SCOTT MACDONALD

DESIGN PORTFOLIO

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PRODUCTION

The journey from concept to production is long and diverse in nature. I have been lucky to witness transformations from napkin sketches to tier 1 manufacturing lines, and believe each stage of development offers unique opportunities to make beautiful, functional, enjoyable objects. These projects represent both personal and professional efforts to apply engineering and design to product development.

Concept to Production

MULTIDISCPLINARY DEVELOPMENT | SUPPLY CHAIN INTEGRATION | ADVANCED 3D SURFACING & MODELING

I have also been able to leverage my passion for electronics while working on devices in which electronics and connectivity play a pivotal role in the customer experience. Subpac's wearable tactile audio system allows digital media afficionados to feel sound. The hardware required to achieve this required validation of ergonomic, asthetic, and funcitonal components ranging from voice coil drivers to volume knobs. Through vendor management and beta testing, I worked alongisde senior engineers and designers at Playground Global to optimize both user experience and price point. I also worked with Pax Labs Inc. on prototypes for a next generation device that used state of the art heating and insulation technologies to vaporize plant matter. In the process, I worked with the management team to scope and define requirments, as well as the internal engineering resources to design plastic, metal and elastomeric parts, program embedded systems on microcontrollers, and interface directly with vendors and contractors for quotes and test runs of parts and processes.

SUBPAC®

PAX®

Professional Mechanism and Design Integration

PART SELECTION & VALIDATION | TOLERANCING | MASS MANUFACTURING

I have had the opportunity to work with several world class teams to create successful products. Working with logitech in their first exploration into hardware, I helped develop and refine mechanisms that used magnets, suction cups and friction hinges to bring their vision for a great driving experience to life. More recently, I worked with Nebia to define the internal components and geometries necessary to achieve a vertically adjustable shower head. Using sheet metal and extrusion geometries in tandem with friction generating inserts and injection molded parts to create this effect while allowing an internal, pressurised hose translate vertically was an ambitious but rewarding undertaking.

nebia

Logitech
Case + Drive

Travel Safe

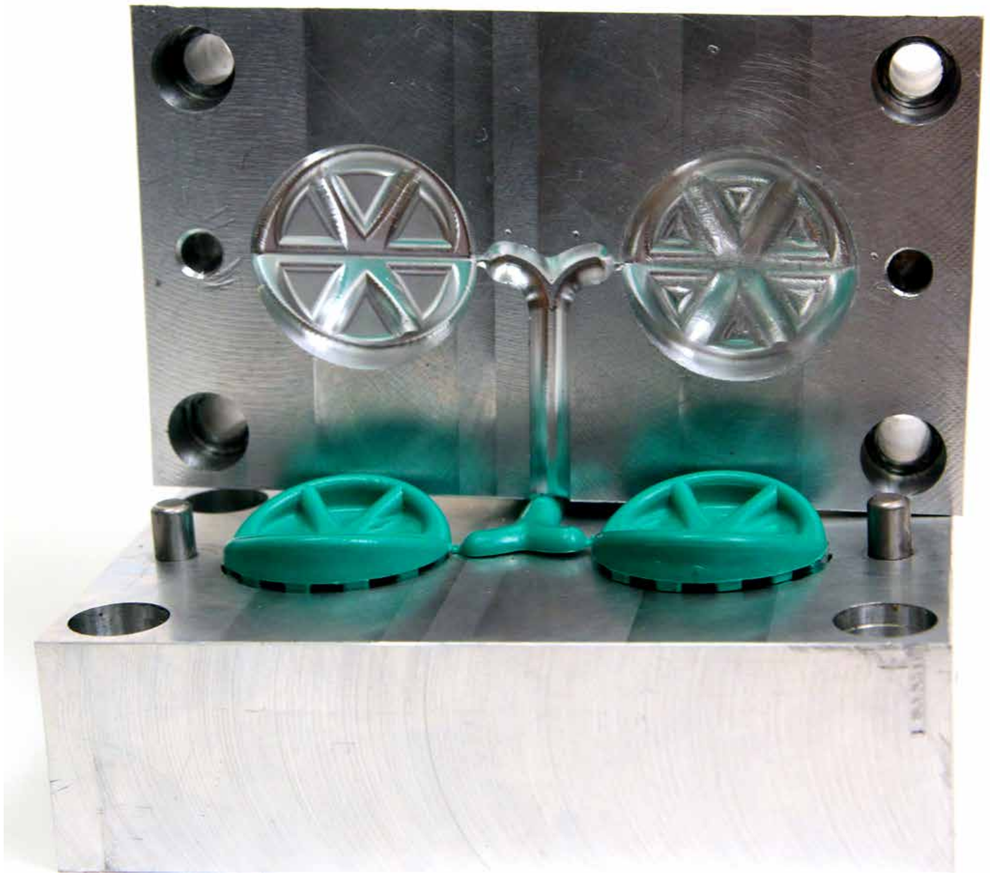
SHEET METAL FORMING | TIG WELDING | FINISHING

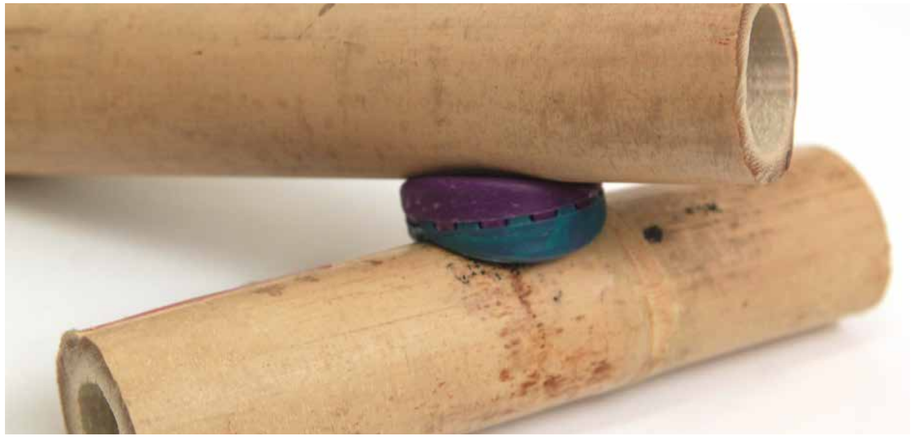
Fascinated by the diversity of the worlds cultures and landscapes, I love traveling. But I found myself worrying about the security of the resources and tools I use to capture and share my experiences. I wanted to create something that would give me piece of mind regardless of where I went. I iterated through several design concepts, and eventually used sheet metal processing and TIG welding to produce a travel safe that could be locked to any exposed pipe or bedframe using a light weight bike lock. I shaped the safe to be egronomically dropped into a backpack, using aluminum to maximize the strength to weight ratio. Adding a water resistent liner ensured that the contents would be safe regardless of the environment.

Injection Molded Bamboo Joinery

INJECTION MOLDED PART DESIGN | CNC MACHINING | MOLD FLOW ANALYSIS

Inspired by bamboo scaffolding in Asia, wanted to find ways to facilitate the use of bamboo construction. I noticed that the natural variation in both diameter and geometry made anything but lashing perpindicular joints between two pieces of bamboo incredibly difficult. However, after dozens of design iterations, I discovered that by using the same geometry that lets poker chips stack and rotate radially and a “v-block” shape common in retaining round objects in machining, I could rotate two pieces of bamboo at various angles and lash them together to create angluar bamboo structures. I designed a molding pattern, fabricated it on a Haas CNC, and used a vertical injection molding machine to produce more than 300 pairs of a joint that could be used with twine or zipties to produce angular joints in bamboo.





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SMART PRODUCTS

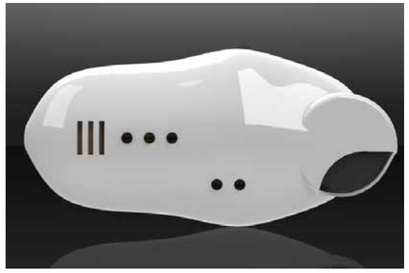
In today’s market, hardware products need to be smart. But that doesn’t just mean adding an internet connection, it means offering users insight or control over their world in a way that opens opportunities rather than dictate behavior. These projects, while not on the market, demonstrate the ability of hardware to achieve that end.

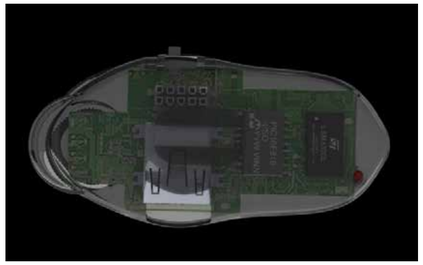
Surgical Posture Monitor

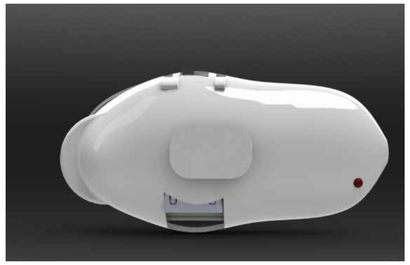
WEARABLE DEVICES | USER TESTING | REAL-TIME FEEDBACK

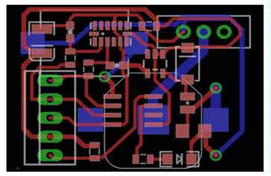
Chronic neck pain is listed as the primary cause for retirement among 10% of surgical professionals. In observing typical head posture during long surgeries, it is clear that soft tissue in the neck is damaged by abnormally prolonged and intense loading. However, because this soft tissue is viscoelastic in nature, it is possible to prevent permanent damage caused by creep by “resetting” the head position periodically, allowing the load to be displaced temporarily and restarting the creep cycle.

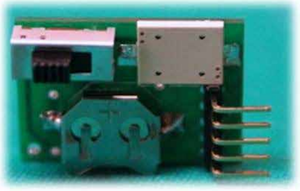
I worked with an occupational therapist and a firmware engineer on prototypes for a wearable device that would remind surgeons to reset their head position. The device was designed to be mounted to surgical loupes, and used a microcontroller gathering accelerometer data to trigger timed alerts. Our first prototype was a fully functional a custom PCB and PIC microcontroller that used a buzzer to indicate it was time to rest. We quickly learned by testing with surgeons that the alerts would need to be adjustable, and catered to the OR assistants rather than the surgeons themselves. Subsequent versions to incorporated adjustable audio and a series of LED’s positioned to visually indicated to assitants that it was time for the team to take a rest.

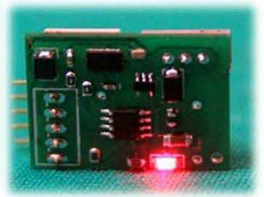








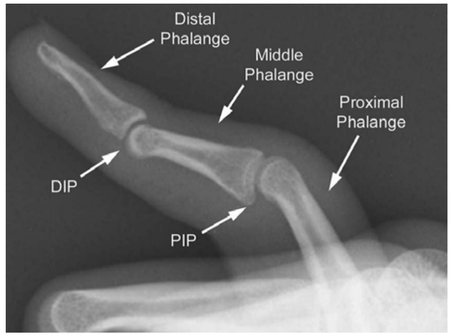


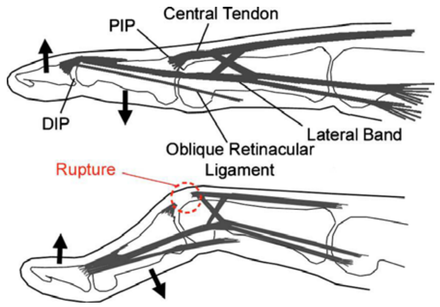


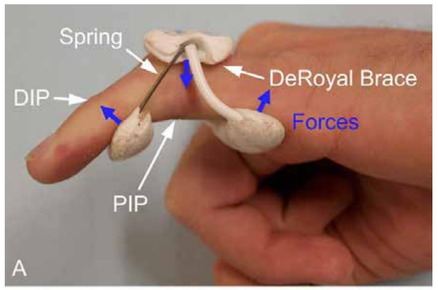
Seca Cafe

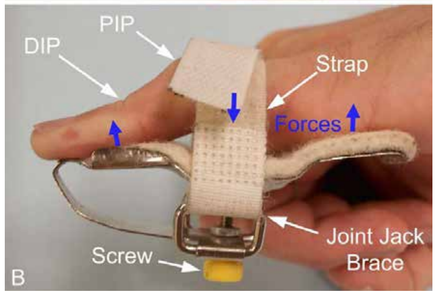
SENSOR INTEGRATION | SYSTEM CONTROLS | ENTREPENEURSHIP

As part of Stanford's Design for Extreme Afforability class, I had the opportunity to redesign coffee processing equipment for rural farmers in Colombia. In a country where the harvest season is also the rainy season, the ability to dry regardless of environmental conditions is invaluable, and prevents hard earned crops from rotting or growing fungus. I used microcontrollers to sense temperature and humidity, and used them to optimize use of fans and extternal heating elements when solar drying was insufficient. The low cost dryer is still in development, and currently uses a hybrid system of propane augmented solar to accomplish controlled drying.







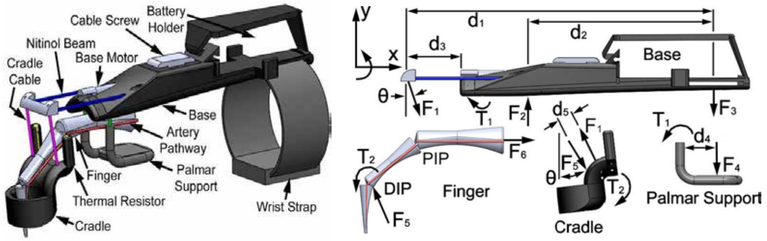


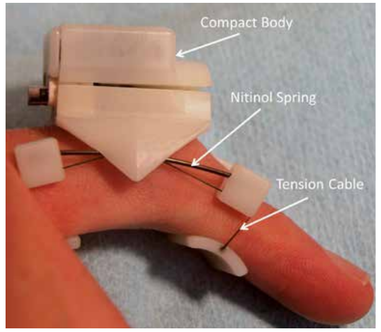
Improved Boutonniere Brace

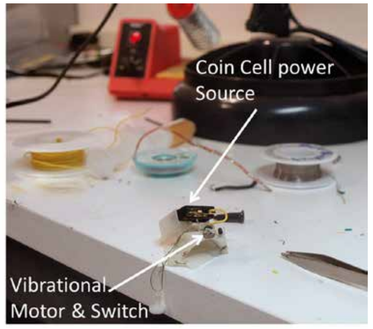
BIOMECHANICS | ERGONOMICS | 3D PRINTING

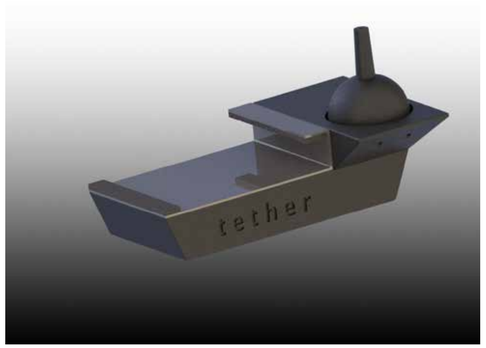
After neglecting to treat a dislocation to a finger on my left hand, I developed what is known as a chronic boutonniere deformity (X-rays and pathoanatomy shown upper left). The only treatment for the condition is done with primitive and painful braces (images bottom left) that were intended to stretch those lateral tendons to their initial length, but because of poor design and improper fitting, my condition worsened when I used them.

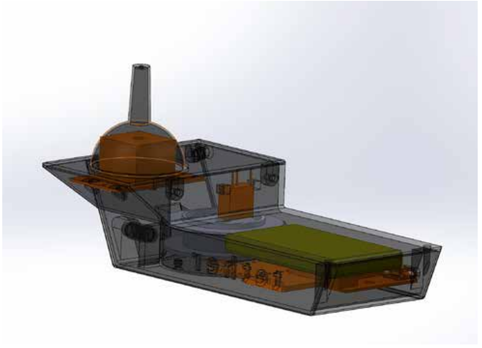
As a result, I designed and fabricated alternative geometries and mechanisms that incorporated improved ergonomics and aspects from soft tissue physical therapy, like heating and vibration. Using knowledge of soft tissue mechanics and anatomy, I used rapid prototyping techniques to created 13 iterations of an improved brace (images to the right) that allowed for a floating, adjustable tension mechanism on two nitinol rods that provided a user specific mechanical advantage and geometry, and used heating elements and vibrational motors to improve blood flow and quicken the recovery process. The process and results were published in the Journal of ASME medical devices.

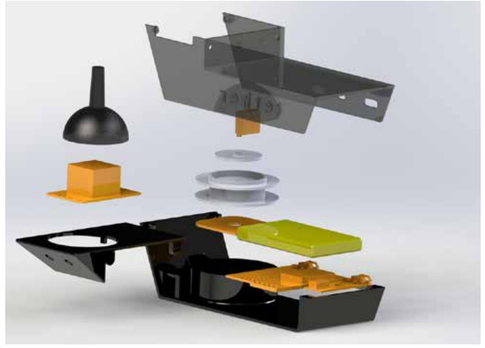










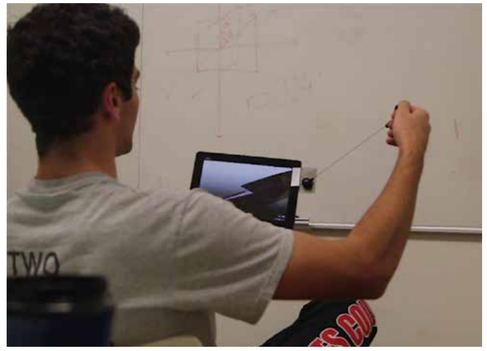


Tether: 3D Input Device

watch the video here

CIRCUITS | SIGNAL PROCESSING | SOFTWARE DEVELOPMENT

Tether was created as part of a mechatronics course at Stanford as an intuitive, physical way to interact with three dimensional software. The mechanism tracked x and y coordinates using two analog potentiometers, in a fashion similar to a gaming joystick, and tracked z coordinates using a torsional spring reel seen in badge retractors. That data was processed and communicated using a bluetooth connected microcontroller, and could be interpreted as a standard HID signal, mimicing a computer mouse, or using an simple API, could give programs coordinates in 3D space. Using off the shelf parts we created a custom PCB to handle the electronic signals and used a 3D printer to create a housing that would self attach onto mobile phones and tablets. I led hardware development efforts, while the signal processing and software was written by my teamates. In 4 weeks, we were able to create the prototype shown, and pitch to a panel of VC's. Our functional demonstration proved that while technically feasible, the experience of using a physical tether didn't add enough value over traditional touchscreen controls to justify the necessary hardware and software.



3

FUNCTIONAL ART

Engaging products often combine beauty and functionality to create a novel experiences, and I believe the most engaging art does as well. These projects are explorations of that union, and reflect a lifelong admiration of nature’s mastery and blending the two.

watch the video here

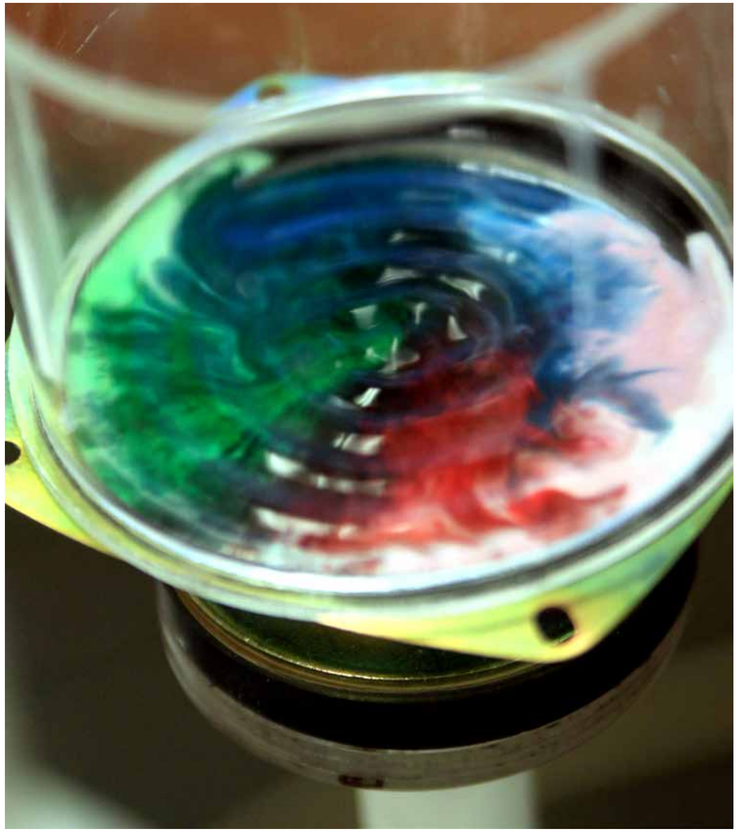
Non-Newtonian Sound Cloud

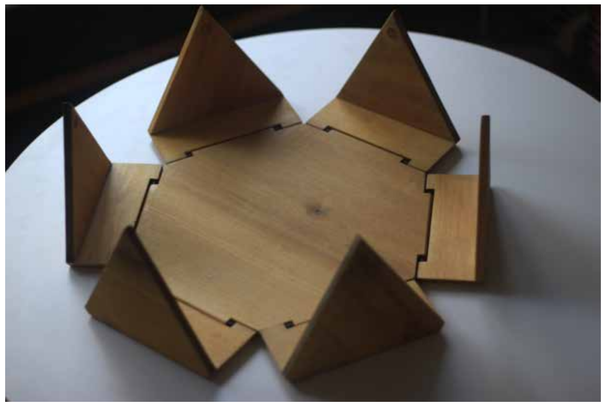
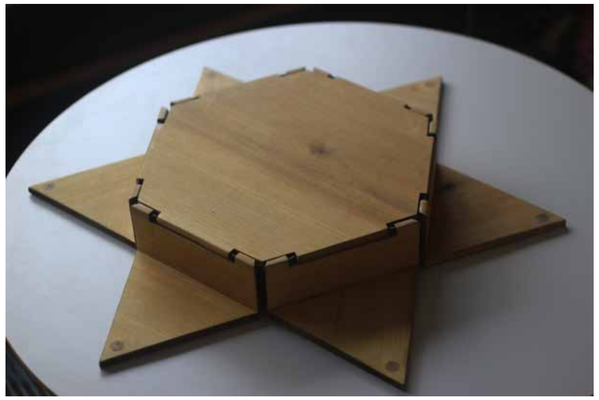
FLUIDS | COLOR THEORY | AUDIO ART

I have always loved music, and have fond memories of the music visualizers common in the 90's. I wanted to create a physical manifestation of music visualization, and used 12 speakers to do so.

The audio channel was split to two sets of speakers, one providing surround sound audio, and the 2nd tied to media that would react dynamically to audio input.

That media included non-newtonian fluids stimulated by a subwoofer and paints and colorants mixed on solid and liquid canvases by tweeters.



Honey Comb Case

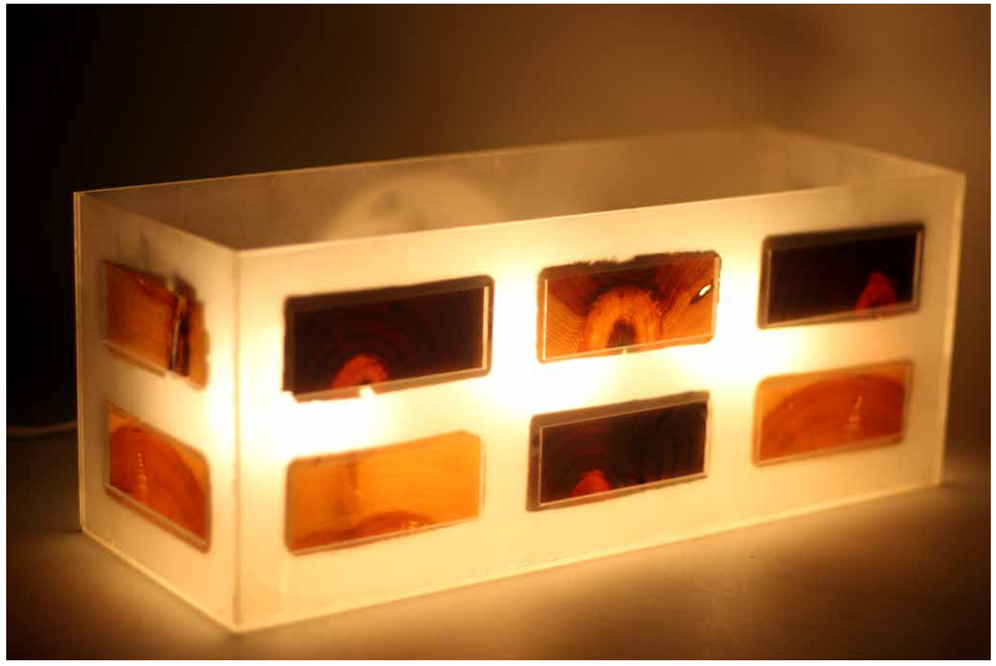
SAND CASTING | WOOD WORKING | GEOMETRIC DESIGN

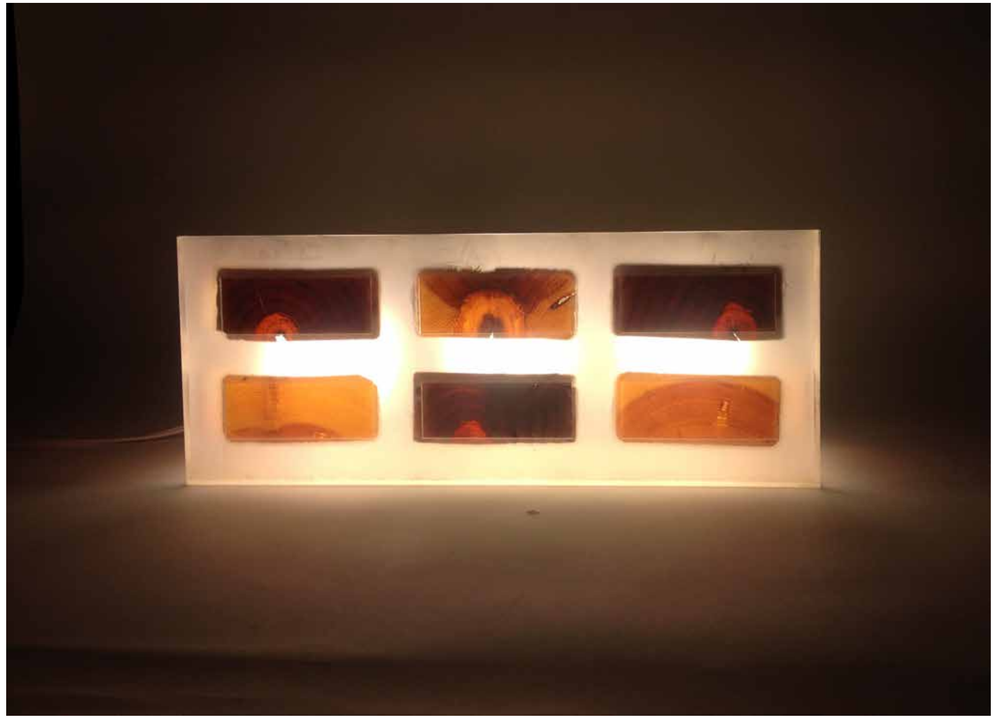
Created to both protect and display its contents, the springloaded, actuating arms are held in place by a cast aluminum clasp that contains magnets with radially alternating polarities. In combination with similarly radially alternating polarities in the arms of the wooden arms, a lock is created that is best undone by rotating the clasp in order to shift magnets from attraction to repulsion which allows the torsional springs to unfold, and at the end of their rotation, push the base of the box upward towards the viewer.

Turbulent Flow Carbon Fiber Longboard

COMPOSITES | VECTOR DESIGN | LASER CUTTING

Immediately after being introduced to composites, I decided to use carbon fiber to make something light, strong and fast. Imagining the feeling of gliding downhill reminded me of air flow visualizations from my fluids class, and inspired me to etch a turblent fluid flow pattern onto the top of the board.





Two-By Lamp

PROCESS INNOVATION | LIGHTING DESIGN | RECYCLING

After mismeasuring a two-by-four and having to correct it by removing 1/16th of an inch, I noticed the remnant was translucent and highlighted the natrual beauty of the wood grain. Intentionally “shaving” 9 more remnants off of the end of another two-by four and using a laser cutter to create a suitable frame allowed me to create this lamp.

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