CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Oscar Aviles; Manuel Gonzalez

Project Number

S0701

Project Title

Photo-Voltaic Cells

Abstract

Objectives/Goals

The objective of the project was to conduct research and laboratory experimentation to study photo voltaic cells and their practical applications.

Methods/Materials

Experiments were done to determine the following:
A:Do similar PV cells produce similar electrical output?
B:How does light intensity affect the electrical output of a PV cell?
C:How does the angle of the PV cell to the light source affect the electrical output?
D:How does the distance from the light source affect the electrical output of a PV cell?
E:How does placing part of a PV cell in Shadow affect its electrical ouput?
F:How does the color of the light affect the electrical output of a PV cell?
G:How does combining PV cells in parallel affect the electrical output of the PV cells?
H:How does combining PV cells in series affect the electrical output of the PV cells?

Results

a: Similar PV Cells produce almost similar electrical output.
b: More the light intensity, greater the electrical power output.
c: Electrical output is maximum when the light source is at right angles to the PV cell and reduces as the angle decreases.
d: The power output decreases as the distance of the light source increases.
e: Electrical output decreases as the area in the shadow increases.
f: Since color blocks off part of the light waves, the output decreases. The reduction is least for red and the most for blue.
g: In parallel, the current increases, but the voltage remains the same.
h: In series, the voltage increases, but the current remains the same.

Conclusions/Discussion

Photo-voltaic cells are very important sources of future electrical energy as non-renewable sources of energy get depleted. At present they are very expensive. However, with more research, it would be possible to produce them more economically

Summary Statement

Photo-Voltaic cells are a promising source of electrical power for the future.

Help Received

Our teacher, Mr. Bindra procured the necessary test equipment and guided us in doing the project and helped us prepare the Project Report.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Harout Barsegyan

Project Number
S0702

Project Title
What Is the Effect of Temperature on Solar Cells?

Abstract

Objectives/Goals
The purpose of this project is to see the effect of temperature on solar cells converting light energy to electrical energy. I hypothesized that the warmer cells would produce more energy

Methods/Materials
The solar cells were connected in parallel form using copper links with positive sides connected with positive and negatives with negative. The cells were frozen for an hour at -10° C, in a laboratory refrigerator, afterwards their temperature was checked with a multimeter and thermocouple, and then put under a 100 watt light bulb. The resulting voltage was measured digital multimeter. The steps above were repeated at 2-degree increments until 24° C. Then the cells were heated in a laboratory oven to 100° C and their voltages were checked. This test was repeated by changing the temperature of the oven variably until 24° C.

Results
The voltage produced by the frozen cells reached 1.78 volts at -10°; the voltage at room temperature (24°) was 1.39 a 14% diffrence of voltage produced. The voltage produced by the heated cells dropped as low as 0.81 Volts at 100° C

Conclusions/Discussion
The hypothesis was wrong; when the cells were at a lower temperature they produced more voltage. Although the difference of voltage produced does not seem very large under a 100-watt light bulb, differences under natural sunlight can be much more. By keeping the cells cooler we will not only produce more voltage but also prevent overheating which will increase the longevity of the cells. A 2,000 watt solar cell system for a single-family home can provide around half the energy needed by the household. Use of this solar cell system, in turn, would result in a significant reduction in the amount of coal burned and 10,000 lbs fewer greenhouse gas emissions.

Summary Statement
The effect of heat on open circuit solar cells to see the diffrence of voltage they produce.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Andy Chon; John Lee

Project Number
S0703

Project Title
Converting Ambient Sound into Electric Energy by Utilizing a Dynamic Cone Speaker

Abstract

Objectives/Goals
The purpose of this experiment was to determine what effect sound decibel, frequency level, and proximity from a sound source, had on voltage output measured by a voltmeter, which was connected to the input terminals of a receiving speaker. There are a few fundamental elements of the mechanics behind sounds waves that were needed to be discussed prior to understanding the results of this experiment coherently. The speaker incites an impulse, it applies a chunk of energy to the air. As the front expands, the energy is spread, in a way suggested by the relationship between the radius and area of a sphere, A=4I#r The total energy stays the same, the area expands, so the energy in one unit of area decreases with the square of the distance from the source. The front will continue moving until there isn't enough energy to measure. This information explains why the results in this experiment were obtained.

Methods/Materials
To find the various trends that were needed to answer our hypothesis, an experimental design containing two dynamic cone speakers, acoustical equipment, and electrical equipment were used. The experiment began by the use of various programs that provided a constant sound sample at different frequencies and intensity levels. This was then replayed by the source speaker, which would send the sound waves through the medium of air at specific distances away from the receiving speaker. The receiving speaker then in turn captured these sound waves and turn them from a physical state of energy to a electrical state, in which the voltmeter indicated a AC current being produced from the input terminals of the receiving speaker.

Results
The experiment yielded results with a mean between 0.050 and 1.655 Volts AC for each frequency level. The average deviation was between the range of 0.001 and 0.002. The percent deviation 0.060% and 4.255% for each frequency level.

Conclusions/Discussion
The results conclusively pointed out to the reasoning that although with the same amount of energy used, the way in which it was changed caused the resulting output voltages to vary based upon the properties of a sound wave.

Summary Statement
Conceiving a way to harness and channel ambient sound into electric current through the use of a dynamic cone as a receiving apparatus.

Help Received
Partner helped complete this whole project

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Thamine Dalichaouch

Project Number
S0704

Project Title
Is Your Body Exposed to Potentially Harmful 60 Hz Magnetic Fields?

Abstract

Objectives/Goals
The objective of this project is to measure Extremely Low Frequency (ELF) magnetic fields emitted by household electrical appliances and compare them to values found in epidemiologic studies to determine whether they are potentially harmful to the human body.

Methods/Materials
The measurements are made using a high resolution 3-axis ELF Magnetic Field Meter (or gaussmeter). The gaussmeter was used to measure the 60 Hz magnetic field emissions for the following appliances: vacuum cleaner, microwave oven, electric oven, television, blender, toaster, hairdryer, washing machine, and fluorescent light. We also measured magnetic emissions in the presence of the following shielding materials: mu metal foil, copper plate, and a wood board. The measurements were performed by dividing the area in front of a given appliance into a grid of regularly spaced intervals extending away from the appliance and recording the magnetic fields along each line from 0" to 36".

Results
The results indicate that at close distances all appliances have significant 60 Hz magnetic emissions, which generally exceed the value of 4 milligauss (mG) linked to childhood cancer in epidemiological studies. The levels of these emissions decrease with distance at different rates depending on the appliance.

Conclusions/Discussion
After recording all the data, I identified four main groups. For Group 1 (washing machine), exposure to 5 mG or more occurs within 4 feet of the appliance. For Group 2 (microwave oven and fluorescent light), exposure occurs within 3 feet. Group 3 (electric oven, kitchen blender, toaster, vacuum cleaner) has an exposure range of 2 feet. For Group 4 (hairdryer and television), exposure range is 0.5-1 foot around the appliance. For the shielding experiments, the data clearly show that wood and copper shields have little effect on the magnetic emissions. However, the mu metal shield has a big effect on 60 Hz field, reducing it by as much as a factor of 10.

Summary Statement
This project investigates whether the human body is exposed to potentially harmful 60 Hz magnetic fields emitted from household electrical appliances.

Help Received
Mother helped set up display board. Father supervised the experiments and guided me through project.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Scott M. Elder

Project Number
S0705

Project Title
Minimizing the Effect of GPS Multipath on a Autonomous Mobile Vehicle

Abstract

Objectives/Goals
The objective of my project is to minimize the effects of reflected GPS multipath signals on an autonomous mobile vehicle. Alice was the name of the autonomous vehicle team Caltech entered into the DARPA Grand Challenge. My goals were to create a controlled multipath environment, research/design a multipath blocking fixture, define the multipath Fresnel zones for the vehicle, and then mount my fixture on Alice for autonomous mobile operations.

Methods/Materials
This project incorporated two former science projects. Building upon the results and knowledge of these first two projects, I applied my experience by designing a fixture to minimize the effects of GPS Multipath. First, I created a GPS multipath environment and then tested various materials for the GPS reflection characteristics. Once I determined the best material, I analyzed the multipath reflective Fresnel zones on Alice and built a fixture that would block these signals. I tested the fixture and then was approved by team CalTech to place the fixtures on Alice.

Results
I was able to determine that PVC pipe was the best material for my fixture. I built two fixtures for the two GPS antennas on Alice. I collected 500 data points for an antenna unprotected from multipath and 500 data points for one protected by my fixture. The unprotected antenna altitude range variance was 15 feet. The protected antenna altitude range variance was 4 feet. The 4 foot variance is attributed to DOP error and not multipath.

Conclusions/Discussion
I began working with Team Caltech in June of 2003 and was again accepted as a team member in Feb. of 2005. I worked on my project throughout the summer and in Aug. I presented my design and testing results to the Terrain team. I was given the OK to install my fixtures on Alice#s two GPS antennas. Further analysis from the vehicle testing verified that the fixtures did reduce multipath while not having any negative effect on GPS positioning. The fixtures were used during the DARPA Grand Challenge qualification tests and final race.

Summary Statement
Building on past science projects, my current project of multipath testing/analysis/fixture design and through working with CalTech on their DARPA Grand Challenge entry #Alice#, I was able to minimize the effects of multipath on an autonomo

Help Received
Dad helped with transportation and building the fixture. Dr. Murray and Team CalTech supported my research and allowed me to use #Alice#.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Shari W. Eskenas

Project Number
S0706

Project Title
Determining the Coefficient of Kinetic Friction with a Microcontroller

Abstract

Objectives/Goals
My objective was to determine whether I could effectively measure the coefficient of kinetic friction for "wood on wood" using a microcontroller device.

Methods/Materials
An accelerometer circuit, an LCD circuit, and a touch sensor circuit were built onto a Basic Stamp 2 microcontroller programming board. The board was attached to a wooden block. A wooden platform with a spring was built on which to launch this block. The average spring force and the mass of the block were determined. These values were plugged into a horizontal forces equation in a PBASIC computer program. The computer program was written so that once the block was launched, the instantaneous acceleration would be measured by the accelerometer and the program would use this value in the equation to compute the coefficient of kinetic friction for "wood on wood".

Results
An average value of 0.181 was obtained from ten trials. This value is within proximity to the approximate scientific value for "wood on wood" of 0.2.

Conclusions/Discussion
Determining the coefficient of kinetic friction using a microcontroller is an effective experimental method. The microcontroller's capability to execute computer programs at 4,000 instructions per second enables it to measure the instantaneous acceleration with an accelerometer and a touch sensor. The microcontroller can calculate the coefficient of kinetic friction by utilizing the horizontal forces equation after the instantaneous acceleration is determined.

Summary Statement
I devised a new method for determining the coefficient of kinetic friction that can replace time-consuming common laboratory methods.

Help Received
Father helped construct launching platform; Used Mr. Ramstedt's lab equipment

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Karin E. Fisher

Project Number
S0707

Project Title
The Effect of Core Geometry and Bias on Solenoid Efficiency

Abstract

Objectives/Goals
My objective was to determine how much I could improve the efficiency of a solenoid (used to actuate a target arm in a game system) by varying the geometry of the core and by using a permanent magnet to bias the core.

Methods/Materials
A testing apparatus and one solenoid were built. Six different core geometries were tested on the solenoid: a tube core, a rod core, a tube and rod core, a washer configuration, and two different U-bracket configurations. Also, four different bias magnets of varying strengths were tested in conjunction with the cores. The minimum current and voltage needed to pop the apparatus target arm was measured.

Results
The larger diameter core required slightly less current than the smaller diameter, and the U-bracket that didn#t extend all the way to the top of the solenoid decreased the required current significantly. The bias magnets dramatically reduced the required current.

Conclusions/Discussion
I increased the efficiency (power usage in watts) of my solenoid by 92% from last year#s solenoid with the tube core. A U-bracket that extends the core around the solenoid, but not too far, increases efficiency. Bias magnets can effectively compensate for both the weight of the target arm and the sticking force of the target arm magnet to the core.

Summary Statement
This project explored the effect of core geometry and magnetic bias on the efficiency of a solenoid in actuating a target arm.

Help Received
Dad helped with circuit

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Wayne L. Jackson

Project Number
S0708

Project Title
Hydrogen Fuel Cells

Abstract

Objectives/Goals
The objective of the project was to conduct internet research and ladoratory experimentation to study the theoretical principles behind fuel cells and their practical applications.

Methods/Materials
Experiments were done to determine the:
a. Characteristic curve of a fuel cell;
b. Faraday efficiency and energy efficiency of the fuel cell;
c. Impact of catalyst concentration on the characteristic curve of the fuel cell;
d. Impact of gas input on the characteristic curve of the fuel cell; and
e. Impact of total resistance on the characteristic curve of the fuel cell.

Results
The significant findings were as under:
a. Fuel cells are efficient.
b. Fuel cells are clean.
c. Fuel cells are quiet.
d. Fuel cells are modular.
e. Fuel cells are environmentally safe.

Conclusions/Discussion
As our demand for electrical power grows, it becomes increasingly urgent to find new ways of meeting it both responsibly and safely. In the past, the limiting factors of renewable energy have been the storage and transport of that energy. With the use of fuel cells and hydrogen technology, electrical power from renewable energy sources can be delivered where and when required, cleanly, efficiently and in a sustained manner.

Summary Statement
The project is about Hydrogen Fuel Cells which can produce portable electrical power from hydrogen and oxygen.

Help Received
This project was conducted under the guidance of Mr. Bindra. He obtained the equipment required for this project, guided me in doing laboratory experiments, and writing the project report.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Alex J. Keimach

Project Number
S0709

Project Title
The Effect of Circular Directional Waveguide Antennas of Varying Volume on the Signal-to-Noise Ratio of a Wireless Netwo

Abstract

Objectives/Goals
The purpose of this experiment was to determine the effect of circular directional waveguide antennas of varying volume on the signal-to-noise ratio (SNR) of a wireless network. It is believed that increasing the volume of the antenna will cause an increase in the SNR. Directional waveguide antennas, or cantennas, work by focusing the gain from a theoretical isotropic source into a narrow beamwidth with a longer range. The strength of the signal transmitted by a directional waveguide antenna depends on the wavelength of the electromagnetic signal, the polarization of the waves, the shape and volume of the antenna, and the material from which it is made.

Methods/Materials
The cantennas were created by drilling a hole in the can, inserting the pigtail into the can and then attaching it to the router. The cantenna was mounted on a tripod and directed towards the wireless receiver chip in a laptop in another room. The program NetStumbler was used to gather the SNR data for each cantenna. Five trials were taken for each of two control groups and five data groups. Each trial consisted of twelve consecutive SNR readings.

Results
The first control group, using the Linksys omnidirectional antennas, had an average SNR of 36.98 dBm. Group 5, using the dried tomatoes cantenna, had the highest average SNR at 43.55 dBm. Group 6, using the Pringles cantenna, had the lowest average SNR at 36.07 dBm, below that of the control.

Conclusions/Discussion
These results do not support the original hypothesis. It is likely that the shorter cans, such as the dried tomatoes can, had a wider beamwidth than the longer antennas, which would have a stronger signal at such a short distance. Another possible factor contributing to these results is that the Pringles and cashews cans were made out of much thinner aluminum, while the other cans were constructed of solid metal.

Summary Statement
This project is about finding the best cantenna to use for improving dead spots in a wireless network.

Help Received
Father helped construct cantennas and set-up experiment

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Asmita Kumar

Project Number
S0710

Project Title
Alternate Electrolytes for Organic Dye Sensitized Photovoltaic Cells

Abstract

Objectives/Goals
To design a replacement electrolyte for the potassium iodide/iodine electrolyte in Grätzel type dye-sensitized photovoltaic cells using simpler materials. Research has shown that cell performance is directly related to electrolyte presence.

Methods/Materials
Grätzel type photovoltaic cells were made with ITO glass. All cells had one electrode composed of a mesoporous titanium dioxide layer with absorbed blackberry anthocyanin or citrus chlorophyllide dye and a second graphite catalyst electrode. Control cells had a commercial KI/I electrolyte in ethylene glycol placed between electrodes. Water, inorganic and organic salt mixtures, strong oxidizing agent based electrolytes, and electrolytic capacitor electrolytes were tested as alternate electrolytes. Performance of each electrolyte was evaluated by measuring voltage and current of photovoltaic cells under a calibrated halogen light.

Results
Most of the designed electrolytes carried some charge because cells showed an ability to convert photon energy into electrical energy. Water based electrolytes were not as useful as charge carriers though good open circuit voltage of up to 0.5V was observed. Strong oxidizing agents like potassium permanganate destroyed the photovoltaic cell. Electrolytic capacitor electrolytes made with ethylene glycol, boric acid and ammonium hydroxide show promise as replacements for the conventional KI/I electrolyte. Among alkali metals, the potassium ion in ethylene glycol provided best results. The best current carrying capacity of alternate electrolytes was nearly 50% of the conventional KI/I electrolyte.

Conclusions/Discussion
Organic dye-sensitized photovoltaic cells can use alternate electrolytes that do not contain the iodide/iodine redox pair to act as charge carriers. These alternate electrolytes provide less current than the KI/I electrolyte, but open circuit voltage remains the same. Superior performance of electrolytes based on ethylene glycol rather than water indicates that ethylene glycol is a necessary solvent. Different organic dyes sensitizers such as anthocyanin and chlorophyllide may require different electrolytes for optimum performance.

Summary Statement
Alternate electrolytes for anthocyanin and chlorophyllide dye-sensitized photovoltaic cells were developed to replace conventional KI/I electrolyte by substituting the redox pair with inorganic salts and electrolytic capacitor electrolytes.

Help Received
Dad provided supervision. Michael Reidy of Hartford Glass provided glass, commercial electrolyte, and titania. Ms. C Peauroi and Professor A. Niemz provided materials for alternate electrolytes.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

James (Jiajun) Luo

Project Number

S0711

Project Title

Analysis of Physical Properties of Linear Accelerators

Abstract

Objectives/Goals

One of the most interesting applications of magnetism is its ability to accelerate objects at tremendous speeds through the use of linear accelerators. In addition to applications in military fields, these launchers are the future of space travel and exploration. Also, the potential to launch projectiles at hypervelocity has been realized and these ¡°guns¡± allow us a glimpse into the realm of relativistic effects. However, specific directions to amplify these guns must be taken first, as numerous research institutions have yet to discover the areas in which to improve these accelerators. Thus, the crux of my research lies in analyzing the interaction between the physical dimensions of these accelerators and the projectiles.

Methods/Materials

Experimentally, I designed and built several of these accelerators and tested their properties by experimentation. I analyzed the projectile-launcher relationship and the overall affect of projectile geometries on rail erosion and efficiency. Mathematically, I derived several equations modelling the energy and velocity of the projectile as it moved through the launchers and found limits to the performance of the Gauss Gun.

Results

It was found that the Gauss Gun can be amplified not through an increase of length, but rather by an increase in width. Furthermore, increased resistance in the coils demonstrates higher projectile velocity. The Rail Gun has infinite possible amplification in terms of length. Also, the use of different rail compositions alters performance. Carbon rails were found to be most efficient for larger-scale implementation, whereas aluminum and copper rails were best suited for small and medium-scale implementation. In addition, the shape of the launch opening is best designed towards the specific shape of the projectile to create better connectivity.

Conclusions/Discussion

Experimentally and mathematically, I explained methods to amplify the linear accelerators and also amplified themselves by using experimental means. Even moreso, I clarified the problems regarding these accelerators. Experimentally, the designs of the guns must be improved to a point where aerodynamic influence and travel efficiency are maximized. Future work will be done on the performance of the rails undergoing real-life erosion, including mathematics such as line-integration and maximum energy achievability.

Summary Statement

My project attempts to amplify and clarify amplification for Linear Accelerators.

Help Received

Sean Jung helped experiment; Used lab equipment at California State University Los Angeles under the supervision of Dr. Oscar Bernal.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Ross A. MacKinnon

Project Number

S0712

Project Title

Marx Bank Driven Flash X-ray Generator: A Powerful Tool to Study High Speed Phenomena

Abstract

Objectives/Goals

The purpose of this project was to develop a low cost compact flash X-ray source that would produce high energy, extremely short x-ray pulses for the study of high speed phenomena. The concept was to use a Marx Bank high voltage generator to produce a very short high voltage pulse to drive a simple x-ray tube to get a short yet powerful x-ray pulse.

Methods/Materials

A series of Marx generators were built with each succeeding design using lessons learned from the previous designs. The final design was a 12 stage triggerable Marx bank that was optimized through distributed stage to ground capacitance, pressurization to 7atm, optical spark gap coupling, and low inductance interstage coupling. This design utilized 30KV 2700pF strontium titanate dielectric capacitors and 1M ohm 2W ceramic composition resistors with a charging voltage of 30KV. This final Marx was efficiently coupled to a simple tungsten anode cold cathode x-ray tube. Finally a digital delay generator with 10usec resolution was developed to provide the delayed triggering required in many research applications.

Results

The final Marx design produced an output of >300KV with a rise time of <2ns and an output pulse width of <20ns. When coupled to an inexpensive x-ray tube, a variety of dynamic (>1000 m/s) phenomena were captured on Polaroid 3000 speed film loaded in Polaroid XR-7 film pack.

Conclusions/Discussion

The combination of an optimized Marx high voltage generator with a simple x-ray tube results in a low cost compact, yet high performance flash x-ray source capable of recording phenomena moving at extremely high velocities (calculated to be >10 km/s). Such a device is a useful research tool in both academic and commercial environments.

Summary Statement

A high performance flash x-ray source can be constructed at reasonable cost by using an optimized Marx Bank high voltage generator to drive a simple x-ray tube.

Help Received

Dr. David Platts of LANL advised me on this project; Used lab and machine shop equipment at Sage Instruments; Machining help from Jim Schierenbeck.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Jack McSweeney; Gemma Ypparila

Project Number
S0713

Project Title
Transmission of Sound Waves through Fiber Optics and Red Light

Abstract

Objectives/Goals
We wanted to find out if we could build a fiber optic system which was capable of transmitting a signal from both an iPod and signal generator to a set of speakers. We also wanted to find what range of frequency the system could effectively transmit without significant loss.

Methods/Materials
Our hypothesis was that if the fiber optic link was useful then it would transmit a range of frequency between 50 Hz and 15,000 Hz without losing more than 30% of the original signal. With the help of mentor, we drew up schematics for the transmitter and receiver circuit boards. Using these as a guide, we built the circuit boards, soldering the parts together and altering them as needed. Then, we tested to see if the board was wired correctly by plugging the iPod into the input and connecting the output to a set of speakers to see if the music was audible. We hooked the signal generator to the input and compared the original signal to the output, testing different frequencies in order to find the minimum and maximum values before the signal was significantly distorted.

Results
By testing a large range of frequencies, we discovered that between 40 and 15,000 Hz we could effectively transmit the signal so that less then 30% of the original signal was lost. We also found that all frequencies between 130 and 5,000 Hz produced zero signal loss, and therefore were most efficient.

Conclusions/Discussion
In conclusion, our hypothesis was correct in the essence that we were able to successfully build our own fiber optic system and we were able to find the exact frequencies that the system could effectively transmit. If we could extend our project we would use a longer fiber optic cable and test what effect a longer cable would have on the range of the frequency transmitted.

Summary Statement
Our project is about whether or not we could build our own fiber optic system and how efficient the system would be in transmitting red light.

Help Received
Father served as the mentor and helped with schematics

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Evan T. Morikawa

Project Number
S0714

Project Title
Chording Glove: A Novel Alternative to Text Entry in Bluetooth Enabled Peripheral Devices

Abstract

Objectives/Goals
As the world trends towards a time when portable computing devices are miniaturized to the point where they become wearable, efficient human interface with these electronics becomes more difficult. The #qwerty# keyboard, while standard in the consumer market, is inherently large, inefficient, awkward, and not suitable for miniaturized electronics. A solution to this problem exists within single handed chording technology as a method of efficiently and portably entering text into peripherals. A chording device generates text through the striking of a combination of keys simultaneously; much like the chords that are played on a piano. This project intends to develop an efficient and effective means of inputting text through a wireless Bluetooth connection utilizing single handed chording technology.

Methods/Materials
This project demonstrates the effectiveness of this technology when placed on the fingertips of a wearable, portable glove. Buttons at the end of each fingertip relay signals to a PIC 18F4680 Microcontroller, which then interprets those signals and relays the proper output codes to an HID enabled Bluetooth transmitter. Through the Human Interface Device (HID) profile of the wireless Bluetooth stack, the device transmits the interpreted text input commands wirelessly to any HID Bluetooth enabled peripheral device such as a personal digital assistant (PDA) or cell phone.

Conclusions/Discussion
The resultant device effectively transmits a standard alphanumeric key set to any HID Bluetooth enabled device. Due to the compact nature and high level of efficiency constructed into the device, it has the potential to exceed input speeds exhibited with current portable input methods such as cell phone keypad entry and PDA graffiti; thereby making it a viable alternative for text entry in the consumer markets as well as for applications from the military to disabled persons.

Summary Statement
A novel and portable method of inputting text quickly and efficiently to any Bluetooth enabled device.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Anthony J. Neuberger

Project Number

S0715

Project Title

Development of an Autonomous Navigational System with Applications in Homeland Security, Transportation, and Research

Abstract

Objectives/Goals

The goal of this project was to design, build and demonstrate the feasibility of a low cost, GPS based, navigational system to pilot an aircraft without human input. The autonomous navigational system must be reliable and accurate yet easy to modify to meet the specific needs of a diverse set of future applications which may include scientific, military and commercial uses.

Methods/Materials

The navigational system, designed to mimic the human nervous system, was built using two microcontrollers programmed in BASIC (peripheral nervous system), and a central processor, AutoNavigator (central nervous system) which was written using the LabVIEW programming language. The first microcontroller collects wind speed and direction, GPS coordinates, altitude, heading and velocity, using an anemometer, compass, clock, PING and GPS unit. To test the navigational system, a propulsion system was also designed and built. The propulsion system built for this project uses 4 drive motors that can moved in the X,Y and Z axis. A test device was also built which facilitated troubleshooting, fixing and upgrading both the navigational system and the propulsion system.

Results

An autonomous navigational system was build, integrated into a test device and successfully tested. Results demonstrated the basic stamp can collect, package and send the data to AutoNavigator program for analysis. Based on the logic built into AutoNavigator, motor control commands were generated and sent to the motor control basic stamp for implementation. Initial test runs were designed to optimize the AutoNavigator program. The current version of AutoNavigator can perform a controlled takeoff, maintain a specified altitude and correct for wind speed and direction while navigating toward a pre-programmed target. A manual override was also incorporated into the AutoNavigator program allowing a remote operator to take control and navigate when desired.

Conclusions/Discussion

A functional, autonomous navigational system was developed, incorporated into a prototype propulsion system and successfully tested in a test device. The AutoNavigator program is easy to use, reliable and can be integrated into lighter-than-air aircraft to perform a variety of different applications including Homeland Security (monitoring of the borders), scientific research (tracking and monitoring endangered species, pollution) and transportation of commercial goods.

Summary Statement

The purpose of this project was to design, develop and construct an autonomous navigational system and incorporate it into a novel propulsion system that can be used on lighter-than-air aircraft.

Help Received

Mr. Craig Williams helped with the math and my father helped with construction of test device.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Vinayak Ramesh

Project Number
S0716

Project Title
A Collaborative Framework to Enhance Camera-Based Security Systems using Intelligent Wireless Sensor Networks

Abstract

Objectives/Goals
A site council meeting at Oak Ridge High School, highlighted how the school's PTZ camera-based security system was unable to provide adequate security coverage on campus. Addition of more cameras was very expensive. This prompted the idea to build an innovative and cost effective system to enhance the existing security system. The hypothesis is that the camera-based security system, in collaboration with the WSN system, would increase the number of events recorded.

Methods/Materials
The approach involves a Wireless Sensor Network (WSN), consisting of "motes", to monitor motion around the school.
The WSN system uses household wireless motion sensors. A transducer was designed to convert motion to light readings. Motes were programmed to detect light readings and transmit the data wirelessly to other motes in the network using a multi-hop scheme. A base mote channels the data to a PC-based data logger which logs events related to motion.
The experiment was conducted in Oak Ridge High's parking lot, monitored by a PTZ camera. Monitored by a 4-node wireless sensor network were two points. A subject was made to run across the areas monitored once every few minutes, 60 times.

Results
Out of the 60 trials, total, the PTZ had a 12% success ratio, whereas the wireless sensor network had a 95% success ratio. Combined, the wireless sensor network, working together with the camera, would catch 57/60 events, in the worst case, and 60/60 events, in the best case. This indicates that hit detection of the camera system is enhanced by about 750% when working together with the wireless sensor network. A 2-proportion Z-test statistically proved the WSN + camera system to be significantly better than the current system.

Conclusions/Discussion
By enhancing the current camera system by adding the wireless sensor network, performance in hit detection has gone up by 750%. This wireless sensor network is proactive: it alerts security as an event happens, not after the fact. Without adding new and additional cameras, which are very expensive, the whole school can be covered by a wireless sensor network, in addition to the current cameras; this is a much more cost effective approach. These networks can easily be deployed and moved, as they are wireless and fast to setup. These experiments show that this wireless sensor network setup with motion sensors does enhance the current camera system significantly and at low cost.

Summary Statement
My project is on enhancing current camera-based security systems by adding a wireless sensor network.

Help Received
My father helped with programming; Assistant Principal + school's Security officer helped by allowing me to use the school campus and experiment with the camera system.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Will Rendall; Caleb Zeid

Project Number
S0717

Project Title
Photovoltaic vs. Solar Thermal Energy

Abstract

Objectives/Goals
Our purpose was to investigate the efficiency of Stirling Engines and Photovoltaic Cells in harnessing solar energy.

Methods/Materials
We used a compass to orient our project, as well as a protractor to acquire the correct altitude and azimuth angles for optimal sun exposure. Having correctly mounted the Stirling Engine, we attached a 1 meter length of fishing line to its wheel and a 1 Kg mass. We used a stopwatch to measure the time required for the engine to complete the 9.8 joule process.

Results
A standard photovoltaic cell (solar panel) produces .017 Watts/Cm^2, while our Stirling Engine harnessed .003 Watts/Cm^2 making them 12.1% and 2.14% efficient, respectively.

Conclusions/Discussion
Our data suggests that a Stirling Engine is vastly outperformed by a Solar Cell. However, our multitude research asserts that while the upper echelon solar panel is 15% efficient, a Stirling Engine can be upwards of 30% efficient, thus we conclude that our particular Stirling Engine was inferior, but not all engines as a rule.

Summary Statement
A comparative analysis of energy collection through thermal and photoelectric use of the sun

Help Received
Donn Cushing, JVHS Shop Teacher, provided engine

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Travis Dean Stagnaro

Project Number
S0718

Project Title
Wireless Signal Interference

Abstract

Objectives/Goals
I chose to do my science fair project on wireless technologies, mainly seeing how different commonly used building materials such as sheetrock, cement, wood, and metal affected wireless speed, signal and quality.

Methods/Materials
Materials: laptops, Wireless router, Wireless card, 1/2in 5ply plywood, 1/2in Sheetrock, Metal (.08in), 1/2in Cement, Fiberglass insulation, Cat-5e Cable.
Procedure
1. Construct four boxes out of the following building materials: half inch sheetrock, .08metal, half inch cement, and half inch 5 ply plywood.
2. Construct each box such that the interior dimensions are roughly 25cm x 25cm and 24cm tall.
3. Find open area.
4. Place the wireless G compatible router on the ground, and connect a laptop to the router with cable, and set the computer up with a shared folder.
5. Now take the second laptop and place it three meters away from the router.
6. Connect to the laptop and download a 50 megabyte file and record the average transfer speed. Also record the signal and strength reported by the Linksys wireless card management software.
7. Move the laptop three meters back and repeat step six until there is no signal.
8. Repeat steps five through six three times and average the results.
9. Once results are averaged changes the media through which the wireless signal travels by placing a different box over the router or adding fiberglass insulation to the current box and repeat steps six through eight.

Results
Steel had the greatest interference, only lasting fifteen meters before the signal started cutting out. The cement box caused the wireless signal to only go thirty meters before it became unstable. The wood started having connection issues around thirty nine meters, and was dead by 48 meters, whereas the open signal made it forty five meters before having connection issues. The sheetrock lasted 36 meters, and had connection issues at 39. The fiberglass insulation made no difference.

Conclusions/Discussion
As far as steel goes you defiantly do not want steel products in the same area as your router or the computer receiving the wireless signal. Cement did cause enough interfernce so it should be avodied, but

Summary Statement
To test how different building materials affected wireless signal, strength, and speed.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Benjamin H. Wheeler

Project Number
S0719

Project Title
Speed and Efficiency Relationships in a Direct Current Motor in a Light Electric Vehicle Application

Abstract

Objectives/Goals
The objective of this project is to find the most efficient speed at which to run a Light Electric Vehicle(LEV). This would be the speed at which the batteries have the least drop in voltage over a specified distance. I hypothesized that the most efficient speed would be approximately 75% of top speed. Top speed is the speed achieved when the motor is run at its highest rated amperage.

Methods/Materials
This project uses a homemade electric bicycle, a handheld GPS and a digital voltmeter as the primary materials. The electric bike is equipped with two twelve-volt sealed lead-acid batteries, a 24-volt DC motor, and a Pulse Width Modulator which is the speed controller in this experiment. For the experiments, the bike was run at different speeds for the same distance in seperate trials after the batteries had been recharged to the same voltage, (e.g. 16.8mph for 1 mile, 2 miles). The voltage is measured before and after and then the drop in voltage is used to determine the most efficient speed at which to run the bike.

Results
The test trials at 75% and 87.5% of max speed were the most efficient. While the test trials of 25% essentially had the same drop in voltage, it took almost 4 times as long to cover the same distance. The least efficient trials were 100% and 50% in that respective order. An additional intermediate trial was run at 62.5%

Conclusions/Discussion
My hypothesis was proved mostly correct through my experimentation. The most efficient speed at which to run the bike was between 75% and 87.5%. This research is important because it will help in the advancement of Light Electric Vehicles (LEV's), helping solve the LEV vehicles most significant problems, which is lack of range. Further experimentation with different types of batteries and more specific measurements with voltage draw over greater distances to magnify the variances are on the drawing board.

Summary Statement
This project utilizes a homebuilt light electric vehicle to measure efficiency in a direct current motor by measuring voltage drop in the power source of the LEV over a controlled distance.

Help Received
Dad helped with transportation, funding, safety, LEV design and construction and editing of presentations. Grandpa provided electronics advise.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Elizabeth L. Llanes

Project Number

S0799

Project Title

Assessing the Performance of the Viterbi Decoding Algorithm Using Convolutionally Encoded L2C GPS Data

Abstract

Objectives/Goals

The objective of this project is to assess the performance of the Viterbi decoder used in the transmission of L2C GPS civil navigation messages when the link is corrupted by noise. It was hypothesized that if the input bit error rate into the Viterbi decoder is 1x10-6, then the Viterbi decoder will correct all bit errors and recover all of the original civil navigation messages. If the input bit error rate into the Viterbi decoder is 0.1, then the Viterbi decoder will be unable to correct any bit errors or recover any of the original civil navigation messages.

Methods/Materials

A program was created in Visual Basic which simulates the link, including the convolutional encoder, the addition of noise, and the Viterbi decoder. The program was executed with varying input bit error rates, and the results were written out to an Excel spreadsheet.

Results

The input BER was plotted against the output BER and the percentage of civil navigation messages that were rejected. In the graphs, the data was terminated once the percentage of rejected messages reached 100%. Logarithmic scales were used to generate the above mentioned plots because the magnitude of the numerical results spanned several decades, and logarithmic scales are useful for comparing values that are very small to values that are very large.

Conclusions/Discussion

The hypothesis was proven to be too conservative. The Viterbi decoder performed better than expected. For small values of input bit error rate, the output bit error rate was 0, up to an input bit error rate of 1x10-5, which was an order of magnitude better in performance than was expected. For large values of input bit error rate, the percentage of rejected civil navigation messages did not reach 1 (or 100%) as soon as expected, occurring at an input bit error rate of 0.14 instead of 0.1.

Summary Statement

This project assessed the performance of the Viterbi decoder used in the transmission of L2C GPS civil navigation messages when the link was corrupted by noise.

Help Received

L2C GPS navigation data was obtained from an ITT owned Spirent simulator. Father taught Boolean algebra and Viterbi decoding basics.