CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Dhruv Aggarwal

Project Number
J0901

Project Title
Turbocharge Your Wireless Signal

Abstract

Objectives/Goals
My goal was to increase the wireless signal strength in my house. I created parabolic reflectors, which attach to the antenna of the router to direct the electromagnetic waves. I also wanted to shield the waves from outside my house.

Methods/Materials
My preliminary design was per the Deep Dish Parabolic Reflector template from FreeAntennas.com by M.Erskine. I opened up a tin can, aligned it with the antennas focal length and measured the strength using the InSSIDer software. I conducted these tests with an aluminum foil sheet and with a thinner sheet, and found a similar strength increase, which confirmed that the thickness did not matter. However, it was difficult to align the reflectors with the antennae i.e. low reliability.
I researched and found the Windsurfer template, which slides onto a dipole rod-like antenna. I picked points that had a weak signal and maintained them to control the distance.
My prototype was 6-inch reflectors, and my measurements confirmed a signal strength increase, however, I also found that it varied, and so, I took multiple measurements over 9 days. I statistically analyzed the data and compared using distribution charts and boxplots.
While the signal strength was higher everywhere, it was better outside too, where I had expected it to drop. I noticed that the 6-inch reflector did not cover the length of the antenna, and so I built 9-inch reflectors. I also measured speed using Speedtest.net and throughput using Ixia QCheck, which simulated a 100kB signal from my laptop to the router.

Results
Both reflectors increased the signal strength inside the house, however, the 6-inch reflectors did not decrease the strength outside. The 9-inch reflectors increased the signal inside, and decreased it outside (>10dBm). This proved that the reflectors must be tall enough to shield the antennae backwards.

Conclusions/Discussion
The 9-inch parabolic reflector was the best design for my router. The 6-inch reflector increased the signal everywhere, including outside the house, where it should have decreased. The tin can design was not helpful since it was difficult to position.
Since the reflectors are made from everyday materials, they are cheap and easy to build, easy to service, and my statistical analysis showed that they are reliable.
The parabolic reflectors worked well with the external antennae, and I would like to investigate a similar solution for the internal antenna routers.

Summary Statement
This project evaluates the effect of a parabolic reflector on wireless signal strength.

Help Received
My sister, Shruti Aggarwal mentored me through the process.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Tristan Brown

Project Number
J0902

Project Title
Infant Sensing Integrated System

Abstract

Objectives/Goals
The goal of my project was to design and install a pressure sensor in an existing infant car seat and integrate this system with a vehicle, which will reduce the occurrence of an infant being left alone in a locked car.

Methods/Materials
I made the following assumptions:
1. The car is equipped with Bluetooth (standard feature in most cars). 2. A smartphone app will be developed to alert the caregiver to the child left behind if the paired phone is greater than 50 yards from the Infant Sensing Integrated System (I.S.I.S) / Dont Leave Me system. 3. The Bluetooth on the phone will be forced on if the system is activated by the depression of the pressure switch. 4. The cars Bluetooth will enable the cars horn to be sounded in the event of an alert.
I acquired the following components: a. Iteaduino Bluetooth microcontroller to be used as my motherboard; b. Electronic push button to simulate my car seat pressure switch; c. Electronic magnetic switch to simulate a car door switch; d. Electronic relay assembly; e. Siren to simulate a cars horn; f. Associated connecting cables.
2. The push button, magnetic switch and relay assembly are plugged into the digital input/output terminals (D8-10) on the microcontroller. 3. The relay is programmed to close the normally opened (NO) contacts and sound the siren if the push button (pressure switch) remains active and the magnetic switch (door switch) is opened. 4. The microcontroller is programed using a PC and the Arduino Integrated Development Environment application to read a high and low value for the devices. The program code was standard from the manufacturer and only required consolidation for multiple components.
Testing was broken up into three major phases: 1: Component Testing; 2: Integrated Testing; 3: Final Testing.

Results
The system worked as designed, alerting the caregiver to the presence of the infant in the seat, except when the sensor was placed in the small of the back.

Conclusions/Discussion
My conclusion is this system will reduce the number of infants left alone in vehicles.

Summary Statement
This project is designed to prevent heat related infant deaths as a result of being left accidentally in a locked vehicle.

Help Received
My dad helped me write the computer code.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Deveshi Buch

Project Number

J0903

Project Title

4eyes: An Ultrasonics-based Solution to Collisions Involving Cellphone Distracted Pedestrians

Abstract

Objectives/Goals

The goal of this project was to investigate the use of ultrasonics on a mobile device to help prevent collisions that involve pedestrians distracted by cellphone use. The objectives were to characterize ultrasonic sensors, build and program a prototype device, and analyze device performance in different experiments.

Methods/Materials

A large set of experiments were conducted, including: sensor calibration, single/dual sensors, effect of material type and distance, field and angle of view of sensors, different object shapes and types, object motion, etc. The prototype device was built and programmed using a microcomputer and sensors, mainly ultrasonic sensors. Material types tested include metal, plywood, ceramic, glass, rubber, plastic, foam, etc. Obstacle detection ability was tested at different distances, angles, and orientations. Device performance was investigated for stationary objects and objects in motion. Real-world testing was also conducted. To account for device motion in a more controlled way, a motion simulator was constructed and programmed. Data logged by the programs was uploaded to Microsoft Excel for analysis.

Results

The ultrasonic sensor was calibrated and its characteristics were determined. Hard as well as soft objects were detected well when stationary. The sensor was found to have a distinct field of view. Moving obstacles in different planes were detected. Measurement error was characterized for rectangular and cylindrical objects, and cylindrical objects were clearly more difficult to detect. Real-world experiments showed that different obstacle types were detected while the device was in motion, but the detection range varied.

Conclusions/Discussion

A dual-sensor configuration (4eyes) was found to provide a good balance between sampling speed and uncertainty in measurements, and a flipped configuration improved the field of view. Motion simulator experiments showed that detection accuracy was very good for larger objects for both horizontal and vertical movement. However, narrow cylindrical objects were challenging to detect. These results can not only help avoid accidents involving cellphone-distracted pedestrians, but also have other applications including obstacle detection for the visually impaired.

Summary Statement

This project investigates ultrasonics for obstacle detection on a mobile device to help prevent collisions involving pedestrians distracted by cellphone use.

Help Received

I would like to thank my teachers for motivation and support. Parents helped with taking pictures & board layout.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Sophia Ceman; Siena Lucido

Project Number

J0904

Project Title

The Effect of Distance and Mode on Cell Phone Radiation Emission

Abstract

Objectives/Goals

The purpose of this experiment is to observe levels of radiation emitted by cell phones and see if they exceed the safe radiation limit set by the FCC which has been determined to be 5 watts. If a cell phone in calling mode is placed facing forward 0cm, 5cm, 15cm, and 30cm away from a microwave leakage meter, then the amount of radiation will be greater than a phone in texting mode at that same distance and angle. Also, the closer the phone is to the microwave leakage meter, the more radiation will be detected.

Methods/Materials

Methods: Ten cell phones were tested at four different distances (0cm, 5cm, 15cm, and 30cm) and in two modes (calling and texting). A jig was designed and constructed with a microwave leakage meter which measured radiation. Materials: adjustable cell phone holder, centimeter ruler, 4 oz of paint, ball bearing drawer slide, microwave leakage meter, foam paint brushes, Phillips head screw driver, wood screws, museum putty, 10 different cell phone models with no cell phone protective casing and 100% charged, slab of wood, blue masking tape, L-Bracket, Gorilla Glue.

Results

One major pattern in the data was that radiation levels rose as the cell phone moved closer to the microwave leakage meter. According to the graph comparing texting mode data, the median of all ten cell phones in texting is 0.05, the mode is 0.04, and the mean is 0.77949. According to the graph comparing calling mode data, the median of all ten cell phones in calling mode is 0.14, the median is 0.07, and the mean is 2.08825. The p-value of all of the data is 0 which signifies that there is a significant difference between the data.

Conclusions/Discussion

After testing and recording the results, the scientists learned that the closer the phone was to the microwave leakage meter, the more radiation was detected. Calling mode emitted a greater amount of radiation than texting mode because of its direct connection with the cell phone towers. Both alternative hypotheses were supported. A future study could include testing cell phones at each distance more times to produce a more accurate average.

Summary Statement

Cell phone radiation levels will be observed at four different distances and in two modes in order to see if the FCC's limit is exceeded.

Help Received

Friends and Family loaned cell phones; Parents provided work space; Home Depot employee suggested ideas to build jig; Teacher supported students

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Anthony E. Felts

Project Number

J0905

Project Title

Cycle Speed: Testing Computer Processing Speed

Abstract

Objectives/Goals

In this project, computer processing speeds were tested while changing memory size and CPU variables to see which had a greater impact on the computer's processing speed.

Methods/Materials

This project is divided into two parts, the hardware test using a Z80 based CP/M computer I built, and the virtual machine (VM) test. Due to connectivity difficulties with the serial connection on the Z80 based CP/M computer (which I am in the process of resolving), I completed testing in a virtual environment. In the virtual environment, I ran tests on the processing speed of a computer while changing memory size and CPU utilization resources. For instance, in one test I analyzed how long the computer took to calculate to the 5000 digit of pi while changing the processing utilization levels, and the memory size.

Results

The memory did not have a major effect on the computer's speed until the CPU utilization was significantly reduced. During the test, the CPU utilization was reduced from 100% to 25%, in 25% increments. My theory is that since modern processors in the virtual testing environment are so fast, they do not need memory as much as older computers with slower processing speeds.

Conclusions/Discussion

In the end, I concluded that my hypothesis was partially correct. The processing resources affect computers more than memory at smaller processing loads. With a larger processing load, the memory size has some impact on the computer's speed; however, not as great as the CPU utilization.

Summary Statement

This project tests whether a computer's memory or CPU has a larger impact on the computer's processing speed.

Help Received

A family friend has been a resource on troubleshooting. A graphic artist allowed me to use his printer to print my display board.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Raghav Ganesh

Project Number

J0906

Project Title

A Low Cost, Adoptable, User Tested Add-on Device for the White Cane Facilitating Safer Mobility of the Visually Impaired

Abstract

Objectives/Goals

90% of the visually impaired are unemployed, 82% are aged 50+, and the number of diabetic and elderly who are visually disabled is growing annually [WHO October 2013]. Most cannot afford or easily adapt to the expensive gadgets available. The $50,000 cost to train guide dogs is unaffordable for many. Instead, the primary mobility aid remains the traditional white cane ($20), which needs to be replaced every 6-12 months. Based on research and discussions with the visually disabled, my project goal is to develop an inexpensive device that augments the white cane's usage, extends its range by at least 2.5 meters, costs under $100, weighs under 500 g, and reliably works in the real world.

Methods/Materials

My device computes the distance of obstacles beyond the reach of the cane by sending and measuring the time taken for ultrasonic pulses and angles of the infrared light being reflected back from the obstacles. I used the Arduino microcontroller to compute and communicate the distance information to the user through modulated vibrations of a micro motor/servo attached to the cane's handle. I finished my project in four revisions. In each revision, I improved the software, tested various sensors & motors, and measured the accuracy of object detection. I moved these obstacles at different speeds and placed them at various distances. I also collected feedback from a real cane user after every revision.

Results

My final prototype successfully exceeded all design criteria and is available for demo at the science fair. My first version used an ultrasonic sensor. It detected objects up to 3 meters away with 2 cm accuracy, but missed objects that either absorbed or deflected sound. My second version used an active infrared sensor. It detected most of the objects between 0.5 to 3 meters away with 15 cm accuracy. In my third version, I improved the response time by replacing the servo motor with a Micro DC motor and modifying the software. In my final version, I used both the ultrasonic and infrared sensors to provide the best overall detection and user experience. I also incorporated a smaller microcontroller that lowered the total cost of the prototype to $55.

Conclusions/Discussion

My results show that a low cost, detachable, lightweight, and responsive device can be added to the traditional white cane#s usage model of sweep and tap; it can be easily adopted by the visually impaired.

Summary Statement

I created a low cost device that can be attached to the traditional white cane to help detect obstacles beyond its physical reach for the visually impaired.

Help Received

My parents funded my project and drove me to buy materials. Mr. Steve Mahan from the Santa Clara Valley Blind Center tested my prototypes and gave me valuable feedback.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Yannick Gloster; Sachin Suri

Project Number

J0907

Project Title

Battle of the Bots: Raspberry Pi vs. the NXT and Omnidirectional Steering vs. Car-Steering

Abstract

Objectives/Goals

The purpose of this project was to study how processors affect the speed of a robot following a track and to study how steering design affects the speed of a robot following a track.

Methods/Materials

We measured the time it takes robots made from Lego Technic parts to travel four times around an oval path taped on the floor. There were 15 trials for each of the four robot and processor combinations. The robots used Lego motors and a Lego color sensor. One of the processors was a Lego NXT processor and the other was a BrickPi with a Raspberry Pi. One of the robot designs used omnidirectional steering and the other used car-steering.

Results

A car-steering robot using the NXT processor was faster than a car-steering robot using the Raspberry Pi. For an omnidirectional robot, the speeds were about the same for both processors. A robot with a car-steering design was faster than a robot with omnidirectional steering when using either the NXT or Raspberry Pi.

Conclusions/Discussion

We concluded that the efficiency of a controller is based not only on its computer power but on other parameters such as the car design, coding and sensor and motor relay paths. We concluded that a car-steering robot is faster than an omnidirectional robot for this particular task. In general, a car-steering robot is faster compared to an omnidirectional robot, but a car-steering robot can get stuck in dead-ends on more complicated tracks. Since the track used was wide enough for the car-steering robot to turn on, it is not surprising that the car-steering robot was faster for this task.

Summary Statement

The purpose of the project was to compare the efficiency of two different processors and the efficiency of two different robot designs at performing a particular tracking task.

Help Received

We received help from our parents with editing our posters and presentations, and programming help from the Santa Barbara Makerspace which meets at the Santa Barbara Public Library.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Mary E. Jolly

Project Number
J0908

Project Title
Where's My WiFi?

Abstract

Objectives/Goals
My objective is to learn how different materials block WiFi signals, and which building material obstructs radio signals the most.

Methods/Materials
In my experiment I used foam insulation, dry wall, and concrete to build three separate small house models to do my testing. To test, I placed the house model over the WiFi router and used the WiFi analyzer phone app to measure the strength of the radio signal. I repeated this process six times at different distances using three different phones, recording the results after each reading.

Results
The results of my project are that foam insulation blocked the radio signal the least and had better signal strength than the results from the trials I did without any covering. In my experiment the cement blocked the radio signals the most followed closely by drywall.

Conclusions/Discussion
After completing my experiment my hypothesis that the concrete would obstruct the WiFi signals the most, turned out to be correct. Using this information I would say that it would help you understand where to place your WiFi router. Also, As radio becomes more a part of our lives, construction companies can apply this information to decide which materials to use to make our lives easier by having the best signal strength possible.

Summary Statement
In my project I was trying to determine which building materials obstruct WiFi signals the most.

Help Received
Father helped build house models & set up WiFi router, Mother helped with board design.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Nina K. Kagan

Project Number
J0909

Project Title
Autonomous Ultrasonic Sensor Robot

Abstract

Objectives/Goals
To chart was to see how different shapes and angles could be sensed more accurately than others. Three different shapes (cylinder, cube and rectangular prism), and two different angles (45 and 90 degrees) were used to test the ultrasonic sensors accuracy compared to the actual distances measured by a ruler. I put the ultrasonic sensor bot 6 inches away from each object and programmed the ultrasonic sensor bot to stop once it sensed an object four inches away from the sensor.

Methods/Materials
Spider hexbug, Ultrasonic sensor, arduino micro, macbook pro with arduino software

Results
the ultrasonic sensor was able to detect the 90 degree angle with the most accuracy, and the rectangular prism with the least accuracy consistently.

Conclusions/Discussion
My conclusion is that sound reflecting from an angle is not as big of an issue as I originally thought.

Summary Statement
My project is about the affect of different shapes and angles on the accuracy of readings for an ultrasonic sensor robot

Help Received
Tutor assisted building the robot

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Emir Karabeg

Project Number
J0910

Project Title
Robot-Computer Communication

Abstract

Objectives/Goals

The invincible tic-tac-toe playing robot, Invictus 2000, challenges you to put your mind to a test. As you play, the robot#s #brain#, the computer, makes hundreds of calculations and decisions based on the inputs from robot sensors, and transmits commands to motors and other robot #muscles#.

As a future roboticist, I wanted to find out which network communication protocol should I use in my robot designs, when response time is the most important requirement.

Methods/Materials

1. Gather materials:
1.1. EV3 robotics kit
1.2. Computer for software development
1.3. Tablet computer for testing
1.4. Visual Studio development environment
1.5. EV3 robotics software
1.6. Wi-Fi network adapter
1.7. Wi-Fi network router
2. Build the robot
3. Program the computer software
4. Program the robot
5. Test Bluetooth interface
6. Test Wi-Fi interface
7. Create a graph
8. Write conclusion

Results

The experiment requested information from the robot in a loop, measuring total response time. The first 10 measurements were done using Bluetooth, and the second group of measurements was done using Wi-Fi. To compare the two groups, mean value was calculated for each group of measurements.

Conclusions/Discussion

The experiment confirmed my theory. Invictus 2000 responded 10.77 % faster when using Wi-Fi, then when it was using Bluetooth to communicate with the computer. In conclusion, Wi-Fi is faster than Bluetooth for Robot-Computer communication.

Summary Statement

Finding the fastest Robot-Computer communication protocol.

Help Received

Father helped with some C# code.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Solomon Kazmie

Project Number
J0911

Project Title
Murphy: Covert Emergency Reporting and Transmission System

Abstract

Objectives/Goals

The movie Lone Survivor tells the story of Lt. Michael Murphy. When his squad came under attack, during a covert mission in a valley in Afghanistan, their radio could not transmit back to base. Lt. Murphy gave his life climbing to the top of a high peak, under heavy gun fire, so that he could successfully transmit a desperate call for help.

Dedicated to Michael Murphy, The Murphy CERTS repeater system is a network of small, portable, camouflaged radio repeaters, which can easily be carried and planted along a path by a covert scouting team or a search and rescue team, as they move through any terrain. The repeaters will sit silently waiting for an encoded message, and only then repeat and relay that message back down the trail to one or more identical repeaters.

Methods/Materials

I researched micro-controllers, electronics and rf transmission. I wired 430Mhz transmitters and receivers to a PSOC 4 processor. I used PSOC Creator to configure the chips and program them. The PSOCs listen for a manchester encoded message and then rebroadcast it four times at random intervals, to avoid interference.

I tested the Murphy repeaters many times in a number of locations. I tested them in sets of two and three, with and without wire antennas. My original prototypes just used a simple button that would send out a random number. The number was displayed as a color on an RGB LED. I tried adding a keypad to the repeaters, but then decided to use a CapSense touch sensor to allow the troops to covertly transmit their own messages with just a slight move of a finger.

Results

The Murphy CERTS successfully transmitted, received and relayed their messages. The use of a wire antenna significantly increased the range. The addition of an in-between repeater, transmitting several randomly delayed echoes, doubled the range of the single transmitter and receiver.

Conclusions/Discussion

Small battery-powered micro-controllers with simple transmitters and receivers can relay messages from point to point along a covert repeater network, that can be easily carried, planted, disguised and concealed along a path to relay critical reports and distress signals back to base. No soldier, ranger, rescuer, medic, scout or patrol should ever again have to give their life to send a call for help.

Summary Statement

Lone Survivor's Michael Murphy gave his life to make a radio call to get help for his team, inspiring my new "Murphy - Covert Emergency Report and Transmission System", a life-saving message relay network of small digital radio repeaters.

Help Received

A family friend loaned me three PSOC Kits and taught me how to use them. Youtube blogger Kevin Darrah demonstrated the basics of Manchester Encoding in an awesome online video. Dave Van Ess' great PSocToday! videos explained how to use the PSOC peripherals.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Sahar A. Khashayar

Project Number
J0912

Project Title
Wildfire Early Warning System Using Computer Science: C.S. to the Rescue!

Abstract

Objectives/Goals
The objective is to design, build and test a prototype hardware and software to detect fire in its infancy and produce an automated warning response via Bluetooth.

Methods/Materials
Fire detectors sense presence of fire by responding to changes in their local environment that are indicative of a fire within the area of coverage. The goal is to select conditions for sensing fire as early as possible. Various fire conditions may produce different fire signature characteristics depends on the location and source of the fire. Using three different sensors allows the system to detect fire in several different ways and will improve the possibility of early detection by several factors.
Each sensor keeps track of its input individually. Once the sensor detects an abnormal measurement of heat, gas, or IR then it will check to find out the state of other sensors. The truth table in the program will set the threshold for each sensor to decide the presence of fire and issue a warning to the nearby cell phone via Bluetooth. Once the warning is issued the massage could be communicated to a local fire station.

Results
Using three different sensors, IR, Temp and gas, I was able to detect fire fast and accurate. Each sensor is set to detect and measure heat or gas and consequently send a text massage to a nearby smart phone once it hits its system defined threshold for each measured data.
The prototype is stable and able to detect variety inputs and produce a warning text to the phone.

Conclusions/Discussion
Wildfires and house fires are becoming an increasing issue in the US. With rising heat, increasing dryness and longer summers, it#s no surprise that this is a problem. Using my simple and cheap prototype (under $40), I am able to detect fire early and accurately. Early detection is the best way to fight fire while save money, resources and even lives.

Summary Statement
Cost effective early fire detection and warning system prototype using of the shelf hardware and simple programming

Help Received
My father helped me build the test environment for the sensors

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Joonhyuk Lee

Project Number

J0913

Project Title

Catching Wave(length)s: The Effect of Electromagnetic Fields on Fiber Optic WDM Signal Quality

Abstract

Objectives/Goals

Modern fiber optic companies use wavelength-division multiplexers (WDM's) to send multiple streams of information at the same time on a single device This technique maximizes efficiency. However, several variables such as electromagnetic fields could play a role in the performance of these systems. The goal of this project is to discover how the ways that EM fields affect light apply to WDM system performance. As WDM systems grow more popular, this interaction becomes more and more critical to understand.

Methods/Materials

This experiment was solely performed using the network simulation program OMNet++. Two programming languages, C++ and NED, were utilized to describe 4 different WDM systems inside the simulation (32 channel, 16 channel, 8 channel, and 4 channel). The simulation was run several times with millions of signals sent across 4 trials to acheive a consistent BER (bit-error rate). Then, the same simulation was performed with the WDM systems, except with a C++ code designed to simulate an EM field. Between each trial, the channel spacing (amount of "distance" between signals) was changed.

Results

The results showed that WDM modules that were exposed to EM influence increased in number or errors as compared to the control group. For example, System B, with 16 channels, had a BER rate of .0000003 when not exposed to EM, but had a rate of .0000005 when exposed. Overall, all the systems showed small decreases in signal quality. However, the systems that had less "channels", or streams of information being transmitted at once showed the least change when exposed to EM. Despite this, systems with a larger amount of channels such as system A, with 32 channels, showed a greater decrease in efficiency when exposed to EM interference.

Conclusions/Discussion

In conclusion, WDM systems that have been exposed to EM influence show a general decrease in effeciency. However, these results should partially be accredited to the channel spacing of the WDM systems, which was shown to increase BER in control systems as well. A trend that was discovered was the amount of channels multiplexed tended to correlate with the amount of BER increased of decreased. These results may become more relevant in the future due to design parameters focusing more on greater channels and lower channel spacing.

Summary Statement

How do the effects of electromagnetic fields on light affect fiber optic network quality?

Help Received

Mother helped with board.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Kaley L. Matthews

Project Number
J0914

Project Title
What Are the Maximum Functional Ranges of Two Brands of Two-Way Radios in Preparation for Emergency Communications?

Abstract

Objectives/Goals
My project was to determine the effect of distance, user location, and position, on signal strength of two different commercially available sets of Motorola Two-Way Radios in preparation of an emergency event.

Methods/Materials
Two sets of commercially available Motorola Two-Way Radios, with different signal strengths were evaluated. A channel and privacy code were established on the radios. Location of person A was established and maintained as a constant. Person B then went to different locations. Exact distances between radios were established using the odometer on the vehicle traveling from the fixed location of person A to the various locations of person B. Location was evaluated with respect to all obstructions that might reduce signal strength. Lastly, position with respect to open spaces between radios was evaluated.

Results
The signal strength of the MT351R was strong over an approximately 50% longer distance than the MG163A when there were geographic obstructions between users. The signal strengths of both radios could be improved by both parties being outside, rather that inside a house or car. Clear reception quality could be heard approximately 70% farther on the northern route of the testing, where there were significantly less obstructions. The overall reception quality increasingly improved as the fixed location changed from inside the house, to outside the house, to an open field, to the top of a small hill.

Conclusions/Discussion
During an emergency event or natural disaster, cell phones and land line telephones will likely not be available due to damage or overloaded systems. Families will need alternative communication tools during these events. Commercially available Two-Way Radios offer an alternative. The MT351R ($69.99) provided a stronger and better quality reception over a longer distance than the MG163A ($24.99). Obstructions played a significant role in reception quality, particularly concrete/steel overpasses and solid land. Families with a plan in place to get to open spaces, utilizing an established channel and privacy code, will be able to communicate over pre-determined distances, which may save lives and help keep children safe.

Summary Statement
My goal was to inform families about the capabilities of an alternative communication device that can be used for kids to comunicate with their parents during an emergency event.

Help Received
My mother, father, and brother helped by driving to the various locations to test signal strength, and ensure I was safe at all locations.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Xochitl Morales

Project Number
J0915

Project Title
The Gauss Rifle: A Magnetic Linear Accelerator and Kinetic Energy

Abstract

Objectives/Goals
The objective of this experiment is to determine how the number of magnets in a magnetic linear accelerator will affect the kinetic energy of the projectile.

Methods/Materials
In my project, I used a ruler with a cylindrical groove in the middle, ten steel ball bearings, four neodymium magnets, a meter stick, masking tape, Scotch tape, and a calculator.

Results
My results showed no specific pattern in the kinetic energies. First, the kinetic energy nearly tripled. Then, when the rifle with two magnets was compared to the the rifle with three magnets, the kinetic energy was extremely close to doubling. However, when compared to the results with four magnets, the projectile of the rifle with four magnets' kinetic engery only increased by about ⅙.

Conclusions/Discussion
The results of the experiments allowed me to conclude that my hypothesis was, indeed, incorrect. My data suggests that the kinetic energy will add up linearly, but the speed will not. Instead, the speed seems to increase by a smaller amount each time a magnet is added. At one point in the project, I noticed an anomaly associated with the neodymium magnets; some had a stronger electromagnetic pull. This unexpected happening would be a relevant and interesting topic for future research and may be the reason for the unexpected results.

Summary Statement
The objective of this experiment is to determine how the number of magnets in a magnetic linear accelerator will affect the kinetic energy of the projectile.

Help Received
Mrs. Rios helped spot where the projectile landed; Mr. Nail provided neodymium magnets and steel ball bearings; Father helped revise Abstract and Background Research.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Ronak K. Mundkur

Project Number

J0916

Project Title

Surfing on Nano-Magnets

Abstract

Objectives/Goals

Determine if surfing trains on nano-magnetic Ferrofluid would permit higher transportation efficiency, relative to magnetic levitation - Maglev, by either reducing transportation costs by one third, or increasing speeds by three times today#s fastest trains to outperforming air travel.

Methods/Materials

Set up a Maglev track of 609.6 mm length, 40.54 mm width and 19.05mm height, on a leveled glass base board. Levitated a pinewood block on the track representing the Maglev Train, measuring 38.10 mm wide, 127 mm long and 19.05 mm high, with repelling magnetic strips on the under side. Used a plunger to push the train along the track, for 6 loads from 0.18 to 0.92 Kgs. Took 5 readings each for the distance traversed by the train to one one-hundredth mm accuracy, using laser beams and digital calipers. The experiment was repeated with Ferrofluid between the magnetic track and the train. Resultant distances traversed for the two experiments were compared for equivalent loads applied.

Results

The train surfing over Ferrofluid moved between 3.18 to 3.77 times further than the magnetic levitation train, for the same loads applied to move it. As the plunger loads were increased, the distance moved by the train followed Newton's second law of motion - parabollic curve. All readings showed very high level of consistency and repeatability.

Conclusions/Discussion

In the scaled experiments, Ferrofluid based transportation is at least 300% more efficient than Maglev transportation, per the hypothesis. For about 50 readings, graphs consistently validate Newton#s second law of motion. For land transportation, this provides tremendous opportunity for reliable travel at a speed of up to 1503 Kmph or Mach 1.23. Alternatively, it creates opportunity for low transportation cost of 1.46 cents per ton Kilometer, at today#s peak speed of 501 Kmph, down from 4.38 cents/ton Km.

Further research must be done to overcome challenges:

a. Ferrofluid is expensive at 40 cents/cc, with opportunity to reduce costs.

b. Ferrofluid is messy to handle and jumps in strong magnetic fields, requiring containment.

c. Dimensional tolerances for the train and track need to be down to the millimeter, with ability to build accurately over long distances.

d. Ferrofluid tracks will be 100 times costlier that conventional tracks, at $20M per Km, with opportunity to reduce costs.

Summary Statement

Determine if surfing today#s Magnetic Levitation trains on nano-magnetic Ferrofluid would permit 3 times transportation efficiency, by reducing transportation costs by 1/3, or increasing speeds by 3 times, to outperform airplanes.

Help Received

Science teacher, Mrs. Anuradha Murthy guided me to develop research scope, structure and ensure compliance. My father, Kiran Mundkur guided me during project setup and while taking the readings.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Pranav Nagarajan; Aadeesh Shastry; Abheer Singh

Project Number

J0917

Project Title

Vibes: A Novel Way to Alert the Deaf

Abstract

Objectives/Goals

The goal of project Vibes is to make a vibrotactile haptic device that can help the deaf to sense audible alerts, such as a car honk or a fire alarm. Such a device can greatly improve the sensory range and general safety of over 90% of the world's 360 million hearing impaired people who are unable to use hearing aids.

Methods/Materials

Our device uses an Arduino to continuously process sound samples and actuate a vibration motor to alert the user when an audible alert is detected. Experiments were conducted using audio recordings representing ambiances and decibel levels of various day to day environments like a library, a busy street and a mall. Another audio source was used to mimic audible alerts, in a similar manner. Observations were made when the device triggered, either falsely or in response to an actual audio alert.

Results

After multiple iterations, we were able to minimize false alerts and make the device function reliably by dynamically varying the vibration threshold based on the loudest sound samples in the prior few seconds. This was a great improvement on our initial implementation that simply compared the sound samples against a running average of amplitude of all sound samples.

Conclusions/Discussion

Our project successfully demonstrates that devices like Vibes can be made effectively and at an affordable price. Our device depends on a sudden increase in amplitude of sound to differentiate an audible alert from ambient noise. The device is also limited by the frequency response of the mic used. Further work is planned to consider frequency in addition to amplitude for detecting alerts and more closely match the response of a human ear.

Summary Statement

Our project improves the general safety of the hearing-impaired by creating a vibrotactile haptic device to alert them to audible alerts in the environment.

Help Received

Project advisor guided us in programming process.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Andrew B. Nazareth

Project Number

J0918

Project Title

Radiation: How Safe Are You with Your Daily Devices?

Abstract

Objectives/Goals

My project compares electromagnetic radiation levels emitted from our daily devices at multiple measured distances and times, investigates which device exceeds the federal safety limit of.001mW/cm2 to 1mW/cm2 for the various devices, assesses the effect of aluminum foil as an effective radiation absorber,and determines a safe distance to use these devices to avoid the harmful effects of radiation.

Methods/Materials

44 trials were conducted with each trial from 3-7 times and at 4-7 distances to measure the electromagnetic radiation level with a 8 GHz Basic RF Meter, emitted from the cell phone tower, microwave oven, cell phone, smart meter and AT&T U-Verse modem. The readings were then compared to the current FCC/FDA safety limits for each device. For 9 trials, the radiation levels from the cell phone tower, AT&T U-verse modem and microwave oven were measured using aluminum foil to investigate if aluminum could absorb and reduce radiation levels emitted from these devices.

Results

The cell phone tower readings ranged from 3.9 mW/m2 at 25 m to 0.2 mW/m2 at 125 m. The smart meter readings ranged from 3.1 mW/m2 at 1 m to 0.005 mW/m2 at 10 m. The cell phone readings ranged from 5.1 mW/m2 at 5 mm to 0.01 mW/m2 at 15 mm. The microwave oven readings ranged from 1827 mW/m2 at 2 in to 48 mW/m2 at 18 in. The AT&T U-Verse modem readings ranged from 317 mW/m2 at 5 in to 12 mW/m2 at 15 in. With measuring 3 devices with aluminum foil, the microwave oven readings dropped by 90% to 182 mW/m2 (total average)at 2 in. The AT&T U-Verse readings dropped by 44% to 179 mW/m2(total average)at 5 in. The cell phone tower readings dropped by 45% to 2.14 mW/m2 (total average) at 25 m.

Conclusions/Discussion

All the measured devices showed decreases in EMF wave field strength, with increased distance from the devices. All devices (except possibly for the microwave oven at 2 inches) did not exceed the FCC/FDA limit for uncontrolled exposure. The microwave oven and AT&T U-Verse readings were comparatively higher than the cell phone tower,cell phone and smart meter readings. People should be aware that there is a bigger risk of radiation exposure especially to children, when using microwave ovens, AT&T U-Verse modems and other wifi devices than from cell phone towers, smart meters and cell phones. The FCC/FDA should consider a separate safety limit for children. Aluminum foil is an effective absorber of radiation.

Summary Statement

My project compares radiation levels emitted from our daily devices at various times and distances and determines if they are within the FCC/FDA safety limit of .001mW/cm2 to 1mW/cm2 for the various devices.

Help Received

Dr. Youssef Ismail helped me understand the concepts related to EMF emission from wireless devices and guided me through the various stages of the experiment.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Adam Z. Noworolski

Project Number

J0919

Project Title

Stove Alert! A Programmed Safety Device to Aid People with Hearing Loss

Abstract

Objectives/Goals

Currently ¼ of all older people cannot hear over 4 kHz sounds, which is the sound that stove timers commonly make. The main goal of this project is to create a device that plays a lower pitched sound when it hears that higher pitched one.

Methods/Materials

First, I developed python code that created a sound recorder, a sound analyzer, and a sound player. Then, I viewed a sonogram that showed that stove alarms beep at 4.0 kHz. After that, I constructed code to listen and detect 4.0 kHz sounds with a bandpass filter, then I played a lower frequency sound. Later, I created a small device. Then, I tested it in a kitchen while an alarm was playing and/or people conversing. Finally, I created a threshold to balance true positives and false alarms.

Results

I understood what sound kitchen appliances make: 4.0 kHz. Stove Alert! had a 100% sensitivity, specificity and negative predictive value. It also had a 91% positive predictive value.

Conclusions/Discussion

Over a testing period of 36 hours, or five-million one-hundred and eighty-thousand time samples, the Stove Alert! worked well. Since the purpose was to have hearing disabled people always hear their stove alarm, the 100% sensitivity was the most important feature. The project met the objective.

Summary Statement

The Stove Alert! is a programmed device that assists hearing disabled people with hearing stove timers.

Help Received

Mom and Dad reviewed poster slides and helped teach me about sounds and filters and Dad fixed the sound drivers on the BeagleBone Black.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Melba H. Nuzen

Project Number
J0920

Project Title
Can You Hear That Note? A Specialized Hearing Aid for Musicians

Abstract

Objectives/Goals
The goal of this experiment was to find and redesign a standard audio amplifier to fit a homemade band pass filter. The band pass filter was designed to detect the specific frequencies of a violin. Together, the amplifier and filter would be able identify and amplify the frequencies of a violin. The objective was to get the amplifier to amplify at a 85 percent accuracy level, and it was expected to amplify at a 60 percent level.

Methods/Materials
Five different schematics were put together, fitted with the band pass filter, and then tested in this project. The schematics consisted of capacitors, resistors, and other electrical parts. The diagrams were tested on breadboards before soldered. The final amplifier was tested with six different songs, and was awarded points across five scales covering five different areas of sound properties.

Results
Only a buzzing sound came from two of the five schematics, and another two didn#t work. The one that did work was tested, and the results were compared to the results of a standard amplifier.

Conclusions/Discussion
The first three schematics didn#t work properly due to miscalculations and the last schematic detected violin frequencies at a 63.9% accuracy level. The highest ranking scale was loudness, which meant the amplification process was successful, and the lowest ranking scale was crispness. The standard amplifier performed at a 64% accuracy level.

Summary Statement
I built a violinist's hearing aid from a standard audio amplifier fitted a band-pass filter and tested it in 5 areas of analysis for the sounds of the violin.

Help Received
Teacher reviewed report; Dr. Erika Zettner helped with basic understanding of human audiology.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Benjamin E. Ormond

Project Number
J0921

Project Title
Knock Knock, Who's There?

Abstract

Objectives/Goals
Objective: To replicate, then modify an engineering project found online using the Arduino microcontroller.

Methods/Materials
Materials: Arduino Microcontroller, 9v battery, 3 LEDs, Rectifier Diode, Transistor, Wire, Pushbutton, Casing, piezo sensor, a motor, a buzzer, and any tools necessary.

Methods:
1. Program the Arduino
2. Set up the circuit
3. Test the circuit
4. Continual Modifications due to numerous challenges
5. Hardware Setup
6. Continual Modifications due to numerous challenges

Results
The end result was a device completely different from the original design, resulting in an unmotorized project providing increased security, aural and visual alarms, and a cleaner look.

Conclusions/Discussion
This was a far more challenging project than I ever expected, and I had to address a variety of challenges. But I am very pleased with the end result and that the modifications were successful and produced a unique and helpful device.

Summary Statement
The transformation of an Arduino circuit and language from an original design to a new one.

Help Received
Father helped in using drill.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Jack F. Pecoraro

Project Number
J0922

Project Title
Factors Affecting Electromagnet Strength

Abstract

Objectives/Goals
My objective was to understand key factors affecting electromagnet strength. Specifically, how the number of wire windings and voltage applied to those windings, affects how much weight can be lifted.

Methods/Materials
Four electromagnets were built over identical iron cores (4# long bolts) with wire winding counts of 50, 100, 150, and 200 turns. The strength of each electromagnet was measured by the weight of steel BBs and iron block which could be lifted as different voltages (1.5, 3.0, and 6.0 Volts) were applied to the windings of each electromagnet. Averages were determined based on 5 trials for each combination of windings, voltage, and material lifted.

Results
Electromagnet strength was shown to increase in proportion with both the number of windings and voltage applied. The amount of weight that could be lifted was also strongly affected by the material being lifted. The magnets were able to lift 10 times as much iron block as steel BBs.

Conclusions/Discussion
The results supported my hypotheses and research suggesting that there should be a proportional relationship between the independent variables (windings and voltage) and electromagnet strength. Other important variables identified are the type and form of the material being lifted and the geometry of the windings on the electromagnet.

Summary Statement
My project is about understanding the factors which affect the strength of electromagnets.

Help Received
Dad helped with methods and data analysis. Mom helped with project board, Uncle helped with data analysis.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Cade Pretorius

Project Number

J0923

Project Title

Developing Superpowers by Controlling a Robotic Arm Using EEG Signals

Abstract

Objectives/Goals

With the ever increasing influence of technology on our lives and the use of devices to augment our everyday actions, the integration of man and machine has already begun. On the medical front, this means amputees can regain control of their lost limbs with the use of robotic prostheses. In our everyday lives, this could extend to controlling even ordinary devices with our minds. My project has three major implementation phases over a six year period, starting with controlling a simple robotic arm, by utilizing concentration levels and eye movements of the user. The second phase will include smoother movements and better Electroencephalogram (EEG) data. By the third phase, I intend to expand this to other objects and programs that will be able to be integrated into our daily lives.

Methods/Materials

Following an online blog post, I opened the Mindflex# headset and soldered in two wires to the NeuroSky EEG chip, which I then connected to my Arduino Uno. I did research into controlling multiple servos with an Arduino and found out that the only ways of doing it involved a motor shield or a breadboard and an external power source. I opted to use the Adafruit v2 Motor Shield, which allowed easier use than other options. The servos can be easily plugged into headers on the motor shield and controlled.

Results

After many changes to my code and hardware, everything worked individually and could be tested as one whole unit. I tested if the motors moved if my attention levels were high enough and if the program iterated between the different motors when I blinked. I calibrated the headset and brought my attention levels up. The first motor started moving. I then blinked and a few readings later, the next motor started moving and the previous motor stopped. I repeated this over and over consistently, proving that everything worked accordingly.

Conclusions/Discussion

My project uses EEG data and controls four motors on a robotic arm by monitoring a complex combination of signals reported by the NeuroSky EEG chip as Attention, which reflects the level of concentration. The attention level powers the servos and, using theta waves, blink detection is possible and is used to switch between brainwaves. This has been done using materials that cost under $160 and around 6 months of research and development. In preliminary testing the system has been proven to work with other individuals besides myself in various circumstances.

Summary Statement

I have created a brain#-machine interface that uses EEG signals to control the movements of a robotic arm.

Help Received

My dad helped me to understand some of the coding concepts and my mom helped with the display board and write-#up. Mrs Alexander and Mr Mays from Santa Rosa Academy helped me with the project preparation.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Jagannathan Rangarajan

Project Number
J0924

Project Title
The Untold Truth! The Effects of Cell Phone Radiations (Comparision)

Abstract

Objectives/Goals
Does your cell phone emit radition, which brand emits the most radiation, compare radiation strength during incoming and outgoing calls and at what distance will generate the most radition waves.

The objective is to create awareness about this biggest non-drug addiction in the 21st century.

Methods/Materials
Materials: A jig to hold the cell phone, few cell phones and a EMF detection meter.

Methods: Mount the cell phone on a jig and dial to that cell phone and measure the radition. Move the cell phone at different distances and measure the radiation. Do this for few other cell phones, and chart the results.

Results
The radiations levels are generally the same on all aspect of the experiment, classified as : the more the distance from the phone, the less radiation. Samsung Galaxy S4 when held zero inches away from cell sensor during the incoming call produced the most radition waves (Comparision based on LG, Blackberry and Samsung Andriod phones).

Conclusions/Discussion
The inferrence is that the farther one holds their phone from their head, the less radition the human brain is exposed to. Other ways to discount radition exposure is the use of bluetooth or speaker phone.

Children are at greater risk than adults for developing brain cancer from cell phone as their nervous systems are developing and more vulnerable to factors causing cancer. Their heads are smaller compared to adults and have a greater proportional exposure to the field of radio frequency radiation emitted by cell phones.

Summary Statement
The Comparision and Effects of Cell Phone Radiation

Help Received
Dad reviewed my grammer, and ordered me a cell phone detector meter.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Jahan Razavi

Project Number
J0925

Project Title
The NavHat: A Mobility Aid for the Blind

Abstract

Objectives/Goals
The objective of this project was to build a mobility aid for the blind, called NavHat. It uses three ultrasonic radar modules connected to two earphones for the sides and to a cellphone buzzer for the front. As the person wearing the hat gets closer to an object, the earphones and the buzzer ping faster.

Methods/Materials
I used three radar modules that were powered by 9-volt batteries and switches. They were placed on a cardboard rim and were secured by screws and nuts. The switches and the batteries were taped to the rim.

Results
I tested NavHat on three people with different heights. I found the minimum and maximum distance from a wall, a window, and a picture frame before the pinging started and after it stopped. The data for the front had two outliers, while the other data were very closely spaced. The left-side data had a range of about 20 inches for the maximum distance. The right-hand data had the least variation, about 10 inches.

Conclusions/Discussion
My hypothesis was correct, and I did not run into any objects during testing. This can help the blind because it prevents them from running into objects to the sides and in front of them, thus reducing the number of injuries. The wearer would still need a white cane to walk around to detect objects on the ground.

Summary Statement
My project was to build a mobility aid for the blind consisting of three ultrasonic radar modules and test it on different people and with different obstacles.

Help Received
My father introduced the ultrasonic module to me. He also taught me how to solder. The idea of using three radars and placing them on a rim was mine.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Sarah R. Sumner

Project Number
J0927

Project Title
Amounts of Electromagnetic Pollution (Transients and Harmonics) Emitted by Light Bulbs

Abstract

Objectives/Goals
My goal was to determine which light bulb emitted the the most dirty electricity, so I could possibly help people who might suffer from the effects of it.

Methods/Materials
Procedure

1. Get the Stetzerizer EMF meter and plug it into the outlet
2. Measure the amount of electromagnetic pollution or transients and harmonics emitted without the lamp plugged in
3. Put the Candescent-Fluorescent light bulb in the lamp
4. Turn on the lamp with the first light bulb
5. Measure it with the Stetzer EMF meter to determine how much electromagnetic pollution is emitted from this light bulb
6. Record the information in my data book
7. Repeat 10 times for each light bulb

Results
The following are averages of each light bulb tested with the EMF meter.
LED 60 watt - 138 GS units
LED 100 watt - 323 GS units
Halogen 60 watt - 66.1 GS units
Halogen 100 watt - 66.4 GS units
CFL 60 watt - 407.3 GS units
CFL 100 watt - 233.9 GS units

Conclusions/Discussion
Conclusion

After completing my investigation on amounts of dirty electricity emitted from light bulbs, I found my hypothesis was correct. My hypothesis stated that Candescent-Fluorescent light bulbs would emit the most electromagnetic pollution. The light bulb that emitted the least amount of dirty electricity was the Halogen 60watt & 100watt. Candescent-Fluorescent 60watt & 100watt emitted the most dirty electricity.

Summary Statement
Some types of light bulbs can produce harmful amounts of electromagnetic pollution (transients and harmonics).

Help Received
My mother helped with the board set up and purchased the Stetzerizer Microsurge EMF meter.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Utkarsh Tandon

Project Number
J0928

Project Title
A Wearable Device for Spinal-Lumbus Modeling to Recognize and Correct Posture through Real-Time Flex Sensing Analysis

Abstract

Objectives/Goals
The purpose of this project is to build a belt that could be used by anyone who wants to correct their posture. Since reminders from parents are not always available, the belt should be able to recognize a user#s posture and in real time display if they need to correct it and provide useful statistics. The algorithm should be able to convert flex sensor angle measurements into degrees and collaborate with the JavaScript to depict a user#s posture on a webpage. The engineering of this belt should give users the freedom of adjusting their posture independently.

Methods/Materials
The major equipment used by all designs are shown below:
Raspberry Pi, Flex Sensor, Battery Pack, USB connector, Breadboard, Pi Cobbler, Ribbon Cable, 1uF capacitor, 3D printed compartments, Wi-Fi router, Band/Strap.
Three sets of procedures were created to test out my belt at different design intervals. One procedure was conducted to find the values in an array to later find a trend to improve the degree#s accuracy. After this, I tested for the degree#s accuracy by using a protractor. And lastly a stopwatch was used to measure the amount of delay it took to display the user#s posture on a webpage.

Results
The analysis of my data started with plotting the first procedures data on a line graph. I noticed a trend and was able to improve my algorithm to return accurate degree readings. This was then tested by the second procedure that showed the algorithm to be very accurate at forward bends(0-30 degrees) and a little less accurate at backward bends(-10 degrees) but this didn#t affect the reading of posture. The last analysis of the speed delay pulled out an outlier, which was at the beginning of the testing showing that at startup the webpage is slightly slower. The average speed delay was 1.812 seconds.

Conclusions/Discussion
All engineering goals were satisfied at the end of enhancements but more could be added to the project such as Bluetooth connectivity, vibration alarms, and auto-calibration. However, this belt successfully accomplished my goal of giving users the freedom of correcting their own posture.

Summary Statement
My project aimed to create a wearable belt using flex sensing capabilities for anyone who wants to correct their posture via a stick figure animation and statistical analysis.

Help Received
Dad helped me understand RC circuits; Brother helped connecting the backend and frontend; Mr. Dave from makexyz.com provided assistance during 3D printing.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Benjamin C. Tarr

Project Number

J0929

Project Title

The Effect of Different Sized and Shaped Coils on the Speed of a Motor

Abstract

Objectives/Goals

The ultimate purpose of this project is to find out how to make the fastest D.C motor.

Methods/Materials

Materials: Windows 7 Computer Arduino uno (1) USB wire (1) Arduino programming software (1) Strip of copper wire insulated (12 ft.) Photo Resistor (1) Jumper wires (200) 9 Volt Battery (1) Copper strips with holes (2) Screws (2) Screw driver able to fit screws (1) Magnet (1) Methods: Place the magnet in the center of the block. Orient the magnet on block so that the width is smaller then the height, the height is the shorter axis of the block. (Im cutting off here to minimize character length. I can send you the whole document if you like)

Results

As shown in the table, the 50% circle coil enabled the motor to run fastest. All of the triangles disabled the motor to even run. The smaller 20% coils were too small to continue running at a steady pace for a long period of time. Sparks flew off the motor the coil came to a halt. The large coils were to big for the magnet and ended up stopping under one minute. With the large coils coming to a halt, the energy was able to run through the coil just like a regular wire and short the circuit.

Conclusions/Discussion

My question: What configuration of coil size and shape will make an electromagnetic motor run fastest? My hypothesis: If I format the coil to have the configuration of an 80% maximum width (maximum width is the absolute largest size a coil could possibly be with the ability to fit in the provided space) square, the motor will run faster than if another configuration was used. Using an arduino, I measured the rotations per minute the motor could generate. I used a photo resistor and a flashlight to calculate when the photo resistor could see light or dark wth the coil blocking the light. After I looked at the data, I found my hypothesis was incorrect. This was because the 50% circle had the fastest average (876 rpm) out of all other coils, and my hypothesis was that the 20% square would have the fastest average (625 rpm). I think the 50% circle was the fastest coil because of two reasons. Cutting off here.

Summary Statement

My project is the testing of different sized and shaped coils and seeing how that effects the overall speed of the motor.

Help Received

My mom helped me bend the coils.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Nicole M. Valdivia

Project Number
J0930

Project Title
The Effect of Neodymium Magnets on Induction Loop Traffic Detectors

Abstract

Objectives/Goals
My goal in this project was to test whether neodymium magnets will assist scooters to trip difficult inductive loop traffic detectors.

Methods/Materials
Materials:
Neodymium magnets (4)
Car
Scooter
Accessible inductive loop traffic light
Cell phone
Procedure:
1)Stick neodymium magnets to square piece of Velcro. Attach the adjacent piece to the bottom of the scooter, or strap on foot, making sure they will be parallel to the ground.
2)Download "Physics Toolbox Magnetometer" to cell phone.
3)Go to location of traffic light.
4)Open application and press record.
5)Place cell phone in center of lane, making sure no other vehicles are in that lane, and that the light is red.
6)Drive scooter over edge of the loop on either side of the cell phone.
7)If magnets are on foot, place foot carefully on the edge of the loop.
8)Once the light has turned green and the scooter has gone, pick up cell phone and press stop.
9)The magnetometer will show the change in the magnetic field due to the neodymium magnets.
10)Conduct experiment without neodymium magnets, then with car.
11)Compare the difference in the change in the magnetic field over time with the different variables.

Results
My results showed that the average change in the magnetic field over time for the scooter with the neodymium magnets and the car were very similar. This shows that the neodymium magnets do help to change the electromagnetic current much more than the scooter without the neodymium magnets.

Conclusions/Discussion
I conclude that neodymium magnets are strong enough to assist scooters to trip inductive loop traffic light detectors.

Summary Statement
Are neodymium magnets powerful enough to trip induction loop traffic detectors while on or near a scooter?

Help Received
Mother drove scooter, helped make model and charts. Viewed computer box with help and under supervision of Dr. Duncan Hughes.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Jeffrey W. Xing

Project Number
J0931

Project Title
A Study of Levitation Distance and Stability Range in Diamagnetic Levitation

Abstract

Objectives/Goals
This project studies how ferromagnetic and diamagnetic forces affect magnetic levitation distance and its stability, respectively in diamagnetic levitation.

Methods/Materials
Materials used include neodymium magnets N42/52 with different strength, weight and geometry as lifter and levitator; pyrolytic graphite plates with different strength providing levitation stability. A novel apparatus is built to carry out experiments in which vertical position of magnet and pyrolytic graphite plates can be continuously adjusted. Ruler stickers with both metric and English units for precise measurements are attached.
Levitation distance and stability range are measured when altering controlled variables like lifter and levitator magnet pull force, levitated magnet weight, pyrolytic graphite strength and environmental temperature. Each data point is the average of 5 repeated measurements to further improve the accuracy.

Results
Levitation distance increases with stronger lifter magnet or less weighted levitator. Stronger pyrolytic graphite plate, but not more plate counts, increases stability range of the levitation. Magnet pole facing has no impact on levitation distance and stability range. Higher temperature weakens ferromagnet strength, therefore decreases levitation distance, while no impact to stability range.

Conclusions/Discussion
Magnet can be stably levitated with assistance of diamagnetism. Magnet is levitated when magnetic force and gravity force are balanced. Hypotheses stating that longer levitation distance can be achieved by either stronger lifter magnet or less weight of levitator magnet are supported by data. On the other hand, stronger diamagnetic material creates a larger stability range due to its increased repelling force. However, the statement of more stacked diamagnetic plates creating a larger stability range is not supported by data. This is because diamagnetism (repelling effect) only happens on the surface of the diamagnetic material based on further study. Heat impact magnetic strength, therefore levitation distance, but not diamagnetic strength, so no stability range change observed. The project can be expanded using electromagnet and electronic system.

Summary Statement
This project studies how ferromagnetic and diamagnetic forces affect magnetic levitation distance and its stability, respectively in diamagnetic levitation.

Help Received
Father helped ordering magnets. Dr. Li gave useful advice.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Daniel S. Yacoubian

Project Number
J0932

Project Title
Using a Car's Tailpipe to Create Electricity

Abstract

Objectives/Goals
The objective of this project is to determine whether electricity can be captured from an automobile tailpipe using a uniquely designed apparatus based on the principle of thermocouples.

Methods/Materials
A thermocouple device (a thermopile) utilizing copper and steel wires run in series was designed and assembled around an automobile tailpipe model. The device contained a cold junction and a warm junction, between which a large temperature gradient was created using flames at one end and ice at the other. According to the Seebeck effect, this temperature gradient along metal wires would produce electricity. A voltmeter was used to detect electric production along the temperature gradient and an infrared thermometer was used to measure temperature differences.

Results
The results of the testing clearly demonstrate that the apparatus is successful in producing a voltage as the temperature difference between the warm junction and the cold junction increases. Conversely, as the temperature difference decreases, the voltage production also diminishes.

Conclusions/Discussion
The results supported the hypothesis of successful electric production from a simple apparatus that can be applied to an automobile tailpipe. The ultimate objective of this study is to enable energy conservation and improved electric efficiency of an automobile from energy that would otherwise go wasted. This energy can be put toward function of the vehicle, recharging the battery, or for powering personal electronic devices.

Summary Statement
This project introduces a unique apparatus that creates electricity from the heat of a car's tailpipe based on the principles of thermocouples and the Seebeck effect.

Help Received
Mother helped acquire supplies. Father helped to secure the display board.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Madeline A. Yu

Project Number

J0933

Project Title

iPhone Microwave Emissions on 3G/4G: Is Faster Better?

Abstract

Objectives/Goals

I noticed that at the top of my mobile phone display, was an icon that indicated a connection to 1x or 3G networks. I also noticed my brother's iPhone5, switched between LTE, 3G, and 1x. I wondered whether the microwave emissions might vary significantly on different network technologies. My hypothesis was that 4G/LTE would produce the lowest microwave emissions, followed by 4G/HSPA+, then 3G technologies (UMTS and CDMA2000). I believed streaming video would measure the highest iPhone microwave emissions when compared to sending a picture, making an outbound call, or when the phone is idle. Finally, I expected the lowest microwave emissions would occur when the iPhone was idle.

Methods/Materials

I designed a project to focus on performing common mobile functions across different iPhone models. I performed 425 trials and documented over 10,000 data points. I used a microwave leakage detector which measured microwave emissions at frequencies of 2450 MHz and lower.

Results

According to my data, I discovered the 4G/LTE network technology measured the highest microwave emissions when compared to 4G/HSPA+ and 3G. Sending a picture measured higher microwave emissions when compared to streaming video. The iPhone in idle state measured the lowest microwave emissions across all network technologies.

Conclusions/Discussion

The FCC tests compliance of mobile phones to RF safety limits based on the specific absorption rate (SAR) of 1.6 Watts/kg. For other 'mobile' devices the FCC guidelines state the maximum permissible exposure (MPE) for RF emissions during uncontrolled exposure in the frequency range of 1,500-100,000 MHz is 5.0 mW/cm^2 over 6 minutes. My experiment recorded significant measurements higher than 5.0 mW/cm^2, but not for six minutes continuously. According to my results, when sending and receiving data, faster may not be better. The faster network technology resulted in a higher number of microwave emission spikes across all tested iPhones. I believe customers should minimize exposure to microwave emissions while using an iPhone on LTE by carrying the mobile phone at least 5 cm away from the body. This is important even when the mobile phone is not in use, because the background synchronization processes could cause microwave emission spikes. I plan to tell friends, family, and everyone who lent me their iPhone about the results I discovered.

Summary Statement

My project focused on studying the differences in microwave emissions while performing common mobile functions across different iPhone models, when connected to 3G/4G network technologies.

Help Received

Friends and family who let me borrow their iPhones; Mr. Martin Cooper for helping me think through research topics in search of a meaningful project; Mom for helping collect/return test iPhones; Dad for helping me with excel formulas; Ms. Hunker, my science teacher and project advisor.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Shaya Zarkesh

Project Number
J0934

Project Title
A Novel Approach to Generating Electricity through Walking Shoes

Abstract

Objectives/Goals
Portable and wearable devices are becoming more and more of a part of human lifestyle. Unfortunately, these devices are limited by their battery life. As non-renewable energy sources begin to diminish and as we go further into the digital age, finding new sources of energy will only become more significant. A shoe that could transform downward pressure exerted while walking into electricity would be groundbreaking if it was comfortable and efficient enough to charge mobile devices.

Methods/Materials
After some research, two forms of electricity generation, piezoelectric and a generator, proved to be the most feasible to accomplish this feat. Although piezoelectric would be easier to implement since it takes up less space, I chose to use a physical generator because of its much higher efficiency. Existing solutions that used piezoelectric only generated 1-2 mW, which is thousands of times too small to charge a smartphone with a battery of 6 Watt-hrs. After testing a hydrogenerator and realizing how insignificant its electricity output was, I tried using a mechanical generator. By removing the large parts of a salad spinner, I was able to attach its core to the shoe box, and its lower section would spin when the button was pressed downward. Two bevel gears then changed the axis of rotation from vertical to horizontal for the generator shaft to spin.

Results
At first, I used a gear ratio of 1:1, but when I tested the generator's output with a multimeter, the power generated only averaged 280 milli-Watts. Though far better than piezoelectric solutions, it still proved somewhat impractical for charging phone batteries. To improve my design, I increased the gear ratio to 37:13, which increased the average output to 740 mW. When coupled with a transformer and regulator, this shoe could theoretically charge the iPhone 5s in 8 hours.

Conclusions/Discussion
My implementation of electricity generation in a shoe generates over twice as much electricity as current solutions have shown. However, the shoe is currently too large and uncomfortable appeal to consumers, and lowering the sole height would be crucial. Before the competition, I aim to reduce the height of the sole, insert padding for comfort, and implement a means of transferring the harvested electricity into a smartphone. If time permits, I would also like to increase the electricity output further by implementing a gear train inside the shoe.

Summary Statement
My project aims to design and produce a shoe that would generate electricity, allowing its user to charge a mobile device.

Help Received
Grandfather helped with sawing and gluing parts of shoe together, Mrs. Morgensen helped with abstract and general guidance; Father helped with buying materials and general knowledge about circuits.