Abstract: Science and Engineering Fair of Houston

1246

Saltwater Battery

Jacob Ojeda
Weis Middle School

Category

Engineering Mechanics

the experiment successfully powered an LED light, showing that the galvanic cell generated enough electricity to light the LED. However, the generated current was insufficient to power devices requiring more power, such as a DC motor or a fan, indicating that while saltwater-based cells can produce electricity, the output is dependent on the power requirements of the device being used. This experiment demonstrates the basic workings of a simple galvanic cell and highlights the importance of materials, electrolytes, and the cell design in determining its power output. Further studies could explore how adjusting the concentration of the electrolyte or using different materials might improve the efficiency of the cell. In conclusion, saltwater is able to conduct electricity because the dissolved ions, such as sodium (Na^+) and chloride (Cl^-), are free to move and carry electrical charge. When saltwater is used in conjunction with metals like zinc and copper, it forms a galvanic cell, where chemical reactions at the electrodes generate an electrical current. The conductivity of saltwater is influenced by factors like salt concentration and temperature, with higher concentrations resulting in better conductivity. In this experiment, the saltwater was able to power an LED light, but it was not able to power a DC motor or fan. This outcome occurred because the electrical current produced by the saltwater wasn't strong enough to drive devices that require more power, such as motors. The LED light, however, requires much less power and can be powered by the lower voltage generated in the saltwater setup. This principle of saltwater conductivity and galvanic cells is important in many applications, such as batteries and electrolysis, where understanding the conditions that optimize conductivity and power generation is essential.

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Abstract: Science and Engineering Fair of Houston

1247

The underwater assistant pt.2

Olivia Bonilla
Alief ISD

Category

Engineering Mechanics

Marine pollution is a significant environmental issue that involves the dumping of around 14 million tons of plastic in bodies of water every year. The goal is to develop a Remotely Operated Vehicle (ROV) called SeaPerch, which can collect plastic from any water source without endangering the environment or marine life. Underwater robots began with a book on how to build one. Professor Tomas Conis at MIT created a curriculum around SeaPerch for Ocean Engineering. SeaPerch is now versatile and can tackle water pollution. To create a SeaPerch prototype, the following steps were completed: Cut a pipe and pool noodles, attach pool noodles to the pipe and connect pipe pieces, secure a cage base using zip ties, prepare the motor by covering its holes with waterproof tape and placing it inside film canisters, cut and connect the tether cable to the motor wires, and finally, Soldered the circuit board and connect the cable using alligator clips. During the testing phase, prototype testing showed that the aluminum could be grabbed and secured if the net had a sturdy rim around it. However, the robot had difficulty rising to the top, due to lack of power. In conclusion, the SeaPerch prototype works better with modifications. Adding a net with a sturdy rim and an extra motor will allow the Seaperch to be more effective in collecting and removing trash from our bodies of water.

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Abstract: Science and Engineering Fair of Houston

1248

Swing Dis

jonathan harrell
Conroe ISD /Irons Junior High

Category

Engineering Mechanics

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Abstract: Science and Engineering Fair of Houston

1249

Noisy Floors

Gwendolyn Garcia
Raul Rojas
Alief ISD

Category

Engineering Mechanics

This project is about finding the decibel value of different types of flooring. Our research included finding five different types of flooring to use in our experiment. I hypothesized that wooden flooring would have the loudest decibel rating. The five different floorings were carpet, ceramic, vinyl, wood, and concrete. After getting our materials and writing our procedure, we set up the music and recorded the spikes of certain points of the song the reader recorded. We put the results in the chart and graph. We found that ceramic tile is the least absorbent instead of carpet being the most absorbent of soundwaves.

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Abstract: Science and Engineering Fair of Houston

1250

Friendly Filters

Eden Shumate
Zoe Romero-Simpson
Central Middle School

Category

Engineering Mechanics

We are testing different filters to see which ones filter out the most chlorine. We are doing this because we wanted to know which way we can get the safest drinking water. We found eco-friendly materials to make all of the filters. We ran the water through the filters 2-3 times during our tests we found out that the gravel filter worked the best and the leaf filter didn't work

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Abstract: Science and Engineering Fair of Houston

1251

Cooling Vest

Om Arcot
Timothy Levenets
Calvin Che
School of Science and Technology, Houston - MS

Category

Engineering Mechanics

The purpose of our experiment was to create a cooling vest. Our procedure is to turn on the fan on the vest and measure the temperature after a certain amount of time. Our most significant result that we found was that our internal temperature dropped 1.6 degrees Celsius in 3 minutes of continuous cooling. In conclusion, our project succeeded in proving our hypothesis correct and in the future, we hope to improve our design.

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Abstract: Science and Engineering Fair of Houston

1252

Flipping out

Keegan Morris
Central Middle School

Category

Engineering Mechanics

The goal of this project was to create a prototype that scientists could use to teach others how to recognise sea turtle flipper marks on sand. I created a small version with salt dough to model sea turtle tracks and then created a larger version to be used on the beach. By taking photos of actual Kemp's ridley tracks as well as their flipper measurements from the Gulf Center for Sea Turtle Research (GCSTR), I was able to create a tool for conservation use.

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Abstract: Science and Engineering Fair of Houston

1253

Klash of the Keyboards

Luke Masel
Joseph Shabot
Central Middle School

Category

Engineering Mechanics

Last year, we tested typing speeds on the laptops we use at school and on student's smartphones. This year we are going to do it again, but measure the difference in growth from 6th grade to 7th grade. Have we gotten better at one versus the other? This could lead to the future having texting classes rather than typing classes. (continued) Problem: We don't know what is faster, typing on a keyboard or texting on a phone. We want to know if phones are really the future of typing or if computer keyboard typing with all of your fingers is the better option for the future. We would also like to know if being older can affect your typing. Procedure: We had students take three, one minute typing tests on computer and mobile and got the words per minute and accuracy. Results: Accuracy and words per minute were better for seventh graders than sixth graders. People with correct hand placement in seventh grade tend to type faster. Conclusion: When determining if computers were more efficient than typing on a phone, we found out that computers are more efficient in words per minute than phones. However accuracy for both devices stayed mostly the same.

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Abstract: Science and Engineering Fair of Houston

1254

Nozzles for the Better

Cameron Starnes
Conroe ISD /Irons Junior High

Category

Engineering Mechanics

The objective of this experiment is to decrease gas pollution in the world. The findings of this experiment will help improve the pollution problem in the world. The hypothesis stated that if I decrease the length of the nozzle to 4 inches, and increase the diameter of the nozzle to 1 ½ inches, then more gas should enter the tank and less should escape. In order to test this hypothesis I had to first create all of my nozzles. Then I decided to change the conditions of my nozzles, so on the second nozzle I tested to see what it would do with high winds blowing on it, so I put a fan next to it and started to blow the wind from it to see how much water would fall out. Lastly, I used the condition of extreme heat to resemble a heat wave, so I wrapped it in a heating pad, and also put it in the sun, then put water through to see how much would fall out. The data showed that when using the fan to resemble high winds, more water fell out. This correlation means that my gas nozzle is not the best in high winds. This study shows that my gas nozzle needs some improvement but overall is successful.

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Abstract: Science and Engineering Fair of Houston

1255

Is it worth it to build a Radon Detector?

Ethan Moore
Jackson Husted
School of Science and Technology, Houston - MS

Category

Engineering Mechanics

In this project, our purpose in building a radon detector was to help people be more aware of the radiation without spending as much money. To execute the project, we first built the radon detector with many easily accessible parts, such as a coffee can, 30-AWG wrapping wire, and Gorilla brand epoxy. After we built it, we tested the detector in three places; the ground, above water, and in a tightly enclosed area in Ethan Moore's house, the most significant being the door with 15.87 millivolts. To conclude, we have found that we have likely done the readings wrong, as the readings are very distant, so to improve the research, we should do much more readings next time so that we can find a widely acceptable median.

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Abstract: Science and Engineering Fair of Houston

1256

Most Efficient Hydraulic Fluid

Emily Alexander
Conroe ISD /York Junior High

Category

Engineering Mechanics

This project could help society by helping engineers to develop more efficient hydraulic fluids by using the data discovered during these trials. More efficient hydraulic fluid translates into more efficient hydraulic machines with less margin for error. Also, hydraulics is a much cleaner form of powering machines than burning fossil fuels. A major reason there are those who choose to remain using forms of power machines that damage the environment is because they believe that no other form could work better. However, if even more efficient hydraulic fluids were created, those people could be convinced into leaving those forms of energy behind and switching to one that is much cleaner.

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Abstract: Science and Engineering Fair of Houston

1257

A Tale of a Furry Friend in need of a Tail

Nessa Cmerek
Clear Creek ISD /Westbrook Intermediate School

Category

Engineering Mechanics

I chose the feline prosthetic tail topic because the tail plays important roles in a cat's life, and right now they have no way of getting a tail if they don't have one. Based off the idea of prosthetic limbs for humans, my goal was that I would be able to make a prosthetic tail for a cat. I started this project by observing how other cats used their tail in their daily lives, and took measurements on how long the tail was to find how long it would need to be for my specific cat, Rayne. Then I started thinking of what my design would be like. How many joints are there, what kind of joints are they, and where is each joint is going to be? After some research and observing other cats, I created a design that incorporates the main characteristics. I built the design then moved on to coding. I decided on 8 main movements for the tail to achieve and then I coded each individual Arduino servo to the right position, so the tail could achieve the correct orientations. Once finished with the general design, I cleaned up the tail and wires to make it as pleasing to the eye as possible. This tail provides a very strong foundation for other prosthetic tails in the future that could impact a cat's life significantly.

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Abstract: Science and Engineering Fair of Houston

1258

Magnetic Levitation and electromagnetic propulsion

Shreya Sen
Conroe ISD /Knox Junior High

Category

Engineering Mechanics

This experiment was conducted to test whether or not it is possible for a magnetic levitation train to function normally without the help of electricity. The hypothesis states that if stronger magnets propel the maglev train quicker, then there will be a faster way of transportation because as the train levitates off of the ground the stronger magnets will create a greater force field, minimizing drag. The original plan was proposed by Robert Goddard and it is an idea that could revolutionize the way we travel. This experiment took two days to achieve levitation and another three days to get propulsion in place. The process begins by making the tracks of the train. Next the propulsion mechanism is put into place. The final step is to ensure all parts are securely connected. The most significant result of this experiment is that it was proven that maglev trains are functional without electricity. The hypothesis was supported by the experiment. This research will be useful in incorporating trains for various purposes in areas where electricity is not available. These trains can carry food, water and other supplies and provision safe transport during evacuation procedures.

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Abstract: Science and Engineering Fair of Houston

1259

Testing Different Seawall Types

Matthew Bazhanov
Weis Middle School

Category

Engineering Mechanics

This experiment was conducted to determine which seawall design worked the best against storm surges. First, I built the clay seawall. Then I wrote 1-8 cm on a piece of paper. Then I stuck the paper on the clay seawall. Then I created the section for holding water. Then I poured the desired amount of water into the beaker. Then I transported the water from the beaker into the water section. Then I pulled out the wall stopping the water from flowing out, simulating the wave. I recorded if the water breached or not, and how far the first wave went. I restarted the experiment to compare different seawalls and volumes of water. We found that mounds worked the best. In conclusion, design no. 8 worked the best, which was a mound going inward.

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Abstract: Science and Engineering Fair of Houston

1260

one-way health

Phliopateer Ghattas
Clear Creek ISD /League City Intermediate School

Category

Engineering Mechanics

Through my previous research I had learned one-way mirrors can prevent excessive heat and harmful UV rays. This inspired me to use a temporary sheet of one-way mirror film that would go over a window capable of being rolled using a mechanism which included a motor, gears, and switches. These equipment's allow the one-way film to roll back up whenever it is not necessary. This mechanism makes it possible to function as normal window, and then pull down the one-way film when needed which aids people with sensitive skin, prevent skin cancer in drastic cases that are caused by UV rays, and lower the electric bills that for an average household during hot summers which can lead electrical bills to exceed $700.00 per month in some states.

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Abstract: Science and Engineering Fair of Houston

1261

The Plunger Prosthetic

Gavin Tjanis
Weis Middle School

Category

Engineering Mechanics

This project was developed to address the lack of accessible and affordable prosthetic solutions for individuals with limb loss, particularly in low-resource settings. High-cost prosthetics often prevent individuals from regaining mobility and independence. By utilizing simple, inexpensive materials like a plunger, PVC pipe, and household items, this project aims to create a low-cost prosthetic prototype that demonstrates the principles of balance, support, and stability. The research contributes to the growing need for innovative, cost-effective solutions in prosthetic technology. How can simple materials such as a plunger, PVC pipe, and a crutch be combined to create a functional and affordable prosthetic leg that provides stability, comfort, and mobility? If a plunger, PVC pipe, and crutch are used in combination, they will form a prosthetic leg that provides sufficient stability, comfort, and support, comparable to more expensive prosthetic designs. Engineering Goal: To design, construct, and test a low-cost prosthetic leg model that is stable, comfortable, and adaptable for use on various surfaces.

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Abstract: Science and Engineering Fair of Houston

1262

Improving wheelchair functionality: Voice Automated wheelchair prototype

Jensen Delaney
Derek Chan
Stafford STEM Magnet Academy

Category

Engineering Mechanics

In this year's project, we have created a voice automated wheelchair. This wheelchair can help many disabled people commute easier and safer. We have seen many struggling people in wheelchairs, we want to help them by creating an easier accessible wheelchair. There are many types of wheelchairs in the market, but we believe that our voice automated wheelchair is best for disabled people. Manual wheelchairs need physical strength or help from other people. Powered wheelchairs also require some form of physical movement which may not always be suitable for the disabled patients. Our voice automated wheelchair requires little to no physical strength.

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Abstract: Science and Engineering Fair of Houston

1263

An Electromyogram (EMG) Controlled Robotic Hand

Nicholas Bacchus
SST - Champions College Prep - HS

Category

Engineering Mechanics

Middle schoolers sustain hand injuries while playing sports quite frequently which prevents them from being able to do all the tasks they need to do in school and in life. When adults sustain injuries like this it interferes with their jobs and lifestyle. What if they had a robotic hand to help them get back to their normal activities? An electromyogram (EMG) controlled robotic hand can help people and students get back to performing their daily activities. The purpose of this project is to design a robotic hand that works in synchronous motion to real hand movements of the human operator using electromyography. An EMG controlled robotic hand can be used to enhance recovery and restore capability in people with physical injuries and disabilities, and even middle schoolers.

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Abstract: Science and Engineering Fair of Houston

1264

Taking the Next Step

Dhruv Goyal
Vivaan Sadare
Adarsh Mohanty
CAK Pack - Homeschool

Category

Engineering Mechanics

The time has come for us to revolutionize walking. To do this, we will utilize piezoelectricity (the process of turning mechanical energy into electricity) to develop an optimal shoe system that is cheap and generates reasonable electricity. With this invention, we can revolutionize energy conservation by allowing people to use piezoelectricity as a charger for their devices. Our invention takes a new perspective on piezoelectric tiles by making them more globally accessible and cheaper by using piezoelectric disks which are thirty-three cents per disk. We hypothesize that if piezoelectric sensors are placed on the toe region, then it will generate the highest electrical output compared to other areas of the foot because it experiences the most force while walking. We tested this by walking ten steps on each area throughout multiple trials to see which generated the most electricity. The most important variable in the experiment was the piezoelectric disks as they got worn out after each test, so we replaced them accordingly. We figured out that the toe area generated 1.368955 watts, the heel region 0.63896 watts, and the toe and heel region combined 0.20132 watts. Our project benefits engineering mechanics by conserving energy through mechanical energy. Luckily, we did accomplish our goal of generating an optimal shoe system that uses piezoelectricity cost-effectively, though it did not come without multiple failed prototypes before it. The path to a sustainable future is before us, and it starts with the very ground beneath our feet.

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Abstract: Science and Engineering Fair of Houston

1265

Whatever Floats Your Boat

Bryan Relyea
Clear Creek ISD /Seabrook Intermediate School

Category

Engineering Mechanics

Boats and ships have been the most used transport in history, and still are used commonly today. Small canals provide shortcuts but require tight turns. Rudders are what turn these huge cargo ships, and this project is designed to research how the shape of a rudder affects the efficiency of it. What is the effect of rudder shape on the time it takes for a boat to complete a full turn? The hypothesis was that the trapezoidal rudder with the point at the bottom would work the best. The boat was set in a lake and pointed at a landmark. Then, the throttle was set to full power. The boat was timed on how long it took to do a full circle with each rudder. The best working rudder was the wide rectangle with an average time of 8.831 seconds. The worst performing rudder was the semi-circle, with an average time of 10.563 seconds. Having the trapezoidal rudders with a point up and another with a point down seemed to have nearly no affect, with the difference of their average times being 0.005 seconds. This information helps with sailors and marine engineers to keep improving their ships.

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Abstract: Science and Engineering Fair of Houston

1266

The Capturing of Energy From Physical Movements

Alivia Hus
Conroe ISD /McCullough Junior High

Category

Engineering Mechanics

With each step a human takes, energy is wasted. Is there a way to capture this energy? Some materials can convert energy from forms of stress, such as a triboelectric nanogenerator (TENG) or the piezoelectric generator/harvester (PG or PZT). When a mechanical movement or stress is applied, the PZT current flow reverses. From this alternating current flow, energy can be harvested. A PZT can be fitted into a shoe and connected to a light source, and light can be produced when the wearer starts performing activities. A multimeter can be attached to the place of the light. The wearer can read the Amps and Volts when performing different activities or tests on the shoe or the PZT. The Amps and Volts can then be calculated into Watts, hence quantifying the amount of energy produced. Stairs generated the most microamps and had the longest duration. Sprinting generated the most amount of Volts. Cycling was the least productive even though it had a moderate duration.

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Abstract: Science and Engineering Fair of Houston

1267

Lego house V.S Natural Disaters

Jeremiah Rodriguez
Conroe ISD /Moorhead Junior High

Category

Engineering Mechanics

The experiment that I conducted was, What form of internal structural design for a LEGO model house would be the strongest against natures dangerous natural disasters. The internal designs I modeled were ,A completely filled house, A hollow house, and a half full house. The purpose of the experiment was for me to know that, if I become a construction worker what model house would be the strongest. The house that was the strongest was the completely filled house was the strongest, while the hollow one was the weakest.

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Abstract: Science and Engineering Fair of Houston

1268

Does the angle of the nail affect the wieght it supports?

Damian Rodriguez
YES Prep

Category

Engineering Mechanics

My project focuses on the angle of the nail because many people over the years have been doing a lot of nail angles for construction, but the most common one was 45 degrees, 90 degrees, so I wanted to test out which one is better for holding weight/wood better, because even 1 nail can make a big difference. The overall reason of my project was to help people understand that the angle does affect the nail and the weight it can support also.

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Abstract: Science and Engineering Fair of Houston

1269

Underwater ROV

Eli Hale
Clear Creek ISD /Brookside Intermediate School

Category

Engineering Mechanics

The problem of polluted water inspired this project. Wish to contribute to the society by managing this issue of pollution. This project will provide meaningful research of cleaning up the ocean floor with a robot that is similar to a submarine. This robot will be able to sink with float by up with the trash it collects. The process of building this robot is bigger than imagined. Learnt many valuable lessons, including the engineering side of it and time management. This project is successful in sinking, the time it took to sink with weights were 2.52, 1.23,1.21, 1.15, 1.04 seconds and resurfacing time took 1.3, 1.5 2.3, 3.8 from 0-4oz without powered (motors), it only lasted till 4 ounces. With motors it took 0.8, 0.9, 1.1, 2.5, 3.6, lasted 4-8 ounces! For the 10-yard swim, it took 24.51 22.34, 23.22, 23.78, 25.32, 24.18, 24.49, 27.72, and 27.77 seconds from 1oz-8oz. To improve this robot, it needs to have bigger motors and more buoyancy to scoop up heavier trash.

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Abstract: Science and Engineering Fair of Houston

1270

Magnetohydrodynamic Thrusters

Ashton Creasey
Conroe ISD /McCullough Junior High

Category

Engineering Mechanics

My project was made to illustrate how a magnetohydrodynamic thruster functions and works. The main goal of the experiment was to create the highest velocity possible with simple lithium-ion batteries. To do this, I created a boat with a large ruler to measure thrust in velocity (metres/second). I then created different parts for the MHD drive testing, usually a different electrode or a completely different design. I would then measure with the bathtub and ruler, and record my results in my notebook. In the end, we conducted many tests, varying between magnetic strength tests and voltage tests, and copper electrodes produced the highest velocity. My Project was successful and it answered my question. Can you make thrust with no moving parts? Yes. Does it pollute the earth's water or make too much noise? No.

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Abstract: Science and Engineering Fair of Houston

1271

Fine Woodworking

Viviana Henry
Clear Creek ISD /Seabrook Intermediate School

Category

Engineering Mechanics

Several types of joints are used in carpentry, this project tested the strength of different common joints, for example, Dovetail, Tongue and Groove, Groove, Box, and Rabbit. The strength of each joint was tested using a specially designed jig; the force required to break the joint was applied using a screw jack and measured using a Dynometer. The stronger the joint, the more force is required to break it. The Hypothesis was partially correct. because the Box and Dovetail joint had almost identical results of (oak) 766.95 N and 753.63 N; and the weakest joint (oak) Tongue and Groove at 200.07 N, surprisingly, even though the Box and Dovetail technically failed, they became loose, but they never separated, while all the other joints would easily pull apart after testing. In conclusion, the Box joint is the strongest by 13.32 Newtons, likely due to the large surface area for glue up. For Dovetail, the strength of the joint comes from the mechanical advantage of the inter-locking design. For future experimentation, one should try higher range Dynometer and longer glue dry time, and real world application is carpenters can use the best technique.

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Abstract: Science and Engineering Fair of Houston

3224

Earthquake Resistant Buildings

Julio Acioli Gabeira Brandao
Arianna Vazquez
SST - Champions College Prep - HS

Category

Engineering Mechanics

Our project explores how, through our research, we can better understand and leverage new technologies to design and construct safer buildings in earthquake-prone areas. As we explore these careers, we aim to contribute to the development of safer, more durable communities. Our goal is not only to address immediate safety concerns but also to promote sustainable building practices that can benefit future generations. By investigating these innovations, we hope to make a meaningful impact on both the safety and sustainability of the built environment.

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Abstract: Science and Engineering Fair of Houston

3225

Adding an Extension to the Cell Phone for Rheumatoid Arthritis Patients

Alexa Lopez
Clear Creek ISD /Clear Springs High School

Category

Engineering Mechanics

Many people suffer physical disabilities that do not allow them to engage in simple everyday tasks such as using a cellphone properly. The cellphone is designed to be easy to hold, use, and move for the large majority of population. But what about that small percentage where it isn't easy to hold, use, and move. A device capable of helping someone with restricted mobility in their joints to simply use their cellphone properly is sought. In this project, an extension that uses a combination of the clamp, ball and socket joint, and telescopic beam engineering design concepts is created and tested to provide the ease and comfortability people with disabilities are seeking. A prototype was first built using Lego pieces that enabled varying the lengths of the device. 4 different lengths were tested, and data were collected on heart rate, time it took to answer cellphone, ease of use, and comfortability. Design criteria (effectively answer phone calls with the device; ease of use; comfortability; weight; and cost limits) were defined to determine the success of designing an effective attachment. The results showed that a length of 30cm provided the comfortability and ease of use that the player desired, enabling her to effectively answer phone calls while requiring the least amount of effort (lowest heart rate). The final attachment design, made entirely from 3D printing, met all the design criteria.

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Abstract: Science and Engineering Fair of Houston

3226

Automotive mechanics

Richard Umanzor
Allan Gonzalez
SST - Champions College Prep - HS

Category

Engineering Mechanics

The purpose of our project is to show the people how cars work and what their mechanics are. We are using a small to medium sized model of a system of gears to help demonstrate these mechanics. We found that a single gear can effect how to car operates, a small change or a screw missing can make all the difference in the cars performance. Overall we have found that the car has some very simple and complex mechanics that help in supporting other mechanics.

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Abstract: Science and Engineering Fair of Houston

3227

HydroRescue: Solar Powered Desalination for Emergency Water Supply in Coastal Disaster and Post-Conflict Zones

Nakshatra Kothapalli
Fort Bend ISD /Dulles High School

Category

Engineering Mechanics

According to the World Health Organization, over 1.1 billion people worldwide lack access to clean water, and 2.7 billion experience water scarcity at least one month each year. Natural disasters, including hurricanes, tsunamis, and floods, as well as conflict zones, frequently disrupt water infrastructure, leaving affected populations vulnerable to dehydration and waterborne diseases. This study aimed to develop a portable, solar-powered seawater desalination and purification system, HydroRescue, to provide safe drinking water in humanitarian aid, disaster relief, and emergency situations. The system integrates three stages of filtration: mechanical filtration for large debris, reverse osmosis (RO) to remove salt and contaminants, and UV sterilization to deactivate bacteria and viruses. Powered by two 5 W solar panels, HydroRescue operates independently without the need for external power sources, making it ideal for remote areas and emergency situations. The system can purify approximately 70 liters per hour, producing up to 43,800 liters annually, with an operational cost as low as $0.02 per liter-96% cheaper than traditional desalination systems, which cost $0.50 per liter. A cost analysis demonstrates that if adopted in regions in need of water relief, HydroRescue could save an estimated $2.63 trillion per year in desalination costs alone. This innovative system provides a low-maintenance, environmentally friendly solution, with the potential to rapidly improve water access in disaster-stricken and emergency zones, while significantly reducing operational costs in urgent situations. When every drop counts, HydroRescue is here to make a real splash.

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Abstract: Science and Engineering Fair of Houston

3228	**Category** Empty Table

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Abstract: Science and Engineering Fair of Houston

3229

Enhancing Tactile Feedback in Haptic Gloves for Immersive Virtual Reality Experiences

Justin Tai
Westchester Academy for International Studies /Spring Branch ISD

Category

Engineering Mechanics

This research aims to develop a haptic glove capable of replicating realistic textures to enhance user immersion in virtual reality (VR). Utilizing an ESP32 microcontroller, vibration sensors, and motors, the project simulates tactile sensations such as roughness and friction. Sanding sponges of varying grades (60, 80, 120, 220) were used as physical textures, with vibrations measured, replicated, and analyzed to establish a relationship between surface roughness and tactile feedback. Unity software was employed to create virtual models of these textures, linking them to real-world vibration data for immersive VR interactions. Experimental tests were conducted to evaluate the system's performance. Data collected from the ESP32 and Artemis Data Logger revealed discrepancies due to the Artemis Logger's voltage cap, particularly with rougher grades, highlighting equipment limitations. Volunteer participants engaged in texture identification, sensory feedback, and reaction time tests. Results showed that users accurately identified textures but experienced delays in VR reaction times, emphasizing the need for faster data transfer and improved vibration motors. Future development focuses on refining the glove's design, integrating machine learning for precise texture simulation, and expanding haptic feedback capabilities across various VR applications. Factors such as user movement speed and interaction types will be considered to enhance realism further. This study demonstrates the potential of haptic technology in VR, addressing critical challenges in tactile replication and paving the way for advancements in education, training, and entertainment through immersive virtual experiences.

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Abstract: Science and Engineering Fair of Houston

3230

Sensing the Future of Agriculture

Jason Merino
Francisco Coronado
Derrick Villegas
Fort Bend ISD /Willowridge High School

Category

Engineering Mechanics

Currently, one of the major issues in the world is climate change. With climate change, one of the significant challenges is the increasing unpredictability of weather patterns. Droughts, floods, and temperature fluctuations all disrupt traditional farming cycles. Unfortunately, this leads many farmers and gardenersâ€"both beginners and experiencedâ€"to struggle to adapt to constant changes. Our AI-driven agricultural device analyzes local weather data and recommends optimal planting and harvesting seasons, helping farmers make informed decisions based on real-time conditions. With AI implementation, the device processes large amounts of data collected from various sensors, making it a powerful tool that elevates agricultural practices. The goal of this project is to develop a device that uses real-time data to present users with efficient analysis and guidance on how to garden effectively.

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Abstract: Science and Engineering Fair of Houston

3231

Plantar flexion torque assisted barefoot exoskeleton

Chenhao Wang
The Village School

Category

Engineering Mechanics

With the aging population and the increasing prevalence of motor dysfunction, the demand for effective assistive walking devices has become more urgent than ever. This project focuses on designing an innovative, flexible assistive walking device that overcomes the limitations of traditional tools. By incorporating origami structures, carbon fiber supports, and 3D printing technology, the device achieves a lightweight, cost-effective, and highly adaptable design. Key structural components include soft cushions for leg fixation, durable carbon fiber supports, and precision-engineered 3D-printed elements. The hardware integrates an Arduino circuit board, a voice module, and a dual-motor system, enabling intelligent assisted walking based on the lever principle. Experimental results validate the device's tensile strength and hardware performance, demonstrating its potential for practical application. Future research will focus on optimizing the structure, improving stability, and enhancing adaptability to meet diverse user needs. Ultimately, this project aims to revolutionize assistive walking devices through technological and structural innovation, providing users with a more convenient, stable, and comfortable walking experience while advancing the field of mobility assistance.

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Abstract: Science and Engineering Fair of Houston

3232

Tool-Changer For Robotic Arm

Carter Boland
Clear Creek ISD /Clear Creek High School

Category

Engineering Mechanics

Introduction / problem statement: I became interested in Mars rovers only recently, but I have always been passionate about creating or designing something to fix a problem, along with fueling a passion for learning. It was these things that led me to find the Mars rovers, and it clicked in me. I learned about the science and engineering fair, and then entered. I saw that 3D printers had tool changers to print multiple materials with one gantry system, and thought about if that could be applied to an arm. How would a tool changer impact extraterrestrial robotic missions? What benefits or downsides would it have? Would it be reliable or feasible for future missions? Procedures: I thought up an idea and documented it. I then started to research and brainstorm ideas. Then, I signed up for my campus's science/engineering fair, and got approved to start. I created designs and documented flaws and improvements. I then assembled the parts safely and started testing and documenting. Results and conclusion: The tool changer and robotic arm demonstrated reasonable reliability, with room for improvement. It shows how a robotic arm can swap tools remotely, and showcases that through rotating toolheads itself. Occasional failures did occur due to manual operation and misalignment.

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Abstract: Science and Engineering Fair of Houston

3233

DIY "Sunflower" Solar Panel

Ashley Djouguem
Harmony South District

Category

Engineering Mechanics

Solar Energy is a multi-use renewable energy resource and has been implemented in a variety of technological devices. Including diversifying energy sources, solar tech is used to improve efficiency and save money, and one of the most commonly used solar tech are solar photovoltaics or solar panels. Despite saving thousands of dollars in electric bills to millions of households, for the longest time, solar panels had limited potential due to being stationary. Now enter the sun trackers. Sun trackers were developed to optimise solar energy usage. Like a sunflower, the tracker has sensors able to track the direction with the maximum amount of sun, and these sensors signal the device to turn in that direction in order for the solar panel to absorb a higher amount of energy. One problem remained, however: cost efficiency. Sun Trackers have a higher solar energy potential, but they also come with higher initial costs due to the high price of the machine itself, a complicated installation process, and an even more complicated maintenance plan. These may all be unimportant to large industries, but are a deal breaker for residential users. In this project, the original design and materials to the sun tracker will be analyzed and will be implemented and tested into more cost efficient materials in order to permit households to have an increase in solar energy use without the financial burden.

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[X] yes [ ] no

Abstract: Science and Engineering Fair of Houston

3234

Solar Energy Powers Tech & Saves Us

Brianna Cardenas
Eduardo Garcia
Fort Bend ISD /Willowridge High School

Category

Engineering Mechanics

My partner and I designed a solar-powered phone charger using a 10W solar panel that converts sunlight into electricity with its regulated output of a stable 5V USB charge. First, we had to overcome some problems with the internal wiring because it produced energy losses and could be dangerous. We needed to find the problem and eliminate it. In the design, this charger has been improved by adding an LDR sensor, which would detect the intensity of sunlight and manage the charging. Testing this charger, it was found that it works only if something dark covers the solar panel. This organization would help optimize energy use to avoid overcharging for the purpose of extending the life cycle of both the charger and the phone battery. Our charger, under best sunlight, will take 2 to 4 hours to fully charge the phone-hence, quite practical for off-grid power. This project showcases how the use of renewable energy combined with smart technology yields efficient and sustainable charging solutions for modern devices.

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Abstract: Science and Engineering Fair of Houston

3235

Roboscope: A Compact, Patient-Friendly Soft-Robotic Bronchoscope Modifier for Early Detection of Lung Cancer

Donovan Burke
Conroe ISD /AST: Academy of Science and Technology

Category

Engineering Mechanics

Lung cancer is the third most common and deadliest cancer, killing 125,000 individuals annually. However, traditional bronchoscopes have too large of a diameter to navigate into the smaller bronchi of the lung, allowing cancerous tissue to develop in these areas. In order to solve this issue, a millimeter-scale soft robot was developed to go deeper into the lung bronchi. To minimize the size of the robot, rather than traditional cable-driven actuation, this novel soft robot utilized fluidic actuation through continuum bodies to maneuver within the lung. The continuum bodies were manufactured using Dragon-Skin 10 silicone rubber, which mitigated possible damage to the lung in case of the robot making contact, poured into a 3D printed mold with 2 channels, one for soft robot to protrude and one to hold air pressure that would control the degree of freedom that allows the soft robot to navigate the lung. The engineering goal of this project was to develop continuum bodies wrapped at 5, 7, 10, 12, 15, 18, and 20 degrees, and evaluate whether the continuum bodies could become a feasible replacement for cable-driven actuators used in contemporary bronchoscopes. To test these different bending angles, a testing setup was designed in which one end of the continuum body was held in place while the other side was free to movement so that when pressurized, the free side could bend to its maximum angle. The results of testing found that the continuum bodies were able to function as intended and could be utilized as a replacement to traditional cable-driven actuation. That being said, future research will move towards incorporating these continuum bodies into the millimeter-scale soft robot in navigating in an in-vivo and ex-vivo setup. This soft robot could provide a possible solution to late detection of lethal lung cancer.

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Abstract: Science and Engineering Fair of Houston

3236

Adaptable Doorknob

Anistacia Beatty
Clear Creek ISD /Clear Brook High School

Category

Engineering Mechanics

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Abstract: Science and Engineering Fair of Houston

3237

Solutional Study To Urban Flooding With Floating Infrastructure

Elijah Washington
Conroe ISD /ASHP: Academy for Science and Health Prof

Category

Engineering Mechanics

Urban flooding poses significant challenges to infrastructure, transportation, and safety in expanding cities. This project explores floating bridge infrastructure as a solution to mitigate the impacts of urban flooding and improve city resilience. Using small-scale models simulating urban environments with varying layouts, I analyze the effectiveness of floating bridges in maintaining transportation access and improving water drainage. Heavy rainfall is simulated, and data such as drainage time, water levels, and drained water volume are collected. Comparisons are made between models with and without floating bridges to evaluate their impact on water flow and drainage efficiency. Results aim to highlight the potential of floating bridges to adapt to changing water levels, reducing flood-related disruptions. By addressing urban layout design and resilient infrastructure, this study seeks to contribute to sustainable civil engineering practices and provide practical solutions for flood-prone urban areas. The findings could guide future city planning and infrastructure development to combat the increasing risks associated with climate change and urban expansion.

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Abstract: Science and Engineering Fair of Houston

3238

Improving Submarine Designs through Adaptations of Aquatic Animals

Natalie Nickell
Holly Granger
Princess Tambong
Clear Creek ISD /Clear Brook High School

Category

Engineering Mechanics

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Abstract: Science and Engineering Fair of Houston

3239

Engineering an Ergonomic Hip Support Feature in Backpacks for Female Students

Catalina Delgado Cepeda
Conroe ISD /AST: Academy of Science and Technology

Category

Engineering Mechanics

Heavy backpacks are recognized as a common cause of back pain among students. Current solutions for this issue are considered inadequate, as they are not designed to accommodate laptops, books, or the anatomical differences of the female body. An attachable device is aimed to be designed in this study, with the purpose of redistributing the weight of the backpack from the upper body to the hips and lower body, utilizing technologies from baby hip carriers and external backpack frames, while the anatomical differences of women are considered. School backpacks with and without the device were tested by human participants, who walked for 5 minutes in each condition. A survey was completed by participants following each test to assess which muscles were felt to be engaged, whether this muscle engagement was perceived as an advantage or disadvantage, and which condition was reported to provide more comfort to the back. It was revealed by data analysis that significant muscle engagement in the neck, shoulders, and upper back was caused by the backpack alone. In contrast, much of this muscle engagement was successfully transferred to the hips and lower body by the device, reducing strain on the upper body. It is suggested that the weight of the backpack is effectively redistributed to the hips and lower body by the device, providing greater comfort and reducing strain on the back. It is believed that this approach could be beneficial for female students in preventing future back problems related to heavy backpacks.

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Abstract: Science and Engineering Fair of Houston

3240

Most Effective Filter Cleaner

Jacob Oman
Conroe ISD /AST: Academy of Science and Technology

Category

Engineering Mechanics

Filter cleaning is a time-consuming and labor-intensive process but is required to keep pools functioning properly and safely. With personal experience in the field, the student researcher aims to find a more efficient, less labor-intensive way of cleaning pool filters. This device could reduce the required time, cost, and strain on businesses and do-it-yourself pool cleaners, leading to less expensive, more frequent filter cleanings resulting in cleaner, safer pools. The first model of the cleaning device was designed using 3D Modeling Software. The student researcher found many issues with the first iteration such as durability, buildability, and water pressure. A second version was developed. To combat the issues from the first generation the student researcher constructed the device with light but durable PVC pipe, mounted the filter horizontally, and utilized a pressure washer to increase the pressure of the system. The new iteration utilized a long tube with slits down the sides spraying water to the filters this design could not effectively clean the filters as it was unable to put out enough gallons per minute. A new nozzle design was developed as the student researcher balanced the psi and gallons per minute of the system. The student researcher used a timer, hose, and standard filter-cleaning hose nozzle to run three trials on the dirty pool filters gathering the average time required to clean a filter without a device. Three tests were conducted with the assembled device, a timer, dirty pool filters, and a pressure washer. The average time for the pool filter to be cleaned with the device was compared to the time taken without a device.

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Abstract: Science and Engineering Fair of Houston

3241

Revolution on Wheels: Solar Powered Vehicles

Louis Elizondo
Ephraim Perkins
Roberto Alvarenga
SST - Champions College Prep - HS

Category

Engineering Mechanics

With every sunrise, solar-powered vehicles capture the energy of the sun, transforming it into a clean, unstoppable force driving you toward a brighter, more sustainable future. The world should look forward to this development to not delay evolution, but to create a more sustainable form of travel for all. The goal of our project is to enlighten people about the future possibilities of transportation and with that carry the hope of the future along with the hope for a brighter tomorrow.

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Abstract: Science and Engineering Fair of Houston

3242

Revolutionizing Cycloidal Speed Reducers: A Study in Performance Improvement

Winfred Pham
Jonathan George
Clear Creek ISD /Clear Brook High School

Category

Engineering Mechanics

Cycloidal speed reducers are widely used in robotics, automation, and heavy machinery due to their high torque potential and small form factor. As a potentially more efficient alternative to traditional power transfer systems like gears, cycloidal drives offer several advantages, including zero-backlash operation, compact design, and high reduction ratios. These drives use non-circular gear profiles derived from cycloidal motion, leading to complex interactions and unique geometric properties. However, current designs often overlook the importance of optimizing eccentricity, leading to inefficiencies and reduced performance. This study aims to explore the impact of eccentricity adjustments on the efficiency and reliability of cycloidal speed reducers. The research will involve a series of simulations and practical tests, measuring parameters such as torque output, energy loss, and mechanical wear. This exploration of cycloidal speed reducers highlights the potential of eccentricity optimization to enhance the performance of cycloidal speed reducers, providing a more robust and efficient alternative to traditional gear systems. By addressing the previously neglected aspect of eccentricity, this research offers a pathway to more efficient and reliable applications, benefiting industries such as robotics, automation, aerospace, and heavy machinery. Future research will expand on these findings to develop comprehensive guidelines for the design and implementation of optimized cycloidal speed reducers and investigate other variables such as tooth profile, load distribution, and material composition.

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Abstract: Science and Engineering Fair of Houston

3243

Crystal Clear Energy: How Quartz Minerals Can Power a Computer Mouse

Caitlin Hull
Claire Robin
Emerson Solberg
Conroe ISD /ASHP: Academy for Science and Health Prof

Category

Engineering Mechanics

This project explores the designing and construction of a piezoelectric wireless mouse. Traditional wireless mice require a battery, but the goal of this project is to reduce the waste created by replacing batteries with a piezoelectric disc. Piezoelectricity is created by converting kinetic energy, such as clicking on the mouse, into electrical energy. By switching to piezoelectric-powered mice, the number of AA batteries disposed of each year could be reduced by approximately 14 billion. The mouse is designed so that the piezoelectric disc is embedded into the mouse structure. The performance of the wireless mouse is tested on running time, distance the mouse can go from the computer without disconnecting, and the amount of electricity the mouse produces. After each trial, adjustments will be made to improve the wireless mouse. These trials demonstrate the functionality of the mouse, proving that it can operate efficiently. This project aims to showcase the potential of piezoelectric technology for powering everyday electronics and promote a more sustainable approach to product design. While testing the mouse, it was discovered that clicking the pad of the piezoelectric disc when connected to the circuit board of the mouse successfully powers the mouse's LED. After getting all the required materials for this project to function, the trials and data analysis can occur.

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Abstract: Science and Engineering Fair of Houston

3244

SearchSnake: Soft Path-Finding SAR Robot

Jacqueline Thomas
Xunyi Liu
ST. JOHN'S SCHOOL

Category

Engineering Mechanics

Traditional Search and Rescue teams have often faced difficulties in efficiently saving victims under collapsed structures due to the complex processes of communication, location, and manual extraction. Due to limited oxygen, dust content, and the potentially critical condition of the victim within void spaces, time is a crucial factor during SAR (search and rescue). This project, the Trailblazer SARbot, expedites the search process and reduces the need for manpower, navigating void spaces in complex environments and efficiently locating trapped victims. Conducting a literature review on pre-existing snakebots and soft robotics for mobility inspired the creation of various prototype joints. Utilizing serpentine locomotion and soft actuated connectors, Trailblazer SARbot can maneuver through tight gaps, navigate uneven debris, and adapt to complex obstacles. Thermal detection sensors enable the Trailblazer SARbot to identify victims through debris and communicate the coordinates where high heat detection occurs to a SAR team. The A* pathfinding algorithm equips Trailblazer SARbot to calculate an optimal path to victims. An initial physical prototype is currently in the testing process and, as the Trailblazer SARbot is refined, it will be introduced to a three dimensional sand obstacle course with a predetermined map and a heat source to test and develop it's physical maneuverability through complex terrain and the pathfinding algorithm. Further tests will focus on training the robot with unfamiliar environments and refining sensor accuracy. With the Trailblazer SARbot, the team aims to make SAR operations more time-efficient, reducing human risk, and maximizing the number of survivors.

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Abstract: Science and Engineering Fair of Houston

3245

SmartPanel: An ML-Assisted Active Control System for Reducing Solar Array Vibrations of Satellites

Cayson Wang
Conroe ISD /AST: Academy of Science and Technology

Category

Engineering Mechanics

Satellites are integral to the modern world, enabling phone calls, internet services, financial transactions, GPS navigation, environmental monitoring, and more, all powered by solar panels. However, temperature changes, attitude maneuvers, and deployment impact cause satellites' solar panels to vibrate, leading to negative effects on satellites' accuracy and stability, disrupted communication, and structural damage. As the number of satellites increases exponentially, the problem with their solar panel vibrations will only become more prevalent. Because current solutions are bulky, ineffective, or consume lots of power, there exists a strong need for a modular and effective vibration reduction system: SmartPanel. A model solar panel was built, with a thin flexible Macro Fiber Composite (MFC) piezoelectric film placed on its clamped end. Using Solid State Relays, a circuit was constructed, allowing the MFC to function as both a sensor and actuator through rapid switching. The circuit was controlled by a Raspberry Pi Pico, further increasing modularity. Compared with traditional methods, SmartPanel uses one material to sense and actuate vibrations. PID control was implemented to determine the output actuation onto the MFC and actively suppress vibrations, with optimal coefficients found through ML and Nedler-Mead optimization. Data from a wireless accelerometer showed effective vibration attenuation, with a 53% decrease in RMS, allowing for less structural fatigue, and a 54% peak-to-peak reduction, meaning increased satellites' stability. Overall, SmartPanel significantly reduces vibrations in a cost-effective and modular design under $250 and 60 grams with many applications including wind turbines, airplane wings, and solar sails.

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Abstract: Science and Engineering Fair of Houston

3246

A Soft Actuator Made with Molded Silk Fibroin

Anik Banerji
ST. JOHN'S SCHOOL

Category

Engineering Mechanics

Silk has been used for textiles and sewing for centuries, but this material may have important uses in the future of biomedicine. Silk fibroin (SF), a protein-based biopolymer, possesses unique strength, softness, and biocompatibility that make it suitable for bio-fabrication. Prior developments have focused on extracting and processing this protein, but this application goes further by demonstrating SF's applications as a material for the construction of soft and compliant actuators capable of safe and effective interaction with biological systems. In this project, aqueous SF was extracted from silk cocoons, and used to construct a soft continuum actuator. Silk cocoons were boiled to isolate the fibroin protein, dissolved in lithium bromide, and purified with dialysis and centrifugation. The actuator was constructed using injection molding and salt treatments, which polymerized the silk into an elastic structure. The mechanical properties of various silk structures, such as stiffness and tensile strength, were evaluated using rheological testing. This device can undergo high amounts of elastic deformation, allowing it to bend in all directions without breaking. Not only is this actuator capable of hyper redundant fluid motion thanks to its compliant structure, but the utilization of natural and biocompatible materials with minimal processing ensures that this device is capable of interacting with humans, plants, and animals in a safe and comfortable manner.

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Abstract: Science and Engineering Fair of Houston

3247

Exploring the Force and Efficiency of a Hydraulic Press

Maya Villatoro
SST - Champions College Prep - HS

Category

Engineering Mechanics

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Abstract: Science and Engineering Fair of Houston

3248

sorting in motion

Katya Trejo
Alief ISD

Category

Engineering Mechanics

My research looks at how gravity-powered sorting machines can be created to automatically sort objects by size or weight. These machines use gravity to move materials down sloped surfaces, like chutes, where items slide and are separated. The design needs to find the right slope angle so the items keep moving smoothly and don't get stuck. I learned that sorting by size is the most effective method for these machines. Ultimately, these machines save energy because they don't need electricity or fuel, which helps businesses lower their costs and reduces harm to the environment. This can also create new jobs in fields like engineering, agriculture, and manufacturing.

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Abstract: Science and Engineering Fair of Houston

3249

Fin-tastic Voyage: Harnessing the Sailfish Secret to Revolutionize Underwater Transport"?

Conan Helm
colin helm
Ushan Danansooriya
Conroe ISD /ASHP: Academy for Science and Health Prof

Category

Engineering Mechanics

This study investigates if a dorsal fin would affect the speed of a submarine. A general consensus is that the fin will affect the speed of the submarine. The study of the possible increase in speed of a submarine via the attachment of a dorsal fin is important because if it is true, then it could be revolutionary to the future of water travel and hydrodynamics. 20 tests timing the time for the submarine to travel across a set distance with and without the fin was done and recorded. After analyzing the recorded data it was concluded that the addition of the fin to the submarine had done little to no significant change in the speed or velocity of the submarine. In hindsight this makes sense because the submarines movement is done from a engine powered motor, this means that the fin addition would likely do no noticeable change due to the way the motor propels the submarine, it would possibly be different if the submarine had a different way of propulsion, but using a motor the fin gives would likely give no change in the speed of the submarine.

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☐ yes ☒ no

4. This project is a continuation of previous research.

☐ yes ☒ no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

☒ yes ☐ no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

☒ yes ☐ no

Abstract: Science and Engineering Fair of Houston

3250

Fin-Tastic Design: How Fin Curvature Affects Boat Performance

Aron Par
Bryce Harmon
Cooper Rogers
Conroe ISD /ASHP: Academy for Science and Health Prof

Category

Engineering Mechanics

Hydrodynamics is a very complicated subject to understand. Due to this, it's heavily researched. However, one subject that doesn't seem to be discussed is the effects of a fin's curvature on a boat's performance. Through this, there can be a richer understanding of propeller designing and of hydrodynamics. The method to then discover this was to bring in an RC boat with its set propeller. This propeller would be the control, named "Propeller 4". Propeller 4 would then be designed to make 3 different propellers which would all be 3D printed. These propellers would all have different curvatures on its fins. Each propeller would be tested on the boat to see the difference of speed. However, 3 of the propellers broke on the first run. Then, on the second run, the boat spun on itself for 3 of the propellers, only working with Propeller 4. What will be done in the future should the project continue is to test whether the cause of this could be due to multiple reasons such as a miscalibration on each propeller. This project is vital to help fully grasp the functions of hydrodynamics in a way more people can understand.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human participants ☐ potentially hazardous biological agents

☐ vertebrate animals ☐ microorganisms ☐ rDNA ☐ tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

☒ yes ☐ no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

☐ yes ☒ no

4. This project is a continuation of previous research.

☐ yes ☒ no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

☐ yes ☒ no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

☒ yes ☐ no