic product over the course of the se-

mester, focusing on electronics, enclosures, form, and function. In addition, students developed plans for manufacturing, estimated costs, and proposed potential supply chain systems from electronic component suppliers to end users (with D. Mellis, M. Coelho, M. Feldmeier, N.Gong, N. Peek, and A. Zoran).



Blink-blink by Sam Jacoby



Blink-blink by Sam Jacoby



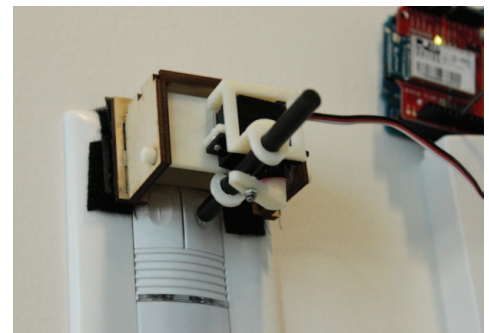
Eclat by Xiao Xiao



Quartz by Shaun Shalzburg



Bijoux by Jennifer Broutin



Remotables by Roy Shilkrot

