cameronalberg

ENGINEER | DESIGNER | LEADER

I believe that the best designs are the ones that look like they haven't been designed at all. Driven by a passion to create, I merge **mechanical engineering** and **design thinking** methods to develop products that are **effortless** to use.

INTERACTIVE MEMBERSHIP CARD

MECHANICAL DESIGN | GRAPHIC DESIGN

A 3D printable membership card for Makers UIUC members, with a rotating gear and easy customization for personalized names.

SOLO PROJECT

Makers UIUC is a hands-on design organization I founded in 2014 due an **unmeet need** I noticed: students didn’t have access to many hands-on design opportunites during the first few years of college. Freshmen engineers come in excited to start working on cool new projects, only to discover that most design courses don’t begin until the 3rd year, and many design groups only let upperclassmen do real project work. At Makers UIUC, students are encouraged to form teams and work on any project they’re interested in, regardless of experience or ability. One of my favorite projects is an automated **3D body scanner** that lets people create printable action figures of themselves.

SKILLS

CAD (Solidworks, Fusion 360)
Rapid Prototyping
Graphic Design
Gear Design

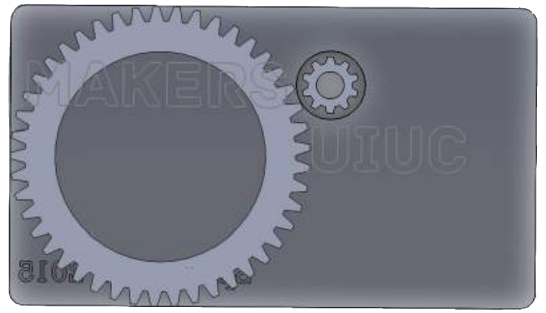
MY ROLE

Designed gear mechanism and housing
Designed connection mechanism
Tested prototype

WHY

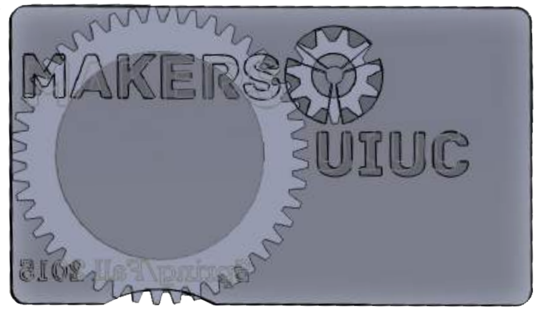
How can we design a membership token that relates to the purpose of our organization?

When Makers UIUC started collecting dues to be able to provide additional materials and resources, we wanted to give our members something physical in return. Other groups gave out t-shirts and hoodies, but that didn’t feel like it really represented our organization. We wanted to do something fun and unique to express our appreciation for their committment to Makers UIUC. I had the idea for an interactive card when I saw similar designs on Thingiverse.



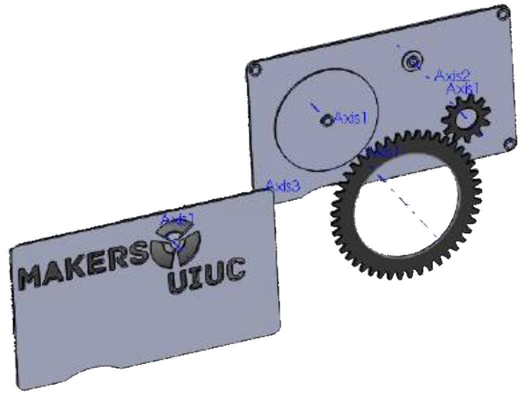
Initial design

I chose a rotating gear design as it paired well with our logo, which contains a gear itself. The larger gear was designed to reach the edge of the card so that the mechanism could be turned using a finger.



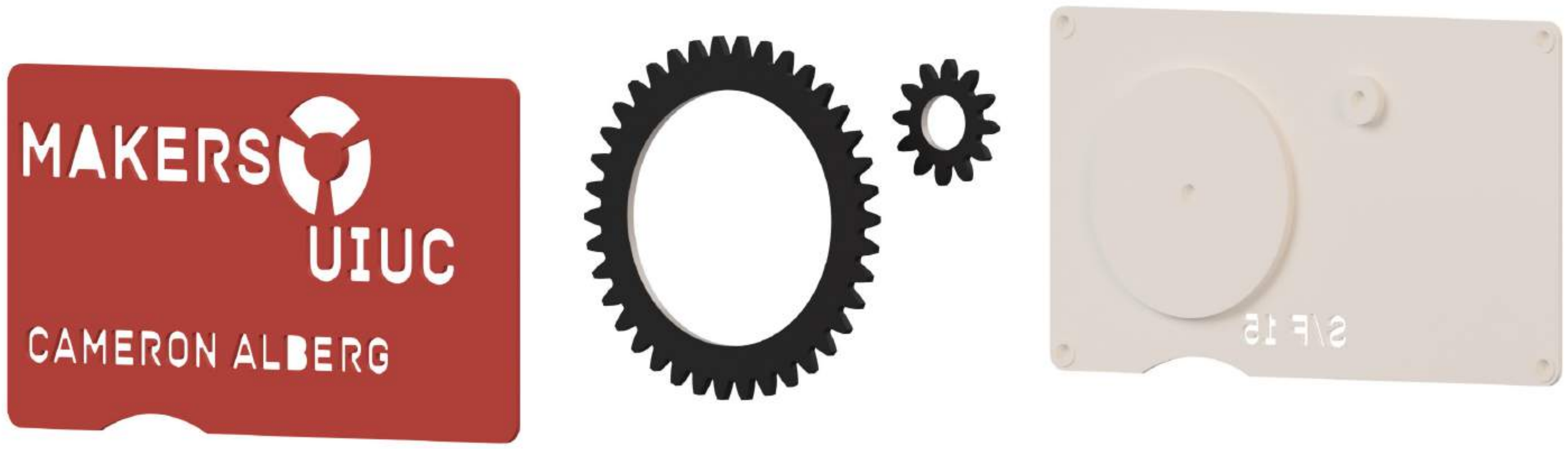
Revised design

Initially I had trouble getting the gears to turn smoothly, until I learned that gears can only mesh correctly if they have identical diametral pitches and pressure angles. With that information and an online gear generator, I was able to design a pair of meshing gears that fit perfectly into the design of the card.



Exploded view of revised layout

To get the front and back pieces to stay together and hold the gears in place, I experimented with 3D printing snap fits. I chose tolerances that created a very tight fit because once the card was assembled, it didn't need to be taken apart. By 3D printing the design, the front of the card can be easily customized to any name. The text was designed as a cutout instead of extrusion to showcase the inner workings of the mechanism.



Exploded view of final design (Solidworks)

MAKERS UIUC

The interactive membership card allowed us to give our members a personalized gift that embodies the motto of Makers UIUC: Make and Inspire. It is inexpensive, easy to customize, and the designs can be shared so that members can print out as many as they want.

3D printed prototypes (MakerBot Replicator 2)

ADJUSTABLE DOG BRACE

PRODUCT DESIGN | FREEFORM SURFACE MODELING

I developed a brace for dogs with torn ligaments that are unable to undergo surgery. The design is breathable, lightweight, and easily customizable. Its adjustability helps prevent muscle atrophy that occurs when rigid braces are used.

The brace was created as part of an interdisciplinary product design class.

CLASS PROJECT

Cameron Alberg, George Couston, Joey Lund

SKILLS

Freeform Surface Modeling (Fusion 360)
CAD (Fusion 360)
Rapid Prototyping
Finite-Element Analysis (Fusion 360)
Ergonomic Design

MY ROLE

Generated concepts
Developed design
Created CAD models
Tested and refined prototypes

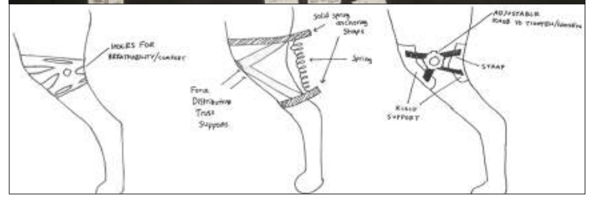
WHY

How can we design a brace that provides rigidity while remaining flexible enough to prevent muscle atrophy?

A tear of the Cranial Cruciate Ligament (CCL) can severly impair a dog's ability to move. While surgery is the preferred option, older dogs usually cannot undergo operations. In this case, a brace is recommended to immonilize the torn ligament. However, current braces are either too expensive or ineffective.

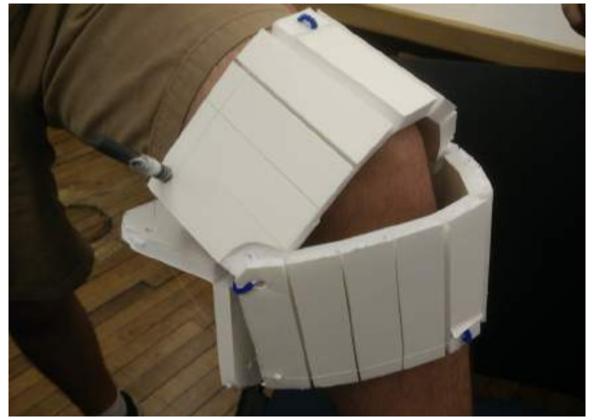
Initial brainstorming

Concept sketches



After brainstorming everything and anything we could think of (such as an inflatable brace that worked similarly to a blood pressure cuff), we refined our ideas to a few concepts that we sketched out in more detail. We met with a veterinarian to better understand the problem, and showed her our initial concepts. Together we concluded that an adjustable brace would be the most effective.

Rough prototype



The brace was sculpted in Fusion 360 using an existing 3D model of a medium-sized dog, then printed and tested on an actual dog throughout the process. We incorporated an existing ratchet mechanism to provide the adjustability feature, but moved to a dual ratchet system to improve usability. By tightening each ratchet (connected to a rope around the brace), a dog owner can fine-tune the fit of the brace and loosen it when their dog becomes uncomfortable or needs to exercise.

Testing fit

To reduce the weight and improve breathability of our design, we removed material in non-essential areas of the brace. These locations were determined by conducting stress tests on our initial design, and removing material where low stress concentrations appeared. Grooves were added to the back piece to prevent the rope from getting snagged, as well as decreasing the overall size of the brace.

Renders of final prototype (Fusion 360)

3D printed prototypes (Stratasys Dimension)

An adjustable brace with a ratchet system that restricts rotational movement of the knee, while remaining comfortable and controllable. The final prototype costs $30 to make, compared to $600 for other braces on the market.

Future improvements could include using elastic straps instead of rope to reduce the likelihood of fraying due to biting/scratching. Padding could also be added on the insides of the brace to increase comfort.

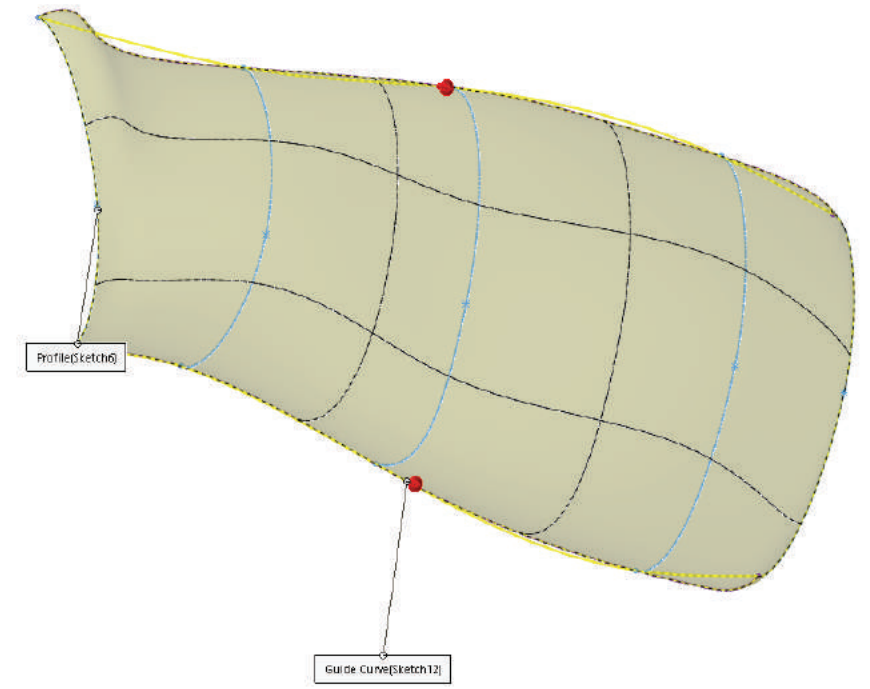
Final prototype

PAINT BUDDY

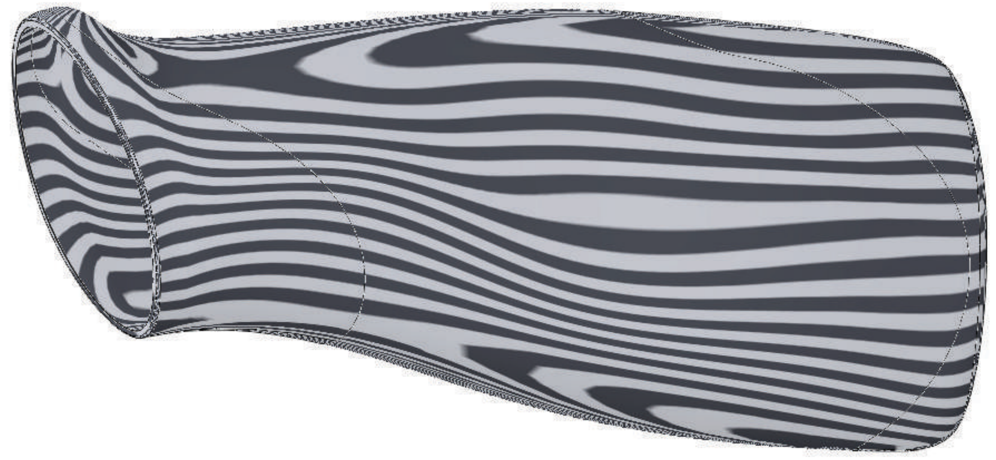
CLASS A SURFACES | REVERSE ENGINEERING

Reference images

Modeled an existing product (Rubbermaid Paint Buddy) from scratch using complex surfaces.



Profile and guide curves for container section



Zebra stripe analysis

DIRT DEVIL

CLASS A SURFACES | REVERSE ENGINEERING

Final render (exploded view)

Modeled an existing product (Dirt Devil Express v6) from scratch using complex surfaces, including interior details.

Reference images

Final render (front piece-internal)

DISASTER RELIEF SHELTER

MECHANICAL DESIGN | FINITE-ELEMENT ANALYSIS

A lightweight, compact and inexpensive shelter solution for disaster relief efforts in developing countries. The shelter can be assembled without tools, and includes a rainwater collection and filtration mechanism.

The shelter was created as part of my mechanical engineering senior design class.

SENIOR DESIGN PROJECT

Cameron Alberg, Nicole Allegretti,
Audrey Chou, Emily Weerakkody

SKILLS

Mechanical Design
Finite Element Analysis (Abaqus)
Fluid Systems Design
Material Testing

MY ROLE

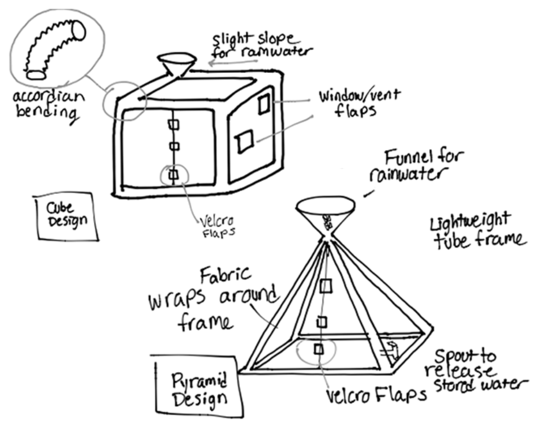
Generated concepts
Designed joint mechanism
Designed water filtration mechanism
Conducted finite-element stress analyses

WHY

Can we design a lighter and cheaper relief shelter, and also provide users with the resources to be more self-sufficient?

Natural disasters have displaced 26.4 million people each year since 2008. Many of these people require some form of temporary shelter that can be distributed and constructed efficiently and provide necessary protection from the elements. Current shelters are often heavy, expensive, and inefficiently sized, all factors that can result in fewer shelters being provided during recovery efforts.

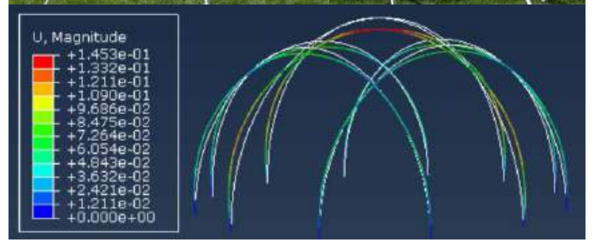
Many of these relief shelters also fail to provide any other additional resources, such as potable water. This results in added costs to recovery efforts, due to the expense of providing bottled water on a regular basis.



Concept sketches

After coming up with several concepts, we used design matrices to evaluate the optimal geometries for the shelter. Considering factors such as livability, strength and weight, a dome shape proved to be the most suitable for our design.

Experimental roof loading



Simulated roof loading

Our first prototype was constructed out of 1" diameter PVC. We didn't have access to equipment that would allow us to test the maximum roof/wind loading we needed to withstand, so we designed a CAD model to stress test using finite-element analysis simulations. We also conducted point loading experiments on our actual prototype, to validate the model we created.

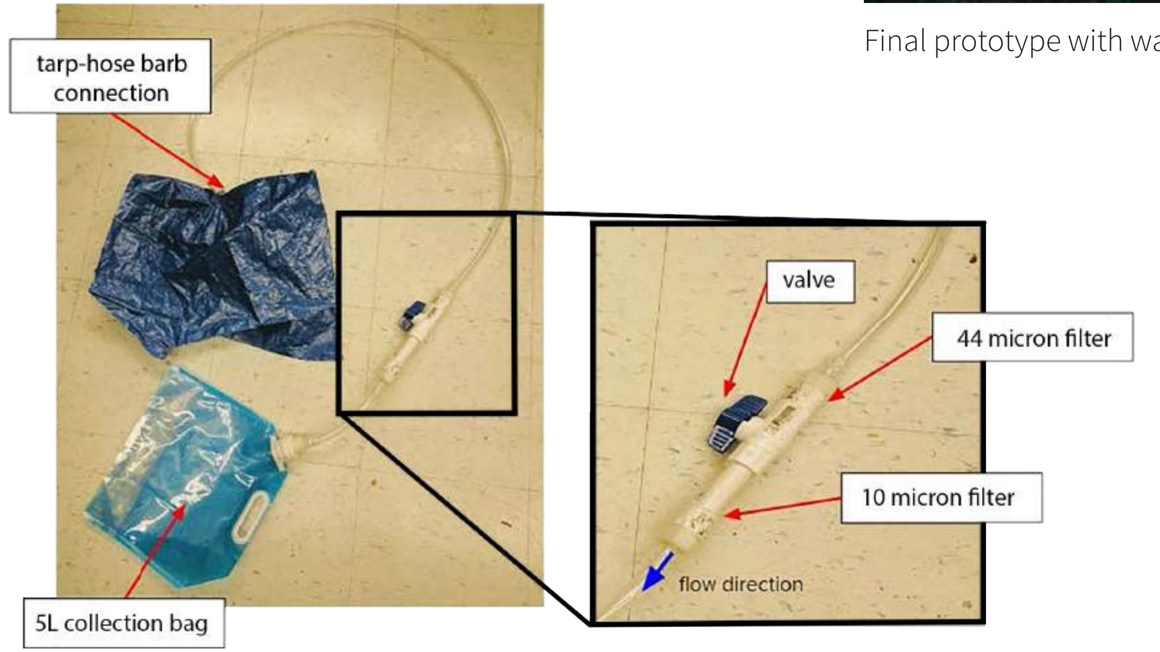
Original and revised joint designs

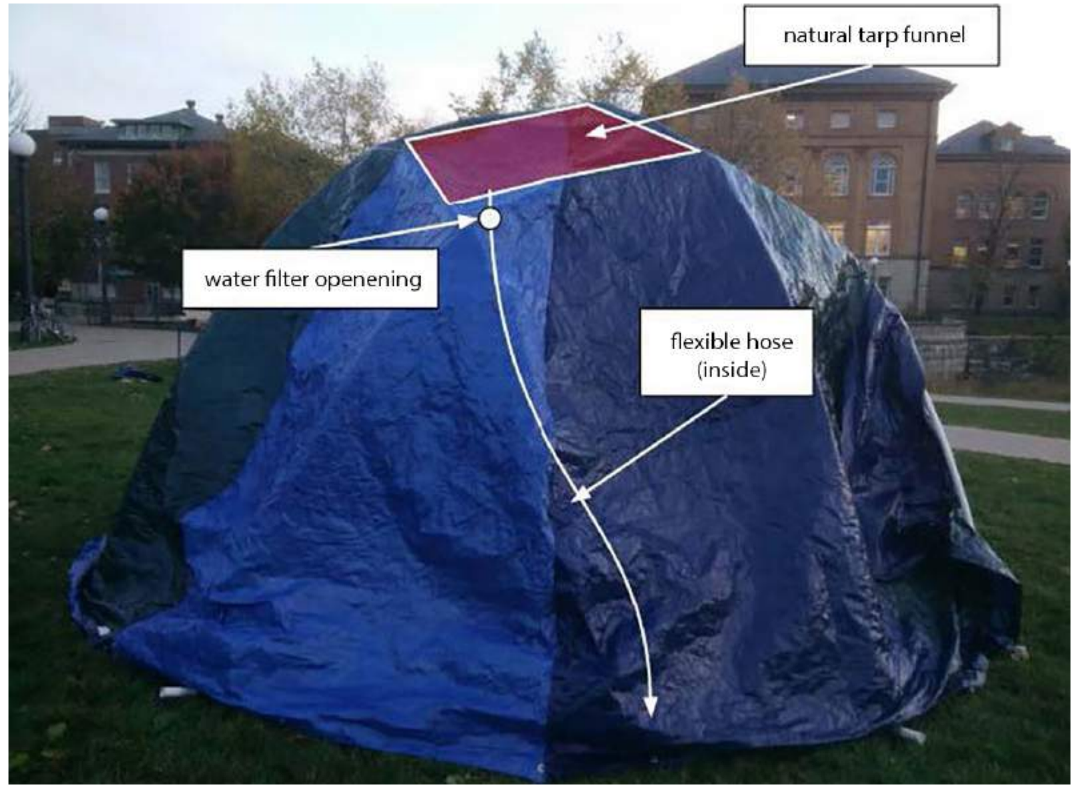
Pacakged size of final prototype

Initially, standard 4-way PVC joints were thought to be sufficient to connect the arches of the structure. However, many of the junctions did not naturally tend towards 90° angles. I developed an improved joint using larger PVC tubes secured by zip ties (inexpensive and lightweight). To make it easy for 2 people to carry, the entire shelter is able to be packaged into a cylinder 4 m long (0.3 m diameter).

We designed the water collection mechanism to hold 20L in 4 separate collection bags using a four funnel system. Each funnel uses the tarp covering of the shelter to collect water and filter it through a series of meshes to remove any debris/sediment. Each system has a valve so that collection bags can be removed and used when needed. This system is not designed to replace bottled water, but to reduce the amount that relief organizations need to provide. If this mechanism was used in 6,000 shelters (the amount of shelters we could provide based on past relief budgets and the cost of our shelter), **$7.4 million** could be saved in bottled water costs.

Water collection mechanism

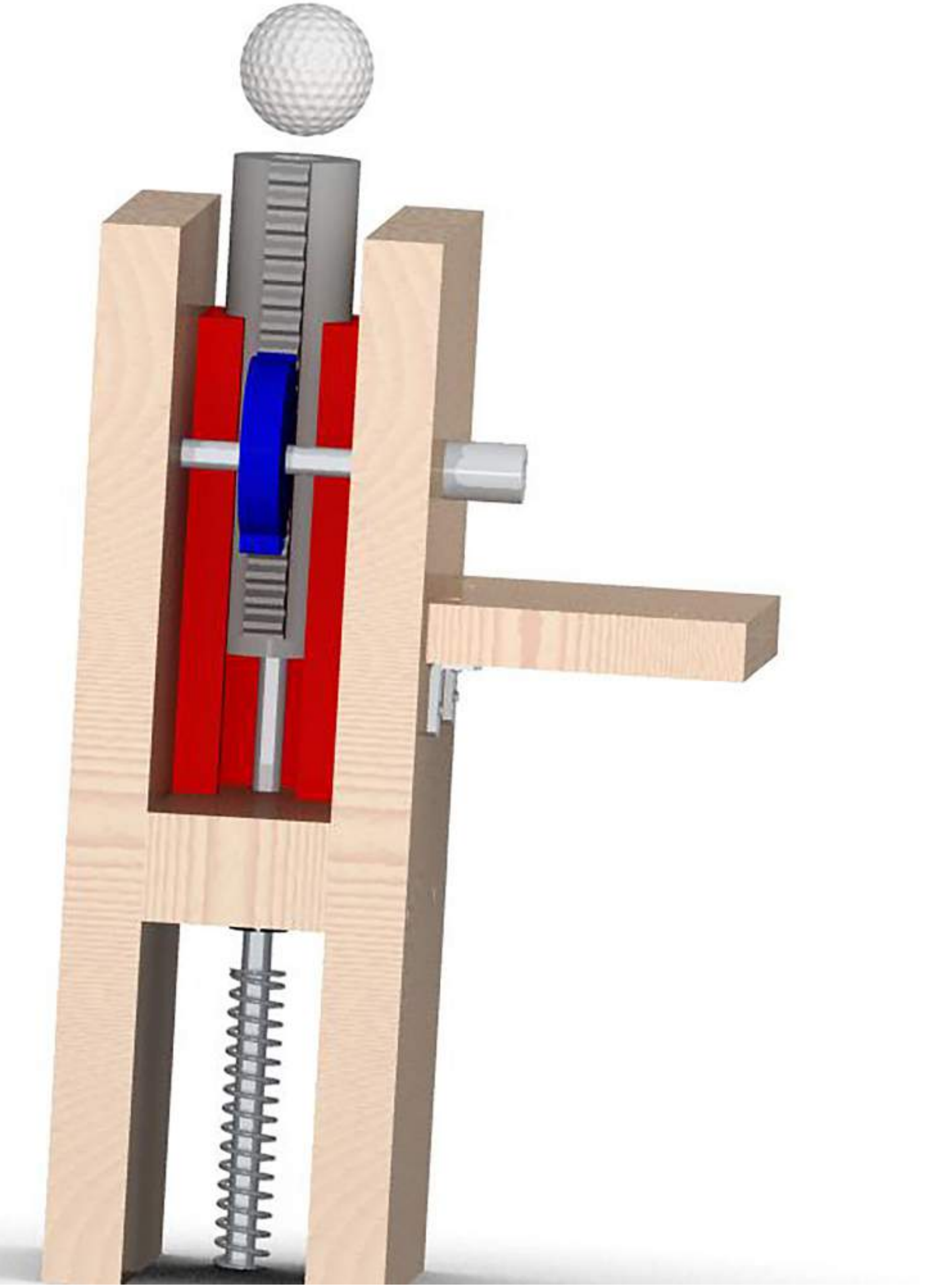




Final prototype with water collection schematic

The final prototype constructed is able to withstand the loading required by international relief organizations, and can adequately accommodate 5 people. It includes a practical water collection mechanism, and requires no tools to assemble. The projected cost of the shelter is $160, which is 60% cheaper than the current shelter used by relief organizations.

Future iterations would include flaps or windows for ventilation and lighting, as well as a more secure seal between the tarp and water filtration system to improve durability.



GOLF BALL RETURN

MECHANICAL DESIGN | DESIGN FOR MANUFACTURING

The Zinger is a voice activated ball return device that can be installed on any golf course, launching a ball vertically when a key phrase is spoken.

The Zinger was created as part of a design for manufacturability course.

SKILLS

Design for Manufacture and Assembly
Mechanical Design
CAD (Creo, Solidworks)
Rapid Prototyping
Design of Experiments

MY ROLE

Generated concepts
Created CAD models and renderings
Tested prototypes

CLASS PROJECT

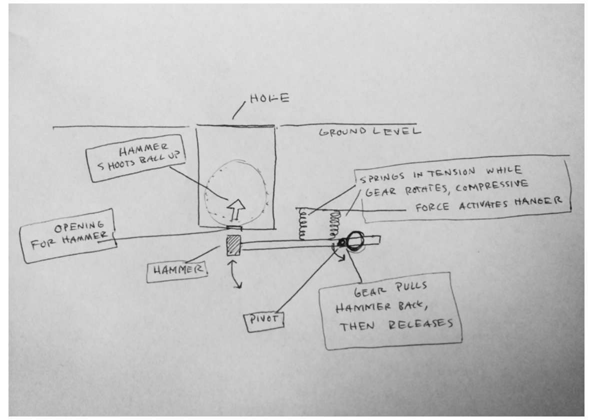
Cameron Alberg, Adam Flowers, Jason Pierce, Mitchell Martin, Jacob Wienhoff, Ivan Zlatanov

WHY

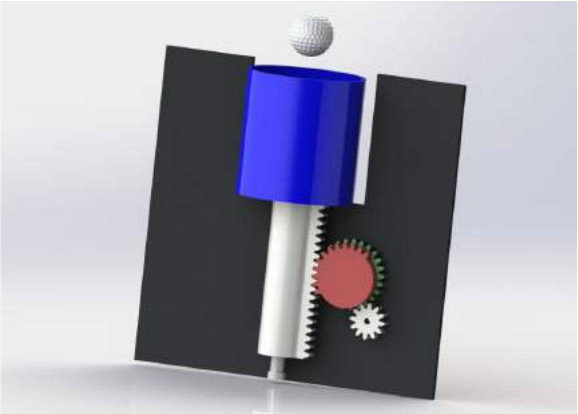
How can we remove the need to pick up a golf ball, and make golf more exciting?

My team and I set out to add a technological twist to golf by developing a golf ball return mechanism. Existing products send balls back to the user as soon as it enters and launch at an angle, resulting in the ball still ending up on the ground. We wanted to make a mechanism that added some flare to golf, and eliminated the mundane task of bending over to pick up a golf ball.

The Zinger's launching mechanism is comprised of a simple spring loaded piston, which is compressed by a rack and pinion system. All of these components are constrained by a wooden frame which provides optimal strength and rigidity. Once a golf ball has entered into the cup, it settles into the depression at the uppermost portion of the piston. The user speaks the command "golf ball", and the motor is activated, rotating a gear which moves the racked piston downward into the loaded position. The pinion only contains teeth on a quarter of its circumference, so once the motor spins far enough, the teeth of the racked pinion disengage and the compressed spring is allowed to release, launching the ball approximately three feet into the air for the golfer to catch.

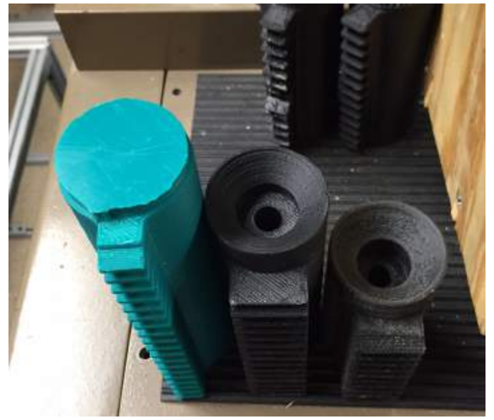

Initial design concept


Preliminary CAD model


Revised CAD model

In the early stages of the design process, the main problem was finding a spring stiffness that yielded the desired launch height. The goal was to achieve a consistent launch height of three feet, allowing the user to easily catch the ball around waist height and move onto the next hole. Design of experiments (DOE) was utilized to determine that the spring constant was the most significant variable affecting launch height. We tested springs ranging from 5 to 27 lbs/in, with a combination of a 9 and 6 lbs/in springs in series yielding the desired launch height.

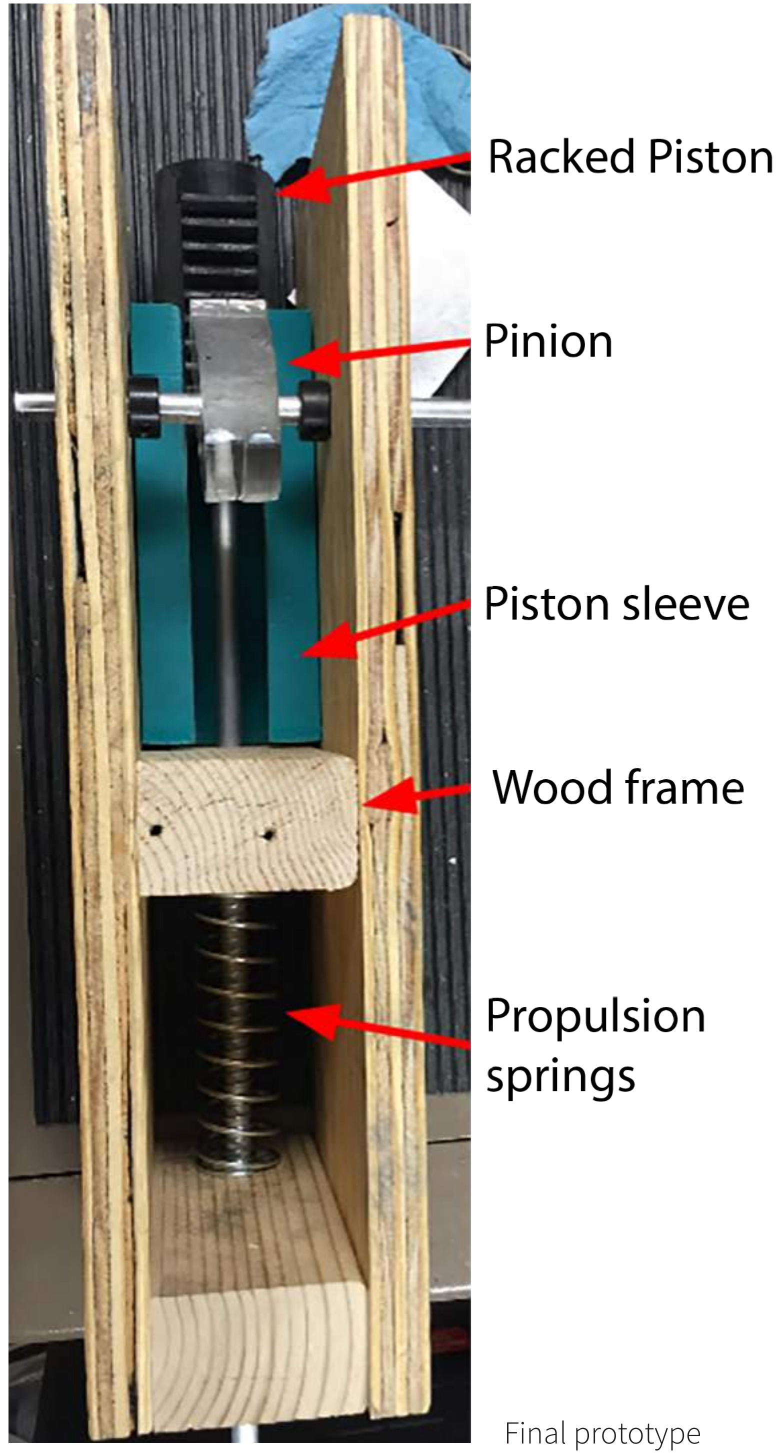
We determined that the cheapest and most effective methods for manufacturing the wooden and plastic parts would be blow molding, which produces a much lower price for the desired part tolerance than 3D printing or injection molding (using the given geometries). Based on design for assembly (DFA) analysis of the Zinger, the mechanism takes a total time of 149 seconds to assemble.


Prototypes of racked piston


Testing piston-sleeve fit

Our final protoype was successfully able to launch a golf ball three feet vertically in the air by using a voice command. The Zinger can be installed on any golf hole, and is battery powered.

Future models would feature a more compact design with a protective casing. Additionally, overall assembly time could be drastically reduced if wooden components were replaced with parts designed using a rapid prototyping method. This would remove many of the required screws, cutting the build time by 40%.



Final prototype

DETACHABLE SKATES

PRODUCT DESIGN | QUALITY FUNCTION DEPLOYMENT

This mechanism is placed between the boot and wheels of an inline skate, allowing the user to quickly remove their wheels and walk into buildings, classrooms, etc. It is compatible with skates using the UFS standard.

This product was created as part of a product design class focused on engineering design principles.

CLASS PROJECT

Cameron Alberg, Peiyan Gui,
Matt Werth, Nick Wright

SKILLS

CAD (Solidworks, Fusion 360)
Mechanical Design
Quality Function Deployment

MY ROLE

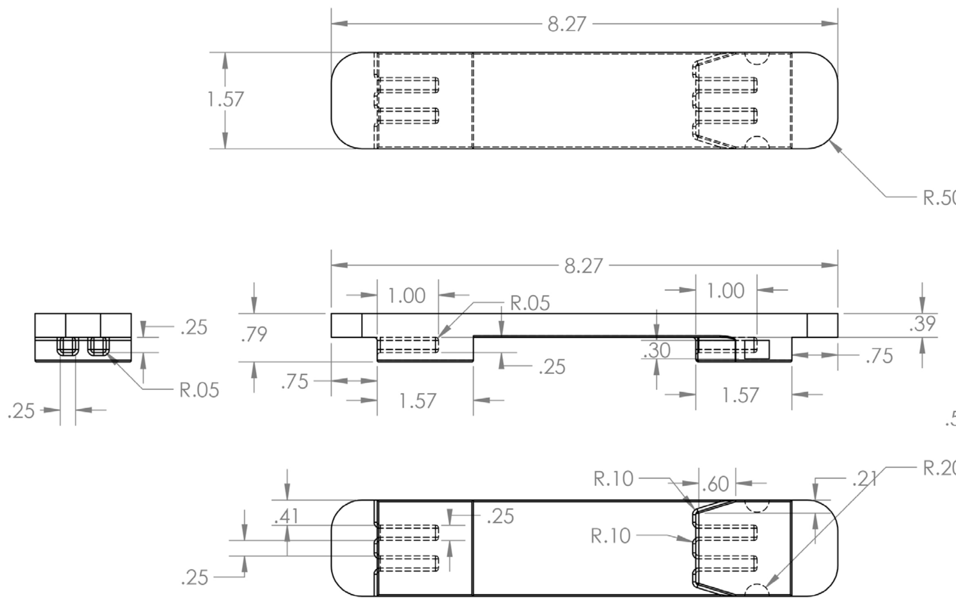
Developed concept
Designed detachment mechanism
Created CAD models, animations and renderings

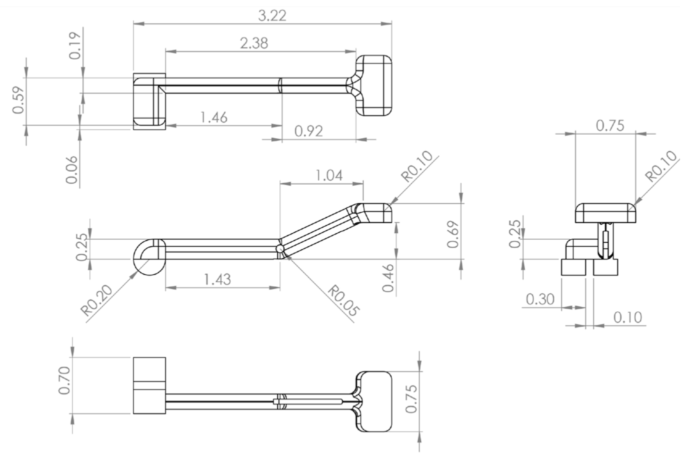
WHY

How can skating be a more practical mode of transportation?

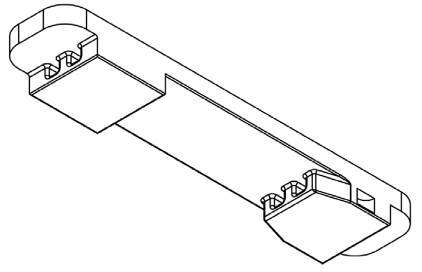
Students are always looking for quick and convenient ways of getting around campus. Many campus locations are not accessible by car, and bicyles need to have a secure spot to be locked. Skating is efficient except for the fact that an extra pair of shoes are needed to go indoors, and putting them on in the first place takes time. There are existing products that attach on to regular shoes (for those who don't own skates), but they are not as reliable or effective as actual roller skates. Skates that are easily detachable could become a more feasible way of transportation not just for students, but for any active user.

We deliberately decided not to redesign a skate with an embedded mechanism, due to the fact that many popular and effective skates already exist. Our target user was a regular or semi-regular skater who would have their own pair of skates, so we focused on designing a mechanism that would be compatible with existing products. We used the quality function deployment (QFD) method to identify the relationships between user desires for certain features and the engineering features that we had control over. Based on this analysis we determined the most important features to focus on, such as reducing overall weight, and designing the release force of the locking mechanism to be easy to use, but secure.



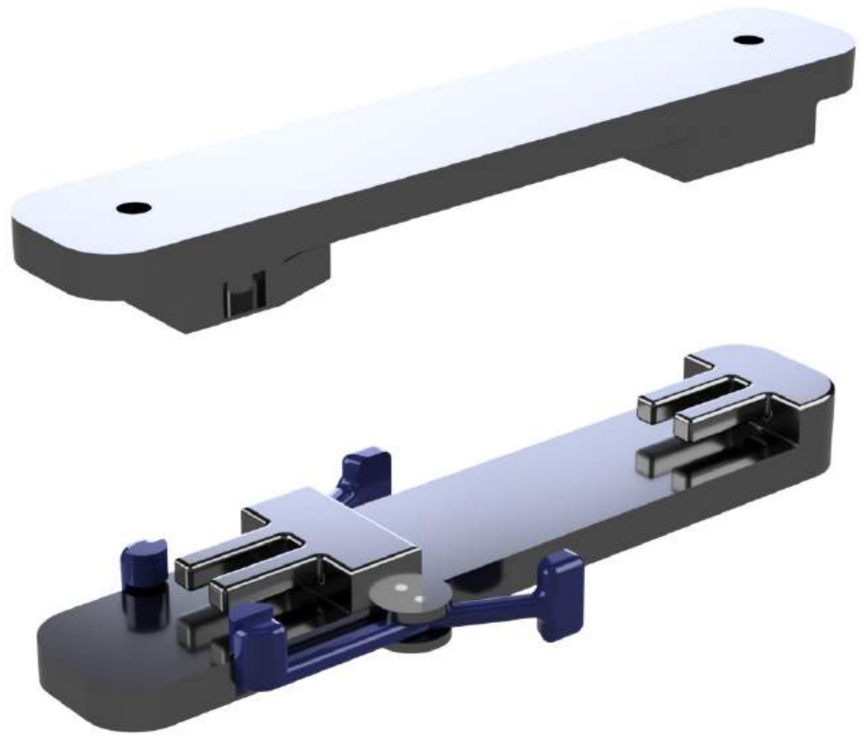


Engineering drawing of push button



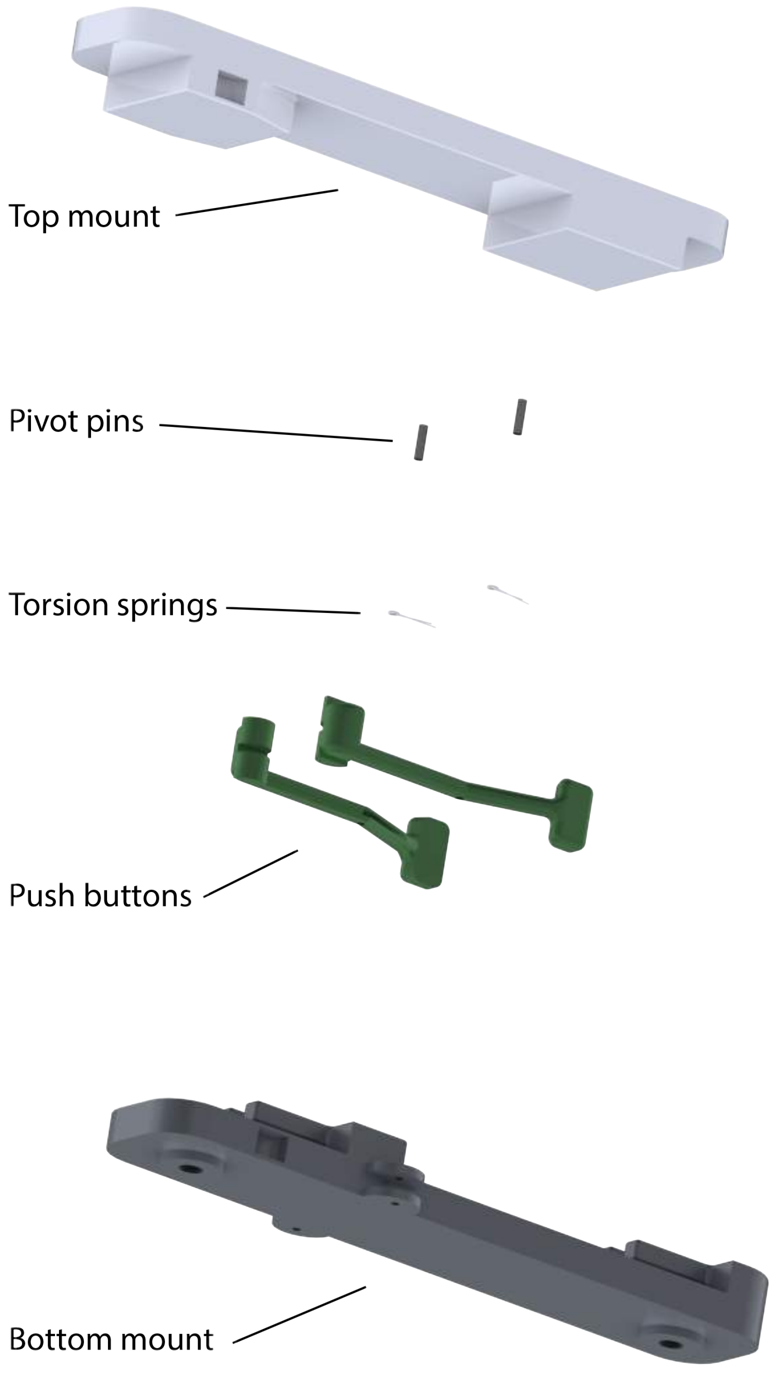
Engineering drawing of top mount

The main components of the design are two mounts which attach to a skate boot and wheel frame using two pairs of screws, with hole placements defined by universal frame system (UFS) standards. The pieces have sets of male/female rail system to provide a secure fit when slid together. Two push button on either side of the design keep the top and bottom pieces together with high strength torsional springs. The pieces can only release with a significant force on both buttons simultaneously, ensuring that the skates don't detach accidentally.



Final design

The detachable skate mechanism is compatible with any UFS (universal frame system) skate so that users can use their own skates. Users can skate from one destination to another, easily disembarking to walk or step inside without having to worry about bringing shoes. The mounts and push buttons would be made out of 6061 aluminum and a rubber insole would be attached to the underside of the top mount to make walking more comfortable.



Exploded view of final design

cameronalberg@gmail.com
cameronalberg.com
773 · 742 · 4700