CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Zara Ainge

Project Number
J0301

Project Title
Measuring the Effectiveness of Earthquake Survival Strategies

Abstract

Objectives/Goals
The objective of my experiment is to prove which earthquake survival strategy, Duck and Cover, or Triangle of Life, is most effective at protecting people within a building during an earthquake. This is important because earthquakes are unpredictable so people are often unprepared and need to react quickly. My hypothesis was that Duck and Cover would be the most effective way to avoid impact from falling debris in an earthquake.

Methods/Materials
The experiment was done by building a homemade shake table and conducting the experiment repeatedly for each strategy. I built the shake table using a cardboard box, a motor with wires and potentiometer. I also needed blocks and planks for the table and small pots of playdo to test the level of damage. I found my data by writing down how much damage the subject had after the shake table had caused the simulation. For example if the subject got hit in the head that can be very dangerous and can be put as a 3 or a 4 out of 5.

Results
According to data collected, the control (no protection) averaged 2.33, Triangle of life averaged 2.16 and Duck and cover averaged 1.41. Duck and cover had the least damage making it the safest strategy to use to survive in an earthquake. Triangle of life followed with the most dangerous strategy to survive in an earthquake. The control had a higher Average amount of damage.

Conclusions/Discussion
Overall, the variable proved that Duck and cover was the safest independent variable because the table used in the strategy stopped blocks hitting the playdo. I found the relationship between the cause and effect in this experiment was Duck and Cover is safer than Triangle of life because that Duck and cover is a more efficient strategy to survive an earthquake. My experimental testing data evidence didn't support my research but shows which strategy is better to use in an earthquake. It is still a topic to be investigated more and shows that previous claims about Duck and cover vs. Triangle of life are true.

Summary Statement
Testing strategies to survive in an earthquake to determine which one is safest to use if an earthquake occurred using a homemade shake table as a earthquake simulation.

Help Received
My father helped me buy the right equipment for my shake table and he also showed me the way to balance out the simulation process.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Alex Alvarez

Project Number
J0302

Project Title
Stop Hoof Harassment

Abstract

Objectives/Goals
The objective of this study was to find a safer way to attach horse shoes to horses hooves. Metal nails are most commonly used to adhere shoes to horses, but the nailing process can cause serious injuries, such as laminitis. My goal was to find alternative methods for shoeing horses that would be safer and effective.

Methods/Materials
Scale, segments of nylon cutting boards to simulate horse hooves, 5-inch-long metal horse shoes, horse shoe cleaner, industrial Velcro, industrial glue (epoxy), and nailers nails. Used scale to measure the effectiveness of different adhesion of horse shoes to the simulated hooves.

Results
Three trials were conducted using Velcro, glue, and nails to adhere five-inch horse shoes to segments of plastic cutting board, a material closest to a horse hoof. A scale measured how much effort it took to remove the shoe from the material and checked the damage it did to the material. The results showed that the nails adhered the best, but also did the most damage when removed. Velcro was the second best in terms of effective adhesion and caused less damage than nails when removed. Glue was the least effective.

Conclusions/Discussion
I wanted to prove that nailing shoes on horses hooves is the wrong way to go, and design an alternate product. As part of the product design, I wanted to find a safer method for the horse shoe-applying process. I glued, attached Velcro, and nailed five-inch horse shoes onto a material closest to horses hooves. My hypothesis was incorrect in which would be the most effective materials and method to attach a shoe onto a horse. I predicted the glue would be strong enough for a horse without damaging the hoof, but the Velcro proved to be the best. Although my results did not support the hypothesis, my project did identify safer, effective options for shoeing horses. Velcro horseshoes would be an effective product and safe alternative to nails when attaching horse shoes to horses.

Summary Statement
My goal was to find alternative methods for shoeing horses that would be safer and effective.

Help Received
My biology teacher helped me refine my project and gave suggestions on how to execute it effectively. I conducted the experiments myself.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Eric D. Amezquita; David L. Hernandez

Project Number
J0303

Project Title
Domino Theory

Abstract

Objectives/Goals
The experiment was conducted to find out if the distance between domino's will affect how fast a marble will go. If the increase space between the dominoes will create more speed for the marble because of the contact with the domino's and the kinetic energy that#s transferred between the dominoes.

Methods/Materials
The experiment was formed by using domino's with different space in between them and used a set marble to measure the speed and distance of the impact from the dominoes.

Results
The experiment as seen, the dominoes 1 centimeter apart started to fall very quickly. While this was happening,the results were recorded by measuring the time and how far the marble went from its starting point. The next experiment with the dominoes 2 centimeters from each other, fell slower. The last experiment, the dominoes 3 centimeters apart fell about 2 seconds more than our first experiment. After the tests there were 3 different variables, the results were: 1 cm apart will have an average of 23.086cm per second, 2 cm apart dominoes have an average of 20.96cm per second, and 3 cm apart dominoes move at a rate of 19.87cm per second.

Conclusions/Discussion
The results proved the theory wrong. The hypothesis stated spaced out dominoes will transfer more kinetic energy to make the marble travel at a faster speed, but since the dominoes that were 1 centimeters apart created more kinetic energy because the dominoes had less time to fall, than the other spaced out dominoes. Now the fact is that the dominoes that are spaced out more will take more time for them to fall and won't have enough kinetic energy to transfer.

Summary Statement
We perused our hypothesis by spacing out the dominoes and explored the affect the speed of the marble had when contacted.

Help Received
This project was done between my partner and I only.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Michael P. Bedrosian

Project Number
J0304

Project Title
Comparing the Strength of Reclaimed Wood to New Wood

Abstract

Objectives/Goals
The objective of this study is to determine which type of wood is stronger. My goal is to determine if reclaimed wood is stronger than new wood. Reclaimed wood would give builders a recyclable option for their building materials.

Methods/Materials
Fabricated 10 32" by 1 1/2"length wood planks of each new and reclaimed Douglas fir and Redwood types(40 planks). Used rope, cement blocks, scale, trough, sand and various weights. Stacked cement blocks 16" apart side by side and placed wood on top. Wood planks are center between blocks. Rope tied to plank of wood and trough. Trough gradually filled with weights and sand till board breaks and weighed. Procedure repeated 10 times for new and reclaimed Douglas fir and Redwood wood types. Results are recorded and a strength average is given for each wood type.

Results
The results of my investigation on comparing the strengths of new and reclaimed wood shows that reclaimed wood is stronger than new wood. On the two types of wood tested, new Douglas fir had a strength average of 157 lbs. vs. 164 lbs. reclaimed Douglas fir. The reclaimed Douglas fir is 5% stronger than new Douglas fir. New Redwood had a strength average of 130 lbs. vs. 190 lbs. reclaimed Redwood. Reclaimed Redwood tested way higher with a 33% strength average difference over new Redwood. This further proves that reclaimed wood is stronger than new wood.

Conclusions/Discussion
I found that my hypothesis for reclaimed wood being stronger was correct. The reclaimed Douglas fir was slightly stronger than new Douglas fir which was not significant. However reclaimed Redwood was much stronger than new Redwood which was very significant. The tests supported the research that reclaimed wood is stronger than new wood. People can make important building decisions as to which what type of wood to use for strength and durability if they knew which wood is stronger. Better quality and more sustainability, is a win win for our environment. It is not always true when we say,"In with the new and out with the old."

Summary Statement
I compared the strength average of reclaimed wood to new wood, and reclaimed wood was stronger in both types of wood.

Help Received
The following employees of National Raisin Co. did the fabrication of the wood planks; Frank Reyna, James Vance, and Phat Phan. Marc Mandel owner of Crossroads Lumber the selection of reclaimed wood.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Aidan T. Byrnes

Project Number
J0305

Project Title
Avian Dangers: Developing Devices for the Prevention of Bird Strike

Abstract

Objectives/Goals
I am very interested in aviation, and I know from past research that bird strikes are a danger to air travelers. I decided to try to test devices I developed to find the most effective method of preventing bird strike in the hope of reducing these dangers. I hypothesized that a device I constructed intended to deflect birds would be the most effective and that a device intended to destroy birds would be least effective.

Methods/Materials
I tested using simulated "birds" which were chunks of potato fired from a potato gun which I built. For each test, I loaded the potato gun, aligned the potato gun with the fan, which was mounted in a special device which I built, turned the fan on, and fired the potato gun. After 20 tests for each device, I tested another one and repeated the process.

Results
I tested over 70 times in total, in the process of testing three devices I developed which were a mesh cone as the deflection device, a flat sheet of mesh as the blocking device, several blades of steel as the destruction device, and a control. I found that the device I constructed intended to block birds was most effective at protecting from bird strikes, followed by the deflection device, followed by the destruction device. The blocking device prevented any damage to the fan, but sustained a great deal of damage to the device itself. The average device damage rating for the blocking device was 1.8, meaning that the damage on average to the device was minor, and the average device damage rating for the deflection device was 1.3, meaning that the damage was even more minimal. According to my rating scale, this was a difference in damage ratings of 29% between the two devices. The deflection device sustained damage to the engine in several tests, however, making the deflection device second place on the effectiveness scale.

Conclusions/Discussion
My findings in this project might be used to help design future bird strike prevention devices, in which finding an inexpensive and effective design would be crucial. My findings might also be used to design new bird-strike preventative shock cone intakes for ramjet engines.

Summary Statement
I am very interested in aviation, and the goal of my project was to develop and test devices to prevent bird strikes in the future.

Help Received
My mother, Karen Byrnes, drove me to stores so that I could acquire necessary materials and supervised my project for safety reasons. My science teacher, Roxanne Hunker, helped me to refine my project and loaned me several pieces of equipment which I required.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Sophia Calvillo; Sarah Fong

Project Number
J0306

Project Title
Prosthetic Leg Support for a Disabled Dog

Abstract

Objectives/Goals
The objective is to build a prosthetic limb support for a disabled family dog who has only a deformed front leg and two healthy rear legs.

Methods/Materials
Moldable plastic, Velcro, neoprene, hot glue, and rubber shoe soles. Timed dog with and without the prosthetic support in different environmental conditions, multiple times, and in multiple places.

Results
Our dog was tested with no prosthetic support, his old supporting device, and our prosthetic support. Repeated trials were conducted in various locations to measure: time over short distances, endurance, and behavior. Results showed the dog was faster over short distances, had greater endurance, and a reportedly happier demeanor and was more energetic while wearing our prosthetic.

Conclusions/Discussion
Based on the multiple trials and days of use, we found the dog performed better in all measurable categories. We further found that as he became used to wearing our device his owners reported the dog was able to exercise for much longer periods of time and was now able to socialize and play with other dogs which he was not able to do before.

Summary Statement
We created a prosthetic leg support that greatly improved a disabled dog's ability to run outside, play, and socialize with other dogs.

Help Received
My partner and I designed and built the prosthetic leg support by ourselves with input from our science teacher Mrs. Eno of St. Joseph Elementary School and we received feedback from the dog's owners.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Michelle Chen

Project Number
J0307

Project Title
Exploring the Mechanical Strength of Stent Samples with Different Patterns and Strut Widths

Abstract

Objectives/Goals
The purpose of this study is to evaluate the mechanical strength of each stent, the strength needed to compress it, based upon varied patterns and struts width.

Methods/Materials
I tested the mechanical strength of stent samples with different patterns and struts widths. I used stainless steel tubes and a laser cutter to create my stent samples and a force gauge to measure the mechanical strength of each stent sample.

Results
Several stent samples were tested to find out whether the mechanical strength of the stent will change when the struts width and pattern is changed. The greater the struts width and the larger the number of rings, the more the mass that the stent has. The 10 rings performed much better than the 6 ring stents and the 10 ring 500 micrometer struts width stent performed the best of them all proving that mass affects the mechanical strength of stent samples.

Conclusions/Discussion
The repeated trials of testing the mechanical strength of the stent samples proved that the 10 ring 500 micrometer struts width stent samples performed the best of them all. Every time the size of struts width was at its thickest and the number of rings was at its most, the mechanical strength of the stent sample was the highest and this directly related to the mass of a stent. Therefore, I concluded from my experiment that the mass of a stent does affect the mechanical strength of a stent sample.

Summary Statement
Through my trials I found that, every time the size of struts width was at its thickest and the number of rings was at its most, the mechanical strength of the stent sample was the highest and this directly related to the mass of a stent.

Help Received
I designed the stents then had them cut. I performed all of the trials, research, and analysis of the findings, independently. My mom, Joan Bei, get them cut and my teacher, Ms. Furtado, helped me understand my research and findings better.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Jack Daffin

Project Number
J0308

Project Title
Nitromethane Engines

Abstract

Objectives/Goals
The purpose of my project was to determine if the RPMs would differ when more fuel is added to a nitromethane engine.

Methods/Materials
I used a household drill with an adapter to manually start a .21 nitromethane engine. A glow plug igniter was used to ensure the drill was going clockwise, and the RPMs were measured when the drill would cause the engine motor to turn over. RPMs were measured at 3 settings: idle, half throttle and full throttle.

Results
The data I collected indicated that the RPMs rose as more throttle was given. The result in idle was 7,018 RPMs; at half throttle the result was 13,046 RPMs; and at full throttle the result was a high of 20,647 RPMs. These are the average results for each throttle setting.

Conclusions/Discussion
In conclusion, the results of the testing proved my hypothesis correct in that the RPMs of a nitromethane engine increase when more fuel is added. My project demonstrates how nitromethane engines differ from every day gasoline engines and how RPMs differed from each other.

Summary Statement
My project is about nitromethane engines based on the hypothesis that when more fuel is added to a nitromethane engine the RPMs will increase.

Help Received
None. I designed, built, and performed the experiments myself with adult supervision.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Natalie R. Dean

Project Number
J0309

Project Title
What Does a Simple, Low Cost, 3D Printed Design for an Automated Robotic Hand Look Like?

Abstract

Objectives/Goals
With up to one million people in just the United States reported to be missing limbs due to birth defects, injuries, or illness, the need for replacement prostheses is extremely medically important. Furthermore, an equal need exists to make artificial limbs easy to manufacture and assemble at affordable costs so that more people can benefit.

Methods/Materials
A 3D-printed design for a robotic hand was created and sized appropriately to comfortably fit a child near ten years of age. 3D CAD software (123D Design by Autodesk) and a 3D printer (Da Vinci 1.0 Pro by XYZprinting) were used. Commercially-available materials (for example, polyactic filament) and components (for example, monofilament and cotter pins) were selected. Simple geometric shapes and basic 3D CAD software functions were used while creating the design.

Results
The design resulted in a very low-cost and effective robotic hand solution. This design can be scaled larger or smaller using the 3D printer software to create hands for different sizes/ages of people. The entire hand was 3D-printed in just over 19 hours and for less than $10. The parts were designed to be interchangeable, so only a few spares need to be kept by the recipient. Assembly is easy for the user and requires simple hand tools and a short amount of time.

Conclusions/Discussion
The 3D-printed hand functions manually with individual finger movements. Simple tasks such as grabbing and picking up can be achieved but not as easily as expected. Movement of the fingers takes more force/effort than expected, and the fingers do not bend as much as expected. However, the overall design requirements for the hand were achieved.

Summary Statement
Commercially-available software and hardware (3D CAD and 3D printer), materials, and components were used to create a simple 3D-printed design for a robotic hand.

Help Received
None. I designed, built, and performed the experiments myself.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Anna N. Dunn

Project Number
J0310

Project Title
Knee Kindness

Abstract

Objectives/Goals
The objective is to determine which tennis and running surfaces have the least impact on your knee.

Methods/Materials
I will weigh unused and unopened tennis balls and record their weight. I will drop the tennis ball from the same height 20 times on each of the different surfaces and record the results. This will be done by dropping a tennis ball from the top of a yard stick. I will record this on a slow motion camera for accurate results.

Results
In this experiment potential energy was measured twice. The first potential energy before the ball was dropped and the second potential energy at rebound height. The difference is the amount of energy absorbed onto the surface. The higher the rebound the worst for the knees. In the case of the tennis surfaces, the artificial turf was the kindest to the knees. The hard surface tennis surfaces were the hardest on the knees as they had the greatest bounce. In the case of the running surfaces, the ground was the kindest on the knees, followed by the track surface, next came concrete and last was asphalt.

Conclusions/Discussion
The harder the surface the less energy is absorbed into the surface and thus has the greatest potential to cause knee injuries. Conversely, the softer the surface the more energy is absorbed and thus has the least potential for knee injuries.

Knee injuries are the most common injuries for both tennis players and runners. The surface that athletes use has the potential to help prevent knee injuries.

Summary Statement
By measuring the rebound height of a tennis ball on various tennis courts and running surfaces, I found that the higher the rebound height the less energy was absorbed into the surface and thus had the hardest impact on the knees.

Help Received
I designed and analyzed the experiment myself. I did have someone videotape the experiment using a slow motion camera.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Marco R. Evans

Project Number
J0311

Project Title
The Heat is On: Reusing and Repurposing Heat Loss from a Clothes Dryer

Abstract

Objectives/Goals
My goal was to design an efficient heat exchanger to recapture the heat lost from a household clothes dryer. The recaptured heat was used to heat our laundry room.

Methods/Materials
I constructed a test box to measure the temperature changes of each design and measured the temperature changes with two digital thermometers. First, I tested the designs in the test box and then I tested each design in the laundry room. The problem can really be broken down into two steps; the exchange of heat from the heated dryer air to the heat exchanger and then from the exchanger to the room air. I started with the simplest design of a pipe with fins and progressed to a box that affected both the area available for heat exchange and the type of air flow.

Results
The greater the surface area of the design, then the more heat was exchanged. A simple pipe in the test box changed the temperature in 30 min by 12.9C, while the pipe with fins (1.7x larger) changed the temperature by 21.4C. The second design was a rectangular box which had a surface area 2.5 times greater than the pipe and raised the test box temperature by 23 C and by adding fins it raised it by 37C. Inserting baffles in to the rectangular box, created turbulent air flow that further increased the heat captured. I calculated both the heat capacity of the air in the test box and heat transfer in the laundry room.

Conclusions/Discussion
I was able to test 3 different heat exchanger designs that recaptured heat from a clothes dryer. Increasing the surface area increased the heat exchange and fins transferred more heat. Heat transfer was also affected by the type of air flow since the insertion of baffles lead to more heat transfer. Even though the heat exchangers captured only some of the heat from the dryer, it was enough to heat our laundry room and reuse some heat that would have been lost to the environment.

Summary Statement
I designed and tested heat exchangers to capture and reuse the heat lost from a clothes dryer to heat a room.

Help Received
Jim Evans and Bob Rosenbloom

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Espen G. Garner

Project Number

J0312

Project Title

Buzz Trap: Designing an Unmanned Aerial Vehicle to Trap Mosquitoes in Remote Locations for Scientific Testing

Abstract

Objectives/Goals

My project was to determine if I could design an unmanned aerial vehicle (UAV) to fly to a remote area, trap mosquitoes, then return them for scientific testing to help map and predict the spread of viruses.

Methods/Materials

I constructed a high powered unmanned aerial vehicle with a 3D printed mosquito trap of my own design using 123D Design software. The UAV is light weight, includes solar panels to extend the flight range and on-site collection time, and incorporates GPS for autonomous flight with a live-streaming camera for enhanced manual control and maneuverability. The trap has UV lights and produces CO2 to attract mosquitoes.

Results

Experiments revealed the trap with UV light and CO2 production was most effective in attracting mosquitoes. Calculations revealed that the addition of solar panels to the UAV would significantly increase the flight range by allowing the battery to recharge during collection, effectively doubling the range of the drone. Testing in a natural mosquito habitat confirmed the efficacy of the trap in catching mosquitoes and returning them for testing.

Conclusions/Discussion

My conclusion is that a carefully designed unmanned aerial vehicle with a UV light and CO2 collection trap can be flown to gather mosquitoes in remote locations, then, through the use of attached solar panels, it can recharge in order to power a return flight back to the research lab for testing.

Summary Statement

I designed and tested a self-constructed unmanned aerial vehicle with a 3D printed mosquito trap to be used for mosquito collection and sampling in remote locations to help map and predict the spread of viruses.

Help Received

I designed and built the drone myself, with help troubleshooting problems from Mr. Darren Jones. Ms. Ashley Ricart allowed me to use the 3D printer at school to print my self-designed trap. I received background information from Mr. R. Cummings at OC Vector Control.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Zachary N. Goldberg

Project Number
J0313

Project Title
Trebuchet: The Counterweight to Payload Ratio

Abstract

Objectives/Goals
The objective of this study is to measure the largest launch distance of a trebuchet with varying counterweights.

Methods/Materials
Four meter tall trebuchet (That I constructed at home), measuring tape, multiple counterweights, three 250 gram miniature basketballs. Launched basketballs ten times with each of three counterweights and measured distance.

Results
Identical basketballs were launched ten times with each of three different counterweights and their launch distances were measured. The launch distance correlated directly with the amount of weight.

Conclusions/Discussion
Repeated trials showed that a heavier counterweight increases the velocity of the payload at launch. However, drag and structural soundness are large factors in the launch distance of a trebuchet, and eventually a heavier counterweight may fall short.

Summary Statement
I designed and built a trebuchet and showed that a heavier counterweight increases launch distance, but drag and structural soundness play a large factor.

Help Received
I designed and built the trebuchet myself with general ideas from several trebuchet hobbyist websites. The experiment was conducted by my father, my brother, and myself.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Zuriel Erikson V. Joven

Project Number

J0314

Project Title

Using 3D-Printing Technology to Improve the Cost-Efficiency of the EyeWriter

Abstract

Objectives/Goals

The goal of this project was to increase the cost-efficiency of The EyeWriter by utilizing 3D-printing technology.

Quick Background Info: The EyeWriter is an eye-tracking device that allows Locked-in Syndrome (paralysis excluding the eyes) patients to use their eyes like mouse cursors on a computer screen. The EyeWriter is a public project initiated by Zach Lieberman with the goal of providing low-cost eye-tracking technology to patients. I sought to improve the cost-efficiency even further.

Methods/Materials

Software with a "Catch Me" mode created by Zach Lieberman. The standard* EyeWriter was created following the directions posted on instructables.com/id/The-EyeWriter. The 3D-printed model was designed and built with no instruction. Tested both prototypes using the Catch Me mode, in which a box is randomly placed on the screen, and stays until the eye cursor is placed on it for 1.2 seconds.

*standard refers to the EyeWriter design created by Zach and currently used (no 3D printing); it acts as the "control" for comparison

Results

The average speed of the standard EyeWriter was 9.8 boxes caught per minute. The average speed of the 3D-printed EyeWriter was 11.4 boxes per minute. The cost of the standard EyeWriter was $42.45. The cost of the 3D-printed EyeWriter was $34.89. The cost-efficiency of the standard was 0.23 boxes/minute/dollar. The cost of the 3D-printed model was 0.33 boxes/minute/dollar. The 3D-printed EyeWriter is 43% more cost-efficient than the standard.

Conclusions/Discussion

This experiment shows that I successfully improved the cost-efficiency of the EyeWriter with 3D-printing technology. This means more Locked-in Syndrome Patients can be treated more effectively with less money. Future projects should probably also utilize 3D-printing technology to maintain cost-efficiency.

Summary Statement

Utilizing 3D-printing technology, I improved the cost-efficiency of the EyeWriter, an eye-tracking device for Locked-in Syndrome patients, who can only control their eyes.

Help Received

Zach Lieberman's instructions allowed me to build a replica of the standard and currently used model, and his software is necessary to use the device. While I designed and built the 3D-printed prototype myself, my friend Nathan Smith allowed me to use his 3D printer.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Sakshi Kumar; Nithila Poongovan

Project Number

J0315

Project Title

Poop Patrol: Simplifying the Interaction between the Visually Imapired and Their Service Dogs

Abstract

Objectives/Goals

The objective of this project is to build a device that makes it easier for the visually impaired service dog owners to know when their guide dog is excreting waste.

Methods/Materials

Tested different magnetic proximity sensors and magnets of different strengths to find best combination with largest range. Bought remote doorbell to connect to the sensor. Bought knee braces for the guide dog. Attached device on the knee braces. Tested the device by having guide dog sit in the squatting position where one front leg and one back leg come close. If the doorbell rang, then device would be successful.

Results

Out of three trials, the door bell rang two out of the three times, making the device successful. The door bell did not ring the first time because the sensor was positioned a little off (human error).

Conclusions/Discussion

Overall, the device was successful, and user-friendly. The guide dog seemed to have no irritation on skin. The device was comfortable. The visually impaired seemed comfortable with the device too.

Summary Statement

I engineered a successful device that detects when a guide dog's front leg and hind leg are very close, setting off an alarm and letting the visually imapired know when their dog is excreting waste.

Help Received

My team coach helped my team with the component selections of the device.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Felimon Charles L. Legaspi, III

Project Number

J0316

Project Title

To Bridge or Not to Bridge? Truss, Arch, Beam, or Suspension? Strength, Efficiency, and Seismic Safety of Bridges

Abstract

Objectives/Goals

My goal is to determine which bridge is the strongest, most structurally efficient, and most earthquake-resistant, thus safest for all.

Methods/Materials

To make the bridges, I used balsa wood strips, beads, thread, glue, an X-acto knife, weight scale, bucket, rope, an earthquake simulator, and stopwatch. To make the earthquake simulator, I used plywood, an air hockey table, skate wheels, brackets, rubber bands, screws, nails, and a 120-volt drill. I created and tested 4 types of bridges: a beam as my control, truss, arch and suspension. To test the bridges for strength, I found the maximum weight each type of bridge could hold before breaking. I put the bridge on top of an earthquake simulator, tied it to a bucket below, and added weights in increments of 1 lb. each to the bucket. The maximum weight when the bridge collapsed determined its strength. To test the bridges for efficiency, I weighed each bridge, and the maximum supported weight by the bridge on a weighing scale. I used the structural efficiency calculation by dividing the maximum weight supported by each bridge by the bridge#s own weight. To determine seismic safety, I tested the bridges on the earthquake simulator, and observed how long they stood before collapsing.

Results

The suspension bridge was the strongest, carrying the most weight of 32 lbs. or 32 times more weight than the beam bridge. It is also the most structurally efficient as it supported the most weight in proportion to its own weight, with the highest efficiency score of 88 grams, or 85% more efficient than the beam. It was also the most seismic resistant because it withstood the earthquake simulation for the longest time, with an average standing time of 488.41 seconds. This bridge#s stability substantially increased by 3,416% than the control bridge. This suspension bridge performed the best overall among all the bridges I tested.

Conclusions/Discussion

In conclusion, the suspension bridge is the strongest, most structurally efficient, and most earthquake-resistant than the other bridges. It is the strongest because it supported the most weight, and is best in seismic safety when it resisted earthquake forces for the longest time. It is also the most structurally efficient because it carried the most weight in proportion to its own weight. It performed the best in all 3 categories because it withstood the compression and tension forces more than the other bridge types.

Summary Statement

After conducting multiple tests, I found that the suspension bridge I created is the strongest, most structurally efficient and most earthquake-resistant than my control beam, truss and arch bridges.

Help Received

I thank my parents for their overall supervision and assistance in buying the bridge and experiment materials, and my grandfather who helped me build an earthquake simulator.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Sean Li; Aditi Raju; Alex Shin

Project Number

J0317

Project Title

Formulating Novel Acoustic Designs for Varying Building Layouts to Absorb Excess Ambient Noise and Increase Productivity

Abstract

Objectives/Goals

Unseen and undetectable, noise pollution is a severely unaddressed issue in the world. Yet its effects are widespread, affecting everyone, and significantly dangerous, leading to severe hearing problems, increased heart disease risk, disrupted sleep, and drastically reduced productivity. To combat this issue, the purpose of this project was to formulate a cheap, practical, yet effective novel method of sound insulation for all buildings, that reduced outside noise and sound transmission, improved residents# health and increased productivity.

Methods/Materials

To construct the prototype, a scaled down version of real-life building structures was built, with the addition of an optimal combination of soundproofing materials, including plywood, fiberglass, stone wool, mass loaded vinyl, drywall, and double pane windows, in a right parallelepiped of dimensions 7x11x13in. The final prototype consisted of two separate identical floors, fastened with nails and glue. The model then was tested with controlled 90 db beeps outside each lateral surface, and a sound meter inside to measure the amount of absorbed sound.

Results

The resulting sound after passing through the final prototype averaged at 45 db. In other words, it was able to reduce noise transmission by 45 db, which is 33 percent more effective than typical buildings.

Conclusions/Discussion

Overall, the project was a huge success. With a practical structure, it can easily be implemented into existing or new urban structures and benefit all residents. Made of cheap materials, the prototype#s benefits are undeniable. With its effectiveness, practicality, and cheap costs, this novel acoustic method benefits residents and improves health and productivity for all.

Summary Statement

The group formulated a novel acoustic design for building sound insulation that increases resident health and productivity by decreasing noise pollution by 45 db.

Help Received

The group independently created the design after extensive research on acoustics, after which our science teacher reviewed the prototype.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Isaac A. Linares Sanchez

Project Number
J0318

Project Title
Improved Railroad Gates

Abstract

Objectives/Goals
Objective: My project is to improved railroad gates by making them stronger and bigger, as well as making sure that cars can#t cross over easily. I think that if we use a metal gate that comes out from under ground will work better, than just having two wooden arm gates come down.

Methods/Materials
Materials and Method: Using Popsicle sticks and wire I built a jack that will push the metal gate to the surface of the ground. The gate was made with cardboard and wrapped in foil paper to make it look like metal. At the bottom of the jack I attached one syringe and handy plastic tubing connecting to a second syringe, that were filled with water. This allows the first syringe to push water to the second syringe and giving force to push the jack so that it will move upward, and the other way around to make it go down. A box was used to create the surface of the ground and inside the box is the structure of the hydraulic mechanism used. The inside of the box also represents underground. In the real world this hydraulics will be controlled by a motor and the motor will be activated by sensors around the train tracts. Once a train reaches the sensors, the sensors will activate the motor that will make the hydraulics do their job. In my project I my hands will push the syringe to show how it will work.

Results
Results: The gates go up with the push of the syringe attached to the outside of the box to the syringe inside the box. My hydraulic gate did work as planned. I used a toy car to test my metal gate and my result was that the car did not cross over the gate.

Conclusions/Discussion
Conclusion: My project after all was able to work properly, but I did learn that in order for hydraulics; in general, to work they need an equal amount of liquid of some type. Also hydraulics rely on other hydraulics to do their job. I believe that this idea can save more lives and avoid more accidents between trains and motor vehicles.

Summary Statement
My project is about how hydraulics can be used to improved railroad gates.

Help Received
I designed and built my project after i reseached how hydraulics work by warching a youtube video. I came up with the idea of improving the railroad gates by using hydraulics. My mother also help me built my model only when i had to use adult tools. I performed the experiment myself.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Vishnu Matta; Ayush Sheth

Project Number

J0319

Project Title

iTherapy: Robotics Companion for Physical Therapy

Abstract

Objectives/Goals

Children with special needs may have gross motor skills issues. To improve gross motor skills kids go to physical therapy. One of the basic exercises is kicking a ball. This involves two persons, the therapist, and the assistant. Our goal is to build a robot that can substitute for the assistant for this exercise. When the patient kicks the ball, the robot would go and get the ball and roll it back to the patient, instead of the assistant. Our robot becomes especially useful when such exercise needs to be performed at home, where both parents are required to perform this exercise.

Methods/Materials

To build the robot we used the Vex IQ kit. The robot needed to accomplish 4 tasks, detecting where the ball was, picking up the ball, retreating to the throwing position and throwing the ball back to the patient. The experiment was done in phases. In Phase 1 we built a robot that accomplished the above tasks with manual control. Phase 2 we automated the throw of the ball. Phase 3 we tried to automate detecting the ball, picking up and throwing back to the patient.

Results

In phase 1, we found human control had varying results, based on the skill of the robot driver. In phase 2, we found far more consistent results with an automated throw. For the full automated operation in phase 3, we first tried the bumper switch to detect the ball, but when we tested it the switch wasn#t sensitive and the ball kept moving. Then, when we tried to use the color sensor, with a bright color ball. The color sensor resulted in improved detection, we plan to continue to improve the automation using additional sensors.

Conclusions/Discussion

Our conclusion is with improved sensors this robot can be used in the physical therapy offices and households to train special needs kids for improving their gross motor skills.

Summary Statement

Robotic assistant for physical therapy for children with special needs, to assist in exercises for improving gross motor skills.

Help Received

For phase 3 automation of the robot and reliable performance with respect to detecting the ball, we reached out to professors from various universities. We received advice from Prof. Aaron Steinfeld of Carnegie Mellon University. We have incorporated his feedback to our project.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Sophya Mirza

Project Number
J0320

Project Title
Decoding the Artificial Intelligence behind Tactile and Photocell Navigation

Abstract

Objectives/Goals
The purpose of this project is to revolutionize the idea of using sensors instead of joy sticking a ride to places like mars or finding new terrain for people like scientists and U.S Military agents that are navigating through unknown areas. My objective is to use mathematics and the language of Parallax Stamp to decode the artificial intelligence behind the robots in which one has a tactile, touch sensory detection embedded in its hardware and software and the other photo transistors, light sensors embedded in its software and hardware, in which then is tested in a challenge of efficiency and a race against time. The first question I asked myself was, What mechanism, the robot with the tactile or the robot with the photo transistors can complete the obstacle course more efficiently and at a quicker time? After completing the first step in the scientific method, I thought up a hypothesis in which was based on the idea that the mechanism with the photo transistors would complete the course better than the other robot.

Methods/Materials
I began to develop this project by using the scientific method. After figuring out the use of this project, my hypothesis and research, I began to build the two robots. In the lightest and most basic terms, both of the robots consist of adrinos, micro controllers, two servos per robot, and battery packs. After developing the robots and completing small hardware installments such as resistors, LED bulbs and etc, I began to develop the software for the robots. The final steps in my process of developing this project was to design and build my obstacle course.

Results
My hypothesis was based on the idea that the mechanism with the photo transistors would complete the course faster, but it turned out the results indicated that the tactile sensors completed it faster and more efficiently. The tactile AKA whisker sensors completed the obstacle course in 34.19 seconds and the photocell sensory device took 49.38 seconds showing a clear winner the tactile sensory detection system!

Conclusions/Discussion
In conclusion, this experiment helped me as a student and a young engineer to realize that if something can be made easier, in this case testing out different sensors to find the more efficient one to use instead of a human in controls, why not use it. I drew conclusions from my results and learned that the tactile sensors would help a lot in navigating through any kinds of terrain.

Summary Statement
My project compares the efficiency of two robotic mechanisms, one with tactile sensors and the other with phototransistors inscribed in the two robots software and hardware that are in a test against time and efficiency.

Help Received
I didn't get any help from anyone. I designed, built, and performed the experiments myself, but my science teacher Ms. Pearson helped me to put my thoughts together in complete and ethical ways.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Maggie E. O'Rourke

Project Number
J0321

Project Title
Deep Knee Bends

Abstract

Objectives/Goals
The objective is to find how much stress is put onto the knee using a mechanical model.

Methods/Materials
Made a wood and spring model of the knee to test how much stress is put onto the knee depending on the angle. Used wood, power drill and bits, screws, hinges, two springs (different sizes: 1 1/2 inch and 2 1/2), protractor, metric ruler, journal.

Results
When the mechanical knee was bent at the maximum point (which was 20 degrees), it put the most stress on the knee and the force doubled.

Conclusions/Discussion
Built a mechanical model of a knee to measure how much stress was put onto the knee depending on the angle. It is concluded when the knee is bent completely, (20 degrees) the most stress was put onto the knee as the spring expanded the most. The force doubled from a normal standing position (105 degrees) to when bent completely (20 degrees).

Summary Statement
I built a mechanical model of a knee to see how much stress is put onto the knee depending on the angle.

Help Received
My dad and I built the mechanical model, Ms. Katherine Moreno, my science teacher, helped me to understand Hooke's law, and Chris Donohoe helped me with my measurements and graphing.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Beck T. Pedersen

Project Number
J0322

Project Title
Pneumatics vs. Hydraulics

Abstract

Objectives/Goals
Pneumatic/hydraulic systems are used in a wide variety of applications such as toys, construction equipment, and robotics. The goal of my project was to determine whether a hydraulic or pneumatic system could generate more force. The amount of force a pneumatic/hydraulic system can generate determines the type of uses the system would be most appropriate for.

Methods/Materials
I made a crane-like arm with an Erector set, and a pneumatic/hydraulic system using two 60 mL syringes connected with plastic tubing. The arm was operated by depressing the plunger of one syringe, which forced the plunger of the other syringe (connected to the arm) to expand, and made the arm push down on a scale. I filled the pneumatic/hydraulic system with different substances, and with each substance measured the maximum force of the arm pressing down on the scale. I tested the force of air (pneumatics), water (hydraulics), and canola oil (hydraulics).

Results
The hydraulic force generated with water was greater than the pneumatic force generated with air. I was not able to successfully measure the hydraulic force generated with canola oil because it was too thick to work in my system properly. Measurements of hydraulic force generated with water was approximately 60% stronger than the pneumatic force generated with air.

Conclusions/Discussion
My experiment indicated that the hydraulic system generated more force than the pneumatic system, and suggests that hydraulics should be used for projects requiring more force such as moving heavy objects. I think the hydraulic system generated more fluid power because water is not compressible and air is highly compressible.

Summary Statement
I made a mechanical arm operated by a pneumatic/hydraulic system filled with various substances to test which system and substance generated more force.

Help Received
I designed and built the mechanical arm and hydraulic system myself. I performed measurements with some assistance from my father.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Lauren A. Reilly

Project Number
J0323

Project Title
On Course: A New Device in Backstroke Efficiency

Abstract

Objectives/Goals
Beginning backstroke swimmers are having a difficult time swimming straight and preventing collisions. If these swimmers were given the ability to see where they were headed, would they swim straighter and/or faster? Will making special goggles that would change the direction of focus using prisms and mirroring allow backstroke swimmers to see where they were going and give them a better sense of direction? The prism goggles will reflect images at different angles. The refracted images will be viewed by the eyes of the swimmer, which will give them the ability to see behind them.

Methods/Materials
Using store-purchased goggles as the base for the invention, I glued and sealed prisms with silicon glue to the lenses of the goggles. Test subjects were videoed swimming a 50m backstroke once without the prism goggles in order to obtain a baseline, and three times with them using the prism goggles. The subjects# accuracy and speed were determined by analyzing the film.

Results
My hypothesis regarding the improvement of accuracy was proven to be correct. Out of seventeen test subjects, nine showed improvements in swimming straighter in their assigned swim lane. I believe that this is a result of the ability to see where they were going with enhanced visual awareness. My hypothesis regarding the improvements in speed was not proven to be correct. Out of seventeen test subjects, only one test subject showed improvements in time while using the prism goggles.

Conclusions/Discussion
In conclusion, the prism goggles that I engineered did have a positive impact on the abilities of novice backstroke swimmers. The ability to see where they were headed allowed the swimmers to swim in a straighter line. Further testing with improved conditions and more subjects would better support my hypothesis. I hope to continue my experimentation using my prism goggles to enhance the performance of beginning backstroke swimmers.

Summary Statement
I created prism swimming goggles to improve backstroke accuracy in novice swimmers by allowing them to see where they were headed.

Help Received
I was supported by interviewing swim coaches & optometrists and my science teacher guided my research and results.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Preston D. Reynolds

Project Number
J0324

Project Title
Teenage Transportation: Can It Be Improved?

Abstract

Objectives/Goals
Can teenage transportation be improved? My engineering application project includes an original design and build of an electric powered skateboard that provides teenagers with a fun, efficient, low cost, environmentally friendly transportation solution.

Methods/Materials
Using the round trip between my house and Pasadena High school as a test loop, I compared the time, energy, cost and carbon footprint of six different transportation methods that a teenager could potentially use.

Results
Although, walking or riding a bicycle turned out to be the most energy efficient and low-cost teenage transportation, my electric skateboard is 68% faster than walking and 22% faster than riding a bicycle. The car, bus and ride sharing were by far the most expensive using $ .78 of gasoline for the car, $1.75 for the bus fare and $12 for Lyft.

Conclusions/Discussion
However, for a few pennies a day, my electric powered skateboard design can greatly reduce the time for short trips. When you consider how much more efficient it is to ride my electric powered skateboard, it is clearly the best choice for teenage transportation.

Summary Statement
My project is about finding a better soution for teenage transportation.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Geneva D. Trovato

Project Number

J0325

Project Title

OB 1 (Orchard Bot 1): Building an Autonomous Robot

Abstract

Objectives/Goals

California has recently passed a law to increase the minimum wage. This means that it will cost more for orchards to pay humans to pick fruit. The objective for this project is to design an autonomous robot that is less expensive to pick fruit than paying a human. Three parts go into getting fruit, finding fruit, moving to the fruit, and picking fruit. To find the fruit, this researcher used a camera that can detect the color orange and an ultra sonic range finder to get the x, y, and z coordinates. To move to the fruit this researcher built a base that has wheels and motors and used programming. To pick the fruit this researcher designed an arm and claw plus used programming to reach the fruit. To conclude, yes there is a less expensive way to pick fruit than paying for humans to do it. This robot is not the final product, this student is planning of perfecting it for the next four years. This robot is a proof of concept.

Methods/Materials

A citrus picker, some Vex Robotics equipment, RobotC (a Vex Robots programming site), a camera, an ultrasonic range finder.

I programmed this robot with my dad's help.

Results

Several trials were ran by this robot. On the fourth attempt this robot successfully picked fruit on its own. A few problems occurred in the programming as well as the actual design of the robot, but they were fixed and now it works. This robot needs a bit of work, but it works and that was my main objective.

Conclusions/Discussion

In conclusion, the robot that this researcher add is fully capable of picking fruit on its own. Some design issues occurred, but they were taken care of. This student not only has a robot that can pick fruit, but also has a larger knowledge base in robotics and coding. The main objective here was to build a robot that can do something on its own successfully and this objective has been achieved.

In the future, this researcher hopes to expand the robot's capabilities to not just picking oranges, but picking a majority of fruits. This researcher also plans on using Raspberry Pi instead of the VEX robotics cortex and to install treads instead of wheels. They also plan on developing new claws for different kinds of fruit and possibly testing the robot out on actual orchards to see how it would perform its main job.

Summary Statement

I created a robot that can pick oranges by itself using its programming and unique design.

Help Received

I built, programmed and designed this robot in my garage and in my yard by myself. I was helped by my father who is a physicist.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Sofia Velarde

Project Number
J0326

Project Title
Which 3D Printed Wheel Could Operate Most Efficiently on Mars?

Abstract

Objectives/Goals
Curiosity is the name of the rover that landed on Mars on August of 2012. Early on in the mission Curiositys two front wheels began to accumulate damage. Further on into the rover#s explorations, the wheel damage began to worsen causing the robot not to be able to take short routes to various mission sites. The wheel damage is a big problem because it restricts the scientist driving the rover reach different landforms in order to collect data. This is also the core purpose of sending a rover to Mars. The purpose of this science fair project is to design and 3D print different wheels that are able to withstand and drive through the many obstacles of Mars.

Methods/Materials
In order to design the wheels I used Sketchup, Netfabb, and Meshlab. After designing I used a Makergear M2e 3D printer to produce the wheels using PVA filament. I tested the wheel on a Martain simulated course using a Parallax ActivityBot robot that I programmed using Java Script.

Results
Wheel efficiency was tested using the time it took the robot to officially complete the two sections of the course. The results, in order from most efficient to least efficient, over the rock filled crater are Wave Wheel, Rover Wheel, Arch Wheel, Chevron Wheel, and Control Wheel. The results, in order from most efficient wheel to least efficient wheel over the incline are Rover Wheel, Wave Wheel, Arch Wheel, Chevron Wheel, and Control Wheel. In conclusion, the top two wheel designs were the Rover Wheel and the Wave Wheel.

Conclusions/Discussion
This project help discover qualities of a poor preforming wheels. Some of these qualities are: treads that are spaced too close together (chevron wheel), thin treads that are unable to have traction (arch wheel), and wheels with no treads that are unlikely to even scale obstacles (control wheel). The two wheels that lacked any of these poor qualities made them the most efficient wheel designs. For example, the rover that was sent to Mars in 2004 had an underdeveloped wheel design. The wheel design on the rover had straight treads, making the rover venerable to slide slip and punctures. Later in 2012, NASA created a more advanced wheel design that had a chevron pattern with a curved barrel-like structure. Still, this design had trouble navigating through Mars. This goes to show that even the smallest components, like the tread and wheel design, can affect the performance of a rover as a whole.

Summary Statement
In this experiment two wheels, one of my own design and one similar to NASA's design, were able to effectivly get over a Martain simulated terrain.

Help Received
I received help from my dad when using heavy cutting and hammering tools to create the base for the martian simulated course.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Jeanie C. Benedict

Project Number

J0399

Project Title

The Effect of Air Flow Restriction on the Performance of a Vortex Tube

Abstract

Objectives/Goals

A vortex tube has the ability to separate faster and slower moving air molecules. When compressed air is injected tangentially into a circular chamber, the faster (hotter) air molecules take the longer route on the outside, and the slower (colder) molecules are forced to the center. The swirling air exits on opposite ends of the chamber through two holes of different diameters, with the hot molecules exiting the large hole and the cold molecules the smaller. The objective of my project was to obtain the largest temperature difference between the two ends of my homemade vortex tube. I hypothesized that if I added a cap on the larger hole with a vent of various diameters, then the smallest vent diameter would provide the largest temperature difference.

Methods/Materials

I designed and built a wooden vortex tube. Relative amounts of air flow between the two holes were adjusted by using various vent diameters (independent variable) on the larger hole. Eight independent variable levels were chosen, including a control. My control was the largest vent diameter because that is where air stopped coming out the smaller hole; this meant all the air was exiting the larger hole. Five tests for each variable level were conducted. I measured temperatures with thermocouples and recorded data using a DATAQ (data acquisition) program.

Results

After testing my project and averaging my data to eliminate any variability in the measurement system, I found that the smallest vent diameter, 7.9 square mm, resulted in the greatest temperature difference, 5.9 degrees Celsius, between the two ends (smaller and larger holes) of the vortex tube.

Conclusions/Discussion

I designed and tested my homemade vortex tube. My results concurred with my hypothesis - the smallest vent diameter resulted in the largest temperature difference by providing the most selective passing of only the hottest air molecules from that hole. I believe if my design was optimized, it might be possible to separate lighter from heavier gasses or separate water vapor or oil vapors from compressed air.

Summary Statement

My project#s purpose was to find the optimum configuration which provided the largest temperature difference between the two ends of my homemade vortex tube.

Help Received

My dad helped me with the set up of the DATAQ (data acquisition) program.