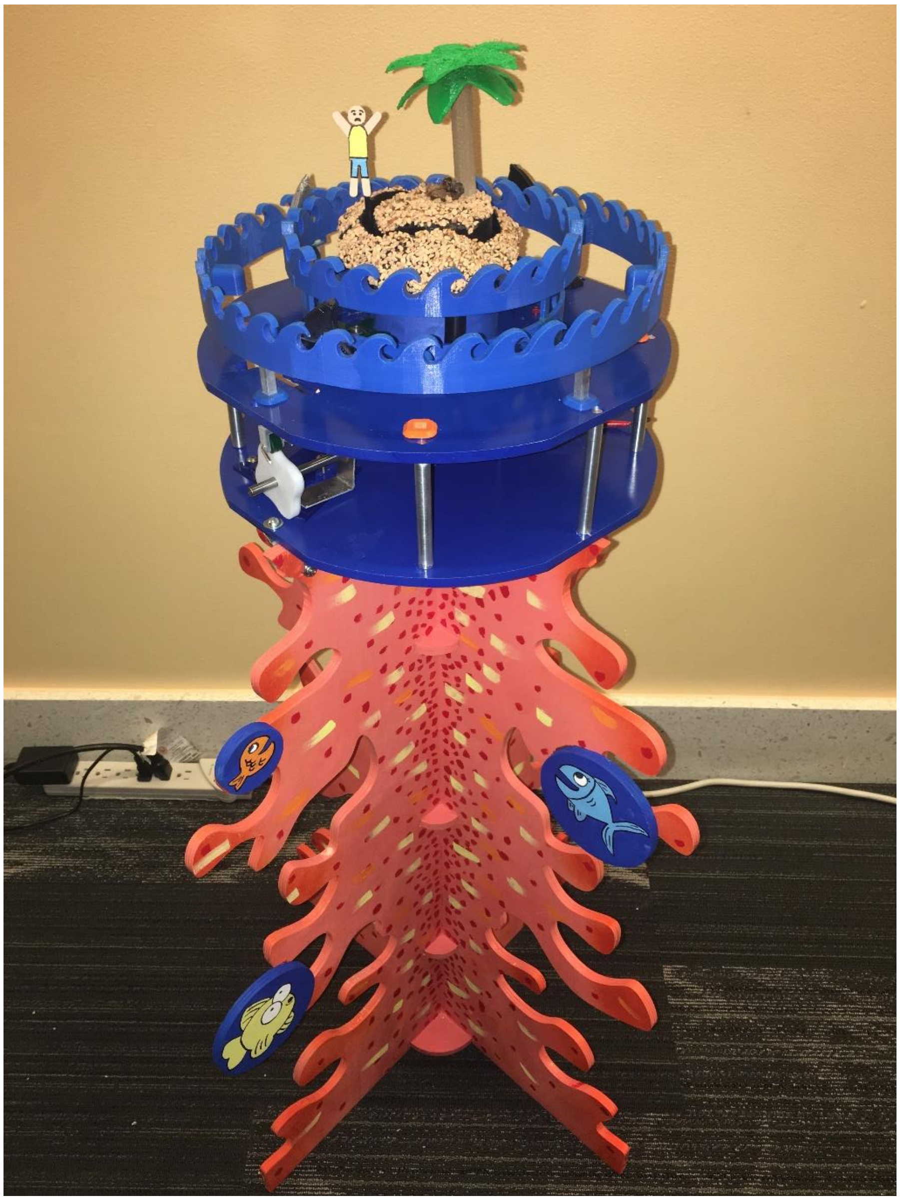
EGR 2330: Mechproto

Dessert Island



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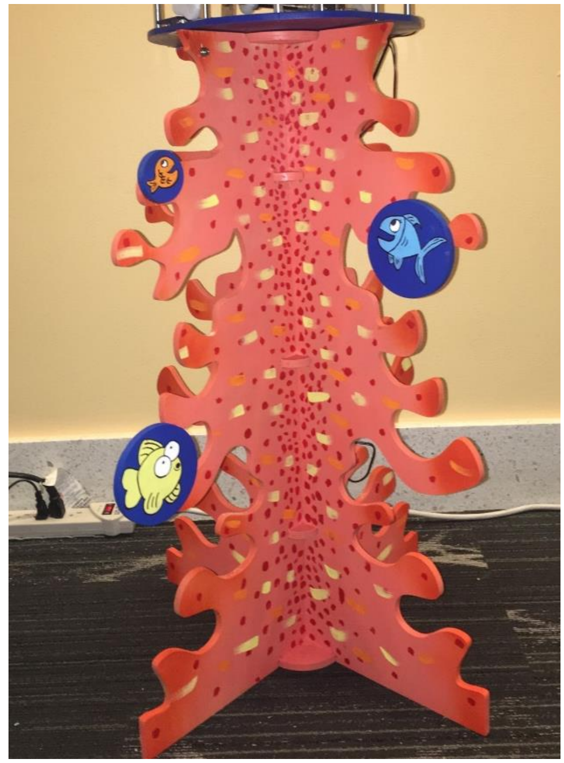
May 1st, 2017

Executive Summary

Close your eyes and imagine that you are stuck on a faraway island in the middle of the sea, surrounded by sharks and dolphins. All there is to comfort the fear for your life is bobbing and rotating waves and giant edible rocks. Well, close your eyes no more for we have been able to bring this dark and scary illusion to life! This punny sculpture uses cams, dolphin four-bars, sprocket gears, bevel gears and more to take you from wherever you are and transport you to solitude at sea. The larger-than-life and totally-out-of-proportion coral base helps sooth the audience by reminding them that this is not reality and they are not in fact stranded. And finally, the rock candy garnish helps soothe the sweet tooth.

The sculpture worked by a jack shaft driven directly by the gearbox. Attached to the jack shaft were the two cams that created the bobbing motion of the outermost wave. The jack shaft also drives one of the bevel gears in order to shift the direction of motion. The bevel gears then enable the sprocket gears to rotate, thus rotating the inner wave and the little man on the island.

The Base



The base was inspired by coral and stands to be about three feet in height. It is made up by four identical shopbotted pieces of plywood. The outer contour is where the coral inspirtation comes into play. This whole structure is joined at the center through a series of concentric circles that work as **lap joints**. The three in the center are smaller and then the one at the top and the bottom are larger for steadiness. All of the circles are reinforced with **adhesive**. The three fish one the coral are attached through **butt joints** and **adhesive**.

Clockcage

The clockcage is made up of two ¼ inch aluminum plates that have been water-jetted with the approproiet dimensions and cuts. The two plates are held apart by aluminum posts that have been turned and dimensioned to act as mortise and tenon joints. No extra adhesive was necessary. The base and the clockcage are held together by metal sheet cut L-brackets and **nuts and screws.** These two attached create a **T-structure.** The **L-sturcture** is seen holding the shaft in place at both ends of the base. The cam followers on either side are **U-structures** holding the wheel. The **C-structure** is found in the intended four-bar that is also held together through nuts and bolts. The gearbox seen in the center of the clockcage acts as the I-structure. And lastly, the whole clockcage together acts as the **box-structure**.

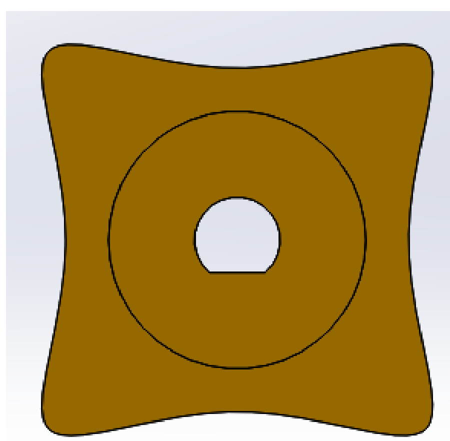
Aesthetics

A major part of the whole scupture was the aethetics—that is what got us the aphrodite prize! The clockcage and the 3D prited waves are all blue to mirror the ocean. These 3D printed waves had to be printed in separate parts and then attached through rabbet joints. The sprocket gears rotating the inner waves are attached through **retaining rings**. At the center is the 3D printed desserted island that has been covered with bits of rocks and sand to look like an actual island. The palm tree was also 3D printed. The little man at the center of the island was laser cut and painted with an acrylic finish. He is attached to the wheel by a **housing joint**.

<u>Cam Design</u>

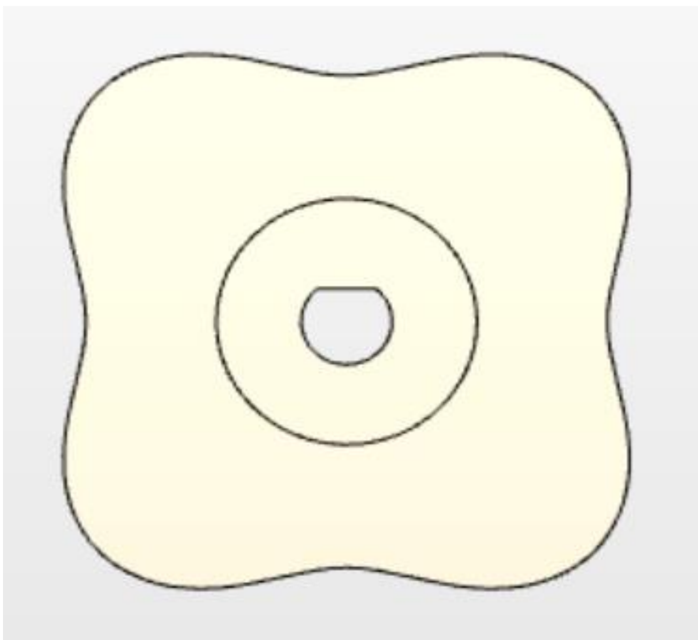
We had to go through two iterations for our cam design. The cam is intened to create a bobbing and rocking motion for the outer most waves. This is achieved through two identical cams on oppsite sides of the scuplture. Both cams were 3D printed. The cams are attached to a single jack shaft through a tight press fit. The jack shaft is driven directly by the gearbox. The casings for the two cam follow cam followers where machiened out of aluminum. The wheel was laser cut and attched by a **bridle joint.** We also 3D printed bushings so that the cam followers that are attached to the outer most waves would move freely with minimal friction. When it came to testing it we ran into some problems.

<u>First Ineration</u>



This first design ran into a significant problem in testing. When hooked up to the moter with the cam follower and waves in place, we observed that the cam follower kept getting stuck. After further observation and testing, we concluded that the reason for this was because the edges of the cam where too sharp and the cam follower did not have the power to overcome it. The convex points of the cam were too high and the concave were too low. Therefore, it was not able to freely rotate.

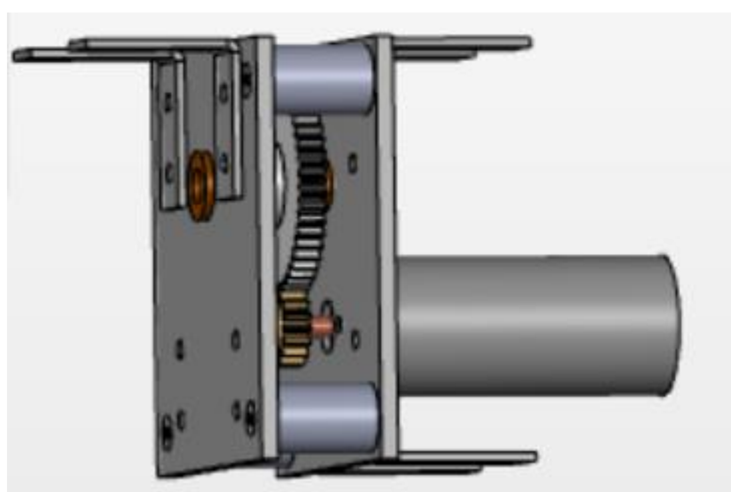
<u>Second Iteration</u>



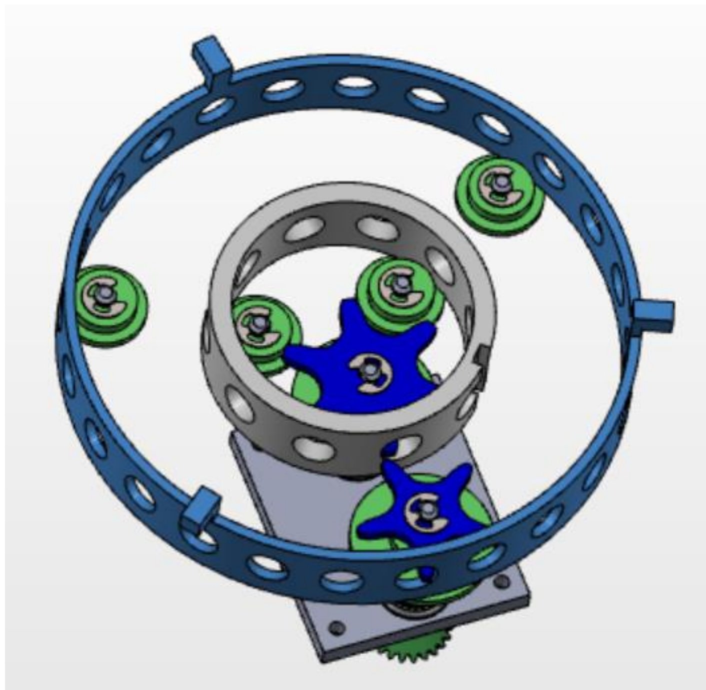
This is an image of the second design of the cam. As you can notice, the concave and convex points of the orignal cam have been significantly reduced in order to create a much smoother cam. When we tested it we were successful and the cam follower was able to freely run through the cam.

Gear Design

In our entire sculpture, we have a total of 6 different type of gears—two sproket gears, two bevel gears, and two spur gears. The main transmission components of the sculpture comes from the spur gears in the gear box. Because our motor had a RPM of 34, we wanted to reduce the speed so that the sculpture would not be moving too fast. After meeting and discussing, we agreed to slow the motor down by 3 times of the original speed. Thus, the motor gearbox would reduce the speed of the motor to about 11-12 RPM. With the motor came a 16 tooth spur gear that did not need extra attachments.



Searching through Mcmaster, we found and bought a 48 tooth spur gear that would attach to the main jack shaft. This spur gear was press fit extrememly well onto the shaft and was further secured through bushings and washers. Combined, the 16 tooth spur gear and 48 tooth spur gear successfully reduced the speed to a 3:1 ratio.



The bevel gears come into play in order to change the direction of motion from horizontal to vertical. One of the bevel gears was fixed onto the main jack shaft, while the second was attached to the outer most sprocket gear, as seen in the image above. Both bevel gears are identical and were bought on Mcmaster. The two sprocket gears were designed and manufactured by us through laser cut. The outermost sprocket gear has a larger pitch diameter than the inner one so that the waves run slower than the running man.

Four-Bar Linkage

The four-bar linkage design and assembly definitely proved to be the most challenging task. Unfortunately, the person responsible for this task did not communicate nor consult with the team about their design. They did not add their design to the master CAD and therefore, ran into many design problems when it came to assembly. Therefore, we had to go through three different iterations of the dolphin four bar.

First Iteration

In the first design, the base plate of the dolphin four bar would have been attached to the base plate of the clock cage. Cutouts were made so that the dolphin can go through the second floor of the clock cage and be seen jumping “out and into the water” between the outer and inner waves. The whole sub-assembly was supposed to be driven by a timing belt directly attached to the main jack shaft. When assembled, we noticed quite a few problems that could

have been avoided if the CAD was added to the master CAD. First, the timing belt bought was too large. Second, the cut that had been made into the clockcage was not large enough for the dolphin to fit through. Therefore, the person assigned to the task had to redesign the four bar to fit the cut that had already been made.

Second Iteration

There is no CAD available for the second iteration because the person responsible decided to adjust the already existing four bar by cutting down the leg posts and ordering a new smaller timing belt. Unfortunately, the redesign ran into interference with the posts and the second floor of the clock cage—even when we milled out a cut she ordered. This could have all been avoided if this person would have referenced the master CAD and added a redesign of the second iteration. Yet, the whole team is at fault here because we should have discussed the redesign with them.

Third Iteration

This last design was created by another team member last minute

so that we could have a working four bar to present on demo-day.

It was adjusted so the shorter led would be attached to the bobbing waves and act as the fourth bar in the assembly.