NAU NORTHERN ARIZONA UNIVERSITY

College of Engineering, Informatics, and Applied Sciences

To: Dr. Sarah Oman

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Re: Final Prototypes Summary

Introduction:
Contained within this memo is a summary and images of the team 18F02 Kinetic A's final prototype for the Fall semester of capstone. This prototype is a kinetic sculpture that will display at least three engineering principles and is detailed below.

Summary and Pictures:
The kinetic sculpture prototype is 3D printed. The printing process to 340-360 hours of printing, which includes failures and reprints. Larger pieces were printed in pieces, then assembled using super glue. The team's full scale prototype is seen below in Figure 1.

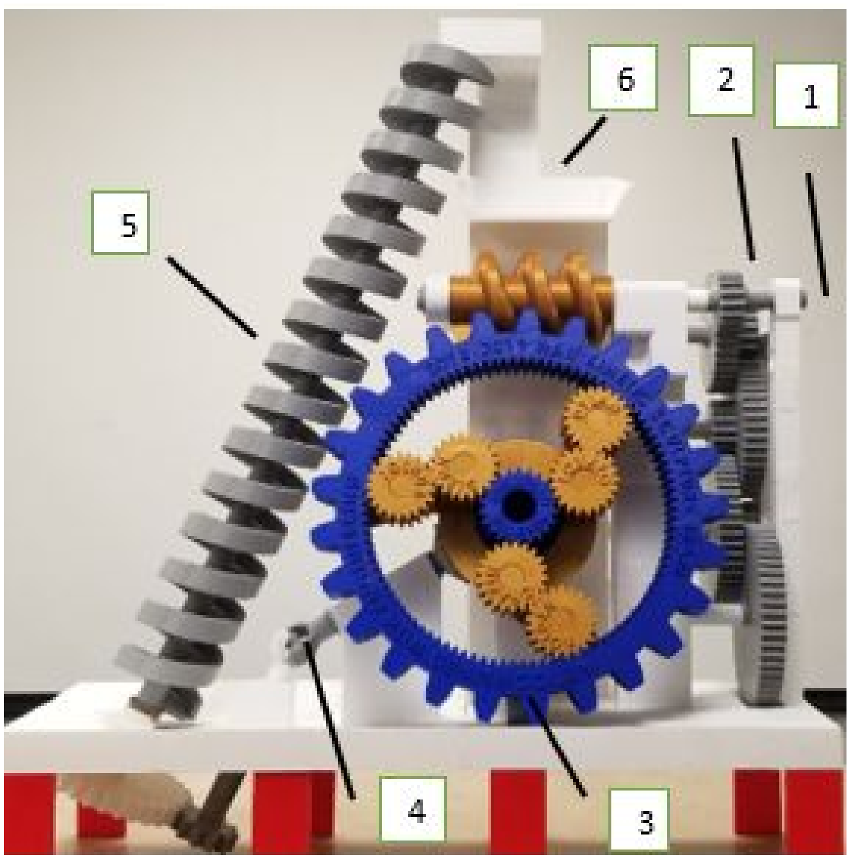

Figure 1: Full Scale 3D printed prototype

The team built a full scale model prototype in order to use these pieces as molds for the casting of the final product. As seen in Figure 1 above, the system begins with a user input. At label 1, a one-way hand crank will be placed. This hand crank is seen in Figure 2 below.

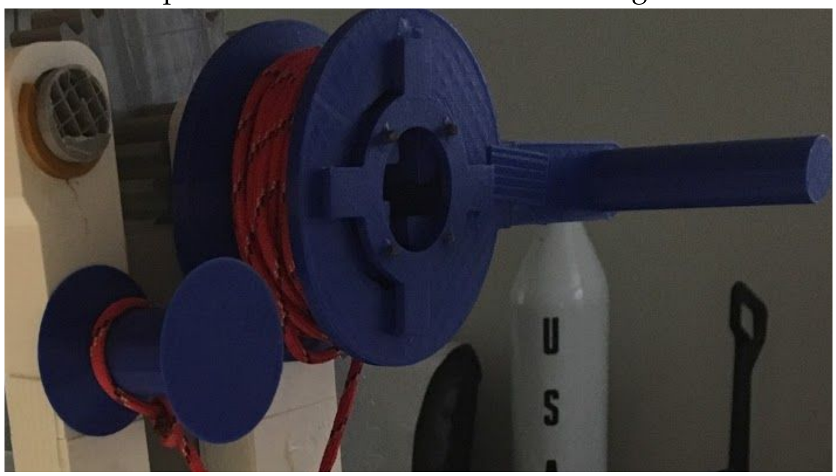

Figure 2: One-Way Hand Crank

The hand crank will wind the rods connecting to the gear train, labeled 2. The hand crank will start to unwind, using a pulley system with a weight. The gravitational force acting upon the weight will slowly unwind the hand crank. This converts the potential energy into kinetic energy. The gear train, labeled 2, is designed to give the blue ring gear, labeled 3, a desired revolution speed of 3 revolutions per minute. The worm gear spins 25 times for a single rotation of the blue ring gear. The gear reduction ratio from the input to the blue ring gear is 67.5 to 1. This gives the sculpture a maximum duration time given minimal user input. The rotation of the ring gear activates the Archimedes screw, labeled 5, via a connecting rod, labeled 4. This is done by placing teeth on the planet gear holder, which holds the planetary gears inside the ring gear. This section is seen below in Figure 3.

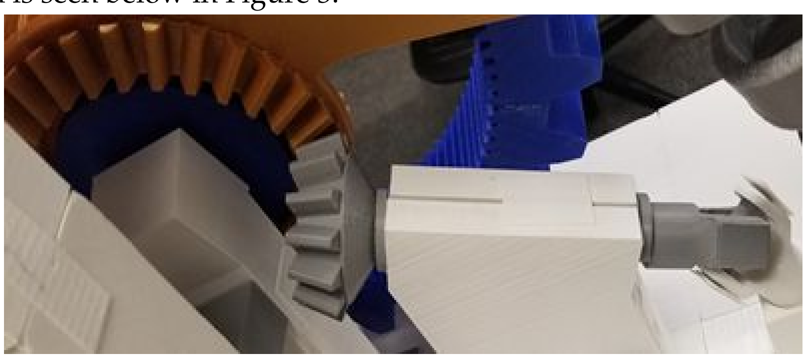

Figure 3: Bevel Gear on Back of Planet Gear Holder

The bevel gear, the grey piece above, activates the Archimedes screw via the connecting rod. The planetary gear holder, the gold piece above, and the bevel gear of the connecting rod have a gear ratio of 3:1. This means the bevel gear will spins 3 times for every single revolution of the planetary gear holder. The connecting rod has another gear on the bottom that connects to the Archimedes screw. This is seen in Figure 4 below.

Figure 4: Connecting Rod to Archimedes Screw

The connecting rod is activated through the rotation of the ring gear. Similarly, the Archimedes screw is activated through the rotation of the connecting rod. The rotation of the bevel gear rotates the connecting rod at the U-joint, seen above in Figure 4. The U-joint then spins the gray rod with a spur gear at the end. The gray spur gear then spins the larger white gear, connected to the Archimedes screw. The ratio between these two are 1:3, meaning the Archimedes spur gear will spin one time for every three rotations of the connecting rod spur gear. Since the bevel gear to planetary gear holder gear ratio is 3:1, this means the blue ring gear and the Archimedes screw have a ratio of 1:1. This gives the sculpture a uniform, aesthetic look. The Archimedes screw is used to elevate liquid to cascade over the main ring gear system. This system is seen in Figure 5 below.

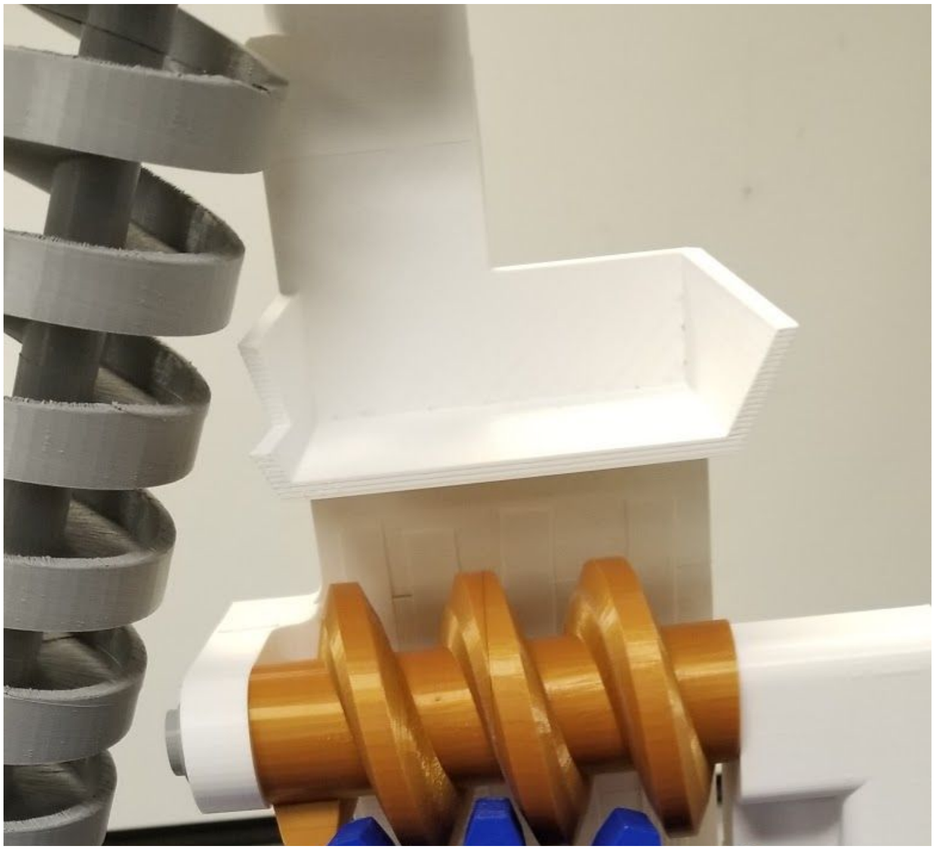

Figure 5: Shelf above Ring Gear System to Cascade Fluid

The Archimedes screw will drop the fluid onto the white shelf, seen in Figure 5 above. The shelf is implemented so the fluid can uniformly cascade down the worm gear and the ring gear system. The fluid then flows to the bottom of the sculpture, which is inclined at an angle that allows the fluid to flow towards the bottom of the Archimedes screw, which then picks up the fluid.

Conclusion:

Building a full scale prototype allowed the team to observe the sculptures functionality. At this time, the team plans to build the final product almost exactly like the prototype, as the prototype worked well. The friction of the material caused the prototype to have a shorter duration time than desired. However, with the addition of bearings and the cascading fluid acting as lubrication, the friction will be minimized. The weight that slowly unwinds the hand crank will be determined through tests once the product is assembled. Different weights causes different duration times and rotational velocities. Lastly, the prototype components will be used as molds during the teams casting process.