CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Josh Aubin; Emma McNellis

Project Number

J0901

Project Title

Holograms: Timing Interference

Abstract

Objectives/Goals

The objective was to determine if changing the amount of time the holographic plate and object are exposed to the laser impacts the clarity of the holographic image.

Methods/Materials

Materials included 12 holographic plates containing an emulsion that was sensitive to laser light in the 625-650 nm range, a 3-4 mW diode laser with 3.0 volts, developing solution chemicals, bowl filled with coins used as object, a glass vase for a stand and a coffee cup filled with salt to minimize vibration, a physics books used as a shutter, a self-made scoring device, and an iPhone to record time. The setup included choosing a dark room, setting up a stable structure for stability, mixing the developing solution, and placing solution in bowls. Object was placed in position of the laser but blocked by the shutter. Lights were turned off, shutter was lifted and exposure time timed. 5, 12, 22, and 60 second exposure times were used. Three tests for each interval performed. Results were recorded and measured using the scoring device.

Results

No initial pattern was detected in all of the averages for the exposure time, except that the 12 seconds plates were the most consistent. The lowest score was an 8 by the 22 seconds plate and the highest was 21. The total possible points that a plate could score was 27, where each plate was divided up into 9 sections. The maximum a section could score was 3. The two highest plates were the 60 and 12 seconds plates. The 60 second plates were clear with a winning average of 15.3̅, while the 22 second plates were clear with an average of 15 points. The third highest was the five second plates with a mean clarity score of 11.6. In the 22 second tests, the images were blurry making 22 seconds the worst with an average of 9.67.

Conclusions/Discussion

The hypothesis was partially correct and partially incorrect. It was wrong because 60 second trial had the highest overall average clarity score. The hypothesis was right because changing the exposure time did impact the clarity results of the hologram, establishing a relationship between exposure times and clarity. If there was not a relationship, all the clarity averages for the different times would be the same. The problem was that a pattern of how these different times helped or made the hologram worse was not definitely detected.

Summary Statement

The experiment was to find out if changing the amount of time the holographic plate and object are exposed to the laser impacts the clarity of the holographic image.

Help Received

Emma's dad helped with the mixing of the more dangerous chemicals and finding some of the materials used in the experiment; Emma's mother helped with cutting the paper on board.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Akhil Bhamidpati; Aadeesh Shastry; Abheer Singh

Project Number

J0902

Project Title

Sensored

Abstract

Objectives/Goals

Our project tests the suitability of ultrasonic and infrared sensors for use with haptic devices to help the blind live a normal life. This concept can be further extended to other applications such as helping military personnel to navigate through the dark.

Methods/Materials

We used an Arduino micro controller to measure the sensor readings and display them on a computer. We tested the sensor's accuracy with objects of different properties, sizes, and external factors like wind. The sensors were placed side by side to reduce the margin of error due to variations in environmental conditions.

Results

Neither sensor was found to be suitable for our application under all conditions. Our infrared sensor's accuracy was adversely affected by the reflective surface that dispersed light and the glass surface transparent to infrared beams. Our ultrasonic sensor didn#t accurately detect small object, sound absorbing object, or objects in the presence of wind.

Conclusions/Discussion

We would like to explore ways to deploy multiple sensors in a single haptic device to make it work reliably under all conditions. Further study should be conducted with other available ultrasonic and infrared sensors. Range sensors based on different technologies, like laser sensors, should also be evaluated.

Summary Statement

Our project tests the suitability of ultrasonic and infrared sensors for use with haptic devices to help the blind live a normal life.

Help Received

Parents bought supplies and gave tips in programming.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Diane Bui

Project Number
J0903

Project Title
Induced Eddy Currents via Magnets in Motion

Abstract

Objectives/Goals
This study examined the effect of insulating and conductive cylindrical tubes on induced eddy currents caused by movements of magnets.

Methods/Materials
The experiment compared how long it took an N42 sphere neodymium permanent magnet and an N50 cylinder neodymium permanent magnet to drop down each tube: Bakelite, fiberglass, plastic, copper, and aluminum. Each tube was tested 10 times (5 trials with the N42 sphere magnet and 5 trials with the N50 cylinder magnet).

Results
In both cases, the magnets dropped the fastest in the Bakelite, fiberglass, and plastic (insulating) tubes, and slower in the copper and aluminum (conductive) tubes.

Conclusions/Discussion
As the magnet dropped down the conductive tubes, the changing magnetic field of the magnet created eddy currents in the tubes. These eddy currents created their own magnetic fields that repelled the original magnetic field of the magnetic, slowing down the fall of the magnet. Copper, being the best conductor, affected the magnets# drop the most and had the slowest time of drop. The insulating tubes had no effect on the magnet, regardless of the strength of the magnets. However, the conductive tubes caused the stronger magnet to drop slower. The stronger magnet had a stronger magnetic field. Thus, more eddy currents were created, and more repulsion. The hypothesis stating that the neodymium magnets will fall slower through the copper and aluminum tubes proved to be true.

Summary Statement
This study examined the effect of insulating and conductive cylindrical tubes on induced eddy currents caused by movements of magnets.

Help Received
Father helped with building the model

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Dominic H. Catanzaro

Project Number

J0904

Project Title

Zappity Zap Zap: The Breakdown Voltage for Two Different Types of Electrodes

Abstract

Objectives/Goals

Gases normally do not conduct electricity. When a large voltage is applied, current will flow through the gas. This is called the breakdown voltage. At atmospheric pressure, the breakdown voltage is thousands of volts. As the pressure decreases, the breakdown voltage also decreases. At a specific pressure, the breakdown voltage begins to increase. This is called Paschen#s Law.

In my project, I wanted to measure the breakdown voltages for two different electrodes: spherical electrodes and parallel plate electrodes. My hypothesis was that parallel plate electrodes will more accurately match the theoretical Paschen curve than spherical electrodes.

Methods/Materials

To test my hypothesis, I built two electrodes, one set of parallel plate electrodes and one set of spherical electrodes, assembled from stainless steel. The breakdown voltages were measured in nitrogen gas using a vacuum chamber located at Surface Optics Corporation. The voltage and pressure were varied and the breakdown of the gas was observed by looking for an arc between the electrodes and by measuring the current flowing through the electrodes.

Results

The discharge appeared as a bright line between the electrodes. When I observed the discharge between the spherical electrodes, the bright line was stationary. It was difficult to observe the discharge in the parallel plate electrodes because it was not stationary. The spherical electrode measurements appeared to match the Paschen curve and were repeatable. However, the parallel plate measurements did not match the Paschen curve and were not repeatable.

I also measured the current flowing through the gas between the electrodes. The spherical and parallel plate electrodes both matched the Paschen curve. However, there was an anomaly in the data that appeared for both electrodes.

Conclusions/Discussion

When I analyzed the data based upon current measurements, the parallel plates match the Paschen curve more closely than the spherical electrodes. Visually observing the discharge was not as good a measurement because it was subjective and it was very likely that the data was unreliable.

There was an anomaly in the Paschen curve. It turns out that the anomaly was two Paschen curves overlaid. One of the Paschen curves represented current flowing from the cathode to the anode. The other Paschen curve represented current flowing from the cathode to the chamber walls.

Summary Statement

I measured the current flowing through a rarified gas as a function of voltage, pressure, and electrode design.

Help Received

Father helped edit report; Used the lab equipment at Surface Optics Corporation under Mr. Dummer, Ms. Zimmerman, and Mr. Colsen's supervision

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Sabrina Chen; Anokhi Patel; Shreya Tumma

Project Number

J0905

Project Title

Wireless Community Alarm

Abstract

Objectives/Goals

Usually, alarms (fire, burglar etc.) installed in one home, do not communicate with the alarms in neighboring homes. Without an automated system that can immediately send emergency alerts to all the neighbors, there is a huge risk to both properties and living beings in a community. The objective of this project is to design and build a low-cost Wireless Community Alarm system which enables communication between alarms in neighboring homes, for sending and receiving remote alarm events.

Methods/Materials

Three prototype devices have been built to demonstrate an example community scenario consisting of three homes. The main hardware components used in building each prototype device are listed below.

* Battery operated wireless hardware module for wireless transmission and reception
* Buzzer for audible alert
* Three LED lights of different colors for visual alerts, each representing a different home
* Button to switch off its own visual and audible alarms
* Thermistor (heat sensor) for detecting the temperature of the environment

After building the electronics hardware, software is programmed on to each device for continuously reading the value of its heat sensor. For designing the demo software, a flow chart representing the functionality of the device is prepared. Based on the flow chart, software scripts are developed and downloaded to each prototype device. The demo software is designed to trigger an alarm, when sufficient heat is applied to the thermistor by holding it between the fingers.

Results

The Wireless Community Alarm system has been successfully tested by triggering alarms on one or more prototype devices and observing the alarms on all the devices. When heat is applied to the thermistor and the preset temperature threshold is reached, the device, not only switched on its own buzzer and LED, but also sent a wireless alarm signal to trigger all the remote alarm devices.

Conclusions/Discussion

To begin with, the idea of Wireless Community Alarm system is inspired by an incident where a neighbor saved the life of an unconscious resident, after hearing their smoke alarm in the distance. If the neighbor did not hear the alarm, the outcome would have been different or even deadly. Wireless Community Alarm system ensures that the emergency alerts are heard by all the neighbors. Also, this system helps in fostering strong and effective community bonds. Indeed, neighbors can save neighbors!

Summary Statement

Wireless Community Alarm system is successfully built to enable communication between alarms in neighboring homes and helps in preventing situations from turning to fatal.

Help Received

Father and mother helped in getting the required components.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Noah R. Crousore

Project Number

J0906

Project Title

Arduino-based P.E.A.K Pad for Carpal Tunnel Syndrome

Abstract

Objectives/Goals

Carpal tunnel syndrome (CTS) is a clinical syndrome manifested by characteristics, signs and symptoms resulting from an entrapment neuropathy of the median nerve at the wrist. I wondered if it were possible to design a computer keyboard device that provides both active noninvasive therapeutic and prophylactic benefits for carpal tunnel syndrome. I believed this could be accomplished through Pulsed Electromagnetic Field Therapy (PEMFT), in which noninvasive electromagnetic impulses are applied to the target area, accelerating the natural anti-inflammatory cascade via the binding of calcium and calmodulin, releasing anti-inflammatory nitric oxide. The goal of my project is to see if it is possible to integrate the benefits of PEMFT into a keyboard accessory for carpal tunnel syndrome.

Methods/Materials

I used two 60 cm long wire coils (PEMF applicator), a PEMF portable emitter, an Arduino UNO# Open-source electronics prototyping platform, TRIFIELD Meter Model 100-XE Magnetometer, Tektronix TDS-210 Two-Channel Digital Real-Time Oscilloscope, ADESSO Ergonomic Keyboard Model PCK-208B, SONY KFRP Series Model PCVA-KBP1/UB Standard Keyboard, and a Demarle F11 Silicon Cooking Pad. I measured the vertical and horizontal strength of the electro-magnetic field generated through varying levels of impedance (Z) to ensure that the signal would transmit through the keyboard and pad.

Results

After validating the fundamental carrier frequency of the electromagnetic coils (27.12 MHz), I attempted to find a way to incorporate it into a computer accessory. After many preliminary design schematics, I was able to construct a device such that there was as minimal field mitigation as possible, which emitted a readable electromagnetic field. I then spent hours trying to figure out a powering method. I programmed an Arduino as a power unit that can be plugged into a computer directly, or a wall-mounted power outlet. Also, by using the Arduino unit for power, I was able to modulate therapeutic time intervals easily, making the device customizable for each individual#s therapeutic regimen.

Conclusions/Discussion

I believe I have built an effective PEMF generator and designed it in a way to power it with the computer or with a traditional power outlet. I have tested the EM field that my device is generating at the target anatomy in my wrist, and surrounding my device is a distinct, readable electromagnetic field.

Summary Statement

I designed and built a therapeutic intervention, powered by an Arduino microcontroller that integrates the benefits of Pulsed Electromagnetic Field Therapy for carpal tunnel syndrome.

Help Received

Parents helped collect data; Science teacher lent materials and her guidance; Used lab equipment at Adori Labs under supervision of Mr. Nathan Iyer; Nathan Iyer also gave advice and guidance during the project.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Kristina G. Gorey

Project Number
J0907

Project Title
Gelatin-based Memristive Device

Abstract

Objectives/Goals
The goal of this experiment was to determine if it is possible to create a macro-scale (as opposed to nano-scale) device that exhibits memristive behavior using table-top materials.

Methods/Materials
1. Create two gelatin-filled glass tubes by inserting each end of the glass tube into pre-congealed gelatin and use household screws on the ends as electrodes to make good electrical contact with the gelatin. One tube consists of lime gelatin (a conductor) and the other tube contains half plain and half lime gelatin (plain gelatin is an insulator).

2. The lime gelatin device is the control device expected to act as a resistor. The half lime/half plain gelatin device is the test device expected to behave as a memristor.

3. Cycle each device to plus and minus 7.5 volts by 0.5 volt increments, first as a #forming step# to establish the device#s memristive character, and on subsequent cycles, record the voltage/current value at each point with a multimeter to determine if the device shows memristive behavior.

4. Plot the values and determine (a) if the lime gelatin device acts as a normal resistor, and (b) if the half lime/half plain device shows the #pinched hysteresis# loop characteristic of a memristor.

Results
1. The half lime/half plain device acted as a memristor, exhibiting the characteristic voltage/current pinched hysteresis loop.
2. The lime gelatin device showed a linear voltage/current plot characteristic of a resistor.

Conclusions/Discussion
Conclusion: The data is consistent with the device being a memristor. To my knowledge this is the first memristor produced on a macroscale.

Discussion: Memristors have been nanoscale devices because memristance is related to voltage and the device cross section. As the cross section gets smaller, the effect grows. The first memristors are devices with sizes in the 100nm range and there was some question as to whether any reasonable voltage could produce the same effect in a device with a cross section of 3mm.

Summary Statement
This project created what may be the first macroscale memristor while using common household materials.

Help Received
I first saw memristors during the #Take Your Kid To Work# day at HP last summer. Members of the memristor design team provided answers to what materials might work for this experiment. My Dad was an extra set of hands in running the experiment and creating the gelatin cells - something harder than it

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Garrett L. Gwinn

Project Number
J0908

Project Title
Practical Application of Parabolic Antenna to Improve iPad Performance

Abstract

Objectives/Goals
The objective of this project was to determine if a homemade parabolic antenna, incorporated into an iPad case, could improve the performance of an iPad. Additionally, varying levels of surface finish were tested with increasing degrees of roughness, to determine its impact on performance.

Methods/Materials
An iPad was placed in a specific corner of the house at a specific orientation and then the iPad's download speed was measured with and without the antenna. Three different antennas, differing only in the roughness of the finish, were tested. Each antenna design was tested 3 times. For each test, download speed was measured 30 times with and without the antenna. All electronic devices in the house were turned off while testing to minimize interference. Each pair of with/without antenna tests was run on the same day. Surface finish was quantified by counting the number of imperfections present within a 1 cm circle placed at three locations across the width of the antenna. A baseline antenna was tested against an antenna with 6 times and 18 times the number of imperfections.

Results
The iPad baseline antenna had a range of download speed improvement from 14-28% over the no antenna test with an average of 22%. Standard deviation of the download speed with the antenna was also reduced by a factor of 2. t-Tests showed a high level of confidence in the difference of the means. The 6 times level of imperfections antenna produced an average 6% improvement in download speed, however t-Tests suggest the level of confidence in the difference in the means to be low to unacceptable. The 18 times level of imperfections antenna produced only a .8% improvement. Again, however, confidence is very low with this data set.

Conclusions/Discussion
The homemade parabolic antenna, designed to fit into an iPad case, did improve the iPad's performance. Download speed and download speed standard deviation were greatly reduced with the baseline antenna. However, the number of imperfections present in the surface finish of the antenna severely degraded its performance.

Summary Statement
My project was about the use of a parabolic antenna to improve the wifi performance of an iPad. Additionally, variations in antenna surface finish were also tested to determine the impact of the finish on antenna performance.

Help Received
I had some help from my dad by buying the materials for the antenna.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Guillermo Haro

Project Number
J0909

Project Title
Electromagnetic Car

Abstract

Objectives/Goals
The objective of my project is to help reduce the pollution in our environment. I want to get rid of tire and gasoline use as a fuel. With the help of levitation there will be almost no friction, therefore not requiring as much energy to gain momentum. This characteristic will save energy and make a more efficient machine.

Methods/Materials
In order to get momentum the model will be using a propeller. Since the car will have friction on the ground without wheel I decided to make it float, and in order to do that I used magnets on both the car and track. To conduct electricity i used copper strips and copper mesh to continue the current at places where there may have been a separation.

Results
I was able to create a model car that has a constant levitation and can gain momentum with the propeller. Once the car has a certain amount of speed it does not need as much power to keep itself going. It was able to keep afloat and stay in motion even after it went through the U turns on either side of the track. Since the car has little friction it gains speed quickly and may go at high speeds if the acceleration is kept constant.

Conclusions/Discussion
This design of transportation would be a great advancement in efficient transportation. The project would have to go into a bigger scale and needs to go through more tests including how it would react to weather like rain, snow, or high levels of heat. The whole concept would involve many funds in order to change and recreate today's roads, however there can be adjustments or other options on how it can be used.

Summary Statement
My project is about getting rid of the use of tires and gasoline to improve the environment.

Help Received
Father helped build project.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Ben C. Hora

Project Number
J0910

Project Title
Watt Phantoms Are Lurking in Your Home?

Abstract

Objectives/Goals
The objective of this project was to determine if electronic devices take up energy in standby mode and if so, how much energy is being wasted.

Methods/Materials
A KillAWatt meter was used to measure the amount of power used, along with the associated yearly costs, of various household electronic products. The products tested were a clock radio, DVR, Nintendo Wii, Nintendo Wii U, television, sound bar and speakers, and a computer with monitor. Each of these electronic devices was tested in standby mode five times each for a span of two hours. The five trials were used to verify that the trial length was long enough to average out any variations in power. The trial length of two hours was used to give a long enough time to allow the kWh value to average out any variation in power.

Results
Six of the seven electronic devices tested used power during standby mode operation, which was within the expectations of my objective. Only the television did not use any measurable power in standby mode. The DVR used as much power in standby mode as during normal operation and considerably more than the other electronic devices. The rest of the electronic devices ranged between 0.3 and 1.7 watts while in standby mode.

Conclusions/Discussion
The results from my testing proved my hypothesis that most electronic devices take up energy in standby mode. The energy costs from these electronic devices were from $0 for the television, to $75 for the DVR per year. The differences in the phantom power usage can be attributed to the amount of software and processing that the device used as well as the age of the electronic device. These results can help people determine which electronic products they can turn off to save money and reduce their power usage. Being aware of phantom power in the home will not only keep costs down, but save natural resources and help the environment too.

Summary Statement
My project was measuring the watts used by electronic devices to determine if they used power in standby mode.

Help Received
My parents helped type the report.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Hayato S. Kato

Project Number

J0911

Project Title

The Relationships Between Gauss Levels and the Weight Held by an Electromagnet

Abstract

Objectives/Goals

My project's objective was to determine the relationships between the gauss levels, the unit for magnetic flux density, and the weight an electromagnet is capable of pulling: whether these two types of units are the same measurements which can be used to find the other.

Methods/Materials

I conducted experiments by comparing the levels of gauss units using a hall sensor and digitally displaying the weight by attracting a metal plate which is connected to a sensitive digital load cell. Then, the electromagnet will be pulled down until the plate releases, and I will record the highest weight recorded. I compared the unit's graphs with both their slope of the graph and the efficiency per gram in order to determine whether gauss units and weight pulled are same measurements.

Results

Each different variable that was tested showed different relationships between the gauss levels and the weight pulled. When the gauss units increase as the weight increases for one electromagnet, it didn't mean that the others also had the same relationships.

Conclusions/Discussion

My conclusion is that the relationship between gauss levels and weight capable of being pulled can be altered by the different variables such as different length coils, different thicknesses of the core, and different numbers of layers wrapped. Since there are no set relation with gauss units and weight being pulled, I conclude that these two units represent different types of measurements which can not be used to find the other.

Summary Statement

My project is about finding out whether gauss units and the weight that an electromagnet can pull are the same or different measurements.

Help Received

Father helped cut iron core and lend me tools for experiments; Mother helped assemble and print the binder

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Saman T. Khan

Project Number
J0912

Project Title
Radiation in My House?

Abstract

Objectives/Goals
The objective of the project was to determine which household electrical device emitted the most extremely low frequency (ELF) radiation while in use.

Methods/Materials
Using a gaussmeter, several appliances including a laptop, microwave, refrigerator, cordless phone, cellular phone, iPad, hair dryer, alarm clock, television, and computer monitor were tested for ELF emission. Each appliance was tested with the gaussmeter at different distances - at 5 cm increments starting from 0cm until the gaussmeter stopped detecting any ELF. This was repeated three times for each appliance. The data was then graphed out.

Results
The appliances all varied in the amounts of ELF emitted as well as in how quickly the ELF dropped as the gaussmeter was distanced from the appliance. The microwave emitted the most amount of ELF and took the largest distance to drop ELF levels to stop being detected by the gaussmeter (40cm). The computer monitor and the cordless phone had the lowest initial ELF readings (both under 2.6 mG) and also the quickest drop in emission as distance was increased. The rest of the appliances all read above the maximum ELF reading on the gaussmeter (5mG) in their initial readings at 0 cm and dropped off at various distances. All the ELF levels decreased as distance between the gaussmeter and appliances increased.

Conclusions/Discussion
All of the devices we use on a regular basis give off electromagnetic forces that can affect our bodies. Though research says that ELF is mostly safe, we should still take precautions and protect ourselves until we are more certain of the effects of ELF. We can do this by keeping a good distance away from and limiting our contact with electrical devices. We should keep alarm clocks away from our heads while we sleep, use air dryers at an arms leghnth away, and stay away from the microwave while we use it.

Summary Statement
This project was designed to determine which household electrical device emitted the most extremely low frequency (ELF) radiation while in use.

Help Received
My mother helped me with measuring ELF emission with the gaussmeter and helped me design my board. My friend Gabriel helped me graph my data using excel.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Patrick Leiser

Project Number

J0913

Project Title

Homemade Computer: Creating an Affordable Computer Using Unconventional Computer Components

Abstract

Objectives/Goals

Computers are expensive. It would be good to have computers that are affordable for everyone. Two methods to make them more affordable are to use less expensive, non-computer components, and to make them yourself while customizing the components and writing software to fit your needs.

It will be possible to construct a computer (non-IBM PC compatible)using non-computer components (such as a $7.00 microcontroller for the CPU), and to write an operating system for the required functions, including word processing, calculations, and games.

Methods/Materials

Identify the requirements; design the electronics and identify needed components; design the circuit; solder the components; program the tests; and write the complete program (the operating system (OS)).

Materials:
serial 20x4 OLED display $30.00; picaxe 28X2 microcontroller (2) $6.80 ea.; plain stripboards (perfboard) (3 - 4) $1.50 ea.; single AA battery holder (3) $1.09 ea.; Alfat SD card reader $44.95; resistors (22k (2), 10k (2), 4.7k (2) negligible ($10.00 for 500 pieces); various wires (negligible;) ps2 keyboard $5.00; ps2 stripboard adaptor $.95; power switch $1.00; sd card (up to 32 GB) (lower capacity acceptable) $6.95 for 2 GB $15.00 for 16 GB; programming adapter (headphone jack) $0.10.

Results

(see conclusion/discussion)

Conclusions/Discussion

In conclusion it is possible to construct a computer and write an operating system using cheap, non-computer components (totaling $129 for all features) that I designed, built, and programmed myself. The PICAXE 28X2 microcontroller worked well as an inexpensive CPU. I successfully programmed it to support a word processor (that I named Wordedit), full reading and writing of .txt (plain text)files from the SD card (including files added to the SD card by other computers). It also has a calculator allowing addition, subtraction, multiplication, division and square rooting. It has an I2C bus that acts like the PCI and PCIe busses on normal computers.

Summary Statement

Creating an affordable computer by using unconventional computer components and building/programming it yourself.

Help Received

mother helped with display board.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Nikita Lubyanoy

Project Number
J0914

Project Title
Best Sensor for Laser Transmissions

Abstract

Objectives/Goals
My objective is to find the best sensor for transmissions by laser and vibrating reflective surfaces, and to learn more about electricity and engineering. I also believe that the more expensive and sensitive sensors will work best in laser transmissions.

Methods/Materials
(1) 9V battery supply (2) Variety of NPN Phototransistors, CDS cells,and/or other photosensors (3) 470uF, 10uF, 0.01uF capacitors (4) 10k and 1k resistor(s) (5) 50k or 100k variable resistor (potentiometer) (6) Wires and cable (7) Headphones (8) Computer (optional) (9) Speaker(s) (10) LM386 IC audio amplifier (11) 3.5mm audio jack connector (12) 9V power switch (optional) (13) 9V batter socket/connection (14) Breadboard or Perforated board (15) IC Base (optional) (16) Soldering iron (17) Solder - lead free and rosin core (recommended) (18) Mirror(s) (19) Helium Neon Laser (recommended)

Build receiver (schematic on board); Place sensor into the base/breadboard; Glue a mirror to a speaker; Point the laser towards the mirror; Place the receiver so that reflected laser beam hits the sensor; Play something into the speakers; Either listen to the output or place it into a computer, run it through audio editing software, and then pick the sound with the best quality; Change the sensor; Repeat step 8 and then 9, until all sensors are tested.

Results
(1) NTE3122 T-NPN, Si Phototransistor - no audible sound was heard. (2) NTE3034A Phototransistor Detector Silicon NPN Photo Darlington - no audible sound was heard. (3) NTE3120 T-NPN, Si Phototransistor - no audible sound was heard. (4) CDS Cell #1 - static, but barely audible sound. (5) CDS Cell #2 - audible, but a lot of echo was heard. (6) CDS Cell #3 - audible and less echo was heard than CDS Cell #2.

Conclusions/Discussion
The CDS Cells worked the best, and I believe this is because even though CDS Cells, in general, have worse quality than Phototransistors, they were in the correct wavelength of the laser light, which in this case was a red color with the wavelength of 630nm. Therefore, I decline my hypothesis because based on my data, the CDS Cells were cheaper and less sensitive than the phototransistors, but actual quality of the performance was based on the ability to receive the wavelength of the red laser beam.

Summary Statement
Best sensor for transmissions that are created by sending a laser beam towards a vibrating reflective surface and capturing the beam at the receiving end to recreate the original oscillations of the vibrating surface.

Help Received
Borrowed laser from Joseph Thinn; took breadboard from Andrey Stebikhov.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Carson A. Pope

Project Number
J0915

Project Title
Testing the Efficiency of a Joule Thief LED Light Circuit

Abstract

Objectives/Goals
The purpose of my experiment is to see if making a Joule Thief circuit is more efficient and uses less voltage to light an LED light bulb than a simple circuit, and has the capability to access lower voltages in low voltage batteries and can light a LED bulb utilizing small amounts of energy (v).

Methods/Materials
I made a Joule Thief circuit (With the help of John Wrigley), and a simple circuit to test if a Joule Thief was more efficient and used less energy than a simple circuit; I also made a LED luminescence sensor to measure and match the luminescence of the Joule Thief and simple circuits so I could measure the mA#s used in both circuits. I put the luminescence sensor over the LED bulb in the simple circuit to measure the voltage read by the solar panel and to measure the amount of mA used. I did the same thing with the Joule Thief circuit but before I could measure the mA I had to use the potentiometer to adjust the luminescence of the LED in the Joule Thief circuit to match the luminescence of the simple circuit; then I measured and compared the mA used to determine the efficiency of the Joule Thief circuit.

Results
The Joule Thief circuit consistently had lower mA readings for each of the 6 different voltage categories than the simple circuit by an average of 0.57mA. At 1v and 1.5v the Joule Thief circuit lit the LED light bulb with 0.03 mA whereas the simple circuit could not light the LED. When converted to joules using the equation mA # V= Power, Joules, or mW, the power usage of the Joule Thief circuit was less than the power used by the simple circuit. The Joule Thief circuit used 28.19% less power than the simple circuit which proves its efficiency.

Conclusions/Discussion
In conclusion, my hypothesis tested true; that a Joule Thief LED light circuit will be more efficient than a simple LED light circuit and can light a LED bulb utilizing small amounts of energy (v). I believe that using the Joule Thief circuit in electronics that use small amounts of voltage could greatly increase the batteries efficiency and save batteries from going to the landfill. The Joule Thief can access lower voltage in a battery that would not otherwise be accessible in a standard or simple circuit.

Summary Statement
Testing the power efficiency of a Joule Thief LED light ciruit compared to a simple LED light circuit.

Help Received
Advisor helped with some wiring of joule thief circuit and father helped with testing the circuit.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Saskia I. Rohde

Project Number
J0916

Project Title
Charge on the Go: Kinetic Energy Generator for Cell Phones

Abstract

Objectives/Goals
Cell phones are becoming a crucial part of peoples lives in Africa, however in some places people may have to walk for hours to get access to power and pay large amounts just to charge their phone. I built a device that harnesses the kinetic energy from walking as a green way to charge cell phones, and most importantly enable cell phone owners to charge them any time off the grid.

Methods/Materials
My goal was to make my device small, light, mobile, eco- friendly, and cheap. First I began designing prototypes. Since movement from walking is mostly up, down, forward, backward, I was not able to use the most common generator design; which converts electricity by rotation. Many prototypes did not work, so I used a method of trying something new and collecting data, figuring out what was wrong and how I could improve my idea. I used simple materials, basic tools from hardware stores. To build my invention I needed thin copper wire, a thin plastic or non-magnetic metal tube, magnets, a spring and electronic components to produce direct current.

Results
My invention was successful. I designed and built a kinetic energy generator, which charges a cell phone. I measured the frequency and voltage, and though it was difficult, I achieved my goal. I had a lot of fun building this invention. Being eco-friendly in these ways is a passion of mine I hope to pursue. I would like to make some improvements, but for now the invention works great. I knew there must be a way to convert walking to electricity, and my invention took form. Though I had many failures along the way, I ultimately succeeded and achieved my goal.

Conclusions/Discussion
In the future to improve my invention I would use stronger magnets to improve the performance. A gap between the magnets and the coil can lessen the electricity generated, so to make it more efficient I would find a smaller, thinner housing. If possible I would make the invention waterproof. My ultimate goal would be to make the invention smaller and lighter, so it could perhaps even fit in your pocket. It would be interesting to test how much voltage is generated while riding a bicycle as well. I would also want to make the whole invention more secure with permanent caps and ends. Lastly, to make it more user-friendly I would like to add a belt clip to the device so it is easier to carry around. It has been so much fun building and designing my invention.

Summary Statement
I designed and built a kinetic energy generator which converts movement from walking into electricity.

Help Received
My father drove me to stores to buy parts, and let me borrow his tools.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Anish Seshadri

Project Number
J0917

Project Title
Automated, Wearable Guidance System (AWGS) for the Visually Impaired

Abstract

Objectives/Goals
The problem that is addressed in this project is that, currently, the visually impaired are not very ambulatory since their impaired vision inhibits them from getting around without any aid. The purpose of this project is to build an Automated, Wearable Guidance System (AWGS) to help the visually impaired with navigation and mobility both indoors as well as outdoors.

Methods/Materials
There are several design criteria for building the AWGS. The AWGS should be able to monitor and process key parameters like elevation, obstruction, location and direction. The AWGS needs to be automated in order to continually monitor these parameters as the user walks from Point A to Point B and take necessary action to give appropriate directions to the user to stay on the recommended course. Based on inputs from the leg and vest sensor circuits, the AWGS needs to turn on/off buzzers and Vibe boards and give directions to the user to stop, turn left or right as appropriate. The AWGS needs to be wireless in order to improve usability.
The AWGS has two modules, the Obstacle detection unit and GPS unit. The Obstacle detection unit is made up of a wearable vest and leg obstacle sensor units. The Obstacle Sensor Unit has an Ultrasonic sensor, Lilypad Arduino and buzzers for obstacle detection and warning. The GPS unit has an Arduino Uno that acts as a host for the GPS device. The GPS is connected through a GPS shield with the Arduino Uno. The GPS collects live data from the satellite.
The AWGS was operated as an integrated system indoors and outdoors with the user wearing the vest and the leg units indoors and using the GPS unit outdoors.

Results
For indoor testing, the user was made to stand at the starting point and asked to start walking blindfolded towards the end point. Every time the user was within 12 inches of an obstacle, the buzzer buzzed proving that the Wearable Vest Unit and the Leg Unit functioned as designed. For outdoor testing, when the user reached latitude and longitude values corresponding to pre-programmed turns, the appropriate vibe board vibrated signaling the user to turn right or left.

Conclusions/Discussion
It can be concluded based on the data collected that the AWGS for the visually challenged met all the success criteria. The current prototype can be improved greatly if it were programmed into an app. This app would connect to Google maps and read live data from Google maps.

Summary Statement
This project is aimed at building an automated wearable guidance system (AWGS) to help the visually impaired with navigation and mobility both indoors as well as outdoors.

Help Received
I want to thank all the volunteers who helped me take very valuable data. I want to thank Mrs. Makhijani for her valuable advice. I want to thank my dad for giving me pointers on Arduino programming. I want to thank my mom for helping me with sewing and soldering.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Utkarsh Tandon

Project Number
J0918

Project Title
Building a Wearable Autonomous Device Providing Personal Assistance to Alzheimer Patients Using the Raspberry Pi and GPS

Abstract

Objectives/Goals
The purpose of this project is to build a device for the personal use of Alzheimer patients, that would act as a virtual assistant for the patient in their daily activities. While it runs on Raspberry Pi mini-computer, the device will take information, process it, and autonomously assist the patient. Alzheimer patients would hopefully be able to use this product to live more independently.
Goals: 1.Weight should be less than 1 pound. 2.Battery should run for at least 1 hour. 3.Should get a 56-60 score in the Testing Criteria. 4.Cost must be less than $70. 5.Should be able to track the patient with GPS capabilities. 6.Device should interact with the patient, such as having a button to make sure the activity is completed. 7. A user interface should be connected with the device to allow information storage for playing reminders.

Methods/Materials
I had two designs, #1 could only sound alarms at a previously set time, and #2 had added GPS tracking and User Input capabilities. These are the general equipment:
Raspberry Pi Model B, case, Mobile Juice Pack, GPS Data Logger, Speaker, Wi-Fi Adapter, 16 GB memory card, Velcro, breadboard, resistors, Push Button, and wires.
Procedures:
For design #1, first alarms would be set at a time 5 minutes later. Then wait for the alarm and notice each aspect for testing. For design #2, again alarms would be set along with distance boundaries. Walk the distance and notice the alarms that would sound when crossing the boundary.

Results
The qualitative testing part of my data was based on six testing criteria and it could be seen that after adding scores for each criterion, design #1 and design #2 achieved total scores of 45 and 58 respectively out of a maximum score of 60. The quantitative portion was on the percentage of error for the tracking accuracy. After finding the error in meters from the set distance and the distance really moved, the difference was divided by the set number and multiplied by 100 to get the error percentage. The average from each trial was 4.6%.

Conclusions/Discussion
By looking at the engineering goals satisfied it can be seen that design #2 satisfied more. Out of 7 goals, design #1 satisfied 3 while design #2 satisfied 6. Though the cost goal couldn't be satisfied, the product could alarm set reminders, track the patient, and take inputs to make sure tasks are understood by the patient.

Summary Statement
My project aimed to create a wearable personal assistant for Alzheimer Patients that would assist through reminders of daily activities, tracking the patients, and taking inputs.

Help Received
Dad helped me set up the Raspberry Pi; Brother taught me how to use Adobe Photoshop; Codecademy website provided free tutorials on Python's basics.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Allan Tran; Ethan Zheng

Project Number
J0994

Project Title
HazardBot: Surveying Hazardous Environments

Abstract

Objectives/Goals
Create a sophisticated, yet low-cost, mobile robot platform with various sensors to survey hazardous environments. The robot is to be controlled from a remote distance. All data gathered from the sensors is analyzed and displayed on a web interface, along with a live video feed.

Methods/Materials
The main computing platform is the Raspberry Pi microcomputer, connected to a 10-bit Analog to Digital Converter. Six channels on the ADC are used to gather the voltage data from the temperature, smoke and flammable gas, alcohol gas, and carbon monoxide sensors, as well as the two batteries. Baseline tests were conducted by exposing the sensors to different levels of carbon monoxide, smoke, flammable gas, and alcohol gas to calibrate the sensitivity. A webcam is also used to provide a live video feed to help the operator navigate. For the robot#s motion control, the PIC18F4620 microcontroller is programmed to decode messages from a wireless receiver and operate the two servo motors accordingly. All components are wired together on a breadboard. The Raspberry Pi interfaces with the PIC18F4620 using coded messages to allow the robot to be controlled from iPhones, iPads, tablets, computers, or any device that supports a compatible web browser.

Results
The robot could navigate in all directions, while analyzing the environment for hazardous airborne substances. The robot successfully detected different levels of gases and displayed the results on a web page over a Wi-Fi network. The live video feed provided a very high quality video stream to the web browser. The battery monitoring program functioned as expected, displaying data on current battery life and showing how much power each battery has.

Conclusions/Discussion
We learned that batteries can experience brownouts, when a battery voltage level drops below critical threshold for control circuits to function properly. This would occur only when a demand for current would spike more than the maximum current that the battery can supply, as in the start of a motors. In order to prevent the brownout occurrences, separate batteries needed to be used for the control circuit and the motors. We also encountered an issue with cross detection between sensors. The sensors detected more than one type of gas. Therefore, we could not positively identify what kind of gas was detected.

Summary Statement
The robot built is sophisticated, yet low-cost, used for surveying hazardous environments.

Help Received
Dad helped with soldering and cutting display board.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Sarah P. Edwards

Project Number
J0995

Project Title
The Point of a Parabola

Abstract

Objectives/Goals
My project determined if parabolic reflectors made from household materials and mounted on a dipole wireless router can positively affect signal strength in a given direction, and, if so, which household material can accomplish this the most effectively. I hypothesized that, out of all the materials tested, the reflectors made from the Pringles cans would be the most effective.

Methods/Materials
There were six parabolic reflectors constructed in total. Two were made from cardboard covered in tin-foil, two from the reflective material inside Pringles cans, and two from printer paper. They were held in shape by pieces of styrofoam cut into parabolic curves. Each pair of similar reflectors was mounted on a dipole wireless router in turn, and they were simultaneously rotated in fifteen-degree increments all the way in a three hundred and sixty degree circle. At each position, the signal strength was measured five times and recorded on data tables. These data were then graphed on polar plots.

Results
The parabolic reflector made from the Pringles can material showed the greatest directional improvement in signal strength. The reflector made from the tin-foil worked well, but was not as effective as the one made from the Pringles cans. The paper made almost no difference. However, all parabolic reflectors made some improvement in signal strength in the desired direction.

Conclusions/Discussion
My hypothesis was supported and I have now concluded that using parabolic reflectors made from tin-foil or a Pringles can is a cheap, easy, and effective way to increase one's signal strength to one computer in their household.

Summary Statement
I aim to find out if parabolic reflectors made from household materials can positively affect signal strength in a given direction.

Help Received
Mother helped cut styrofoam

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Aaron H. Lin

Project Number
J0996

Project Title
An Accurate Lie Detector?

Abstract

Objectives/Goals
When people lie, their skin resistance can increase due to the release of sweat. This response can be used to build a lie detector. My science project titled, #An Accurate Lie Detector?# examines whether changing the band in a galvanic skin response (GSR) lie detector will improve its accuracy. When the lie detector is programmed to monitor the change in GSR for a fixed band (beyond which it detects a lie), it may not be completely accurate in detecting lies; the change in a person#s skin resistance upon lying may be different for different people. Calibrating the optimal threshold for each person may increase the accuracy of this type of lie detector.

Methods/Materials
The lie detector built for this experiment is a homemade detector described in an Arduino project book. I will be testing the device on about a dozen subjects. During the calibration testing, I will first ask them five questions, which they will answer truthfully. When they are answering these five questions truthfully, a Processing program will take the average skin resistance. This average is one side of their unique band between truth and lie. Then, I will ask them five more questions, which they will answer falsely. The average skin resistance taken by the Processing program when they lie will be the other side of the band. The range between the two averages is their unique band. This band will be then entered into the Arduino software. Lastly, I will ask the subjects ten questions, which they will answer either truthfully or falsely. The lie detector will determine whether they are lying.

Results
Without calibration, the lie detector had an accuracy of 38%. With calibration, the accuracy rose to 56%. Therefore, using calibration improved the lie detector#s accuracy. However, the accuracy was not much higher than 50% to consider this technique reliable because guessing randomly would be 50% accurate.

Conclusions/Discussion
Because this lie detector did not exhibit an accuracy much greater than 50% with calibration, I conclude that this method of optimizing the detector performance is not reliable.

Summary Statement
My project is about improving a lie detector's accuracy by calibrating each person's unique "band".

Help Received
Father provided inspiration; Mother helped with the report.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Matthew C. Yerich

Project Number
J0997

Project Title
Magnetic Air Conditioner: Finding Efficiency

Abstract

Objectives/Goals
The objective is to determine if a maximum efficiency exists in an magnetic air conditioning apparatus that utilizes the magnetocaloric effect to produce a temperature change.

Methods/Materials
I designed and built three different assemblies: An electromagnet with adjustable magnetic flux density (magnet strength), a gaussmeter, used to measure the strength of the electromagnet, and a thermocouple, used to measure the minute temperature changes of the magnetocaloric material. I placed a small sample of gadolinium (an effective magnetocaloric material) onto the electromagnet with only a craft stick to separate them. The electromagnet was powered and the temperature change of the gadolinium measured. This was repeated with various magnet strengths.

Results
The results of my tests showed that temperature change did increase with the increase of magnetic flux density, as expected. However, as my hypothesis predicted, the efficiency (expressed as temperature change per magnetic flux density) formed a negatively parabolic curve with a maximum as the magnetic flux density increased.

Conclusions/Discussion
My results led me to the conclusion that in any magnetic air conditioning apparatus, a maximum efficiency exists that would produce the greatest temperature change while requiring the least magnetic flux density. Knowledge of this maximum efficiency would produce the highest profit for a manufacturer. This discovery may lead to the use of magnetic air conditioners in replace of environmentally unsafe Freon air conditioners as well as in situations where a standard air conditioner is inconvenient. Example include the high pressures of the ocean floor, the soldiers in the desert who need a lightweight product to keep cool, and situations where a quiet apparatus is optimal.

Summary Statement
This project strives to identify the existence of a maximum efficiency in the magnetocaloric effect for use in a magnetic air conditioning apparatus.

Help Received
Dr. Karl Gschneidner, Anson Marston Distinguished Professor, Department of Materials Science and Engineering, Iowa State University, gave advice and gadolinium sample; Father helped suggest apparatus; Mother helped with grammar of report.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Ryan D. Barry

Project Number
J0998

Project Title
Velocity Gain in a Gaussian Rifle

Abstract

Objectives/Goals
My project was to determine how the velocity of a projectile is affected by adding additional stages to a Gaussian Rifle (or Magnetic Linear Accelerator) that is made up of half inch neodymium magnets and half inch steel ball bearings.

Methods/Materials
To test my objective, I built 3 components. The first component was the Magnetic Linear Accelerator (MLA), which was built using 2 straight pieces of aluminum, taped to a piece of wood, creating a 1/4" gap for the steel ball bearing to roll on. Each stage of the MLA was created using two 1/2" neodymium magnets and two 1/2" steel ball bearings. The second component was a ramp to provide a consistent starting velocity. This was made using a 10" long piece of 3/4" PVC pipe taped to a wooden dowel. The final component was a sandbox to provide a landing area for the projectile. I first tested the MLA with one stage, launching the steel ball into the sandbox 5 times to ensure valid data. I then tested the MLA with additional stages until I had a total of 6 stages. For each number of stages, I ran the test 5 times. I then plugged the average distance for each number of stages into an equation to determine the velocity of the projectile and compared the result.

Results
The results showed that increasing the number of stages, increased the velocity of the projectile. For one stage the data showed a velocity of 5.02 m/s, for two stages the average velocity was 5.79 m/s, for three stages the average velocity was 6.60 m/s, for four stages the average velocity was 7.18 m/s, for five stages the average velocity was 7.49 m/s and for six stages the average velocity was 7.78 m/s. These velocities provide increases between stages of 15.34%, 13.99%, 8.79%, 4.32% and 3.87%.

Conclusions/Discussion
As you can see from the results, adding stages to the MLA did increase the velocity of the projectile, however the amount of increase for each additional stage got smaller. My hypothesis of a 15% increase was almost exactly the percentage increase between one stage and two stages but after two stages the percentage of velocity increase dropped significantly. Each additional stage is less significant, and I would guess that if I kept adding additional stages, the amount of increase in velocity would eventually drop to almost 0%.

Summary Statement
My project is to determine the velocity increase from adding stages to a Magnetic Linear Accelerator.

Help Received
Dr. Dunn provided advice; Mother and Father helped with board; Father assisted with building components and running tests.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Aaron E. Parker

Project Number
J0999

Project Title
Levitating Train

Abstract

Objectives/Goals
My project was to prove or disprove if the material a levitating train is built with affect its rate of speed. I believe the material a levitating train is built with affects its rate of speed because the lighter the material, the less friction it creates thus making it travel faster and further.

Methods/Materials
1 cart with wheels on the sides that can levitate on a track with magnets. The track and the cart have magnets of opposite poles which create a repulsive force that allows the cart to levitate. The wood block is placed on the levitating cart. The cart is placed at a specific point in the track. It travels freely and is timed until it hits the stop marker. This process is done five times and time is recorded after each time. Change the block on the cart to rubber and metal and repeat testing. Measure the track and calculate rate of speed.

Results
The heaviest material, in this case the metal, had the fastest average rate of speed. The second heaviest material, rubber, travels slower than the metal. The lightest material, wood, had the slowest average rate of speed. Rate of speed is calculated in centimeters per second.

Conclusions/Discussion
The heavier materials, such as metal, travel faster than lighter materials, such as wood, on a levitating track.

Summary Statement
My project was to prove or disprove if the material a levitating train is built with affects its rate of speed

Help Received
Mother helped me put together my display board, conduct my testing, make my cart, and type my report. Father helped me make my cart and printing pictures and report. Ms. Shimizu helped proofreading my log book and final report and guiding me on how to do my science fair report.