Project ID: 731

JR - Engineering: Electrical, Mechanical, and Robotics

Virginia Zhu

Counterweight Trebuchet Design Optimization

Trebuchet is an ancient mechanical device that transfers the counterweight's potential energy to the projectile's kinetic energy. What is the best finger angle to maximize the launch range for a counterweight trebuchet? What design improvement can help to reduce the dissipative forces introduced by the arm rotation? Will a bearing added to the Level Support Rod be able to reduce the dissipative forces and thus to improve the launch range? My overall goal was to launch the projectile further. My first test result confirmed the best finger angle selection. My second test using the optimized trebuchet with an added bearing demonstrated a significant improvement on the launch range. Procedure: 1) Build a prototype trebuchet. 2) Prototype trebuchet tested with 1000 gm counterweight and 1500 gm counterweight; Two different weight projectiles also tested; Launch ranges are compared for different angles. 3) A bearing added the Lever Support Rod to reduce the arm rotation introduced friction: Both Prototype trebuchet and Optimized trebuchet tested with 1000 gm counterweight and 1500 gm counterweight; Two different weight projectiles also tested; Launch ranges are compared: Prototype trebuchet VS Optimized trebuchet. Result 1: The Finger Angle selection test confirmed the maximum range was reached when the finger angle is between 40° to 45°. Result 2: The added bearing to the Lever Support Rod significantly reduced the arm rotation introduced dissipative forces and therefore increased the launch range for all eight selected tests. After the bearing was added, more potential energy from the counterweight got transferred to the kinetic energy of the projectile.

Project ID: 732

JR - Engineering: Electrical, Mechanical, and Robotics

McCoy Powers

Designing and Building a Vending Machine for Chickens

My project was to create a vending machine that my chickens can learn to use. I was trying to solve some of the problems with traditional gravity-operated feeders. Traditional feeders are contaminated by rodents, get clogged very easily, and need daily checking.

My first design had a bucket on top attached to a funnel underneath, an aluminum trigger lever and attachment rod, and a wooden peck plate screwed onto the trigger lever. It was designed so that feed could be poured into the bucket, would flow down the funnel, and would be dispensed in the hole in the bottom of the funnel when a chicken pecked the peck plate.

My first design got clogged easily during testing. Next, I cut a side notch in the bottom of the funnel to increase the size of the opening, but that failed to improve the design because it still got clogged easily.

Next, I cut the funnel so the opening was bigger, the funnel had only one taper, and it was shorter. I then filled the machine with feed, and it continuously flowed out. I then mounted it on the side of my chicken coop. I showed my chickens how to use it by placing mealworms on the peck plate to encourage pecking. They learned fast, and the time it took for them to empty it decreased over three trials. Further testing will reveal if the machine is rodent-resistant. It should be filled and installed in the coop for further observation.

Project ID: 733

JR - Engineering: Electrical, Mechanical, and Robotics

Reed Austin

The Pulley Wheel

I wanted to see what would happen to the speed and number of rotations a Ferris Wheel would spin if it had different size pulleys. I constructed a Ferris Wheel with a design that will allow pulleys ranging in sizes from; 2mm, 4mm, 6mm to be interchangeable. I chose this project because I like to build things and wanted to see if I could engineer a Toy that could have different speeds and rotations based on the user changing the pulley sizes. The Ferris Wheel was constructed out of craft sticks and small wood pieces that had to be precisely measured and glued together. I tested the Ferris Wheel by counting the number of rotations of each size for one minute. This test was performed ten times on each size pulley to find the averages. The average rotation for each size varied slightly; 2mm pulley = 53.1 x's, 4mm pulley = 54.3 x's, 6 mm pulley = 54.5 x's. Although the primary focus of the project was to test the number and speed of the rotations from the different pulleys size, the construction proved to be equally as important. The exact building of the Ferris Wheel measurements were key because both wheels needed to be constructed the same and parallel to each other to rotate around the axel evenly. The testing proved the larger 6mm pulley had slightly more average rotations of 1.4 compared to the smaller pulley of 2mm. In conclusion if you are going for speed, I would choose the 6mm pulley if you are going for better control, I would use the 2mm pulley.

Project ID: 734

JR - Engineering: Electrical, Mechanical, and Robotics

Will Denning

Which is a Safer Option, a Phone or a Computer?

This project examined whether a computer or phone is a safer option regarding radiation exposure. It is hypothesized that the computer will emit more radiation. Each device was tested 10 times at a distance of 16.5 inches away from the screen of each device to the Electromagnetic Radiation Detector (EMF) meter. This meter measures electromagnetic fields in a measurement called milligrays(mG) which is a unit of absorbed radiation. The data showed that the computer ended up with an average radiation of 1.2 mG of radiation and the phone having 1.68 mG of radiation. The hypothesis was not supported from the data shown. The computer is the safer option, having lower radiation emission when doing everyday tasks like typing or searching online. The phone and computer are still ok to use because at present time, there is no data showing that nonionizing radiation has negative health effects.

Project ID: 735

JR - Engineering: Electrical, Mechanical, and Robotics

Ryan Richardson

Conserving Water Using an Automatic Faucet

This project examined the amount of water that could be saved by using an automatic faucet. First, I designed the faucet and all the electronics, including the custom 3D printed designs. Then I obtained all the parts and assembled them. Once it was time for testing, I tested brushing my teeth and washing my hands with and without the automatic faucet code. I was able to save about 71% when washing my hands, and about 89% when brushing my teeth. From this I determined that almost fifty gallons could be saved by a family of four using this device to wash their hands and brush their teeth. Results indicated that my hypothesis was supported - over 50% of water can be saved using this device. While I cannot test every scenario; these figures could be increased even further by also using it for shaving or washing random items. I think I can fairly conclude that this is an extremely useful, effective, and simple device to help fight our state's drought. However, as I stated in the conclusion, this just supports the importance of turning off the faucet when not in use. All this device does is try to determine when the water needs to be running and when it isn't. This can easily be done manually; however, it requires the user to just put in that little bit of effort.

Project ID: 736

JR - Engineering: Electrical, Mechanical, and Robotics

Abby Cena

The Effect of the Base Shape of a Pyramid on Its Weight Bearing Capacity

Even though pyramids have been around for thousands of years, we only really see pyramids with square and triangular bases. Triangles are the strongest shape- would more triangular faces on a pyramid (by adding more sides to the base shape) increase its strength? If more sides on the base shape make for a stronger pyramid, engineers will be able to design structures and supports that can carry more weight. In order to find out if more triangular faces make a stronger pyramid, I designed a bunch of pyramids of different base shape (which all started as circles of the same diameter). Then, one by one, I added weights to each pyramid, recording how much each pyramid could take before collapsing. After testing 3 triangular, square, pentagonal, hexagonal, and octagonal pyramids each, I came to the conclusion that generally, more sides on the base shape means the pyramid can carry more weight. In my experiment, the pentagonal pyramid was the strongest, but the pentagonal, hexagonal, and octagonal pyramids all carried more than the triangular and square pyramids. Another interesting observation that I made while testing was that each pyramid was noticeably more stable than the pyramids with less sides than it.

Project ID: 738

JR - Engineering: Electrical, Mechanical, and Robotics

Zackaria Ouchmame

Smart Medicine Cabinet

The goal of this project is to develop a tool that will help people who take a number of daily prescriptions, mostly aimed at the elderly, remember to take their medication. I constructed a medicine cabinet to record the number of doses taken each day, the time until the next dose, and to ensure the patient doesn't take a medication that wasn't intended to be taken at that time. To enable remote control, the cabinet is constructed on top of an iRobot Create (with the help of the Standard iRobot Remote). The cabinet will then be useful to people who are physically impaired as well.

I utilized a diverse range of tools and materials, such as a KIPR Link Controller, touch sensors, an iRobot Create, and a laptop, to develop the software for the medicine cabinet. The cabinet itself was constructed on top of an iRobot Create that was programmed to be controlled by a remote for effortless accessibility. As a prototype, the cabinet has three shelves, each fitted with a touch sensor beneath it. These sensors are used to monitor the consumption of medication, including the number of times a medication has been taken. If a medication bottle is removed from a shelf during a time when it is not meant to be taken, or if it is removed from the incorrect shelf, the cabinet will emit a constant beeping sound until the bottle is returned to its original location. This feature aims to minimize the likelihood of patients taking the wrong medication or consuming it excessively or insufficiently. Following the programming and construction of the cabinet, the final product demonstrated complete precision.

Project ID: 739

JR - Engineering: Electrical, Mechanical, and Robotics

Sophia Conway

Electromagnetic Efficiency

This project will use many concepts in order to test out 5 coils with different measurements. These coils will have been tested multiple times and the data has been recorded. I will also be using magnetic force to attract and repel.

Project ID: 740

JR - Engineering: Electrical, Mechanical, and Robotics

Leo Hamel

How Does Weight Affect a Drone

Drones are an amazing tool used everyday for many different things. Drones can be used for the military, videography, and entertainment. Over the years, drones have been used for numerous things, but one thing is very common. Drones are often used to carry things. In this project I am going to test the maximum weight a drone can hold, how weight affects the battery life of a drone, and if the weight affects the speed of the drone. I hypothesize that the drone will be able to lift a small amount of weight, but nothing that is too heavy. The drone managed to carry almost double its weight, but the weight had significant effects on battery life and speed. Due to the extra weight, the drone would constantly be falling down, the drone was also very unstable with added weight making the 30 Meter run last longer with each test. The battery life was also greatly affected by the extra weight. The throttle had to be increased to prevent the drone from falling to the ground. The drone itself weighed about 150 grams, and was still able to fly up until 133 grams, where it could no longer take off. Without weight, the drone was able to fly 30 Meters in 14.3 seconds, and with 100 grams in 32.04 seconds. My procedure was to attach weight to the drone and time a 30 meter dash. Once completed I would continue to fly the drone until the battery ran out and document the time. This process would be repeated until 100 grams was reached. In conclusion my hypothesis ended up being incorrect.