CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Jesse Allhiser; Riley Schofield

Project Number
S0801

Project Title
Pedal Power

Abstract

Objectives/Goals

Our two goals for this project were to: (1) figure out a new idea for creating power and (2) to make power from just a battery, an alternator and a bicycle. We wanted to see if we could create power by just doing things that most people do every day, like exercising.

To continue our investigation we are going to try to measure the maximum amount of power that we can generate, by expanding the number of items we power using our alternator. We are also going to rebuild our power generation apparatus, changing it from our mountain bike that we used to an exercise bike.

Methods/Materials

We used boards, nuts, bolts, screws, metal plates, plastic straps, bike, alternator, twelve-volt light, batteries and wires. We constructed a machine, which ran the back tire of a bike against an alternator, to create power. We used a battery to power the magnetic strips in the alternator so that we could create a spark when we pedaled.

Results

When we attached the car battery to the alternator the light lit up partially, even before we started pedaling. As we pedaled the light got brighter and even brighter as we pedaled harder. When we replaced the car battery with a AA battery, we had to pedal harder to get the light to light up at all. This was because the car battery had more voltage running through it than the AA battery did. In both trials, we could see that we were generating power by pedaling the bike.

Conclusions/Discussion

Power was created by hooking up a battery to an alternator in order to power the magnetic strips on the outside ring in the alternator. #Pedal Power# was used to turn the back tire of a stationary bike, which turned the rotor inside the alternator, in order to light up a 12-volt car light. We were successful in creating energy! As we continue our tests, we will try to light up objects that need more power so that we can measure how much power we can create. This could be a great saving in energy cost for gymnasiums everywhere! In addition, if we can find more ways to harness the energy people expend in their lives every day, we could have a whole new source of cheap, renewable energy!

Summary Statement

Our project is about harnessing the energy from things that people do every day.

Help Received

Mr. Allhiser taught us a lot about the physics of power and he helped us put our project together. We hope to be able to use his power tools as we rebuild our project so that we can do all the building ourselves. Mrs. Allhiser and Mrs. Schofield helped us by proofreading our report, working journal and

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Michael K. Benner

Project Number
S0802

Project Title
Exploring Practical Applications of the Seebeck Effect

Abstract

Objectives/Goals
My goal was to create enough energy to charge a car battery utilizing the Seebeck effect.

Methods/Materials
I used copper and steel wire, ice water and a stove to produce electricity with this effect.

Results
The initial test produced an average of 1.45mV and the car frame model produced an average of 0.4mV.

Conclusions/Discussion
The concept did produce electricity but not in quantities to be practical in my applications.

Summary Statement
This project examines electrical production using the Seebeck Effect.

Help Received
Parents provided materials.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Kathryn Callander; Rachel O'Leary

Project Number
S0803

Project Title
A Line Following Robot

Abstract

Objectives/Goals
Our objective in this project was to learn about electricity, circuits, and the physics behind them. We accomplished it by building a line following robot and testing the limits of its accuracy over varying courses.

Methods/Materials
We created a circuit that enabled our robot to follow taped lines based on the light reflected off the ground. The robot is capable of following the lines by comparing light on either side of the different colored tape using light sensors. Through this experience we have learned the basics of circuits, motors, sensors, comparators, and gears.

Conclusions/Discussion
By creating the line-following robot, we learned the basics of energy flow and exactly what building a circuit entails. We found out how voltage is potential energy, and how wires can run in series or in parallel depending on how many points the wires share. We understood the purpose of resistors, to transform excess energy into heat, and we discovered the function of transistors, the comparator, variable resistors, photo resistors, headlights, diodes, motors, and light emitting diodes (LEDs). We came to the conclusion that because we used less power than the robot built by David Cook, we could use less resistance.

Building the robot consisted of a heavy revision and modification process. For example, knowing that the inside of the robot would be crowded with our circuit and power source, we realized that if the gears were also placed inside the robot, they would be incapable of moving without constant adjustment. Consequentially, we decided to locate the gears outside of the robot, allowing a free range of motion with less friction. Another modification we were forced to make involved the headlight circuit. Because the robot was already crowded, we decided to #electrically glue# the headlights to another breadboard using a soldering iron. However, in the end, we disconnected the headlights from the second breadboard and simply added them to the initial circuit.

In the future, if we were to adjust and make further modifications, we would make the wheel size larger and experiment with different gear ratios. After getting a working circuit, we were able to test different configurations and the extent of the the robot's ability to follow a course.

Summary Statement
In building a robot that follows lines, we explored circuits and robotics.

Help Received
Use of Santa Catalina school supplies and lab with supervision from Ms. O'Shea; A modified circuit from "Robot Building For Beginners," by David Cook

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Darren Chambers; Garrett Kronland

Project Number
S0804

Project Title
Skin Effect: An Examination of the Flow of High-voltage, High-frequency Electricity across the Surface of an Insulator

Abstract

Objectives/Goals
To determine how high-voltage, high-frequency electricity flows across the surfaces of various insulators.

Methods/Materials
Tesla Coil capable of being tuned to approximately 1.5 in arc lengths, testing apparatus for measuring arc lengths, 2 in. diameter semi-circular samples of various materials, electrical tape, and clear spray on lacquer.

Test sample was placed in test apparatus. Tesla Coil was connected to test apparatus and powered on causing arc across surface of test sample. The arc gap was adjusted to maximum where arcing occurred continuously. Arc length was measured when Tesla Coil was fully powered down.

Results
All insulators that were tested increased the arc length. The hardwood had the greatest effect, increasing the arc length by approximately 5/8 in. None of the lacquer coated metal samples exhibited a flow of electricity across their surfaces. Therefore, those trails are not significant to the main objective.

Conclusions/Discussion
It was hypothesized that all non-conductors would cause a resistance across their surfaces. This hypothesis was disproved. The insulators increased the arc length significantly; however it is unknown exactly why this phenomenon occurs. . It was also hypothesized that a non-conductor applied to the surface of a conductor would affect the arc length differently than the non-conductor itself. This was tested with metal samples coated in lacquer. The lacquer was not effective as an insulator, and still allowed electricity to flow inside the metal.

Summary Statement
Examining the flow of high-voltage, high-frequency electricity across the surfaces of insulators.

Help Received
Physics teacher offered suggestions on write up.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Stephanie T. Chau

Project Number
S0805

Project Title
The Effect of the Magnetic Field and Diamagnetic Materials on Diamagnetic Levitation

Abstract

Objectives/Goals
The purpose of this project is to find out whether the change in magnetic fields and diamagnetic materials affects to diamagnetic levitation.

Methods/Materials
Materials:
A threaded stainless steel rod, a nail on glides, two wooden support dowels, a wooden adjustable arm, a wooden base, a white delrin rod/bar, floating magnets (NdFeB cubes/ NdFeB discs/ Ceramic disc), lifting magnets (NdFeB/Ceramic discs), and diamagnetic materials (Bismuth discs/ Carbon Graphite blocks).
Methods:
The first major step was building a levitation fixture. The second major step was observing and measuring the distance of the lifting magnet and the floating magnet to the base of the fixture when the floating magnet was in stable levitation during those experimental set ups with the use of Bismuth discs, Carbon Graphite blocks and a Carbon Graphite block. Several different test conditions also were applied in this experiment to see the variation of levitation. These conditions were different types of powerful lifting magnets and floating magnets, different gaps between two diamagnetic materials, two kind of diamagnetic materials, table stand (wood and steel), and temperature (room and hot). Each test condition was tested three times except for the experiment with the use of only a Carbon Graphite block had only one trial.

Results
The results from this experiment were that the stronger the lifting magnet, the farther it could be from the floating magnet while still lifting it; the more powerful floating magnet or the better diamagnetic material was used, the easier stable levitation could be achieved. In addition, the temperature, the steel stand, the use of two diamagnetic materials and their gaps and different kind of materials underneath the lifting magnet also had a big effect on the stable condition of the levitation. However, the most important finding was that the levitator was very sensitive to any disturbance and required a very critical adjustment to make the floating magnet hovered stably.

Conclusions/Discussion
In conclusion, the results of this experiment demonstrated that the stable condition of the levitator really depended on the strength of magnetic field, the kind of the diamagnetic materials, and the floating magnets were used. These results also supported the hypothesis that diamagnetic levitation occurs only when the force on such an object is strong enough to balance the weight of the object itself.

Summary Statement
Placing a magnetic material in diamagnetic field with a biasing magnet is one of many ways to achieve diamagnetic levitation and its stable condition depends on the change in the magnetic field and diamagnetic materials.

Help Received
I would like to thank the members of my family who assisted me with this project: my mom who proofread, and my father who assisted in the construction of the levitation fixture and the display board. A special note of thanks to my science teacher for his expert guidance.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)

Bryce W. Cronkite-Ratcliff

Project Number

S0806

Project Title

It's a Wonderful Light: An Experimental Study of a Fluorescent Solar Concentrator

Abstract

Objectives/Goals

This project examines the viability of one alternative form of solar concentration, the Fluorescent Solar Concentrator (FSC), as a more efficient and inexpensive method of photovoltaic (PV) solar power production. The potential advantages of this concentrator system are many, including decreased cost per unit energy output, small dependence on the angle with respect to the sun, and reduced heat dispersion problems in silicon (Si) PV solar cells.

Methods/Materials

I constructed a FSC by coupling a Si PV cell to the edge of each of various sheets of fluorescent acrylic. I conducted several experiments to examine the effect of different dyes, thicknesses, geometrical configurations, and other factors on the power output of the FSC system. I compared the data with a mathematical model, which was used to explore extrapolations of the FSC in geometry and dye performance. Finally, I examined the economic feasibility of the FSC using extrapolations of the model. I also conducted experiments to compare the photovoltaic power generation of the FSC with two geometrical optics concentration methods (a mirror array and a Winston cone).

Conclusions/Discussion

In comparing the FSC with other concentrators, the FSC is found to be a superior concentrator for Si PV cells. The FSC used in this project achieved concentration factors of 4 and material costs about ½-2/3 compared to a conventional bare Si PV cell system. With better dyes and improved plate mediums, the cost-benefit ratio could become much more favorable, allowing the FSC to become an important technology for a future of renewable energy.

Summary Statement

My project investigates an innovative method of solar concentration, taking advantage of the properties of fluorescence and total internal reflection, to reduce the cost and increase the viability of solar electrical generation.

Help Received

Mother helped proofread writeup; Father acted as mentor

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Aren R. Gates

Project Number
S0807

Project Title
Microprocessor Controlled Electromagnetic Accelerator, Year 2

Abstract

Objectives/Goals
The project goal was to improve upon my year one project, an electromagnetic accelerator, and compare the performance between pre-wrapped and hand wrapped magnetic coils with lower inductance.
.

Methods/Materials
In year one of the project the accelerator was operated with pre-wrapped coils, purchased from an electronics store. Then I wrote a program for a microprocessor which would turn on coils in advance. This was done in order to allow the magnetic field in each coil to build in advance.

In year two of the project I made coils by hand with larger gauge wire. These coils had less resistance and less inductance than the previous coils; this meant that the magnetic field in each coil would form and collapse faster. I also developed a new timing program for the microprocessor.
.

Results
The performance of the new coils was compared to that of the old ones. The new coils performed much better, giving a 60% improvement on exit velocity. All together, due to the addition of zener diodes to further speed the magnetic field collapse, and the creation of a new microprocessor program, there was a 100% improvement in speed.
.

Conclusions/Discussion
The experiment supported my hypothesis which stated that coils with lower inductance and resistance will give a greater pull, because the magnetic field will form and collapse faster, therefore accelerating the projectile more.
.

Summary Statement
During year 2 the Microprocessor Controlled Electromagnetic Accelerator was refined to use lower inductance, higher current coils, and new timing to optimize the formation and collapse of the coil's magnetic fields increasing velocity 100%.

Help Received
Multiple engineers at Xirrus Inc. mentored me: Patrick Parker on the coil winder, Kirk Mathews on the drive circuit, George Gu on the schematic, and Dennis Izumigawa on the PCB. My father was my programming mentor and helped format the final report. My mother helped create my project board.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Reza Gheissari; Danny O'Leary

Project Number
S0808

Project Title
How Does Temperature Affect the Resistance of Various Resistors?

Abstract

Objectives/Goals
Carbon and Metal resistors are an essential building block of most electrical circuits and are expected to maintain a constant resistance in their operating temperature range. We investigated how temperature change affects the resistance of seven different resistors.

Methods/Materials
Using two Carbon Film resistors, three Carbon Composition resistors, and two Metal Oxide resistors we were able to find the resistance of these resistors between 5 and 99 degrees Celsius. The resistors were submerged in water inside a beaker and the temperature of the water was altered while the resistances were recorded with a digital ohmmeter.

Results
We found that in general the Carbon Film resistors were more sensitive to temperature changes than the Carbon Composition ones. One of the key trends in our findings was that as temperature increases from room temperature the resistance generally decreases in Carbon resistors. On the contrary, Metal oxide resistors had an increasing resistance with temperature. Below room temperature, all types of resistors generally maintained the same trend.

Conclusions/Discussion
With further review of the literature, we learned that our findings were correct and that semiconductor resistance values decrease with increasing temperature, while conductor resistors have an increasing resistance with temperature. In conclusion, resistors maintain their values within two percent in temperatures ranging from room 20 to about 30 degrees Celsius.

Summary Statement
We tested how severe temperature change affects the resistances of both conductor and semiconductor resistors.

Help Received
Used Ohm Meter and Resistors given by EE department at CSULB; Performed most of the experimentation under the supervision of Dr. K.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)

Matthew Heydeman; Matthew Stanton

Project Number

S0809

Project Title

Magnetic Levitation: The Effects of Fluid Damping and Control Distance in a Position Feedback Magnetic Levitation System

Abstract

Objectives/Goals

The purpose of this project was to determine the effects of dampening due to fluid viscosity (using water, air, and motor oil as test fluids) and distance from an electromagnet in a position feedback magnetic levitation system.

Methods/Materials

The materials used in this science fair project were an annealed soft iron screw, bolt, DC power supply, coil of copper wire, laser pointer, photodiode, wood with which the experiment was built, a control loop (constructed from electronic devices (detailed below)), a data acquisition unit (NI USB-6009), laptop, a metal test object, sail (Constructed from a plastic sheet), a tank for the fluid, water, and motor oil.

Results

For the tests done in water, as distance increased, the mean current in the solenoid also increased. In addition, the frequency of oscillation decreased. The amount of time the object was held remained fairly constant and then dropped off abruptly. For the tests done in oil, the findings followed a pattern similar to water (in terms of increases and decreases) for held time and mean current, however , it did not oscillate, instead, it simply levitated in place with minute changes in position, or the test object fell. This means that the standard deviation was always very low and the frequency measurements were irrelevant for oil. For tests done in air, increases in distance from the solenoid resulted in increased mean current, while frequency, standard deviation, and time held decreased as distance from the solenoid increased.

Conclusions/Discussion

The hypothesis was supported by the data. The results of this experiment give a fairly accurate representation of the limits of a position feedback electromagnetic levitation system. Further research should be done on a variety of other variables in the system, as is discussed in the conclusion of this experiment.

Summary Statement

Air and water resulted in quasi-stable, chaotic in levitation displacements, while the viscous oil resulted stable levitation, for this distance feedback system, and, for all fluids, stability decreased when control distance increased.

Help Received

Consulted father about control circuit design.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Keal D. Jones

Project Number
S0810

Project Title
Transforming the Way Transformers Work: Electrical Conservation Utilizing an End Device Detection Circuit

Abstract

Objectives/Goals
The purpose of this study was to determine if I could develop a circuit that could detect if an end device was plugged into a transformer or not, thereby turning off when no end device was present. With my new circuit, if no devices,(such as a cell phone, camera battery,)are plugged in or attached to the transformer, the input circuit would be opened not allowing electricity to flow to the transformer, thereby saving energy. If an end device was detected it would allow electricity to flow to the transformer and the end device.

Methods/Materials
I created an ASP web page that would collect data from an e-mail research experiment. The purpose of this was to determine the average number of transformers and their Wattage/Amps per household. Analysis was performed using the Microsoft Access and Excel programs. I then conducted many lab experiments with several different ideas, tools and concepts including a contact switch, battery and relay.

Results
The relay experiment appeared to work best. When the end device was plugged in, it switched the relay on and therefore the main power energized the transformer and held the relay closed. When the end device was unplugged it opened the circuit and switched off the main power to the transformer. Using a switched-mode power supply an internal control circuit switches power rapidly on and off in order to stabilize the output voltage or current more efficiently.

Conclusions/Discussion
I was not able to fully develop a reliable and useable circuit that could detect if an end device was plugged into a transformer or not, thereby turning off when no end device was present. My experiments did however lead me to discover an alternative technology called switched-mode which is 95% - 99% efficient. My hypothesis was on the right track. The concept is correct that if devices are plugged in or attached to the transformer, an input circuit could be opened so as to not allow electricity to flow to the transformer, thereby saving energy, however in terms of being able to actually create a workable model, I would need more development. Failure is one of the roads to the future. Try, try again.

Summary Statement
This project is about transforming the way transformers work and electrical conservation utilizing an end device detection circuit.

Help Received
Father instructed use of elctronic measurement equipment

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Albert C. Kim

Project Number
S0811

Project Title
JENKII: A Wireless Data Transmissions System through Sound Waves with the Use of OFDM

Abstract

Objectives/Goals
The objective for my project is to provide an alternative method for wireless data transmissions to the radio waves that are currently being used. People are becoming more concerned about growing evidence of radio waves causing health problems. With JENKII, this worry will cease to exist because it uses sound waves, instead of radio. It will also utilize the concept of OFDM (Orthogonal Frequency-Division Multiplexing). With this technique, one makes full use of the orthogonal property of waves to save bandwidth and insert more data. Also, the use of OFDM cancels out any multipath distortion. The cyclic prefixes make sure there is no incorrect data due to echoes or fading. I also wanted to create an easily accessible system, and JENKII fits this category perfectly because it only needs a speaker and a microphone to transmit and receive sound.

Methods/Materials
To develop this system, I created transmission and reception programs in C#. I utilized FFT algorithms to calculate the information as quick as possible and the OFDM technique to send as much data as possible. I also had an error-correction algorithm to fix any lost data. I used an interleaver to make sure only random data in the middle, which would be easy to guess at, would be lost. I used my laptop computer speaker and microphone, in conjunction with another, to generate and capture sounds respectively. Then I ran several tests and looked at the amount of incorrect data or data lost.

Results
Up to 2 meters, the average amount of error is less than 5%. I may be able to improve the results in the next several weeks.

Conclusions/Discussion
Up to 2 meters, JENKII allows for an almost perfect wireless data transmissions system, and is completely safe. OFDM is already being used with radio waves. With JENKII, I have shown that OFDM can be applied with other types of waves, such as sound waves. Now, it could potentially be extended into lasers and satellite data transmission could be improved.
Improvements:
1. Ultrasounds will improve data transmission rate with its wider bandwidth. However, it requires ultrasound devices which should be added to computer.
2. With a low data rate application, we can increase the distance by adding extra error correction codes to recover the errors or by increasing processing gain with repetitive codes (like direct sequence spread spectrum codes which is used in deep space communication).

Summary Statement
The goal for my project is to create a relatively cheap and easily accessible alternate method for wireless data transmissions to the potentially harmful radio waves that are currently being used.

Help Received
Father helped to introduce the topic of OFDM and sound communication theory; Mother helped to create presentation board.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Malika Kumar; Haley Zarrin

Project Number
S0812

Project Title
Ocean Wave Energy: Potential and Kinetic to Electrical

Abstract

Objectives/Goals
Ocean waves have huge amounts of energy that can be converted to electrical energy. We wanted to find the best method of converting this energy to electricity and determine the cost of building such a power plant, the amount of power it can convert, and the length of time it takes for it to pay for itself.

Methods/Materials
1. We theorized two concepts for converting ocean wave energy to electrical energy:
a. Globe generator is a floating ball that has 18 coils and magnets. The magnets are attached to a metal weight suspended in the middle with springs. The kinetic energy of the waves makes the metal weight push/pull the magnets in/out of coils. Our prototype had one coil and magnet. We scaled the energy converted up to 18 electromagnets (to represent one globe generator).
b. Reservoir power plant uses two wave collectors to focus the kinetic energy of waves leading the water into a reservoir. The reservoir is built above water level, so all water stored inside has potential energy. The reservoir water is drained onto an electric generator similar to Hoover Dam. We built a prototype of the wave collectors and reservoir plant. Then we built two prototypes of electric generators using coils, magnets, and turbine to measure the amount of electricity converted.
2. Each prototype was simulated using a 70,000L pool. The amount of energy converted was measured using two techniques:
a. Generator charges a capacitor using a diode bridge. Voltage measured and converted to joules.
b. A home-made joules meter built with a sensitive DC motor, and calibrated by discharging a capacitor with known number of joules, and marking the rotation angle of DC motor. A video camera was used to record the motor rotation. We analyzed the rotation by looking at the video frame-by-frame.

Results
The reservoir prototype converted the most amount of energy from the pool waves. A full-scale version would cost about $3.8 million dollars, and would convert 456 kwh. We used PG&E electricity rate of $0.20/kwh to conclude that it takes about five years for the reservoir to pay for itself.

Conclusions/Discussion
Capturing the energy from the ocean is a practical and affordable alternate energy source. The reservoir was more efficient than the globe generator. Going further, we would test our methods using real ocean waves, then with a better generator. We would also test a new method, and see how it compares to the reservoir method.

Summary Statement
We wanted to find a device that efficiently converts ocean wave energy to electricity so the world has an alternative, eco-friendly energy source.

Help Received
Mr. Simon Zarrin helped with the dangerous aspects of the project (using power tools).

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Jodi T. Loo

Project Number
S0813

Project Title
Sending and Receiving Information Using Photons

Abstract

Objectives/Goals
My goal is to demonstrate that photons can be used to send and receive information through optical fibers like how electrons travel through copper wires.

Methods/Materials
In order to achieve my objective, I built an optical transmitter, which converts a voice input from a microphone to photons. I also built an optical receiver which converts photons to voice. The materials used in this experiment were resistors, capacitors, amplifier, optical cables, transmitting and receiving circuit boards, soldering iron and power supplies. To test the photonic link, I also used an oscilloscope, a RF Transmitter and Receiver, TV monitors, and a frequency tuner.

Results
The FO link was successfully fabricated and tested. My voice was first converted to light which was then transmitted through an optical cable to the receiver where light was detected. It was then converted back to voice. An oscilloscope was used to monitor the electrical waveforms to detect signal distortions before and after voice signals at the transmitter and the receiver. Initially, the FO link was noisy. However, I was able to show that it was not due to the link because I was able to reduce the noise by placing a thick towel under the circuits. In my next experiment, I used a frequency tuner to produce a note at 440 Hz and verified that only this note was transmitted through the link. This was measured using an oscilloscope. I measured the wave cycle to be 2.25 ms at the receiver which matches the note frequency at the transmitter. My last experiment was to show the interference effect from a FO link versus a 2.4 GHz RF link by using two TVs and a microwave oven nearby. I took pictures of the receiving TV when the microwave oven was off versus when it was on. From the RF link, I saw a lot of signal disturbance from the receiving TV. There was no interference observed by the FO link.

Conclusions/Discussion
In this project, we can conclude that one can indeed send and receive information in the form of light. Since light has wavelengths shorter than RF, it has higher bandwidth and will provide higher data rate for communications. Today, photonic systems are being used in phones, cable TV, as well as providing the backbone for internet. It will gain even higher popularity if cost for FO link can be further reduced.

Summary Statement
My project is about building and testing a photonic link and knowing the underlying principles of how this link works.

Help Received
Father helped explain concepts.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
James (Jiajun) Luo

Project Number
S0814

Project Title
Circuit Dynamics and Modeling of the Gauss Accelerator

Abstract

Objectives/Goals
The Gauss Accelerator, commonly known as the Gauss or Coil Gun, demonstrates potential for future use in military and space applications. However, efficiency is miniscule due to a lack of understanding of factors that affect the performance of the Gauss Gun. Since the Gauss Gun functions as part of a time-dependent circuit, the circuit itself should play an immense role in the efficiency of the accelerator. Thus, setting parameters for a theoretical, ideal circuitry and design of the Gauss Gun was attempted through the use of Fourier Transforms and Magnetic Field equations.

Methods/Materials
Three methods were used to elucidate the factors involved in Gauss Gun operation. Method one involved magnetic field equations and experimentation to understand magnetic field in terms of increasing length and increasing radius. Method two involved energy calculations using the Biot-Savart Law to determine factors that affected muzzle velocity, with experimental evidence. Method three involved the use of Fourier transforms and the Quality factor to understand energy efficiency in the Gauss Accelerator.

Results
The field model predicts that radial expansion of the Gauss Gun optimizes muzzle velocity and flux density, and energy calculations predict that on some level, higher circuit resistance is beneficial to the system. Experimental results show that between 0-10 amperes of current, 10 Amperes was least effective and 4 or 5 amperes were most effective for projectile distance for the specific accelerator tested. A successful manipulation of the Fourier transform and Quality factor also yielded a possibly important tool for future Gauss Gun designs and optimization.

Conclusions/Discussion
Large-scale implementation of the Gauss Accelerator is only efficient if there is an increase in radius and a calculated increase in length. The muzzle velocity is also dependent on the resistance of the circuit. Fourier transformations prove to be valuable tools for future optimization of time-dependent circuitry and dynamics of the Gauss Accelerator by frequency adjustments in AC, allowing for computer programs that could generate efficient Gauss Gun systems.

Summary Statement
This study uses a combination of electrical theory and experimentation to improve Gauss Gun implementation and also suggest future directions of optimization.

Help Received
Used lab equipment at California State Unviersity Los Angeles under the supervision of Professor Oscar Bernal; Seung Jung helped test experimental data.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Francesca McClintic; Janel Raab; Sarah Roberts

Project Number
S0815

Project Title
Power of the Sun

Abstract

Objectives/Goals
The experiment will test how many volts a solar cell will generate from each type of light, from infrared to ultraviolet when exposed exclusively to each light. The procedure was created to gather information on the sensitivity of solar cells to different the light. in order to help build a better solar cell. The information gathered will prove how much the solar cell absorbs from each light.

Methods/Materials
Materials:
1 Ultraviolet, 5 Blue, 4 Aqua , 3 Green, 5 Yellow, 6 Orange, 3 Red, 1 Infrared, and 4 White. A circuit board, soldering equipment, wire, wire wrap tool, wire cutter, rotary and toggle switch, power supply, and resistors. A black container, and black electrical tape. A Volt Meter and Spectrometer.
Methods:
Build one light chamber and a light board, using ultraviolet, blue, aqua, green, yellow, orange, red, infrared, and white light LEDs. Attach a solar cell to a volt meter. Place the container over the solar cell. Do this three times recording the numbers on the volt meter. Do this for light, turning the rotary switch to change light color.

Results
The data charts and graphs show that the most effective light on the solar cell was the blue light with an average of 0.068 volts. The next light was the red light with an average of 0.032 volts. Then white was next with 0.028 volts; then aqua with 0.2167 volts, then green with an average of 0.012 volts, next was yellow and infrared with 0.010 volts, after that was orange with 0.009 volts, and lastly ultraviolet with 0.0073 volts.

Conclusions/Discussion
In conclusion, the blue light and red light were the most effective when it came to absorbing light and energy. This showed that the solar cell was more sensitive to the ends of the visible spectrum. Surprisingly, the solar cell was less sensitive to the middle of the light spectrum and the invisible lights. This showed that the solar cell is sensitive to certain frequencies of light. This information could be used to help build a better solar cell, because it proves that a solar cell is not using all the light energy that is available. It can be adapted to absorb not only blue, red, and aqua; but also yellow, green, orange and even the invisible light. This way the solar cell can use all the resources to create energy.

Summary Statement
Our experiment was to find exactly how sensitive a solar cell is to the different wavelengths of the light spectrum, so that a better solar cell can be created.

Help Received
Father helped provide equipment and taught us how to solder wires correctly.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Adil Mohd Salleh

Project Number
S0816

Project Title
Home-Built Hydrogen Fuel Cell

Abstract

Objectives/Goals
The main purpose of this project was to find out if the amount of hydrogen gas an electrolyser produces ,depending on the voltage & amperage of its electricity, would affect electrical output of a fuel cell.

Methods/Materials
Made a home-built fuel fom graphite foil, a PEM, and small electrical connecters. Made a home-built electrolyser out of plumbing parts. Used NaOH as the electrolyte for electrolyser. Requires DC converter power supply and digital multimeter.

Connected hydrogen supply (electrolyser) to the fuel cell. Changed the voltage & amperage of the electricity going to the electrolyser with a DC converter power supply. Measured electrical ouptut of the fuel cell with a digital multimeter.

Results
When the voltage & amperage of the electricity being fed to the elctrolyser was low, the elctrical output of the fuel cell was low. When I increased the voltage & amperage of the electricity, the electrical ouptput of the fuel cell increased as well (at certain points).

Conclusions/Discussion
A high voltage & amperage of electricity affects the amount of hydrogen gas produced. When a higher amount of hydrogen is fed into fuel cell, the fuel cell will give a higher the electrical output.

Summary Statement
Testing the electrical output of a home-built fuel cell depending on the electrical input supplied to the electrolyser.

Help Received
Father helped set up experiment and get supplies; mother helped put together display board

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Nitya Rajeshuni

Project Number
S0817

Project Title
Intrigues of the Universe: The Effects of Extreme Conditions on Earthly Power Sources

Abstract

Objectives/Goals
Original Study: For my project, I chose to study the capacity of a dry cell battery to survive at extreme temperatures, in particular, the temperature of Mars, -120 degrees Celsius, the temperature of the North Pole, -60 C, and the temperature of the Mojave Desert, 50 C. Although the planets as well as certain locations on Earth have extreme conditions, institutions such as NASA create magnificent rovers and probes that are capable of surviving such conditions. Hence, I hypothesized that batteries function better at room temperatures than at extreme temperatures.

*Extended Study: For the CA State Fair, I plan on gathering results about energy sources other than the dry cells, including lithium batteries, solar cells, and secondary cells.

Methods/Materials
The four brands of dry cells tested were Duracell, Energizer, Eveready, and Panasonic. Through a thermal chamber, four sets of batteries, one for each temperature, were exposed to their respective temperatures and were then placed inside the flashlights, which were then left to discharge. I then measured the time each flashlight took to discharge. Another four sets of batteries, one for each temperature, were placed in the flashlights, which were then turned on and exposed to their respective temperatures. I then measured the respective discharge times again.

Results
Overall, Duracell and Energizer exhibited longer lifespans than Panasonic and Eveready. Generally, all the batteries, regardless of the brand, discharged faster at lower temperatures. Flashlights tested within the thermal chambers turned off faster than flashlights tested outside the chamber, although the batteries had not yet discharged.

Conclusions/Discussion
After observing the set of batteries that were placed in the flashlights which were then exposed to the extreme conditions within the thermal chamber, I concluded that the time a battery takes to discharge is not unanimous with the time a flashlight takes to stop producing light, for after the flashlights stopped producing light at -120 C, they began to again emit light as the chamber approached room temperature, thereby signaling that they had not completely discharged. Thus, the flashlights did not turn off because the batteries had run out of the chemicals to convert chemical energy into electrical energy, but because they could not supply enough energy to satisfy the demand of the flashlights.

Summary Statement
For my project, I studied the capacity of earthly power sources to survive at extreme temperatures, in particular Mars (-120 degrees Celsius), the North Pole (-60 degrees Celsius), and the Mojave Desert (50 degrees Celsius).

Help Received
Used thermal chamber at JPL under supervision of Dr. Rajeshuni

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
James D. Warner

Project Number
S0818

Project Title
See the Sun, Measure the Power

Abstract

Objectives/Goals
I wanted to find out if using mirrors to reflect more sunlight onto a solar panel would cause the panel to produce more electricity?

Methods/Materials
I used a solar panel that is used in a car, 4 one foot square mirrors, a milti-meter that can measure volts and amps and a battery cable that plugged into the solar panel.
I had myself and up to three other people holding the mirrors so that sunlight would be reflected over the entire panel from each of the mirrors. I recorded the maximum amount of amps/volts that occured during each trial.

Results
I found that using mirrors to reflect more sunlight onto a solar panel causes the solar panel to create more electricity than sunlight alone.

Conclusions/Discussion
During the experiment the number of volts nevre exceded 22 and it stayed there for most of the trials, the number of amps went up however with each mirror added, that is why my hypothasis was correct, if one half of an equation increases, the number it equals also increases.

Summary Statement
Finding out if mirrors can make a solar panel put out more electricity.

Help Received
Students at school along with my mom and dad held mirrors, got multi-meter from my science teacher Erin Vaccaro, my mom got me backing paper and payed for development of pictures, my dad took the pictures, my mom got me the solar panel.