CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Sunil K. Alexander

Project Number
S0901

Project Title
Fibonacci Solar Array vs. Regular Panels on a Roof

Abstract

Objectives/Goals
My goal for this project is to find out if the Fibonacci solar array will be better than roof panels.

Methods/Materials
Pvc pipes, wood, solar panels, wires. used the pvc pipes to make the tree. and the wood for the roof.

Results
The Fibonacci solar array proved to be more efficient by generating more energy than the roof.

Conclusions/Discussion
I found out that trees can teach us how to generate energy.

Summary Statement
I am trying to see if the fibonacci solar array would generate more electricity than regular panels on a roof.

Help Received
Psomasfmg engineer helped with the general idea of how to make project succeed; dad helped with building the project; neghbor helped with the supplies.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Josselyn Alvarez

Project Number
S0902

Project Title
Watts All This Talk about Radiation?

Abstract

Objectives/Goals
The goal of this project was to determine the amount of radiation a cell phone gives off and if the distance away from the cell phone affects the amount of radiation given off.

Methods/Materials
In this project, the researcher used a Digital Microwave Oven Leakage Meter to measure the amount of radiation released in mW/cm^2, a ruler to measure the distance away from the phones, and ten different brands of cell phones. First, the cell phone was placed on a table. The DMOLM was placed at a distance of 5 cm, then 10 cm, then 15 cm respectively away from the cellphone. Then, a phone call was made using another phone to the experimental phone. The amount of radiation was read as registered in the DMOLM. The phone was turned 180 degrees, then took the reading and recorded it. The same procedure was done with nine (9) other phones, three trials (both front and back) for each phone.

Results
The study proved that the bigger the distance between the phone and DMOLM, the less radiation was recorded.

Conclusions/Discussion
The Samsung SIV, one of the most commonly used phones, gives off the most radiation at three different distances.

Summary Statement
Measuring cell phone radiation emission.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Leela Amladi

Project Number

S0903

Project Title

Pill-Buddy Platform: A Smart Pillbox and Web App to Keep Patients on their Medication Schedules and Connect Caregivers

Abstract

Objectives/Goals

The objective of my project was to create a platform consisting of an Arduino-based pillbox and a web application, to assist patients in adhering to their prescription schedules. The goal was to create a pillbox that could notify caregivers when patients forget to take their medications, and to integrate a web-application that would provide an easy way for caregivers to communicate about prescriptions, and by extension, other topics relating to the wellbeing of the patient.

Methods/Materials

To build the Smart pillbox, I designed and built prototypes using Arduino open source hardware and software platform, photoresistors (used to detect if pills are still in their compartment), and LED#s and Piezo buzzers for alarms. The Smart Pillbox integrates Twitter with an Ethernet Shield in order to send tweets to caregivers when patients forget to take their medications. I designed the final pillbox prototype using Autodesk Inventor 3D modeling software and printed it with a 3D printer. To code the web-application, I used Python, specifically the Flask framework, and used it in conjunction with Jinja2 templating docs for the front-end, and MongoDB for the back-end database.

Results

The Smart Pillbox successfully notifies the patient when it is time to take pills; it accurately detects whether prescriptions are taken within ten minutes, and notifies caregivers using Twitter and SMS. The web-application successfully provides an easy-to-use interface for each caregiver and patient to make an individual account with which to modify prescription schedules. The web-application and pillbox successfully communicate with each other wherein the web-application assumes the responsibility for 1) notifying caregivers in accordance with modifications made to the #Followers# tab of a patient#s account, and 2) providing all users with a digital representation of the pillbox and the pills that should be filled in each compartment.

Conclusions/Discussion

My conclusion is that the Smart Pillbox with its integrated web-application is an intuitive and convenient way to keep patients on their prescription schedules, and to connect a community of caregivers around their patient#s Smart Pillbox, enabling them to improve patient care.

Summary Statement

A platform consisting of a Smart pillbox, that senses when patients forget to take pills and notifies patients and caregivers; and a web-application that connects a community of caregivers around their patient and to the Smart Pillbox.

Help Received

For the pillbox: Matt Garten, helped me learn Arduino, TechShop gave me a space to work and access to their 3D printer. For the web-app: Kedar Amladi introduced me to Python and helped me when I was stuck with the code.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Khachik Avagyan; Adam V. Smith

Project Number

S0904

Project Title

Wi-Fi Wizardry! Improving Wireless Network Signals for Multiple Home Computers

Abstract

Objectives/Goals

The real-world objective of this project was to improve the wireless reception of two personal computers by building and testing a parabolic reflector to collect, focus, and extend the range of a Wi-Fi (or wireless) router's radio waves -- thereby improving signal strength and bandwidth. Such reflectors have been used to effectively, if not actually, amplify wireless network signals through focusing radio waves for computers (as well as light and sound waves in other applications), thereby improving Internet connectivity and the downloading and uploading of information.

Methods/Materials

One control computer (a wired desktop computer adjacent to the router, both located on the first floor of a home) and two experimental computers (a wireless-enabled laptop computer on the second floor and a wireless-enabled home-built desktop computer on the third floor) were used to test their signal strength and bandwidth without and with a home-built parabolic reflector that was added to the existing router. This router had a state-of-the-art internal antenna. Over seven days, both quantitative and qualitative data were gathered.

Results

With the use of the parabolic reflector, both experimental computers showed improvements in the definitive metrics of signal strength and bandwidth on a daily basis and when the data was averaged. In fact, the gains were most impressive for the experimental computer on the third floor and farthest from the reflector-and-router assembly. For example, regarding bandwidth, this experimental computer improved most from an averaged ping rate of 67 ms to 64 ms and an averaged download rate of 2.58 Mbps to 2.60 Mbps. Moreover, this farthest experimental computer closely approached the fastest averaged download rate of the control computer, which was 2.61 Mbps.

Conclusions/Discussion

The conclusion, based on the data for both experimental computers, is that a parabolic reflector can improve the wireless network for computers that are separated from a router by significant distances and obstacles. This experiment sought to build upon previous research and expand knowledge by testing a smaller, space-efficient reflector with multiple distant computers, real-world obstacles, and a router that has an internal antenna. Such routers are the present state and possibly future trend for consumer routers.

Summary Statement

This project examined if a parabolic reflector would improve the wireless network for multiple wireless-enabled computers that are separated from a Wi-Fi (or wireless) router by significant distances and obstacles.

Help Received

Parents helped to purchase supplies and drive to libraries for research purposes.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Dominic H. Catanzaro

Project Number
S0905

Project Title
Measuring the Index of Refraction of Various Prisms at 2.4 GHz

Abstract

Objectives/Goals
Many people have experienced problems with the WiFi internet connection to their devices. WiFi signals can be distorted and redirected due to the materials in a house.
The purpose of this project is to measure the index of refraction and transmission of various construction materials at WiFi frequency to better determine the effect that those materials may have on WiFi signals in a home or office building.

Methods/Materials
Using WiFi antennas to test materials turned out to be very difficult. I built a test range based upon a test range that Robert Shelby had used for his experiments for his PhD dissertation on metamaterials at 10.5 GHz. I scaled Shelby's design using the ratio of 10.5 GHz to 2.4 GHz. For a source and detector, I used a hobbyist RADAR designed by MIT.
I measured the refractive index by swinging the receiver around the prism every 10 degrees. To improve the accuracy of the assessment of the refraction, I used a weighted average.
Transmission measurements were conducted by measuring the power with and without the sample.

Results
All the building materials that I tested had an index of refraction of less than n = 1.2. Both types of insulation had an index of refraction less than n = 1.05. The two materials with a lower index of refraction, such as the insulation, were not very dense. Most of the materials that I tested transmit more than 80% of the energy. However, the lumber stands out with a transmittance of less than 60%. The water measurements indicate that aquariums and water pipes are the most likely to absorb WiFi signals. Insulation with foil does not transmit a measurable amount of WiFi signal. The foam insulation that is supposed to be installed upright in walls to insulate against heat and cold could potentially insulate against WiFi signals.

Conclusions/Discussion
The test range that I built was effective for material measurements. This implies that scaling Shelby's model was effective. Using WiFi for a test range was unsuccessful. Using parts from the MIT RADAR was successful because the RADAR was actually a much simpler system than the WiFi.
When building a home or office with the best possible WiFi propagation in mind, the house or office should be built of drywall, particle board, fiberglass insulation and thin wooden beams. Buildings with metal beams or sheets in them will reflect and negatively effect the WiFi propagation.

Summary Statement
I measured the index of refraction of various construction materials to better understand WiFi propagation in homes.

Help Received
Father helped build the RADAR electronics; Used lab equiment at school under the supervision of Dr. Bertch and my father

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Shiloh S. Curtis

Project Number
S0906

Project Title
Enabling Situational Awareness: A Hat-Based Hands-Free Haptic Navigational Aid for the Visually Impaired

Abstract

Objectives/Goals
According to the American Foundation for the Blind, there are over 21.2 million visually impaired adults in the U.S. However, almost all commercially available aids for this population, such as the white cane, must be constantly hand-held, depriving users of the functionality of one hand. Guide dogs can cost $60,000 and have significant care requirements. Commercially available aids have little ability to detect face and torso level obstacles such as tree branches. To answer this need, I designed and constructed a hands-free assistive hat, the Haptic Navigational Aid for the Visually-Impaired (H-NAV), to detect nearby face/torso level obstacles and indicate their location to the user.

Methods/Materials
The H-NAV uses a Laser Distance Sensor (LDS) to detect obstacles and 12 vibrating motors inside the hatband to alert the user to the obstacles' presence and direction. The motors also indicate the approximate distance to the obstacle using the duration of pulsed vibrations. The H-NAV was designed to facilitate situational awareness and enable the user to avoid face and torso level obstacles. The prototype was tested by assessing users' ability to perform common navigational tasks while blindfolded and wearing the H-NAV, where successful completion required detecting and avoiding obstacles without straying off course.

Results
Most users had overall success rates above 80%. For individual tasks, all but one of the tasks had a success rate over 85%, and the least successful task had a 76% success rate.

Conclusions/Discussion
These results indicate that the H-NAV functions as intended. It helps in navigating in common environments and detecting common face/torso level obstacles.

Summary Statement
A hat-based navigational aid for the blind which indicates obstacle direction and distance via vibrating motors in the hat band.

Help Received
Neato Robotics donated four Laser Distance Sensors; Dr. Youssef Ismail provided technological advice; Homebrew Robotics Club advised on sensors and electronics; David Curtis supervised the project.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Suzanne Estella; Tyler Hutchins; Maleen Jayanath Wijeratna

Project Number

S0907

Project Title

Early Warning System for Earthquakes Based on Environmental Precursors

Abstract

Objectives/Goals

The main goal is to design, develop, implement and test a device which could provide an early warning system for Earthquakes. The purpose of this project will be to detect and measure four relevant earthquake precursors; Radon Gas, Ozone, small Magnetic Field fluctuations and Low-Intensity compression waves.

Methods/Materials

We obtained, magnetostrictive material (Metglas), piezoelectric plates, a UVB light source, a UVB sensor, darlington resistor, small piezoelectric plates, a pressure sensor and a temperature sensor. Each sensor was designed and built from off-the-shelf products. After designing and building each sensor, simulated data was acquired by each sensor separately. The Data was collected and calibrated using Vernier voltage, pressure and temperature probes and Logger Pro software. Each sensor was tested to it#s limit of detection. In every experiment we checked for stray electric and magnetic fields.

Results

From our results we were able to detect very small levels of Ozone in our UVB detector, from the magnetometer we were able to detect magnetic fields fluctuations as small as 1 nT at 1-#10 Hz at room temperature, from our Radon detector we can detect Gamma and Alpha radiation 1 meter from the detector. And from our low-intensity compression wave detector we are able to detect extremely small displacements.

Conclusions/Discussion

With off-the-shelf products we were able to design, develop and implement and test a device that senses some important precursors of an earthquake. Our data indicates that the device does detect relevant and important earthquake precursors with a highly reliable accuracy at all times. Usage of 4 sensors instead of one increase the prediction accuracy and ultimately the development and deployment of a sensor based early warning system. Suggested follow-up efforts include large scale deployment of the sensors and sensor networks in earthquake prone regions for field tests and ultimately the development of a sensor-based early warning system.

Summary Statement

This project is on developing, and testing a device which could provide an early warning system for Earthquakes based on precursors; Radon Gas, Ozone, small Magnetic Field fluctuations and Low-Intensity compression waves.

Help Received

Our project advisor, Mr. Dimauro helped us by correcting our mistakes on experimentation. My best friend Aaron Aliga helped me by providing needed equipment to build the prototypes. USGS, NOAA, EPA helped us with obtaining Earthquake data, Ozone and Radon level achieves

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Samuel P. Ferguson

Project Number

S0908

Project Title

The Tin Man and His Heart: Protecting Pacemakers from Predators

Abstract

Objectives/Goals

This experiment was conducted to determine the feasibility of developing a passive defense system to protect implanted medical devices from predatory radio frequency attacks. The first hypothesis stated that variances in skin and fat composition would cause differences in the amount of RF signal received by an implanted pacemaker. The second hypothesis stated that various skin and fat compositions, combined with a layer of various metal fabrics would cause differences in the amount of RF signal received by an implanted pacemaker

Methods/Materials

The experiment used a network analyzer, horn antennas and a human analog to replicate the predatory conditions that a patient with a pacemaker could encounter. Four types of metal fabrics were tested with three patient types. The first hypothesis was tested using three different human analogs, thin normal and obese. The test protocol used a network analyzer emitting a 2.4 GHz signal with the first horn style antenna and then measured signal attenuation in decibels(dB), that occurred with each sample using a second horn style antenna. The second hypothesis was tested using the same protocol with the addition of four metal fabrics; silver, copper, stainless steel and silver-nickel, as a single layer, individually with the three patient types.

Results

The results for the first hypothesis demonstrated that fat and skin composition do contribute to signal attenuation as shown by the 4.1dB signal reduction in the obese patient. The data from the second hypothesis demonstrated that significant signal attenuation of the 2.4GHz signal occurred using silver fabric and stainless steel mesh fabric. The best fabric was silver which reduced signal by 11.4dB in a normal patient, a 44% reduction in signal and the stainless steel mesh reduced signal by 10.4dB. The silver fabric had a p value of 0.014 demonstrating that the data is statistically significant for the fabric type.

Conclusions/Discussion

The percentage of signal strength attenuation at 11.4dB with the silver fabric when tested at 2.4 GHz does demonstrate the feasibility of passively blocking predatory RF signals from reaching a pacemaker. The data from this experiment confirms that it is physically possible to reduce radio frequency signals at the levels most likely to be used in a predatory attack, by using simple and affordable metal fabrics.

Summary Statement

This experiment was conducted to determine the feasibility of developing a passive defense system to protect implanted medical devices, namely pacemakers, from predatory radio frequency attacks.

Help Received

I received lab safety assistance from Dr. Kiourti at Ohio State University.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Arteen M. Galstyan

Project Number
S0909

Project Title
Three Dimensional Tracking Interface

Abstract

Objectives/Goals
The purpose of the project is to figure out a cheaper way of short distance three dimensional tracking through the use of programming in addition to observing the effects of resistance on the sensitivity of the tracking apparatus.

Methods/Materials
The base of the project consist of the sensor made of three cardboard plates that have aluminum foil attached to each side, a microprocessor, and a computer for programming. Each board acts as a capacitor and represents an axis on the digital grid (x,y,z). The user places his or her hand in the apparatus and the computer tracks the movement of the hand.

Results
At higher resistance the values, the tracking apparatus becomes less responsive to the user's hand. It was determined that 10K ohms is the best resistance value for the sensor to function accurately.

Conclusions/Discussion
The user's hand acts as the dielectric which provides a voltage drop in the circuit that is read by the microprocessor and interpreted by the program as a value of distance. This process is used to estimate the distance between the board and the hand. The combination of all three boards provide data to the computer which allows it to track the user's hand in three-dimensional space. Since each input pin is regulated through resistors, varying the resistance can change the sensitivity of the program and how fast it can track the user's hand because the time needed for the capacitor to charge is increased as resistance increases.

Summary Statement
Capacitive sensing and its applications in three dimensional tracking.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Austin Hartman; Ed van Bruggen

Project Number

S0910

Project Title

Blinded by the Night: Engineering Automatic Photo Protective Glasses

Abstract

Objectives/Goals

Night vision while driving can be impaired by bright lights from on coming car headlights causing a period of blindness until the eye recovers. We wanted to build photo-protective glasses to remove this period of light blindness.

Methods/Materials

In our experiment we used a set of LCD 3-D shutter glasses. In order to control the LCD screen on the glasses we use a micro-controller called an Arduino, which enabled us to program it using the C programming language. We used a light sensor to detect the changes in light. When the light was above a threshold value the glasses went dark. We tested the glasses on volunteers by asking them to identify the two letters on an eye chart after a one second pulse from some car headlights. We then repeated this with both the glasses turned off and on.

Results

Our prototype glasses were effective at removing the bright light from the car head lights hitting the retina. The period of visual blindness that normally occurs after a bright light was reduced using our photo protective glasses. We found that the average period of blindness was significantly reduced (5.7 seconds to 3.5 seconds) with glasses activated. The period of blindness was greater in people older than 40 compared to those younger than fifteen (6.3 vs 5.1 seconds) and was reduced to 3.7 secs regardless of age.

Conclusions/Discussion

We successfully built a prototype pair of photo protective glasses and demonstrated their effectiveness to reduce bright light-induced night blindness in people.

Summary Statement

Engineered photo protective glasses to prevent bright light-induced night blindness to enhance night time driving in older people.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Robert C. Henning

Project Number
S0911

Project Title
A Sound Source Localizing System

Abstract

Objectives/Goals
Over the course of this project, I developed and tested a novel method for a device which finds a sound source.

Methods/Materials
With components collected from local and internet stores, the tested device was built from my designs and research. Testing then proceeded with the integration of the original formulas, circuit designs, code, and output system. For each of eight tests, a part of each element was manipulated so that the result on accuracy could be improved in later tests, with the final and ideal combination seen in the eighth test. The standard deviation was used to determine the average inaccuracy of each test.

Results
Although the standard deviation fluctuated significantly with different changes, the eighth test showed the highest accuracy across the board.

Conclusions/Discussion
The capabilities seen in the precision of this novel system for sound source localization reveal that is an ideal improvement over conventional systems for many applications, including teleconferencing, robot audition, and gunshot determining, because it uses simpler calculations, fewer microphones, and a more economical circuit.

Summary Statement
In this project, I developed and tested my novel method for the localization of a sound source, which is composed of original formulas, circuits, and algorithms.

Help Received
Father cut out the frame for the device's board.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Vanessa Ibarra; Judith Martinez

Project Number
S0912

Project Title
Berry De-light-ful

Abstract

Objectives/Goals
In this project we determined which berry juice would absorb the most light and convert it into potential energy in a dye-sensitized solar cell. We hypothesized that if anthocyanins are able to bind to nanoporous titanium dioxide, then a dye-sensitized solar cell made with blueberry juice will convert the most light into energy because it contains the most anthocyanins.

Methods/Materials
We built three dye-sensitized solar cells and soaked each with different berry juices rich in anthocyanins. Anthocyanins are pigments that are able to absorb energy in the form of light, which can then be turned into electrical charges in a solar cell.

Results
Our results proved our hypothesis to be incorrect because although blackberries did not have the greatest amount of anthocyanins, they allowed the dye-sensitized solar cell to have the greatest output.

Conclusions/Discussion
According to our results, the blackberry juice was the most effective natural dye pigment in converting light energy into electrical output. The solar cell coated with raspberry juice had an average output of 151.45 ohms, the blueberry juice had an average output of 174.9 ohms, and the blackberry juice had the highest output at an average of 188.7 ohms. Compared to the silicon solar cell from a calculator, which had an average output of 189.48 ohms, the blackberry juice coated cell was relatively close in efficiency.

Summary Statement
We tested which berry juice would allow a dye-sensitized solar cell to have the greatest electrical output.

Help Received
Our parents supervised and Kyle Webster provided us with lab equipment.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Nathan G. Jacob

Project Number
S0913

Project Title
Solar Charged Secondary Battery Pack

Abstract

Objectives/Goals
The purpose of my project was to both design and build a portable and reliable source of renewable energy that can be used for mobile devices. I designed my prototypes to address problems that existed with current sources of renewable energy, such as inefficient reliability and/or portability factors.

Methods/Materials
Three portable solar charged battery pack prototypes of different electrical and casing designs were constructed. The first first prototype was a base design of how reliable and effective the device could be. The second prototype evolved off of the first one#s problems to create a more electrically and spatially effective device. The third prototype made minor changes from the second to perfect the overall design. Each prototype was used to charge various devices from zero to 100 percent battery capacity to compare charging times and consistency to other controlled methods.

Results
The final prototype was able to charge devices at an average rate of 35Mah per minute. These charging times were very comparable or even faster than the controlled methods.

Conclusions/Discussion
My prototypes show that solar energy can be effectively used as a means for portable renewable energy. I expect this new approach at portable energy may also have a positive, potential impact in the growing consumer electronics market.

Summary Statement
The central focus of my project was to design and construct a portable and reliable source of renewable energy for mobile devices.

Help Received
Step-dad helped in creating custom printed circuit boards.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Hani A. Jandali

Project Number
S0914

Project Title
Anti-Gravity Lifter

Abstract

Objectives/Goals
My intention in performing this experiment was to see if it is relatively possible, and of course to examine and demonstrate the Biefeld-Brown Effect first hand. From this I wished to learn more about how the lifter works, the scientific aspects behind the project and how it falls in accordance with the laws of physics and electrical engineering, and its real world application, such as its potential replacement of the jet aircraft in flight industries.

Methods/Materials
The materials used were rather simple for such a complex project. They were as follows; aluminum foil, balsa wood (1/16 inch thick), copper wiring (non-insulated 30 gauge wire), and cyanoacrylate glue. In terms of power source to levitate the lifter, I used a 12-volt car battery and a transformer to increase the voltage to that of tens of thousands. The first step I performed in this project was creating an equilateral triangle of balsa wood, which would act as the frame. Next, I un-insulated the copper wiring by running it over an open flame, then through coarse sand paper. Likewise, I then proceeded to create an aluminum foil skirt for the edges of the triangle, rounded on top to allow the electric current to flow through the lifter. Afterwards, I simply attached the wiring all together, from battery to transformer to lifter.

Results
For the first lifter, with a width of 110 millimeters, a height of 75 millimeters, and a mass of 4.3 grams, 29 thousand volts was required to achieve lift. For the second lifter, with a width of 180 millimeters, a height of 75 millimeters, and a mass of 6.9 grams, 34 thousand volts was required to achieve lift. For the third lifter, with a width of 200 millimeters, a height of 75 millimeters, and a mass of 8.7 grams, 36 thousand volts was required to achieve lift. For the fourth lifter, with a width of 400 millimeters, a height of 90 millimeters, and a mass of 17.2 grams, 44 thousand volts was required to achieve lift.

Conclusions/Discussion
It is evident when comparing the evidence to my initial hypothesis that my educated estimation was incorrect. Although I had believes that a mere 1500 volts would be required to lift the craft, all four scenarios tested disproved so, requiring tens of thousands of volts instead.

Summary Statement
To levitate an "antigravity" lifter, as well as in turn demonstrate the Biefeld-Brown Effect.

Help Received
Father helped with the wiring of the electrical aspect of the project

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Justin H. Jeon

Project Number

S0915

Project Title

Analyzing the Effect of Ball and Magnet Placement on Ejecting Velocity of Gaussian Cannon

Abstract

Objectives/Goals

The object of this study is to determine the ideal arrangement of balls and magnets for the highest ejecting velocity. I will then analyze what effect the different arrangements have on the velocity. My hypothesis is that the more balls there are, the higher the velocity, since there is less impeding magnetic force affecting the ejecting ball

Methods/Materials

A table was set up with rails on its surface. The magnet and the desired amount of steel balls were set on top of the rail, making it so it would launch off of the table and onto the ground. The ball's distance traveled was measured and recorded. This was done ten times for each arrangement, and an equation was used to find the velocity. The initial input energy was found by using a force gauge to measure the force of the magnet. Lastly, the magnetic influence on the ejecting ball was found using a force gauge.

Results

The ejecting velocities for the different arrangements are as follows: With the 2-ball setup, there was a velocity of 1.47 m/s. With 3-balls, a velocity of 1.89 m/s was achieved. With 4-balls, there was a result of 2.06 m/s, and with 5-balls, 1.75 m/s was calculated. For the initial input energy, 0.02276 Nm was calculated. Kinetic energy of the ejecting ball was calculated for each arrangement, and the highest kinetic energy of the ejecting ball was 0.0169 Nm. The magnetic force pull on the ejecting ball was determined.

Conclusions/Discussion

The ejecting velocity highly varied with different setups, and the optimal arrangement was 4 balls, which disproved my hypothesis, which stated that the more balls in front of the magnet, the higher velocity. It is because the energy lost during multiple collisions became greater, even though the magnetic pull on the ejecting ball decreased with distance.

Summary Statement

The project is about analyzing the physics principles behind the Gaussian Cannon

Help Received

Dr. James Li helped me decide my project and mentored me

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Anish G. Krishnan

Project Number
S0916

Project Title
Electric Vehicle Unplugged: Regenerative Acceleration Generator Technology to Extend the Mileage of an Electric Vehicle

Abstract

Objectives/Goals
With skyrocketing gasoline prices, it has become crucial to develop an energy efficient electric vehicle. The United States spent about $380 billion for imported petroleum last year. Over the next seven years, the federal government will spend $7.5 billion on policies to boost the electric vehicle industry. Besides, the influx of automobiles in today's world has tremendously increased the amount of pollution leading to global warming. Hence many eco-friendly technology companies are making Electric Vehicles. However, its short driving range and lengthy recharge time remains a key challenge. The objective of this innovation was to design and develop an efficient and cost effective system to extend the mileage by harnessing energy from renewable sources like the wind, using the Regenerative Acceleration Generator Technology.

Methods/Materials
This research involved designing and constructing a novel system, which is affordable to everyone. Five propellers mounted onto the front grille of the car, were attached to canon DC motors connected in serial to act as a generator. The voltage and current at various speeds were measured for every 5 miles increment in speed. An electronic circuit was built to charge and discharge three 1F super capacitors to trickle charge a battery. A 555 timer was used to oscillate this cycle every 1.5 seconds. This circuit was run for an hour, the battery was charged and the power generated was calculated. This cycle was repeated by varying the volt input to the circuit, corresponding to the different speeds of the car.

Results
The system was able to produce 30.1, 27.5, 25, and 20 volts, when the car was driving at 65, 60, 50, and 40 miles per hour and the energy equivalent to 68, 53, 43 and 28 Watt-hours were generated respectively. There was no significant difference in the drag ratio after analyzing the fuel cost data from the On Board Diagnostic II Scanner. The energy generated can be used to charge the second battery while the vehicle is in motion or provide a burst of energy to accelerate the vehicle when needed.

Conclusions/Discussion
This project successfully designed an efficient, smart and cost effective system to extend the mileage of electric vehicles by using the Regenerative Acceleration Generator Technology. This work is an important initial step in increasing the driving range of the EV, thereby revolutionizing the recharging industry and pioneering future research.

Summary Statement
An efficient and low cost system was designed to extend the mileage of electric vehicles using the Regenerative Acceleration Generator Technology, addressing vital issues like global warming and fuel dependency that impact the US economy.

Help Received
Dr. Ismail helped answer questions about the electrical circuit. Parents helped in obtaining the materials for the project.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Raul Lara

Project Number
S0917

Project Title
Enhancing Current Fire Safety Technology to Include Adaptive Visual Exit Procedure

Abstract

Objectives/Goals
To create a smoke alarm system with a microcontroller capable of directing people to the nearest exit, and alert them the origin of the smoke.

Methods/Materials
An Arduino was used for the microcontroller and code in C was written and uploaded. The code is then used to control and take data of smoke sensors. Then LEDs arranged in a certain way are near the smoke sensor. These LEDs are soldered with resistors and all hooked up to the input output pins of the microcontroller. The price for the sensors and microcontrollers was added up amd compared to current fire alarm aystems to see if it would be competitive.

Results
A smoke alarm system made with a microcontroller was able to compete with the price of current smoke alarms and was able to create an LED sequence to help lead people out of a smoky building, while showing the origin of the smoke.

Conclusions/Discussion
A smoke alarm system capable of leading those within a burning building to the nearest exit is a feasible system which prices would compete with current fire alarm systems, but might not be feasible for bigger commercial buildings.

Summary Statement
A fire alarm system capable of leading those within it to the nearest exit is possible due to the availability of microcontrollers and sensors.

Help Received
Dean Reese, physics teacher helped fund my project; Tracy High Science department donated the poster board; Alejandro Baez, fire science student, helped with information on current fire safety technology.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Nathan Le; Timothy Le

Project Number
S0918

Project Title
Mayday, Mayday! The Geolocation System for First Responders

Abstract

Objectives/Goals
Many first responder fatalities or injuries are caused by becoming lost during rural search and rescue operations or getting trapped inside burning buildings. We attempted to create an accurate tracking device that works outdoors and indoors and is not affected by a loss in GPS signal. The device would be able to send position beacons outside of a building or across terrain to a incident command (IC) base system displaying the location and altitude of the device on a map.

Methods/Materials
The device created includes a GPS with a high-RF sensitivity, a Honeywell Dead Reckoning Module (calculates position utilizing inertial measurement sensors in tandem with last-known GPS position), an Arduino Mega Pro Mini (3.3v), an XBee data radio, and an amateur radio transmitter with a Byonics TinyTrak3 encoder. The amateur radios form the main communications link between the device and IC. The XBee radios form a small mesh network between each tracking device and IC and outputs raw NMEA data every two seconds for real-time tracking. A Pelican 1020 case enclosed the components. Circuitry and coding for the device was developed.
Tests were run in order to verify operation and accuracy of the device. We staged multiple simulated emergency exercises during which a "firefighter" wearing the device became "trapped" within our school. IC then deployed the rapid intervention team (RIT) with position information to locate the firefighter. The distance between the reported position and the actual position of the firefighter was recorded.

Results
In each of the trials, the RIT was able to arrive at the firefighter's location within one to ten feet. While the radio carried by the RIT did have GPS, the GPS waypoints deviated significantly from the RIT#s actual position while the firefighter unit equipped with the Dead Reckoning Module was more normalized. Furthermore, the altitude only fluctuated when the firefighter moved up or down stairs or changed floors. The device was able to run for over 4.5 hours on a pair of 9 volt batteries.

Conclusions/Discussion
We attained our goal of creating a device that could be used to accurately track firefighters or other first responders outside and inside buildings. The device was able to determine its coordinates utilizing both GPS and dead-reckoning techniques and relay this data to an incident command display which reported the device's location and altitude.

Summary Statement
We created and tested a tracking system designed for first responders which works inside and outside of buildings and isn't affected by GPS status.

Help Received
Friends assisted with testing of the devices.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Jiana Machhor; Claire Mauss

Project Number

S0919

Project Title

A Comparison of Accuracy between Ultrasonic and Infrared Proximity Detectors

Abstract

Objectives/Goals

To determine which proximity detector - ultrasonic or infrared - yields a more comprehensive range of distances and angles. It was hypothesized that the ultrasonic would yield the greater range.

Methods/Materials

The manipulated variable was the type of proximity detector used, with reference to wave type. The responding variable was the range at which these detectors could accurately detect an object#s distance. First, a board that represented the entire of field of detection was constructed - 5 cm marks were labeled along the horizontal of the board and 5 degree marks were labeled along the vertical of a board. Then, the UNO software was programmed to read these voltages from the sensors and convert these voltages into a distance. The sensors were then hooked up to the specific software on a laptop through a USB cable. The sensors were then placed at the top middle of the simulation board. An object was moved about this board at various location and the measured distances were compared with the distances being reported by the sensors that appeared on the laptop. The area in which the sensors could accurately detect the object was recorded. 5 trials were taken for each sensor. This experiment was conducted in a setting away from direct sunlight and any substantial noise levels. Materials: Infrared sensor (Sharp-GP2Y0A21YK0F), ultrasonic sensor (Sainsmart HC-SR04), Arduino UNO software, laptop, ruler, notebook, pencil, protractor, large board, small cardboard box. /

Results

The ultrasonic detector yielded a large range of 3-115 cm and 20 degrees to either side. The infrared yielded a range of 7-25 centimeters with 6 degrees to either side. The ultrasonic also proved to be more precise.

Conclusions/Discussion

The data proves the hypothesis to be supported. The ultrasonic sensor yields a more accurate and more comprehensive range than the infrared sensor.

Summary Statement

The comparison of the comprehensive ranges of two proximity detectors - ultrasonic and infrared.

Help Received

Mother helped set up board; Dad helped program sensors.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Stephen Mann; Viking Mann

Project Number
S0920

Project Title
Parabolic Reflector

Abstract

Objectives/Goals
This project seeks to measure if a parabolic reflector increases the strength of WiFi, and if so, by how much?

Methods/Materials
11x5in Cardboard, Foil, 8x5 3/4 in cardboard, Wifi Router Computer with inSSIDer. To test our hypothesis, a parabolic reflector was crafted, and placed on the router. Then a laptop was set across from the router in an open area, and the WiFi strength measured by inSSIDer (a software capable of measuring the strength of WiFi in decibels). For the interpretation of data, the decibels were converted into a more readily understood unit of power: Watts

Results
Average change in Watts
4.23E-009 1.05E-008 3.36E-009 1.58E-008 3.02E-009 1.36E-008
Change in dBm: 3.933 Change: 6.733 Change: 6.533

Conclusions/Discussion
Our conclusion reflects that although we were correct in that parabolic reflectors increase the strength of WiFi, we found that the strength is actually increased with much more magnitude, about 150%-400%. The procedure went smoothly becaues the data was consistent, the readings were similar, and thus the results are conclusive. However, it would have been better to test the experiment in a more remote location.

Summary Statement
Increasing signal strength by reflecting all transmissions in one direction.

Help Received
None

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Rachel J. Martin

Project Number
S0921

Project Title
Temperature Efficiency of Voltaic Cells

Abstract

Objectives/Goals
The goal was to see what brand of battery/voltaic cell is most efficient over a range of temperatures, and what brand lasts the longest.

Methods/Materials
I used five different brands of batteries and four batteries of each brand. I used a voltmeter to measure current and voltage and a refrigerator, freezer, and toaster oven to reach the desired temperatures. I recorded and compared the prices of the batteries. I tested the current and voltage of each battery at four different temperatures. I then put the batteries in Rayovac Value Bright LED flashlights and left them in a dark room and let them run until they died out. I took pictures of the progress at regular intervals and recorded the data.

Results
The Duracell batteries had the highest power in all temperatures over the 60 second testing period. The batteries at room temperature performed the best. The test results indicate the Sony batteries performed the best in the flashlight, but this was questionable. As expected, the most expensive battery had the greatest power; however, the least expensive battery lasted the longest in the flashlight. (Questionable results)

Conclusions/Discussion
The Duracell batteries, the most expensive brand, performed the best, having the highest currents and voltages, so may hypothesis was rejected.

The batteries at room temperature (80 degrees Fahrenheit) performed better then batteries at increased or decreased temperatures, so this part of my hypothesis was rejected.

The Sony Platinum batteries lasted the longest when tested with flashlights. They were usually one of the worst performing brands as assumed by their power, and they were the least expensive brand, but this might not be reliable because the flashlight died but later turned back on and lasted for a long time on very dim light.

Summary Statement
My project is about testing different brands of batteries to see which is the most powerful and lasts the longest and at what optimal temperature.

Help Received
My dad helped me purchase the correct materials needed for the experiment, set up spread sheets, and answer my questions about my experiment. My biology teacher helped me research information on the topic.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

George D. Morgan

Project Number

S0922

Project Title

A Multi-Architectural Approach to the Development of Embedded Hardware

Abstract

Objectives/Goals

The objective of my project is to develop an electronics prototyping platform designed specifically to run a paradigmatic operating system that I have written in an attempt to make hardware and software development more easily accessible to anyone by enabling a host PC to interact with any hardware peripheral without requiring the user to write any code.

Methods/Materials

An AVR microcontroller was fused with an ARM microprocessor by connecting the two devices together over their SPI and USART busses. The system architecture was devised so that the communications layer of the paradigmatic operating system could be actively executing on the microcontroller to handle communications with a host PC all without disrupting the parallel execution of the scheduler and active processes on the microprocessor. Aside from the performance improvements, such an interface enables a host PC to directly manipulate the hardware resources of the microprocessor by communicating with the microcontroller and requesting that it handle the execution of a particular operation. Aside from real-time manipulation of hardware, programs can also be run in parallel on the microprocessor. During normal execution, the microcontroller handles copying programs from the host PC into external flash memory. The PDMA controller of the microprocessor then takes over by moving them from external flash to internal flash where they can then be executed.

Results

By running my operating system simultaneously across two processor architectures and using specific features of each architecture to improve performance, I was successfully able to create an electronics prototyping platform that can be used by anyone with minimal knowledge of either hardware or software by extending the functionality of any microcontroller or existing development platform to a host PC without requiring the user to write any code.

Conclusions/Discussion

Not only can a multi-architectural approach to running an operating system be used to simplify the software-hardware interface, but can also be used to facilitate debugging, rapid prototyping, and much more. Using this interface, a development PC can be used to manipulate any aspect of the platform's hardware; from raw variable values in RAM, segments of code in flash, or even IO pins themselves, any aspect of development can be achieved without the need to recompile and flash data to the microprocessor.

Summary Statement

After countless hours of research, development, and assembly, I was successfully able to pair my newly developed hardware platform with my paradigmatic operating system.

Help Received

None. All of the work done on this project was my own.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Carlos Pacheco; Jose Sandoval

Project Number
S0924

Project Title
Solar Angles

Abstract

Objectives/Goals
This project involves using different angels to test the power generated by the solar panel. The goal is to find the most energy producing angle on the solar panel and to find how different the power absorbed at that angle compares to the rest. This has been done by using a small solar panel and setting it at different angles in order to test the power created by the solar panel with an oscilloscope. Upon examination of our data it becomes clear that angles have an impact on solar energy absorbed and power produced. Through our data it is clear to see how angles have an impact on energy produced.

Methods/Materials
The use of solar panels in our project was integral as we hoped to find the best angle to use in order to produce the most amount of power from our solar panel. We conducted our experiments thoroughly and discovered the best angle by using a protractor and an oscilloscope.

Results
Our data showed us how the suns rays have a very different and shifting effect on the angle a solar panel is set at. With this data it is very easy to conclude that the angle a solar panel is set at has a great effect on the power output of the panel. Our data shows how as the angle decreases the solar panel gains more power peaking at 100º but after the peak at 100º the angles slowly decrease again. Although at 40º we experienced a flux, and we believe this is due to the reflection of the suns rays on the concrete where we were conducting our experiment.

Conclusions/Discussion
Over the course of our experiment we collected many pieces of data. We took our data and concluded that the angles of a solar panel have a great effect on the power output. We discovered this conclusion through our testing using an oscilloscope and a small motor. This conclusion proves our hypothesis and can allow us to form a new hypothesis testing the strength of solar energy produced per solar panel in order to form a solar field with the most efficient power output.

Summary Statement
Our project is about the impact of angles on solar power.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Abha Pandey

Project Number
S0925

Project Title
Rapid First Response by Creating a Rescue UAV to Locate Trapped Earthquake Victims

Abstract

Objectives/Goals
To be able to detect and reveal a trapped earthquake victim#s location to local rescuers through a Unmanned Aerial Vehicle(UAV).

Methods/Materials
I used a pre-built UAV from Hobby King. In order to test if the UAV was compatible with the Arduino, I did a series of motor tests through PWM ports. The speed was about 100 ticks per second. I used an ultrasonic #ping#, and a passive infrared sensor. The UAV was controlled using an Arduino Uno board after several attempts of using numerous Arduino boards. I coded the program through Arduino IDE, and I set the maximum height of the drone to about 4 feet with the obstacle set about 5 feet away from the wall. I had the UAV fly for about 5 minutes and in that time frame, I checked if the UAV was successfully able to detect the #human.#

Results
The servo motor#s speed had to be constantly adjusted in order to make sure the UAV would not have to crash. The reason why was because at 100 ticks it felt it was too fast and the UAV might go higher than expected. Another problem with the UAV was battery efficiency, after two tests, the batteries would drain out. Overall, the UAV was successfully able to find the obstacle in 5 minutes. However, during the flight, because of a slight imbalance in the propellers, the UAV was wobbly during the flight. It was able to find it through the ping sensor and the passive sensor.

Conclusions/Discussion
The UAV was successfully able to find the obstacle and it worked exactly how I planned it out. For improving this project, a few factors for consideration are having better battery efficiency, a microcontroller that can handle the power of the battery, and a way to make the UAV smaller to help it go through the cracks in a realistic situation of an earthquake.

Summary Statement
This project is used to find trapped earthquake victims through a UAV,

Help Received
My mother timed the flight duration of the UAV.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Kumaran V.K. Ratnam

Project Number

S0926

Project Title

A Novel Energy Harvesting System with a Piezo Element to Power a Visual Prosthesis System

Abstract

Objectives/Goals

The purpose of this project is to design an energy harvesting piezo electric solution to power an internal retinal prosthesis system using the natural eye movement. The best and most recent internal visual prosthesis systems allow patients with certain blindness to see their surroundings with limited clarity. These systems use electrodes to stimulate the optic nerve. The problem arises from the amount of power supplied by the implanted battery. These systems require invasive battery replacement surgeries. In addition, due to the limitation of power, the prosthesis can have only a minimal number of electrodes, hence limited vision. The solution here is to use a piezo fiber, a rectangular paper-like fiber that generates power when compressed or stretched.

Methods/Materials

A small piezo fiber was attached along an eye model's lateral rectus muscle, one of the extra-ocular muscles that move the eyeball. A scale model was built where it simulated extra ocular muscle movement by using a servomotor controlled by a micro controller. The micro controller is programmed in PBasic language. A circuit and an extensive program to continuously measure the voltage produced by the piezo-fiber for a period of time, with various simulated eye movements, was built.

Results

In this experiment, the piezo-fiber is continuously generating voltage between 0.5 and 5 volts.

Conclusions/Discussion

. It was proved that the piezo electricity can be harnessed to power a retinal visual prosthesis system. This will reduce and/or eliminate the battery replacement surgery, and it will open more pathways for advanced systems with more electrodes.

Summary Statement

I developed a way to power a retinal prosthesis system using a renewable energy source that within the body

Help Received

Used Lab equipment from Northeastern University under Supervision of Professor Jalili

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Katie L. Tam

Project Number
S0927

Project Title
Microbial Fuel Cells: The Next Source of Green Energy

Abstract

Objectives/Goals
The objective of this project is to determine if time has a significant effect on the energy produced by a microbial fuel cell. I hypothesize that as time goes on, the electricity produced by a microbial fuel cell will increase.

Methods/Materials
Three microbial fuel cells were constructed, all identical in design. Materials for this project were purchased from local hardware stores, or online. The anode container was filled with a mud sample collected from a local benthic zone, while the cathode was filled with a conductive salt water solution. An electrode was then placed in each container and connected to copper cables that ran out of the anode and cathode. These were connected by a resistor, which is where the test leads of the digital multimeter were placed to measure the voltage in millivolts. Measurements were taken twice a day, morning and evening. At each time of testing, three measurements were taken concurrently for consistency.

Results
Although there were some fluctuations, generally it was found that as time went on, the rate at which electricity is produced by a microbial fuel cell increases.

Conclusions/Discussion
Based on my data, for the most efficiency it is best to operate a microbial fuel cell some time after the initial assembly, with the bacteria inside. Initial bacteria populations were unable to be taken, and the differences in the quantity could have caused the fluctuations in data. Measurements taken in the evening were often higher than measurements taken in the morning. These differences can be attributed to temperature. Changes in temperature were uncontrollable and may have contributed to inconsistent data, as the construction of the fuel cells may have as well. Fuel cell construction was done by the student, so small imperfections that led to inconsistency in data were to be expected.

Summary Statement
Testing the effect of time on microbial fuel cells can help future developments in finding sources for a renewable and inexpensive source of energy.

Help Received
Received support from parents.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Amulya Vadlakonda

Project Number

S0928

Project Title

A Smart Gripping Prosthetic to Aid Hand Amputees in Handling Delicate Objects

Abstract

Objectives/Goals

My objective was to design and build an electronic prosthetic device to handle delicate objects, like eggs, and be size and shape independent. It uses sensors to provide input to a microcontroller, and a feedback-based smart system to make decisions, so it is self-sufficient. Goal 1: Design, develop, and verify the operation of the smart system, including the input sensors, motors, and microcontroller algorithm. Goal 2: Design, manufacture, and assemble the mechanical device for lifting and moving delicate objects. Goal 3: Join the subsystems together, creating an independent system.

Methods/Materials

Device operates on portable 9V DC power; Time constraint of 6 weeks; Budget of $400;
Custom-designed parts created at the pace of the machinist
I used 4 variable resistors, 3 stepper motors, 1 microcontroller, 3 motor drivers, 6 resistors, and 1 push-button switch. I designed the parts for the device--two pincer arms, the bases for the motors, and the brackets for each of the motors. I then calibrated the force sensors by testing amount of voltage produced with different known weights. I set up the sensor and motor circuits. I designed an algorithm to carry and move an egg, and translated it into C. I connected my circuits to the microcontroller, and tested out the final code, representing the mechanical device with my hands.

Results

My device is programmed to initialize motors and sensors, squeeze the egg, lift it, move it, set it down, and release it without breaking it. It uses the proposed smart system. It is superior to previous designs by not being shape or size dependent. It caters to objects of different shapes and sizes within a range of 3 to 7 cm. The complete set of mechanical parts is still being manufactured, so the prototype could not be completely tested. Still, all the parts are designed, and the electronics, microcontroller, and the algorithm work. The only thing keeping the device from being usable is the integration of the circuits and mechanical parts.

Conclusions/Discussion

My project accomplished everything I set out to do. This device is unique because of its ability to handle more fragile objects, while functioning on its own. With this kind of device, hand amputees will not be restricted to bulky prosthetics. Their everyday lives will be improved, because they will be able to handle activities that require fine motor skills, like opening bottles, or even holding the hand of a baby.

Summary Statement

My project was to design and build a device that can handle delicate objects unaided, and is size and shape independent. It uses sensors to provide input for the feedback based smart system the device uses to make decisions.

Help Received

Dr. Youssef Ismail from Schmahl Science Workshops taught me about electrical circuits and programming