CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Joshua M. Arreola

Project Number
S0901

Project Title
Jump-Starting the Electric Car: Improving the Lifespan of Electric Car Batteries by Means of a Generator

Abstract

Objectives/Goals
The objective of my project was to determine if it would be possible to harness the kinetic energy from a model car axle to turn a generator, and use the electricity gained from the generator to recharge a battery.

Methods/Materials
I first created a replica of a car axle using a wooden frame and dowel. I then attached a homemade generator to the middle of the dowel/axle. For the experiment, I fully discharged a 1.2V AA rechargeable battery and attached it to the generator. I used an electric drill to turn the axle and the generator for one hour, checking and recording the voltage of the battery every fifteen minutes; I repeated this step with three other fully discharged batteries. I then hooked up each battery to a 1.5V Mini-Lamp for two hours and recorded their voltages every thirty minutes to see if the generator fully recharged the batteries. I repeated this step with four fully charged batteries to see how long they would last compared to the recharged batteries. These were my control batteries.

Results
My results showed that the generator was successfully able to recharge the fully discharged batteries, but 3/4 of them did not last as long as the fully charged batteries. During the experiment, I discovered that the experiment I performed only showed that the generator would recharge a battery. What I was trying to see is if a motor could run a generator which could recharge the battery that was running the motor. Further research, however, helped me realize that I would have made a perpetual motion machine, which would not have produced any results, so I continued with this experiment in order to achieve some results.

Conclusions/Discussion
My results showed that my hypothesis was somewhat correct. The car axle replica was able to harness enough kinetic energy to power the generator and recharge the batteries, but they did not last as long as the fully charged batteries. For future experiments, I would try alternative methods of improving the efficiency of the batteries by testing solar cells and regenerative braking. I would also run the experiment with different types of rechargeable batteries and run longer trials. This experiment could greatly increase the efficiency of electric cars and help reduce the use of gasoline-powered vehicles.

Summary Statement
This project was conducted to determine if it would be possible to harness the kinetic energy in car axles to turn a generator, and use the energy gained from the generator to improve the lifespan of electric car batteries.

Help Received
My dad helped me construct the framing to hold the car axle. My mom purchased the materials, took pictures, and pasted some of my board. I received advice and mentoring from Mr. Bradford Oliver and Dr. Charles Hurst, both engineers.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Siddhartho Bhattacharya

Project Number
S0902

Project Title
Investigating the Cause of Anomalous Behavior in Operation of the Nintendo Wii System

Abstract

Objectives/Goals
The purpose of this project was to investigate the anomalous behavior in operation of the Nintendo Wii system and identify the cause of this anomaly. The anomalous behavior was the occasional incorrect display and erratic movement of the cursor/pointer on the T.V. screen under certain circumstances. Since the Wii Remote contains an Infrared (IR) detecting device, it was hypothesized that the anomaly may have been caused by interference from sunlight or any other IR emitting sources in the operating ambience.

Methods/Materials
1. The condition at which the Wii remote behaves erratically was identified and it was ensured that this behavior could be reproduced.
2. From the Wii technical specifications, the IR wavelengths used in Wii operation was found out.
3. To detect presence of IR in the operating ambience, an IR detector was built using an IR phototransistor and other semiconducting components and appropriate filter to pass the Wii range of IR wavelengths.
4. Data is collected with varying levels of exposure to sunlight and other possible IR sources such as flashlights, lamps (both incandescent and fluorescent) at varying distances from the detector.
For measurements, oscilloscopes and digital multimeter were used.

Results
It was found that sunlight, flashlight and incandescent light have significant IR content. The light from fluoescent lamp has no or very little IR content.

Conclusions/Discussion
It was concluded that the Wii Remote was detecting IR light from sources other than the intended source and sent incorrect information to Wii console which caused the anomalous behavior.
As a remedy, the IR light emitted by the sensor bar could be encoded to distinguish it from IR coming from other sources. This could prevent erroneous detection of IR light and incorrect operation by the Wii Remote.

Summary Statement
This project was an investigation to find the cause of anomalous behavior in the operation of Nintendo Wii in the presence of sunlight or other IR sources in the operating ambience.

Help Received
Used lab equipment at Via Telecom under the supervision of my father (Prasun Bhattacharjee); Mother helped prepare presentation board; Father provided transportation.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

R. Pat Capulong

Project Number

S0903

Project Title

The Effect of Distance between Two Inductively Coupled Windings on the Current Induced across the Secondary Winding

Abstract

Objectives/Goals

This experiment explored the question: "What is the effect of distance in millimeters (mm) between two inductively coupled windings on the current in milliamperes (mA) induced across the secondary winding?" It was conducted to determine the potential and limit of inductive charging.

Methods/Materials

The hypothesis was, "If the secondary winding is placed 2 mm, 4 mm, 6 mm, 8 mm, 10 mm, 12 mm, 14 mm, 16 mm, 18 mm, and 20 mm away from the primary winding, then the electrical current of secondary winding will be less than 3 mA." To test the hypothesis, an oscillator with a primary winding of coil and a resonator with a secondary winding was built. The primary winding was kept stationary and the secondary winding was distanced 25 various measurements at which the current of the secondary winding was measured ten times. The control group consisted of the aforementioned apparatus, but the windings were kept tangent and then measured for current.

Results

The results of this experiment showed that 0 mm distance yielded the most current, 1.42 mA, and that 50 mm yielded the least current, 0.01 mA. A major pattern noted was an inverse relationship between the distance between the windings and the current of the secondary winding.

Conclusions/Discussion

In conclusion, the data observed supported the hypothesis, although the miniscule amperage readings were not anticipated.

Summary Statement

This experiment was conducted to explore the potential and limits of inductive charging, a method of wireless power, by constructing an apparatus that wirelessly transmits energy through an electromagnetic field.

Help Received

Lateef Kajouke obtained materials; Neighbor Gregory Stiles provided tools and safety lessons; Dutch hobbyist Ko Tilman helped create schematic.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Jared M. Clark

Project Number
S0904

Project Title
Has Interference Knocked Your Wi-Fi Down for the Count?

Abstract

Objectives/Goals
The purpose of this project was to see if wave emitting devices had an effect on the signal quality of a home networks Wi-Fi router. The hypothesis was that the household wave emitting devices will have an effect on the signal quality of a home networks Wi-Fi router. Changing the channel that the router is on will decrease the amount of interference.

Methods/Materials
The signal and noise levels from the computer to the interference source were monitored by a piece of software called iStumbler. The wave emitting devices that were tested were a microwave, a cordless phone, a blue tooth, walkie talkies, and a wireless controller. The router was tested close to the computer, close to the interference source, and equidistant from both the computer and the wave emitting device. Different channels on the router were tested to see what channels were not affected by the microwaves energy.

Results
The microwave had the largest effect on the signal quality of the home Wi-Fi router. The lower channels were not interfered with the microwave while the microwave affected the higher up channels.

Conclusions/Discussion
The results of the experiment suggest that the microwave will interrupt music playing wirelessly and slow video feed from online videos. Further research could investigate questions like, What kind of router works best in an environment with many wave emitting devices?

Summary Statement
This project investigated the effect of wave emitting household appliances on the signal quality of a home networks Wi-Fi router.

Help Received
My scince teacher proofread my papers.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Lauren N. Fratamico

Project Number
S0905

Project Title
Solator: A Static Photovoltaic Solar Concentrator

Abstract

Objectives/Goals
The objective is to demonstrate an economical 50 percent increase in photovoltaic produced power through use of short focal length, static, cylindrical Fresnel lenses.

Methods/Materials
Approximately 20 linear centimeters of photovoltaic cells were placed beneath cylindrical Fresnel lenses with the long axes of the lenses oriented in an east-west direction. The cells were less than one focal length below the lenses and were connected to a resistive load. Output of the array was recorded every 40 seconds through an automated data logger. The power output of a second array, the control group with similar photovoltaic cells but without the Fresnel lenses, was recorded on a second channel of the data logger. The power output was integrated over the course of several days to compare energy production of the two arrays.

Results
Greater than a 50 percent increase in power production was achieved, in accordance with the objective.

Conclusions/Discussion
The Solator demonstrates that the power output of expense photovoltaic cells can be significantly increased through the use of low cost Fresnel lenses. Further, this is achieved without requiring any tracking mechanism or moving parts, and in a very low profile manner by innovative use of short focal length lenses.

Summary Statement
Demonstrated significant photovoltaic efficiency gain using low profile non-tracking cylindrical Fresnel lenses.

Help Received
Father assisted with soldering.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Jonathan Krol

Project Number
S0906

Project Title
Electromagnetic Pulse Accelerator

Abstract

Objectives/Goals
The objective of this project is to create an electromagnetic coil gun with optimum efficiency and power. Affecting variables will be isolated and compared to ensure test accuracy.

Summary Statement
The aim of this project is to create an electromagnetic coil gun with optimal energy efficiency.

Help Received
Worked at the school's electrical lab.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Samuel Lester; Aaron Zhang

Project Number

S0907

Project Title

Relationship between Different Types of Antennae and Their Respective Signal Strengths in a Predetermined Area

Abstract

Objectives/Goals

The goal of this project was to find the relationships between different types of antennae and the position the receiver was at. Each antenna's optimal are of usage would be found.

Methods/Materials

To test this experiment a base laptop stayed stationary and hooked up to one of three test antennae (biquad, parabolic, dipolar). The other laptop was the test laptop with a preconfigured wifi antenna where data points were gathered in a predetermined area. By using programs such as MATLAB, netstumbler, and google earth, the data and results could be expressed in a variety of ways.

Results

The dipole antenna had optimal signal in a 360 degree angle, while the distance reached was relatively short. The biquad antenna's signal had a much longer reach, with an approximately 180 degree angle. The parabolic antenna's signal had 10-20 degree angle, and reached about 15% farther than the biquad (with comparable signal strength).

Conclusions/Discussion

At the end of the experiment the hypothesis was mostly supported. The general trends stayed constant with theory but the biquad antenna showed vastly different resutls than expected. Besides covering the same raidal distance as hypothesiszed, the linear distance at which the biquad traveled was beyond expected results. Besides this inconsitency, the data supported the hypothesis.

Summary Statement

Various antennae were tested to find their optimal usage scenario.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Mitchell T. Maas

Project Number
S0908

Project Title
Electromagnetic Propulsion: Phase III

Abstract

Objectives/Goals
Will redesigning the 1000 turn Electromagnetic coil into two 500 turn Electromagnetic Coils optimize the launch distance of the rocket. If so, what percentage of change will occur between Phase II data and Phase III data.

Methods/Materials
Methods: Redesign the existing Phase II Electromagnetic Launcher utilizing the existing 1000 turn coil, and split it into two 500 turn coils, with dual permanent magnet stacks. Build new coil winding machine to unwind and rewind redesigned coils. Test: Test the redesigned dual coil launcher from one to four capacitors and compare the launch distance data with the Phase II data. Materials: Use existing magnet wire (29 ga.) to build two coils, modify existing 1# wood and masking tape. 1# wood coil winding base and 5/8# square wood for winding spindle. Plastic spool for winding wire.

Results
I redesigned the launcher utilizing only the existing coil material to create two 500 turn electromagnets. I tested the new dual coil launcher using the same test methodology as in Phase II. I had predicted 10% improvement in launch efficiency, and I actually achieved 35% improvement at the maximum distance. The results clearly showed that I had utilized all the stored energy in a much more efficient method than in Phase II. I was clearly impressed that just by optimizing the existing launcher design, I could achieve a 35% improvement.

Conclusions/Discussion
My hypothesis was correct. I had predicted that the redesign of the 1000 turn launch coil into two 500 turn coils would make the rocket more efficient. It was more efficient, but not by the 10% I had predicted, but 35%. I was impressed that the energy stored was utilized fully, as evidence by the graphs showing launch distance.

Summary Statement
Optimizing my existing electromagnetic launcher, utilizing the same materials and developing a coil winding machine.

Help Received
Father helped me unwind the existing coil, and counted the number of turns for the two 500 turn coils, using my new winding machine. He also helped me verify the launch distance readings. My mom also helped verify the launch distance readings. Mr. James Edman supported and reviewed my new schematic

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Ritik Malhotra

Project Number
S0909

Project Title
Multi-Touch Table: An Infrared-Based Touch Interface Designed for Collaborative Data Manipulation

Abstract

Objectives/Goals
Multi-touch sensing touch screens are rapidly revolutionizing the tech industry. With capabilities of sensing multiple touches at once, multi-touch screens are becoming useful for collaborative work and are becoming increasingly popular in corporate environments. But even with such advanced technology, affordable multi-touch products are far too small for the average consumer, while large-scale multi-touches cost too much, and cheap multi-touches have backlighting issues, making them unusable. This project is the construction of an infrared-based, large-scale multi-touch screen for an affordable price, while keeping the same functionality as a capacitance-based one.

Methods/Materials
The multi-touch table was constructed using an infrared-based detection system. An array of infrared light is shined into an acrylic glass sheet at a specific angle, causing the light to reflect inside the glass, bouncing up and down within it. Once a user touches the glass sheet, the light becomes "frustrated" and is reflected directly downwards at that spot. A webcam with its infrared filter removed, and connected to a laptop, is placed on the bottom of the table and is used to detect the infrared light at the spots where the user touches the glass, effectively sensing every point that the user touches.

Results
Multiple touch blobs were detected from multiple users touching the screen all at once, showing that its multi-touch capabilities were functional.

Conclusions/Discussion
The successful construction of my infrared-based multi-touch showed that it was possible to achieve the same effect that a modern-day, capacitance-based, multi-touch screen achieves, but at less than ten percent of the cost (capacitance: $5,000+; infrared: $500). Next, it proved that multi-touch screens would no longer have any size limitations as long as they adhered to the infrared-based detection principle. Lastly, it showed that CCFL backlights could be used to light up the touch screen without causing major interference within the touch sensing system. The multi-touch table could also run many applications. Small scale applications for the multi-touch include photo viewers, multiplayer games, musical synthesizers, and entertainment systems. Large scale applications of the multi-touch include using it for military operations, interactive business conferences, and government use.

Summary Statement
This project is the design and construction of a multi-touch sensing touch screen using infrared light as its detection method.

Help Received
I want to thank my father and my uncle for helping me operate some of the tools during the construction of the project. I also want to send out a special thanks to Sudi Bhat, for providing me with the inspiration to participate in Science Fair this year.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Denyven S. Peng

Project Number
S0910

Project Title
The Effect of Overclocking a Computer and the Use of Different Types of RAM on a Computer's Speed and Stability

Abstract

Objectives/Goals
My main goal of this project was to see if Overclocking a computer was a theoretical speed gain, or an actual speed gain. Another piece of information I wanted to find out was if it was worth it t spend extra money on Overclocked "Extreme" RAM.

Methods/Materials
In order to test this, I built my own computer with a CPU that has a reputation for being a "good Overclocker." Once the Computer was completed I overclocked the computer to 5 different levels (1.8gnz, 1.9ghz, 2.0ghz, 2.1ghz and 2.2ghz) at each clockspeed, in order to test my RAM objective, I ran test with both the standard "basic RAM" and the Overclocked "extreme RAM." I ran 10 tests for every configuration. I tested the computer's speed by running a commonly used benchmark, PCmark '05.

Results
What I discovered was that overclocking is indeed an actual speed boost, and that overclocking just a half a Ghz I could raise the PCmark score by 1000 points or 25% of the score that I got when the CPU was not overclocked. On the contrary, I found out that both the "Basic" RAM and "Extreme" RAM both averaged the same score (they were different by about .7 of a score), thus it was not worth to spend money on the higher end "extreme" RAM.

Conclusions/Discussion
I learned from this experiment that overclocking does indeed really make a computer faster, and also that "extreme" RAM is just as fast as the "basic" Standard RAM. Yet, this could only be a result of my computer being semi-incompatible with the faster RAM.
From this experiment, I Also found out there are so many more different things to discover in the field of computer science, with the most important/interesting thing being how to combat heat when making faster and faster computers. That is why I will further experiment with different cooling methods to see how that affects performance and the ability to further overclock a computer.

Summary Statement
Is overclocking a theoretical or actual gain, is it worth the extra money to buy high end RAM

Help Received
Mother edited the Grammar/Spelling of the report

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Andrew P. Petersen

Project Number
S0911

Project Title
Kinetic Energy through Induction: A Solution to Pollution

Abstract

Objectives/Goals
My objective is to prove that the property of electromagnetic induction can be applied to create a new method of powering transportation. Electricity would pass through a primary coil under the road surface, transfer to the secondary coil in the vehicle through induction, and power an electric motor in the car.

Methods/Materials
A model of this concept was built using an electric motor from a Lego train, a rectifier, a primary coil, and a secondary coil. The coils have iron cores and were wrapped with enameled copper wire. The motor, rectifier, and secondary coil were connected in one circuit. The variables being tested include the distance between the coils, the orientation of coils, the amount of voltage used, and the size difference between the coils. Data were measured by a digital multimeter, a ruler, a protractor, and a variable transformer.

Results
The primary coil provided the best transfer of energy to the secondary coil when the distance was minimal, the coils were parallel, and the length ratio between the secondary and primary coils was one. If voltage provided to the primary coil increased, then the induced voltage also increased. Thus, when certain conditions were met, the primary coil was able to induce the secondary coil to power the electric motor.

Conclusions/Discussion
Creating kinetic energy through induction worked and, under the proper conditions, enough voltage is induced in the secondary coil to cause the electric motor to run. Further testing is necessary to make the road surface longer in relation to the car, so that the technology can be realistically used. If this is possible, then this could be used to eliminate the need for petroleum in motor vehicles traveling on developed roads, powering them instead by electricity.

Summary Statement
Cars can be powered through induction using two separate electromagnetic coils: one imbedded in the road and the other inside the car powering the electric motor.

Help Received
I received help from my grandfather with the concept and with some construction of the model.

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

Akhil Raju; Keshav Saharia; Vyas Savanur

Project Number

S0912

Project Title

Automated Cargo Transport: Microcontrollers Utilizing an Environment Detection System and RF Signals to Follow a User

Abstract

Objectives/Goals

The objective of this project is to create an automated shopping cart that can autonomously follow a disabled person as they move through a store, eliminating the need for physical exertion.

Methods/Materials

The shopping cart has to be able to know the location of the user relative to a set point, and have the ability to move to the point while avoiding any obstacles that might be present in its path. To accomplish this, we created an environment detection system that uses a microcontroller to process inputs from infrared, compass, and RF sensors. The microcontroller, a Boe-Bot from Parallax, uses the inputs from the EDS to calculate a vector between the cart and the user, and modify this vector based on real-time sensor input.

Results

Through testing, we were able to create algorithms that allow the robot to calculate vectors between itself and outside objects. The Boe-Bot was able to successfully follow a user in a lab environment. One major problem we encountered was that the sensors encountered a certain percentage of error that we could not remove. The programming language we used, BASIC, often couldn't handle the numbers to the accuracy that we needed. This became problematic because we were unable to increase our accuracy without further complicating our methodology.

Conclusions/Discussion

The algorithms found through our testing process are sound and usable in the real world. However, if this product is to be used on a larger scale, more robust sensors are required. The error that the sensors were encountering was accumulated error, meaning that the microcontroller's error gradually increases over time until it completely loses track of the user. However, the algorithms themselves worked and can be implemented in a variety of different areas of work, including construction and medical environments, to help workers move materials/people from place to place without unnecessary physical exertion.

Summary Statement

An automated vehicle that can follow a user and manuever around obstacles using an environment detection system.

Help Received

Received materials from Mr. Kawanami, our project advisor

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Alon M. Sacks

Project Number
S0913

Project Title
The Effects of the Operation of Passenger Electronic Equipment on Aircraft Navigation

Abstract

Objectives/Goals
My experiment seeks to answer the question whether passenger electronic equipment affects aircraft navigational instruments or not. I hypothesize that if passenger electronic equipment is on while flying, then the aircraft navigational instruments will be slightly affected, and will show inaccurate data.

Methods/Materials
In order to conduct this experiment I used various electronic equipment including laptops, iPods, cell phones, and FM radios as well as a Cessna 172 four-seater aircraft with the following navigational equipment: a magnetic compass, a directional indicator (DI), an automatic directional finder (ADF), a VHF omni-directional range (VOR) and distance measuring equipment (DME). As each instrument relies on different principles for its operation, certain instruments could be conducted while on the ground while others had to be conducted during flight.

Results
The only pattern present in this experiment was that the negative effects on the aircraft's navigational instruments were consistent, meaning an instrument was either always negatively affected or never negatively affected. The DI, DME and VOR all showed no deviation with any of the electronic devices and the magnetic compass and ADF showed various amounts of deviation with all of the electronic devices.

Conclusions/Discussion
My original hypothesis was rejected by my data, showing that the accuracy of the navigational instruments is dependant on the principles that instrument is conducted by. 3 of the 5 navigational instruments (VOR, DI and DME) showed no deviation of accuracy and the other two instruments (magnetic compass and ADF) showed large amounts of deviation. Although it is possible these conclusions may be somewhat false due to experimental error, they are conclusive enough to determine that aircraft navigational systems are indeed affected by passenger electronic equipment.

Summary Statement
My project is about the effects of everyday passenger electronic equipment on an aircraft's navigational devices.

Help Received
Father helped fly the aircraft

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Elly J. Shao

Project Number
S0914

Project Title
Light, Color, and Electricity

Abstract

Objectives/Goals
The objective is to examine the effect of light color and intensity on the electricity output of photovoltaic (PV) cells. Since short wavelength light is more energetic than long wavelength light, my hypothesis is that light with shorter wavelengths would allow a PV cell to produce more electricity than light with longer wavelengths.

Methods/Materials
My first experiment was to determine the effect of sunlight intensity on the electricity output of two PV cells at noon. To increase intensity of light, a satellite dish was covered with foil and a PV cell was placed at its focal point. Its electricity output was compared to a PV cell directly facing the sun. The second experiment was to determine how color affected electricity production. I used a projector to project seven colored slides with wavelengths ranging from ~400 nm to 700 nm at the PV cell and light meter, and changed the distance between the PV cell and the projector from 3m to 0.5m in order to control the light intensity from ~50 to 15,450 lux.

Results
The satellite dish doubled the intensity of the light on the PV cell, up to 486,000 lux compared to 224,000 lux on the PV cell directly facing the sun. There is a correlation between light intensity and current produced by the PV cell, as current production also doubled in the PV cell facing the dish. Different colors of light did not have any appreciable effect on current production. All colors of light tested in the second experiment produced ~0.7 microamps/lux.

Conclusions/Discussion
Light intensity has a greater effect on current production than color. The photoelectric effect says electrons are emitted after absorbing light energy. If a photon can excite an electron, a brighter light containing more photons can generate more current. Color affects PV cell function by determining if electrons will be freed. An energetic photon gives an electron more energy, but energy greater than that needed to free the electron is wasted as heat. The number of electrons in the circuit determines current and the composition of the PV cell determines maximum voltage. Silicon cells are sensitive to the entire spectrum of visible light, which is only a tiny portion of the electromagnetic spectrum. Light intensity affects current, and voltage is determined by the composition of the solar cell.

Summary Statement
I studied the principles of the photoelectric effect and designed experiments to examine the effect of light color and intensity on the electricity output of photovoltaic cells.

Help Received
Mrs. Usher, my science teacher, provided guidance and feedback to my project report. My father helped assemble the satellite dish light concentrator, borrowed the projector, and printed the one-page poster display. My mother took the pictures as I did the experiments and borrowed books from libraries

CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
Anna K. Simpson

Project Number
S0915

Project Title
A Mobile Autonomous Chemical Detecting Robot

Abstract

Objectives/Goals
A robotic chemical detector, moving and responding to dangerous chemicals without human presence or control, could help save lives. My objective was to create an autonomous mobile chemical detecting robot. Building upon the basic sensor prototype I made last year, I had to increase sensitivity, make vapor movement autonomous, speed up response and integrate the sensor onto a mobile chassis. I hypothesized that I could improve the sensitivity by a factor of 10 using more complicated circuitry, address movement and speed with a fan, and produce a mobile robot to autonomously detect chemical in real time.

Methods/Materials
I added an op-amp, resistors and voltage regulators into the sensor circuit to increase sensitivity, limit drift, and improve signal stability. I also added a fan and ran hundreds of tests of baseline and chemical readings. Then I attached the sensor and fan to a mobile chassis and wrote control programs for it to move and detect autonomously. After the programming, I ran tests where the robot moved over some ethanol placed on the ground.

Results
Tests on the amplified circuit showed limited noise and range in the baseline, and a signal change more than 20 times the baseline when chemical was introduced, far more than was hypothesized. Even concentrations only of 5% ethanol changed the signal markedly. The fan caused almost immediate detection and was placed with the sensor on the mobile chassis. After creating the program, I had the autonomous mobile robot move over a spill of chemical. It consistently and accurately detected and responded to the presence of chemical in real time!

Conclusions/Discussion
My product is a mobile robot that can sense chemical spills on the ground below it autonomously and in real time. The program can be adapted to implement a variety of algorithms for searching and response, as needed for applications in industry, security and counter-terrorism.

Summary Statement
My product is a mobile robot that can sense chemical spills on the ground below it autonomously and in real time.

Help Received
Used lab equipment and lab space at UC San Diego under Professor Michael Sailor