CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Nathan Bales; Daniel Trubey

Project Number
S0701

Project Title
Earthquake Precursor Detection

Abstract

Objectives/Goals
We are trying to see if we can build a radio receiver sensitive enough to detect in the DC-30 Hz range which is know to contain earthquake precursors.

Methods/Materials
We built an inductor coil as our antenna, a receiver circuit, power supply, and we bought an analogue to digital converter to connect it all to a PC. We used an oscilloscope to take measurements and are planning to eventually use a program that came with the ADC to plot the data in live time.

Results
When we hooked the receiver, antenna, and power supply up to our oscilloscope we found that we got what looks like to be the right kind of signals coming out of the receiver.

Conclusions/Discussion
We conclude that the receiver is sensitive enough to detect in the DC-30 Hz radio wave range.

Summary Statement
We are testing the ability of a receiver to detect earthquake precursors.

Help Received
Richard Trubey helped with general electronics questions.
Bruce Mount helped with more in-depth electronics questions that Richard Trubey could not answer.
Charlie Plyler made the schematics we used for the receiver circuit and power supply.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Tyrone T. Chen

Project Number
S0702

Project Title
Locating a Moving Object Inside a Fraction of a Motion Sensor Footprint

Abstract

Objectives/Goals
The objective is to locate a moving object inside a fraction of a motion sensor footprint by overlapping motion sensor footprints. By doing this, the number of sensors required to achieve a certain resolution can be reduced so that less motion sensors would be required to cover that area. The goal is to cut the cost of covering large areas that need tracking devices. This can be applied to homeland security.

Methods/Materials
The experiment was carried out by overlapping infrared motion sensor footprints on flat ground in a clear area. The sensors were placed to try to overlap the footprints evenly. If two of the motion sensors were triggered simultaneously, the moving intruder would be in the region of the overlap. This pattern continues for however many motion sensors are added. The experiment was carried out for up to four motion sensors and resulted in eleven different detection zones for the four overlapping sensor footprints.

The materials needed for the experiment were four motion sensors, chalk, a tape measure, and a digital camera.

Results
This research experiment demonstrates that four motion sensors could be used to create eleven different detection zones, where as typically eleven sensors would be used.

Conclusions/Discussion
As a result of the experiment, I verified that I could overlap motion sensor footprints to reduce the number of sensors required to achieve a certain detection and tracking resolution in an area. Unfortunately, prediction of the size and shape of the footprints and detection zones cannot be accurately predicted for the infrared motion sensors used in the experiment due to the manufacturing inconsistencies and environmental contrast effects.

Summary Statement
The project is about locating a moving object inside a fraction of a motion sensor footprint.

Help Received
Father helped find motion sensors and construct board.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Aaron M. Cox

Project Number
S0703

Project Title
Is It Possible to Levitate an Object Using the Principle of Magnetic Levitation?

Abstract

Objectives/Goals
The purpose of my experiment is to determine if it is possible to suspend an object in space using the principals of magnetic levitation. My plan is to attempt this using both permanent magnets and electromagnets. I will try to make a hemispherical magnetic field by ling a ceramic potting bowl with magnets displaying like poles. My design involving the electromagnet is to drive a coil with a pulse width modulated signal. My approach is to use a Hall effects sensor to detect the presence of the suspended objects magnetic field. This will automatically change the polarity of the coil to compensate for the floating objects altitude. Basically the electromagnet will repel the object if it becomes to close to the Hall effects sensor, and change its polarity to attract the object if it begins to drift away from the coil.

Methods/Materials
Soldering Iron
Roll of Solder
Honeywell high performance SS495A (U2) Hall Effect Sensor
Micrel MIC502 (U3) Fan Management IC PWM controller
LMD18201 (U4) Motor H-Bridge w/ heat sync
Etched circuit card supplied by ART-TEC
LED light bulb
80 Ohm ferrous core solenoid coil (electromagnet)
1cm x 1.75 cm permanent magnets (ceramic)
1cm round neodymium magnets
12vdc power supply
6# ceramic potting dish
36# shoelace
6# length of 1# aluminum angle stock.

Conclusions/Discussion
After completing this experiment, I have determined that it is in fact possible to suspend an object in space using the principals of magnetic levitation. Using the Hall Effect sensor to control the polarity and power of the electromagnet was much easier to levitate an object than the hemispherical permanent magnet design. When trying to balance an object on the permanent magnet structure, it had the tendency to topple over. The object being levitated by the electromagnet would remain vertical and completely suspended with much less effort than the permanent magnet structure.

Summary Statement
Using a self adjusting, reversible polarity, pulsewidth modulated circuit to control an electromagnet.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
J. Robbie Eaton

Project Number
S0704

Project Title
DigiSonic Batman: He's Watching You!

Abstract

Objectives/Goals
My project explores the feasibility of using 5 kHz sound pulses and twin microphones to determine both distance and location of target objects. The application is for autonomous robots or as a blind guidance aid.

Methods/Materials
The last version of my sonar system is composed of a high power tweeter speaker, two condenser microphones, a commercial microcomputer board, an analog signal board, and a servo-controlled dummy head pointing device. The system acts as an interferometer, comparing the phase of signals from two microphones. The microphone signals are amplified and noise filtered, then digitized and fed to the microcomputer which uses triangulation to find the azimuth of the closest target. My program then generates a control signal based on the azimuth which drives the servo pointer. After extensive problems and experimentation with false signal detection, I applied a cross correlation technique used in aircraft transponders which significantly improved operation.

Results
After re-working the analog electronics several times and trying a number of different approaches to detecting the sound pulse, my model now demonstrates that both range and azimuth of a target can be determined. I found that low-frequency and subsonic background noise ("thuds") must be completely filtered to get reliable results.

Conclusions/Discussion
The method used to detect and compare the received signals has a large impact on the reliability of this sonar system. My work could be extended to include multiple target detection. Using a higher frequency sound pulse may help eliminate background noise, but finding very small microphones (because of decreasing wavelength) could be a challenge.

Summary Statement
My project involves the design, construction, and experimentation on a phase comparison sonar useful as an autonomous robot guidance system.

Help Received
Father gave me a paper design for the analog circuits for me to build and debug since I don't know how to design analog yet. Flight instructor explained cross correlation technique. Mother drove me to buy parts, and also took pictures of my project.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Michael Faryna; Jared Shuman

Project Number
S0705

Project Title
Applications of Omni-Directional Antennas

Abstract

Objectives/Goals

Omni-directional antennas have a tremendous application in everyday life. They allow firms to effictivly and efficently transmit data over a high speed connection that only requires a minimial initial investment. We believe that we can futher increase in the gain and decrease the probablity of encoutering a dead zone. Through research of different designs of antennas, we found that a collinear based design would be best for application in a IEEE 802.11b enviorments.

We believe that through alternating ½-wavelength elements we can achieve omni-directional coverage in the x-y plane and reach Rx sites in all directions from a single Tx location. We believe that this can be accomplished through a coaxial collinear antenna design with a foam dielectric from LMR-400.

Methods/Materials

2 meters LMR-400; 2 12" length of 5/16 K&S brass tubing; 1 12" length of 11/32 K&S brass tubing; 1 block of wood of at least 1m long; 4 1" x 2" scrap wood blocks; 1 1/64th thick piece of scrap metal; 1 2# length of 1# brass tubing; 1 brass disk with 1# diameter; Non-acid core plumbing solder; Flux paste; Utility knife; Hacksaw; 300 watt soldering gun; Metal ruler (Metric/English); Metal sandpaper; Metal file;Hand-held pipe cutter; Rotary coax cutter; Vise; Micrometer; Dremel tool with metal cutting head; 1 14 dbm directional antenna; 1 802.11b Access Point; 2 Lucent 802.11b wireless network interface cards; 1 Laptop.

Conclusions/Discussion

We found our experiment to be successful and are very proud of the results. Although we did not achieve true omni-directional coverage, the project forced us think analytically and helped us to come up with possible solutions to this dilemma. One major and unforeseen problem with the omni-directional antenna is the beamwidth. We found that the more elements stacked on the antenna, the harder and more complex it becomes to align the Rx antenna with the Tx antenna. In our 16-element antenna we found that if we did not have our antennas on the same horizontal plane ( ) they would not connect. Overall, the project was a huge success because we learned so much about electromagnetic waves and how they relate to the computer industry.

Summary Statement

Developing an effective omni directional antenna for small business appliction

Help Received

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Pascual Flores; Carl Ihenacho; Raul Sanchez

Project Number
S0706

Project Title
Hydro vs. Aero

Abstract

Objectives/Goals
To identify which type of natural energy source is more efficient. A hydroelectric Dam, or a Wind turbine.

Methods/Materials
These are the materials we used to make our model of the more efficient hydroelectric dam and wind turbine: 7 90 degree angle plastic tube #; Large piece of reinforced Styrofoam; 2 120 degree angle plastic tubes #; 90 degree angle plastic tube ½; 10 foot plastic tube; Plastic valve ½; Sheet Plastic; 10 plastic cups; Voltmeter; Pinwheel; Plastic 1 Gallon container; 2 small electric motors; 4 electrical wires; Electric tape; 4 Washers; Super Glue; Pipe Glue; Elmer Glue; Drill; Sander; Circle saw; Blades; Pipe cutter; Screw driver; Large Tray; 135 gallon per hour / water pump; Vinyl tube; Hair dryer stand.

Methods: We assmbled all these parts into a miniature hydro electric dam and a wind turbine. We then tested the voltage of each electric source, and recorded the results.

Results
Results
Water Turbine 1st Trial 2nd Trial 3rd Trial 4th Trial
Voltage Given 3-5volts 2-4volts 5-6volts 1-3volts
Time 1 Hour 2 Hours 30 Min 5 Hours

Results
Air Turbine 1st Trial 2nd Trial 3rd Trial 4th Trial
Voltage Given 7-12Volts 7-12Volts 7-12Volts 7-12Volts
Time 1 Hour 2 Hours 30 Min 5 hours

Conclusions/Discussion
We have concluded through research and the actual experimentation that our hypothesis was both correct and incorrect. On the correct side we saw that it is more efficient to have a hydroelectric turbine rather than a wind turbine. In a water turbine you have a constant flow of energy throughout the day and night, As to where a wind turbine is only functional when the wind blows with enough force in that direction. Also winds are very scattered at times making it very difficult for the turbines to change wind direction, which consumes energy in itself. On the incorrect side the wind turbine produced 100% more energy than the water turbine. Therefore we have come to the conclusion that both are equally efficient. They both have their flaws but compensate for them in their strengths.

Summary Statement
To determine what type of natural energy source is more efficient, Water or Wind

Help Received
Father helped us choose the parts and drove us.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Christopher J. Gaydosh

Project Number
S0707

Project Title
Voltage Generation with Spinning Magnets

Abstract

Objectives/Goals
The project objective was to determine the impact of internal magnets, including a spherical magnet, on voltage generation more efficient.

Methods/Materials
A model generator was constructed with interchangeable armatures, stators, and internal magnet holders. The two armatures used were varied only in diameter. The stators were varied only in distance between the magnet poles, which affected the magnet to armature distance. The experiment design used fixed external magnets as the control group and measured the effect of distance, rotation (armature versus internal magnets) and internal magnet configuration. Three trials were run on each variation and the data recorded. Data results were evaluated using 2 Standard Deviations.

Results
Data evaluation shows the 2.25 inch stator significantly produced more output voltage than the 3.5 inch stator. Also, a fixed spherical magnet produces significantly more output voltage than the 1.875 inch stator with two magnet pairs. All the other comparisons show there is no statistically significant difference in output voltage.

Conclusions/Discussion
The internal magnets did not produce significantly more voltage than the stator based external magnets.

Summary Statement
Evaluate the effect of fixed and spinning internal magnets (disc and sphere) on an electrical generator's output voltage characteristics.

Help Received
Mother helped publish report and format the board; Dad helped build and test model generator; Dr. William Keig gave permission to borrow school lab equipment

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Danielle M. Gibson

Project Number
S0708

Project Title
A Jacob's Ladder

Abstract

Objectives/Goals
I wanted to test the resistance in different metals and gauges of rods to see if it affected the arc speed of a Jacob's Ladder. I wanted to find the metal as well as the gauge that would produce the fastest arc.

Methods/Materials
-Four (4) by Twelve (12) pieces of Plexiglass
- A twelve inch by twelve inch piece for the top
- Wood Base
- Neon Sign Transformer
- Wires
- Wire and Copper terminals
- Four (4) pairs of copper rods in gauges of; six, eight, ten and twelve
- Silicon Glue
- Wire Cutter
- Stop Watch
- Yard Stick
- Pliers
- Cordless Drill
- Small light bulb

Results
Out of the three (3) metals of brass, copper and steel, the copper rod had the least resistance and produced the fastest arc speed. The twelve gauge of the copper rod produced the fastest arc as well.

Conclusions/Discussion
I found that my hypothesis was incorrect in that the thickest gauge would produce the fastest arc. The relationship of the metal gauges, voltage and resistance showed that as voltage was constant, resistance increased with the increase in gauge size. The highest degree of difficulty in this project was getting the copper rods as straight as possible because of their malleability. The rods required meticulous adjusting because of the distance needed to provide the arc.

Summary Statement
My project is about how resistance in different metals and gauges of rods will affect the arc's speed rate of a Jacob's Ladder

Help Received
Neon sign transformer was donated by American Electric. My father provided minimal assistance.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)

Aaron S. Goldin

Project Number

S0709

Project Title

Autonomous Gyroscopic Ocean-Wave-Powered Generator: Invention of a New Energy Conversion Technology

Abstract

Objectives/Goals

Harnessing ocean power has been a long-sought goal. Existing wave-powered systems are large, land-based or moored, preventing autonomous applications. My goal was to invent a way to efficiently convert ocean wave power to an adaptive, autonomous, easily controlled system. Specifically, I applied gyroscopic precessional torque to convert periodic kinetic energy of surface waves into continuous torque that drives a rotary electric generator.

Methods/Materials

A prototype was designed, built and tested. All parts were scavenged from electronic equipment or fabricated from scraps. Many components were retooled and optimized. The effect of the gyros#s angular velocity on both generator power output and adaptability to varying wave frequencies was determined. Bench tests recorded output power, gyro angular velocity, generator electrical load and slope frequency. A mathematical model was developed approximating precessional torque as a function of wave frequency and angular momentum of the gyro. A buoy was built, gyro-generator and data recorder installed, and tested at sea.

Results

Data show a direct relationship between gyro rate and output power at all tested wave frequencies. Greater gyro rates allowed the generator to adapt to lower wave frequencies and greater electrical loads. Greatest power (1.9 watts) was generated at the highest gyro velocity (90 r.p.s.) with the largest load (33 Ohms); zero power with gyro stopped. The prototype powered the gyro while delivering 0.6 watts into the load. Sea tests confirmed that precessional torque significantly increased the generator#s power by >8x.

Conclusions/Discussion

A practical wave energy converter can be built using gyroscopic precessional torque sufficient to run both the gyro and an auxiliary load. It can be electronically controlled to adapt to different wave frequencies. This technology differs from current systems as it is autonomous, compact, avoids corrosion and rough sea damage common when moving parts directly contact seawater, and is scalable to much greater power outputs.

Summary Statement

I invented a new way to mechanically convert ocean wave energy into electricity.

Help Received

My dad assisted me with testing, electrical circuit theory, and use of power tools. I got permission from Marine Physical Lab at Scripps Institution of Oceanography to use its pier for sea tests.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Mathew Lewis; Jeff Tola

Project Number
S0710

Project Title
Capacitance

Abstract

Objectives/Goals
Can we build a capacitor to reflect our expected results of capacitance over displacement, and will theoretical science and mathematics hold true in our experiment?

Methods/Materials
Procedure: 1. with sheet metal saw, cut a 2, 50 millimeter x 20millimeters; 2. solder wire to plates with soldering iron; 3. glue wooden blocks to sheet plates; 4. set up micrometer stage to move the plates parallel to each other; 5. attach other side of wooden block to micrometer stand; 6. attach wires to the capacitance bridge positive and negative terminals; 7. set up computer to record data on program of choice, exp. Microsoft excel; 8. produce your predicted values; 9. use shim stock to set the constant distance between the plates; 10. set plates so that no area overlaps between the two plates; 11. slowly move the micrometer so that the plates overlap by .5 millimeters and record, repeat until you reach 9 millimeters; 12. Set the plates up so that no area overlaps again; 13. modify capacitance bridge so that the capacitance starts at your predicted value; 14. repeat step 11; 15. while plates overlap by 9 millimeters modify capacitance bridge so that you have your predicted value first; 16. repeat steps 10 and 11; 17. analyze recorded data with mathematical equations.

Materials: 2: 2 millimeter thick metalsheets; 1: sheet metal saw; 1: computer; 1: boonton m7550 capacitance bridge; 5#: Wire; 1#: Solder wire; 1: soldering iron; 1: micrometer stage; 1: Shim stock (.38mm); 2: wooden blocks 15cm x 4cm; 1: bottle of glue.

Results
The First statistical tests that we conducted were t* tests. These tests indicate to us whether or not our data was In a sufficient confidence level . Unfortunately our test yielded unsatisfactory results. The first test had a t* of .127391, which gives an approximate confidence level of 20%, way below our wanted 90%. Our second test had t* of .476496, which gave a confidence level of approximatly40%. Our third test had a t* of .096199 which has a confidence level of approximately 15%.

Conclusions/Discussion
These three tests did not support our original hypothesis, however, they have allowed us to identify key problems that may have contributed to our large amount of error.

Summary Statement
To test theoretical equations in real life situations, in our case we tested capacitance.

Help Received
Father helped take results and set up equipment, Mr. Levy help us organize our project and gave insitful critisim before each fair, Mr. Easton helped with statistics

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Elizabeth L. Llanes

Project Number
S0711

Project Title
A Random Walk Down Chaos Street II

Abstract

Objectives/Goals
This project compares the measurements of bifurcations and chaos from an actual circuit to a 5Spice simulation of the circuit. It was hypothesized that the 5Spice circuit simulator model versus the measured points of bifurcation and chaos of an electrical circuit would differ by no more than 5%.

Methods/Materials
To conduct the experiment, a resistor, an inductor, and a diode were connected in series on a breadboard. An oscilloscope was connected across the inductor and diode to monitor the output of the circuit. The peak-to-peak voltage of the first and second bifurcations, as well as the onset of chaos, were recorded. Applying the measured voltage value of the first and second bifurcations, Equation 20 in the research report was used to make a prediction for the onset of chaos. Then the circuit was modeled using the 5Spice simulator, and an analysis was executed to find the points of bifurcation and chaos. Three different types of diodes were used in the actual circuit and the simulation.

Results
The results of the experiment for the actual electrical circuit were that the onset of chaos was measurable for the 1N4004 and 1N4005 diodes, and when compared against the predicted value for the onset of chaos, the error was small. The 1N4001 diode only produced a first bifurcation, but not the second bifurcation or the point of chaos.
In the 5Spice simulation, the 1N4001 and 1N4004 diodes produced identical results because both diodes are modeled identically in the simulation. The 1N4005 diode had different results then the other two diodes.
When comparing the actual circuit results to the 5Spice simulation results, the points of bifurcation and chaos differed anywhere from 8% to 75%. This error indicates a substantial difference between measured and simulated values.

Conclusions/Discussion
In conclusion, the data recorded does not support the hypothesis that the actual circuit and the 5Spice simulation measurements would differ by 5% or less. In fact, the difference between the two were quite substantial.

Summary Statement
This project compares the measurements of bifurcations and chaos from an actual circuit to a 5Spice simulation of the circuit.

Help Received
Mr. Wellman helped with research materials. Teradyne Inc. allowed me to use their oscilloscope. My father taught me basic calculus.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Linnea L. Motts

Project Number
S0712

Project Title
A Study of Colloidal Battery Performance

Abstract

Objectives/Goals
The experiment investigated the influence of resonance absorption and surface plasmon dipole resonance on colloidal battery performance through the divergence of normally nondiverged Heaviside energy flow. By oscillating Ag plasmons to a resonance frequency of about 410 nm, the experiment attempted to collect more energy by diverging the Heaviside flow.

Methods/Materials
A Ag colloidal solution was created and then used to electrophoretically deposit Ag colloids, or plasmons, onto ITO and sputtered silver film. These electrodes, as well as bulk Ag/Al and thin film reflective corrugated silver/Al were used in a colloidal battery with the Ag colloidal solution as the electrolyte. A UV LED with distinct bands at 400 nm and 410 nm, UV lamp with a range from 400 nm to 600 nm, and UV laser of 409 nm were also used as different UV light sources. A source dipole was established, on the outside of the electrodes in solution, and a voltage applied in order to emit this continuous usually nondiverged Heaviside flow.

Results
The data supported the possibility of diverging portions of the Heaviside energy flow. Combinations of the dipole, magnetic field, and UV light source were used for the UV LED, UV lamp, and UV laser for each electrode system. However, bulk Ag/bulk Al electrode battery produced the highest voltage and current, and thus power in comparison to the other electrode battery systems. The electrophoretically produced electrode systems also showed a percent increase with the dipole electric field, magnetic field, and UV light source used, with the ITO electrode with a percent increase of 20.8 percent.

Conclusions/Discussion
The data does support the possibility of diverging the freely flowing Heaviside energy; however, the actually enhancement in the collection of charge was minimal. Numerous variables could have affected the investigation. Notably, the electrophoretically deposited electrodes were in reality crude compared to past experiments and practical development. There was not an ordered array of surface plasmons on the electrodes, which can be produced with a mask. Also, it is impossible to determine the size of the particles and to observe what was actually assembled on the electrode without an electron scanning microscope. With more sophisticated technology available, the experiment would undoubtedly produce much more impressive results.

Summary Statement
The experiment investigated the possibility of diverging the normally nondiverged Heaviside energy flow.

Help Received
Father provided materials.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Sonia Singhal

Project Number
S0713

Project Title
Computer Haptics: Giving Computers the Sense of Touch

Abstract

Objectives/Goals
The purpose of this experiment was to replicate the sense of touch using a computer.

Methods/Materials
An apparatus was built that allowed a pointer to be moved in space. Two small motors connected to the arms supporting the pointer applied forces to the pointer. Two accelerometers measured the tilts of the arms, which a microcomputer used to calculate the pointer's position in space. The microcomputer also controlled the speed and direction of the motors via a motor controller.

Computer programs were written to simulate four virtual objects or "phantoms." The programs turned the motors on and off near the boundaries of the phantoms, thus resisting the motion of the pointer at those boundaries. This allowed the person moving the pointer to feel the virtual shapes in space.

Results
The computer programs were able to generate virtual objects whose shapes could be sensed by a person feeling in space with a pointer. Although the boundaries were spongy, the shapes could be readily identified by the user.

Conclusions/Discussion
The results of this experiment are useful for applications where the sense of touch is important. Examples include microsurgery, remote sensing, and aids for the blind.

Summary Statement
My project replicated the sense of touch using a computer.

Help Received
My father milled the plastic pieces for the apparatus and answered questions I had on the programs. My mother reviewed the poster.

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Asher A. Williams, III

Project Number
S0714

Project Title
Emergicast Wireless Short-Range Communications for Emergency Vehicles

Abstract

Objectives/Goals
My goal is to create a functioning system that will give motorists a verbal warning of any responding emergency vehicles within a designated radius. I am creating the system to be hard wired into the automobile that will receive its signal thought the factory antenna and will deliver its message thought the speaker system. The device will use a relay that will be able to interrupt any audio device in the car to broadcast its message, then turn off and return to the device that was originally on. If no audio device is on in the car the system will still be able to broadcast because it is totally independent. My most important goal is for this device to become standard equipment on all new vehicles.

Methods/Materials
Materials: Micro-controller, Relay

Method: Use the micro-controller the trigger a relay and hold it open for a designated time to cut out car stereo and simultaneously activate warning message. When designated time is over have micro-controller close the relay to re-instate the radio.

Results
A system has been created that is able to interrupt any audio device running through the car's speaker system and leave a designated pause (area in which message will be inserted). Verbal warning is still being designed and built, hopping to have final product ready for fair.

Conclusions/Discussion
A basic prototype has been designed and improvements are steadily coming along. I plan to have a final market ready device within 12 months.

Summary Statement
A device that will alert motorist when an emergency vehicle is responding to a call in there area.

Help Received
Teacher helped with programing ; Father hellped with creating DSP chip

CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
Christina Zhu

Project Number
S0715

Project Title
The Effect of Wavelength of Visible Light on Photovoltaic Cell Electricity Generation

Abstract

Objectives/Goals
What is the effect of wavelength of visible light on photovoltaic cell electricity generation? The objective is to develop a more efficient method of using light for solar energy.

Methods/Materials
1 polycrystalline photovoltaic cell
3 flashlights
Various cellophane filters (red, yellow-orange, green, blue, and violet)
1 multimeter
2 probe sets
2 alligator clip wires
6 AA batteries
The structure for the shining of light onto the photovoltaic cell was constructed with 2 ringstands with wire strung between them, and the flashlights were clipped onto the wire with binder clips. The photovoltaic cell was placed directly under the light of the 3 flashlights. For each sample, the probe sets and alligator clip wires connected the photovoltaic cell and the multimeter.
The wavelength was the independent variable. Different wavelengths, represented by colored filters, were used to test the hypothesis. White light was produced by mixing equal amounts of red, green, and blue light. Six samples were used (red, yellow-orange, white, green, blue, and violet light). Each sample was tested with three trials. Using the multimeter, the amperage was measured in milliamperes for each of the trials.

Results
As a general trend, a greater amount of current was generated when light of a longer wavelength fell upon the photovoltaic cell, supporting the hypothesis. However, the wavelengths of violet and yellow-orange light did not follow the trend. This signifies a relationship between wavelength and current that may not be completely linear. Outside factors may have also influenced the result.

Conclusions/Discussion
Wavelengths of light do matter in the solar energy industry. Some wavelengths, as was discovered in this experiment, generate more electricity than others. Contrary to popular belief, longer wavelengths of visible light, the ones with less photon energy, are more efficient with photovoltaic cells than shorter, more energetic wavelengths.

Summary Statement
Different wavelengths of visible light were tested for efficiency on a photovoltaic cell.

Help Received