CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Yusra Arub

Project Number
J0901

Project Title
Internet of Things Meet My Data Binder

Abstract

Objectives/Goals
The Internet as we know 5 years ago was made of mostly computers. Today it is more than computers - cars, dishwashers, clothing, keychains - the Internet of Things has arrived.
The purpose of my science fair project is to explore the affects of Internet of Things (IoT) on my own daily learning style. I would like to take an example of my daily homework binder to make it part of the Internet of Things and make it #Smart# and interactive.

Methods/Materials
Raspberry Pi # ; 150 MBPs 802.11N/G/B Mini USB Wireless; 1 x 3x4 Phone-style Matrix ; Keypad; 4 x Round Force-Sensitive Resistor (FSR) (Interlink 402); 1 x Standard LCD 20x4.
Details: Includes the New Raspberry Pi Model B+ (B Plus) 512 MB - Made in UK (Sony Factory), WiFi Adapter; 8 GB Samsung MicroSD Card - Raspberry Pi Foundation Recommended MicroSD Card pre-loaded with NOOBS, Raspberry Pi B+ Case with GPIO Access; 2.5A USB Power Supply with 5-foot Micro USB Cable specially designed for the Raspberry Pi B+ delivering full 2.5A @ 5V; Premium Quality 6-foot HDMI Cable, GPIO to Breadboard Interface Board, Breadboard, Jumper Cables, Ribbon Cable, GPIO Quick Reference Card; RGB LED, 8 x LEDs (Blue/Red/Yellow/Green), 15 x Resistors, 2 x Push Button Switches, CanaKit General Guide for Beginners to Electronic Components.

Results
At school -> Click touch sensors to remind what#s due.
Go home -> binder LED denotes work to be done.
Need help with assignment:: LCD Display -> Receive latest tweet from friend on the subject.
Enter my personal code to secure binder.
Away from binder -> Check the status via remote site.
Receive Tweets from Counselor about upcoming deadline on LCD Display!
Record temperature for specific time interval for ongoing research
Check temperature of draught-resistant plant research project at UCR on LCD Display
Voice Activated -> change subject status via sound sensor.

Conclusions/Discussion
SmartBinder is simple to use. You simply touch the sensors that are seamlessly built into the subject tabs to toggle the state of the subject. The LEDs attached to each subject tab will turn red to denote subject as due. In a Wifi-enabled locations the current state is pulled from the remote sites. The subject status can be updated from the website and the SmartBinder we pull the information and keep its current state

Summary Statement
It is about making dumb things (school binders for ex) smart and interactive using the power of internet of things.

Help Received
Dad's friend Ajay helped wire board.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Akhilesh V. Balasingam

Project Number

J0902

Project Title

A Low-cost, Easy-to-Install, Internet-Enabled Shower Usage Monitor as a Nudge Engine for Residential Water Conservation

Abstract

Objectives/Goals

Water conservation is a pressing national and global concern, and due to the ongoing drought in our state Californians are under increased pressure to conserve water.

In my project I am specifically targeting the reduction of water used for showering, because the EPA estimates that each year 1.2 trillion gallons of water is used for showering. Since shower durations vary a considerable amount even amongst individuals living in the same household, it is an attractive target for conservation efforts. Many people are installing shower timers, automatic shutoff valves and gray water systems to cope with the scarcity and increasing cost of water. However, these products require costly plumbing, and cause inconvenience which leads to disuse after an initial period of experimentation.
I have invented a low-cost, easy-to-use internet-enabled device that takes a completely novel approach to solving this problem. Instead of the forceful measures taken by devices such as shutoff valves, my device introduces a gentler approach that consists in nudging people into reducing their shower durations.

My engineering goal is to construct a device that will keep track of a person's daily shower durations over long stretches of time, and make that information available in a graphical format on smartphones. Much like a pedometer that helps people burn off calories, my device will help people reduce their shower durations by providing quantitative insights into their conservation efforts.

Methods/Materials

I constructed two different implementations of my design: (1) fully-automatic system that determines shower durations using an electret microphone, and a humidity sensor, and (2) push button based system that relies on user input. I implemented the internet, sensor data handling and other computing functionality on a Raspberry Pi using Python and Google Charts. I used pull-down circuits and an analog-to-digital converter chip to interface the R-Pi to the physical world.

Results

I tested my system near a shower over several weeks, and verified that shower durations are logged correctly and displayed on-demand, in calendar graphs on iPhones and other smart devices.

Conclusions/Discussion

I invented, built and tested an internet-enabled shower usage monitor that nudges rather than forces people into reducing water consumption.

Summary Statement

By combining inexpensive hardware components (e.g., R-Pi) and free open software tools and packages (e.g., Python, Google Charts) I have created a finished product that has the potential to reduce the amount of water used for showering.

Help Received

I would like to thank my brother for teaching me Python programming, and my teacher Mrs. Mackewicz for her helpful advice. I would also like to thank my parents for purchasing the necessary materials and for encouraging my work on this project.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Zak H. Bamford

Project Number
J0903

Project Title
Constructing an Arduino Gas Sensor to Detect Odors

Abstract

Objectives/Goals
For my project, I built a gas sensor and coded a program to make it output readings. I chose this project because in my neighborhood, there is a nearby water treatment plant which often produces odors. I hypothesized that I could build the gas sensor, and I hoped its readings would be accurate enough to detect hydrogen sulfide or ammonia emissions.

Methods/Materials
I put together materials for the gas sensor I built, including an Arduino, a gas sensor, the Arduino IDE, and a Java IDE. I placed my gas sensor indoors, outdoors, and at three water treatment plants. During the evening, I placed the gas sensor in one of the locations, and picked it up the next morning. When I picked the sensor up, I transmitted the data onto a computer.

Results
In all of the places that I placed the sensor, there were no odors. Therefore, the readings were similar. However, at each place, the readings decreased at a different rate. I realized that the sensor needs to warm up, and therefore outputs inaccurate readings until it warms up. All of the outdoor locations had readings decrease to 0, and the readings never reached 0 indoors. I also placed the sensor over different concentrations of ammonia-containing window cleaner, since the sensor also detects ammonia. As expected, the readings of the gas sensor were the highest when the sensor was placed over the full concentration of window cleaner, and lowest when the sensor was placed over a 0.25 concentration of window cleaner (the lowest concentration). When the sensor was placed over a 0.25 concentration of window cleaner, the readings were significantly lower than the readings that occurred when the sensor was placed over the full concentration of window cleaner.

Conclusions/Discussion
In my project, I discovered that it is possible to build a low-cost gas sensor. I found that indoor air had higher levels of odors than outdoors, and that the sensor initially outputs inaccurate readings. To improve the testing, the sensor could be taken to a water treatment plant that produces a more significant odor, and the findings could be used to build a low-cost sensor for dangerous gases in homes.

Summary Statement
In my project, I built a gas sensor with an Arduino and coded a program in order to make it output readings.

Help Received
Father helped gather supplies, helped with soldering, and helped with coding; Mother helped with display board; Science teacher helped with report and display board

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Vikram Bhagavatula

Project Number

J0904

Project Title

Dynamic Dataflow Processor (DDP)

Abstract

Objectives/Goals

To see if a scalable Dynamic Dataflow Processor architecture is faster compared to a conventional serial processor and a conventional parallel processor.

Methods/Materials

The materials used for this project was a hardware simulation\synthesis tool called ISE Webpack (a free tool provided by Xilinx). I used Verilog (a hardware description language) for modeling the RTL model of the micro-architecture and simulating my hardware architecture. For designing my architecture, I first created basic diagrams, block diagrams, timing diagrams, and pseudo-code. I then refined my architecture (and micro-architecture) based on all these models, and implemented this into Verilog. After that, I used the simulation tool to simulate my design and analyze, debug, and improve my architecture and micro-architecture. Then, for comparative analysis, I created a behavioral model for a conventional parallel processor and a conventional serial processor in Verilog. I then ran the simulations of all of them under several situations and compared their waveforms. I also changed the number of processors used in the testing to see its scalability (i.e. comparing how a certain number of conventional parallel processors, conventional serial processors, and DDP(s) performed on a larger task, etc.)

Results

The results were estimated that, on average, a single DDP was 4 times faster than a conventional serial processor and 2 times faster than a conventional parallel processor. An array of 4x4 DDP processors were estimated to be 16 times faster than a serial processor and approximately 2 times faster than conventional parallel processor.

Conclusions/Discussion

My conclusion for this project is that a scalable dynamic dataflow processor architecture is faster compared to a conventional parallel processor and a conventional serial processor.The DDP architecture has latency issues with the join or combining of results from other DDP processors in a network and may not be suitable for designs that need low latency or delay. Overall DDP is flexible and scalable to be implemented on chip level or board level with multiple DDP chips on a board.

I also realized, in this project, a systematic top-down methodology was extremely efficient and that behavioral modeling was a very powerful technique useful for this [top-down] approach.

Summary Statement

A parallel dynamic dataflow processor architecture (that is scalable) was developed to study whether this architecture would be faster compared to a conventional serial and a conventional parallel processor architecture.

Help Received

My father primarily guided me in understanding concepts in behavioral modeling , verilog coding, and free tools that could be used to work on this project. I extensively researched online reading articles on VLSI , parallel computing, Verilog RTL coding techniques,and example codes.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Rishabh Rik Bose

Project Number
J0905

Project Title
Outlets Are Out: Light It Up without Wires

Abstract

Objectives/Goals
The purpose of my project was to show if energy can be transferred without using wires. My project used an air-core transformer that stepped up low DC voltage to a very high voltage and frequency. During this process, it created an electromagnetic field around the primary and secondary coil. The device closely followed the theory of the Tesla Coil and used the principles of electromagnetism, electromagnetic induction, and resonance.

Methods/Materials
A variation of a Tesla Coil was created using various electronic components. Multiple variables were used to identify the strength of the electromagnetic field that was being emitted by the secondary coil. The variables I used were the number of loops on the primary coil, the input voltage, the load (number of florescent light bulbs which lighted up without wires), and distance from secondary coil. The test was run 30 times with each variable.

Results
Input voltage of 3 volts and up lit up a light bulb with 8 or 12 primary coil loops. At 18 volts and with 8 and 12 primary coil loops, the electromagnetic field lit up two bulbs. Also, the farther the bulb is held from the secondary coil, the intensity of the light reduced. The best result was with 12 loops and 18 volts. The tests taken with 4 coil loops or 1.5 volts did not provide any result.

Conclusions/Discussion
Based on my experiments, my hypothesis was proved correct. In my experimental circuit, simple low voltage DC is fed into a transistor which switches on and off the power to the primary coil. The resulting electromagnetic field rapidly charges and collapses around the secondary coil, which induces the electromagnetic field in the secondary coil. The primary and secondary coils were also made to resonate at the same frequency.

The rapidly changing magnetic field emitted by the secondary coil energized electrons in the fluorescent bulbs wirelessly and emitted visible light. The magnetic field strength is inversely proportional to the distance from the secondary coil as tested with an EMF meter. The increase in load also reduces the intensity of the florescent bulbs.

Summary Statement
The objective of my experiment, with the device I constructed, was to verify if energy can be transferred wirelessly and can be used to illuminate fluorescent bulbs.

Help Received
My father helped me with the secondary coil winding. My mother helped me with the printouts and display of the science board.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Kellie R. Cao

Project Number
J0906

Project Title
Resonance Wireless Energy Transfer for Biomedical Application

Abstract

Objectives/Goals
The objective is to investigate the effect of the separation distance between the transmitting and receiving coils on the efficiency of resonance wireless energy transfer. My hypothesis is that the efficiency of the wireless energy transfer will decrease as the coils separation distance increases.

Methods/Materials
The first step of the project was to design the circuit. After consulting my mentor and the internet search, my final circuit design settled on a Colpitts oscillator circuit for the transmitter and a parallel LC tank circuit for the receiver. The coils were hand-wound identically and the inductance was measured using an HP 4395A impedance analyzer. The inductor and capacitor on the receiver LC circuit were chosen to be the same as those on the LC circuit on the oscillator, to ensure the wireless energy transfer took place at the same resonance frequency. The transmitter and receiver circuits were built onto two separate prototype breadboards, according to the circuit diagram. The transmitting and receiving coils were connected to the two different voltage probes of a PC oscilloscope USB module. The USB module was connected to the PC to display the voltage waveforms. The circuit was switched on and the voltage measurements were performed by placing the transmitting and receiving coils at specified separation distances from 1 cm to 5 cm. There were a total of 10 trials preformed in the experiment at five different distances with two repetitions at each separation distance.

Results
As the separation distance increased, the transmitter coil#s voltage increased while the receiver coil#s voltage decreased. A voltage transmission ratio was computed by dividing the receiving coil#s voltage by the transmitting coil#s voltage at each distance and averaged from the two repetitions. The voltage transmission ratio was high at small separation distance of 1-2 cm, but decreased steadily as the separation distance increased.

Conclusions/Discussion
The results confirmed my hypothesis, i.e. the wireless energy transfer efficiency measured by voltage transmission ratio decreased with increasing separation distance between coils. It was further observed that energy transfer efficiency was relatively high at a distance between 1-2 cm. Since the human heart resides only a couple of centimeters beneath the skin, this technology shows great promise to directly power devices implanted inside the heart wirelessly.

Summary Statement
My project investigated the effect of the separation distance between the transmitting and receiving coils of a resonance wireless energy transfer system on its efficiency in order to optimize efficiency for biomedical applications.

Help Received
I used lab equipment at the University of California, Irvine under the supervision of Professor William Tang. He also provided different papers to read, explained the concept of wireless energy transfer, and helped with circuit design selection. My parents drove me to the lab and purchased the supplies.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Matthew Cho

Project Number

J0907

Project Title

Braille Pad: An Electric Braille Display Using Solenoids

Abstract

Objectives/Goals

My project goal was to make a braille pad that would be able to display braille characters for the blind using solenoids. This is beneficial to the blind because as of right now braille books are heavy, expensive, and infrequent. This device will allow the blind to read without carrying around heavy braille books with them. I was inspired when I was browsing my local library and came upon a shelf labeled braille books and it surprised me how thick an edition of Charlottes Web was.

Methods/Materials

I made my solenoids by wrapping magnet wire around a straw and I designed braille cells with solenoids to work out the flaws such as interaction when more than one solenoid was grouped together. I modified the core by making it into a iron nail with a flat tip so that I could attach a plastic bar. As for the circuit, a matrix circuit was implemented to drive the solenoids more efficiently. The circuit was prototyped on a bread board then transferred onto a solder board so that it would more sturdy. A 12 volt battery was added to power the system. All of the components were put in a plastic case along with a fan to cool the solenoids and a few buttons to control the pages.

Results

I was successful in making the braille pad and it is able to display all the characters in the number system and alphabet. The pad has a total of two braille cells and the current braille size is 2 times the size of standard braille. It has basic controls that are able to navigate the pages in a braille book.

Conclusions/Discussion

The braille pad is implemented with braille cells that have a set of solenoids. I plan to improve the braille pad in many aspects. To start off, I plan on making a locking mechanism so that the solenoids are not needed to keep the pins in an on position. Even though the current design only has two letters due to issues such as uniformity and manual work, more cells need to be integrated for practical use.

Summary Statement

My project is an electronic pad that helps the visually disabled read braille by displaying braille characters using solenoids.

Help Received

My dad helped me make the case.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Edward D. De Leon

Project Number

J0908

Project Title

Reducing Radiation

Abstract

Objectives/Goals

Radiation. We are exposed to it every day from cell phones and electronic devices. This is why the objective of my project is to find out if it is possible to reduce our exposure to electromagnetic radiation (EMR) produced by wireless devices by moving the device further away, or by changing the connection type from wireless to wired? I thought that, yes, it would be reduced if the device is moved further away.

Methods/Materials

To test my hypothesis, I made an experiment using a radio frequency (RF) meter and devices such as a Roku, an iPhone#s wireless hotspot, and a laptop. Two tests were done to measure EMR # (A) a Distance Test at 0m, 0.5m, and 1m, and (B) a Connection Test (wireless and wired). With all other electromagnetic radiation emitting devices switched off, the EMF meter would record the amount of radiation and it would be written down. This test was to be repeated six times; the connection test would soon follow. A laptop would be tested at 1 meter away while connected wirelessly and later, wired via an Ethernet cable, and the Roku would be tested the same way as well.

Results

Analysis of the power density (amount of radiation a person would receive, measured in mW/cm2) shows that both the wired Roku and laptop had less radiation further away at 0.5 and 1 meter compared to the wireless counterparts (Roku difference is 3.9; laptop 15.17); both the iPhone hotspot and Roku had less radiation while being gradually moved away (iPhone 6 difference is 675.86; Roku 539.5).

Conclusions/Discussion

In conclusion, my hypothesis was correct # that exposure to electromagnetic radiation can be reduced by moving EMR-emitting devices at least 0.5 meter further away and if wired connection is used instead of wireless.

Summary Statement

Find out if exposure to electromagnetic radiation produced by wireless devices be reduced by moving devices further away, or by changing connection type from wireless to wired.

Help Received

Teacher and parents reviewed written project. Mom helped held RF meter while I recorded data.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Kemal Ficici

Project Number
J0909

Project Title
The Relationship between Distance and Capacitance

Abstract

Objectives/Goals
The objective of the project was to identify the relationship between the distance of the hand and the time it takes for a capacitive sensor to charge/discharge. I created a capacitive sensor, which I connected to an arduino UNO.

Methods/Materials
My preliminary design was a capacitive sensor constructed with aluminum foil, connected to an Arduino UNO. I had programmed the Arduino to measure the time it takes for the sensor to charge and discharge. I separated my hand from the sensor by putting paper sheets in between my hand and the sensor. I measured different distances, and took a few thousand trials by keeping my hand there for a few seconds.

Results
The relationship from the distance and the capacitance was inversely proportional by a factor of h^2. In a range of 2 cm, the capacitance of the sensor fluctuated at even intervals.

Conclusions/Discussion
My results supported my hypothesis, as my hand drew closer to the sensor, the time it took for the sensor to charge/discharge increased, due to the higher capacity of electricity. In the range of 2 cm, the capacitance of the sensor started fluctuating at even intervals, this might have been due to the fluctuations of the electrostatic field my heart rate generated. This could lead to advanced heart rate and blood pressure sensors and monitors.The data collected form this experiment could be used to calibrate capacitive proximity sensors. Further research could lead to nonmetal detection and identification(which could be used to detect and identify materials and objects such as restricted items at airports, drugs, tumors, and plastic weapons), better EMG sensors, and NMR scanners

Summary Statement
This project was made to identify the relationship between the distance of the hand and the amount of time a capacitive sensor takes to charge/discharge

Help Received
The Arduino Forum advised and recommended tips for improving, optimizing, and troubleshooting my code.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Max Freedman

Project Number

J0910

Project Title

KAPower Ball: Generating Power with a Soccer Ball

Abstract

Objectives/Goals

The purpose of this project was to build a device that generated power from a soccer ball. I researched existing products, build and designed a prototype and then analyzed its performance in different experiments. My project goal was to develop a solid-state power generating soccer ball using piezoelectric transducers that is more effective, more reliable and more fun than existing designs on the market.

Methods/Materials

My device uses an array of piezoelectric transducers embedded in a foam soccer ball. The circuit has a diode bridge to convert AC to DC, a capacitor to rectify the spikes in voltage, a rechargeable battery to store the energy for later use and an output a port for an LED array. I completed my project with seven different revisions. In each revision, I tested the design using a kicker apparatus, and refined the circuit to modify the resistors, capacitors, and battery.

Results

My final prototype successfully generated power from a kicked soccer ball. In Designs 1-3, I added a bridge rectifier, and tested to find the correct resistor to maximize power output. In Design 4-6, I used various capacitor and battery combinations to store power. In Design 7, I add an existing circuit board with a regulator, a simplified input/output system and a lithium battery.

Conclusions/Discussion

My results show that a soccer ball can generate usable energy. My prototype outperforms the existing design in reliability and game play. This is an innovative way to harness waste energy using piezoelectric transducers.

Summary Statement

I created an innovative way to generate power using piezoelectric transducers embedded in a foam soccer ball.

Help Received

Miguel Anzar for helped me with circuit design. Adam Draeger my teacher helped me with physics and circuitlab.com. Josh Freedman for helped me build the kicker apparatus. Patty Freedman for helped me with board layout and editing.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Siddharth H. Ganesan

Project Number
J0911

Project Title
Wireless Power Transfer: The Effects of Changing the Coil's Diameter on the Power Transmitted

Abstract

Objectives/Goals
The goal of my experiment was to see if it is possible to transfer power wirelessly, and to see if changing the diameters of the transmitter and receiver coils will affect the power transferred. Another goal was to study the impact on the power transferred when using fixed length/variable turns and variable lengths/fixed turns of wire to build the primary and secondary coils. The experiment was extended to study the effects of varying the number of turns of the coils, the gauge of the coils, and relative positions of the primary and secondary coils on the power transferred.

Methods/Materials
Breadboard; Battery; Resistor; Capacitor; Transistor; Wire; Multimeter.

Results
The readings were best for the coil with 30 cm diameter (the largest coil) and lowest for coils with 5 cm diameters. The readings were generally higher for coils with diameter 15 cm and up. For the same diameter, the fixed length coils with variable turns gave higher readings than the variable length coils with fixed turns. From my extensions, the readings were higher with coils of 24 AWG wire than 20 AWG wire. The readings were also generally higher for higher diameter coils with larger number of turns. The readings were also better when the relative positions of the primary coil and secondary coils were such that there was a large overlap in the magnetic fields of the coils.

Conclusions/Discussion
Wireless power transfer is possible because of electromagnetic induction and magnetic resonance. In wireless power transfer, efficiency of transfer is improved when the magnetic resonance between the coils is improved. This can be achieved by making the inductive and capacitive reactances of the coils the same and by ensuring that the magnetic flux fields of the transmitter and receiver coils overlap as much as possible. In my experiment, increasing the diameters of the primary and secondary coils improved the power transferred as there was more overlap in the magnetic fields thus improving resonant coupling. For the same diameter, if the numbers of the turns of the coil was higher we generally got better outcome voltage as it improved the inductive reactance of the coil which in turn increased magnetic flux. When the coils were in placed further away from each other, resonant coupling was low so the voltage transmitted was low. If the coil diameter is lower than the distance between the coils, power transferred falls for the same reasons.

Summary Statement
My project is about wireless power transfer and the effects of changing the coil's diameter on the power transferred.

Help Received
My parents helped me make my setup and create my display board.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Raghav Ganesh

Project Number

J0912

Project Title

A Wireless, Wearable, and Customizable Electronic Solution to Predict and Prevent Autistic Meltdowns

Abstract

Objectives/Goals

Autism spectrum disorder is a neurological and developmental disorder that affects 1 in 68 children and lasts a lifetime. Autistic people periodically experience intense, frustrating, and risky emotional outbursts known as autistic meltdowns. Autistic meltdowns are periods of emotional dysregulation that are triggered by high levels of cumulative stress, sensory overload, and the inability to communicate with caregivers. This project aims to develop an electronic solution to predict and prevent autistic meltdowns by detecting early signs of potential meltdowns, intervening through calming responses to the user, and alerting the caregiver.

Methods/Materials

My wearable device periodically monitors four environmental triggers and three physiological symptoms through environmental and physiological sensors. A microcontroller regulates the various functions of the device. A mobile application is paired with the device via Bluetooth. My device operates in three modes. In the Data Collection mode, the device periodically polls the sensors. The control software stores the calculated environmental and physiological parameters in a database. During the Data Analysis mode, the data from the database is transferred to a PC. The data is analyzed on the PC and user specific thresholds are generated for the environmental and physiological parameters. The caregiver can use the generated thresholds or override them if needed using a mobile application. In the Detection mode, the device continuously compares the monitored sensor data against the configured thresholds. When any threshold is exceeded, the caretaker is alerted about potential meltdown symptoms and a therapeutic response is initiated to calm the user. I tested my prototype revisions in simulated environments and with autistic users.

Results

When tested with autistic users, this device successfully detected periods of high stress and meltdown antecedents. Caregivers and behavioral specialists found the mobile application and the wearable device to be user friendly and valuable.

Conclusions/Discussion

My electronic solution met the design criteria, constraints, and the engineering goal. In the future, the components can be surface mounted to further reduce the cost and weight. Based on the evaluation of caregivers, test users, and behavioral specialists, my solution has the potential to improve the quality of life for autistic people and their caregivers.

Summary Statement

I successfully developed a wireless, wearable, and customizable electronic solution to predict and prevent autistic meltdowns.

Help Received

I am grateful to caregivers, users, and behavioral specialists for their input, feedback, and evaluation of my solution. I thank my parents for funding this project and online forums for technical support.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Adishree Ghatare

Project Number

J0913

Project Title

Adjusting Blood Sugar Levels to Address Diabetes

Abstract

Objectives/Goals

Diabetes patients face challenges to continuously check and adjust their blood glucose levels. My objective is to create a simplified artificial pancreas model that continuously checks glucose levels, automatically adjusts high glucose levels, and gives warning for low glucose levels.

Methods/Materials

My model contained two circuits: first to deliver insulin using peristaltic pump and second to warn using LED. I used acid-base chemistry and represented an acidic solution (vinegar) for high blood glucose levels, a neutral solution for normal glucose levels, and a basic solution (sodium bicarbonate) for insulin. I made a conductivity sensor that uses idea of electrolysis to represent the glucose sensor. As the conductivity sensor has low enough resistivity in acidic solutions, enough current goes into the transistor and pump runs delivering basic solution until the acidic solution becomes neutral. In the second circuit, I used a NOT gate to reverse the effects. LED turns on when the solution becomes neutral indicating acceptable glucose levels and off in basic solution showing low glucose. I tested the response of pump and LED. I measured original and attained pH of the solution and how much basic solution was used to neutralize.

Results

Pump started automatically in acidic solutions (high glucose) of pH 2.5, 4, and 5, and on average, stops at pH 6.28. On average, pump delivered 190 mL basic solution to neutralize 200 mL acidic solution (pH 2.5), 114 mL basic solution to neutralize 220 mL acidic solution (pH 4), and 139 mL basic solution to neutralize 270 mL acidic solution (pH 5). Pump did not deliver the exact same amounts of basic solution for the same pH of acidic solution, however, the variation is acceptable as pH is the negative logarithm of molarity of hydrogen ions in a solution. Pump did not start to deliver basic solution into neutral (normal glucose) of pH 6.5. LED turned on in neutral solutions. LED turned off in basic solutions.

Conclusions/Discussion

My system is able to automatically deliver basic solution, neutralizing the acidic solution. This represents delivering insulin to reduce glucose levels to an acceptable range. It does not deliver basic solution to neutral solutions (normal glucose). It gives warning in basic solutions (low glucose) through LED indicating patients need food. I will explore ways to convert my prototype into a practical, compact artificial pancreas.

Summary Statement

I created a model of an artificial pancreas that continuously checks blood sugar levels, automatically normalizes high glucose levels, and gives warning for low glucose levels.

Help Received

Father taught how to troubleshoot circuits and other difficult-to-understand concepts; Mother supervised me during my experiments.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Shiven Gupta; Mokshith Voodarla

Project Number

J0914

Project Title

Wearable Device for the Visually Impared

Abstract

Objectives/Goals

The visually-impaired don#t have many tools in the market to use that make them really self-dependent. The available tools can not be available to those who are in developing countries for they may cost too much. Our goal is build a device that is user friendly and can function better in these kind of user scenarios.The device is a low-cost hands-free wearable that can be worn on the waist. It alerts the user if there is anything that may come in their way, if there is a change in ground level, and the magnetic direction they are facing. Our design criteria is that it must be under $100, light, accurate, easy to use, and a normal size.

Methods/Materials

Our approach to solving this problem was to see what was available for the visually-impaired in the current market. We then tried to see how those products could be changed to help solve our problem. Next thought of what we could use to solve our problem. We came up with ultrasonic sensors because we figured that they were low-cost and could get our job done reliably (sensing objects and ground level). We tested ultrasonic sensors and how we could use them in the most efficient way and figured out their limitations. With this we calculated that one ultrasonic sensor would be at a 60-degrees and the other one at 15-degrees. We build the circuitry on a breadboard and once we had a working model, moved it into a waist pouch. Next soldered the ultrasonics on a perfboard and connected them to an arduino and a wave shield. Finally, we connected a battery with a toggle pushbutton and the arduino.

Results

We were able to achieve our goals of creating a device that would be able to navigate the user through obstacles. It can easily sense all the things it is supposed to sense accurately and is the size of a normal waist pouch. It is easy to use and can be turned on push of a button.

Conclusions/Discussion

Our device has the potential to help visually impaired people around the world have a much easier and self-dependent life. It will help them do many of their daily tasks in a more efficient fashion and will turn their lives into something closer to the life of a person gifted with good vision. If we build more of the devices, building them in bulk will reduce the materials price of the device.

Summary Statement

We created a wearable device for the visually impaired which detects objects ahead, stairs/uneven ground, and alerts them of magnetic direction.

Help Received

Parent Supervision; Eye doctor feedback;

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Anika M. Hayes

Project Number
J0915

Project Title
Building a 3D Printing Pen

Abstract

Objectives/Goals
My goal is to build a benchtop model which shows the concepts and mechanics of a 3D printing pen.

Methods/Materials
I first researched my topic and started to make my logic diagrams. Then, I bought my materials, including the Arduino Uno micro controller board, J-head hotend nozzle, 5 line 4 phase step motor, Kootek DC 5V 4 phase test module board, and relay. I practiced using the Arduino board with tutorials from the Vilsro manual. I created the individual circuits and programs by referring to online programs, which I modified for my use. I manufactured the phenolic board base. I attached the individual parts to my board and combined the programs and circuits.

Results
For my project I was able to research, build and design the necessary circuits and programs to create a benchtop model of a 3D printing pen. I was able to see how a relay, thermistor and motor circuit are all necessary to make a 3D printing pen work. Each of the circuits worked individually, however, I was not able to combine all the programs and make the model work in unison. I was able to combine the two programs without getting an error alert but, when tested the different circuits would not work together.

Conclusions/Discussion
I found that a motor, relay and thermistor circuit are all necessary components for building a 3D printing pen. I believe that with more time I can fix the programing bugs and get my benchtop model to work together. Also with specialized parts and some added components such as a portable battery package, this idea, with these circuits could become a safe, handheld, 3D printing pen.

Summary Statement
This project explores the components necessary to build a 3D printing pen.

Help Received
My dad, Matt Hayes helped me manufacture the hardware of this project. Chris Nestlerode, helped me work through my final program. Andy Stoller helped me complete my first logic diagrams. My Uncle, Dan McNamara helped me work through the energy flow of the project.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Arthur K. Jakobsson

Project Number
J0916

Project Title
Saving Grandpa

Abstract

Objectives/Goals
One big worry for elderly and for their loved ones is falling. One third of the population above 65 is injured by falling, and falling can cause serious injuries and even death. I built a fall detector using an Arduino Uno and a 9-axis sensor, and programmed the Arduino to detect falls.

Methods/Materials
I built a fall detector using an Arduino Uno, a device that receives sensor data, computes and sends signals. In order to detect falls, I sensed orientation, movement, and acceleration. I used the sensor to determine the angle of the person wearing the device as it changes over time. If the angle change is larger than a set threshold, the device will convey an alarm, since this corresponds to a fall.

Results
I tested my fall detector on seven subjects who performed everyday activities and falls, and found that my device consistently detected all falls and did not send any false alarms.

Conclusions/Discussion
Commercial fall detectors have large error rates. I have studied how to reduce these. This will improve protection for elderly. I experimented on seven subjects, four of which were 60 to 80 years old, and found no false negatives or false positives.

Summary Statement
I have studied how to create a fall detector that has very low error rates, to address a problem commercial fall detectors have.

Help Received
My dad taught me how to program C. My parents and neighbors helped me by being my test subjects.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Nina K. Kagan

Project Number
J0917

Project Title
Battle for the Blind: Is the Mobility Glove More Effective Than the White Cane?

Abstract

Objectives/Goals
The objective is to invent a glove using ultrasonic sensors and vibration modules that is more effective to assist mobility in blind people than the typical white cane

Methods/Materials
5 blindfolded volunteers went through an obstacle course 10 times, 5 times using the mobility glove and 5 times using the white cane. They were each timed and were recorded on how many times they bumped into objects.

Results
On average, participants completed the course from 5-10 seconds faster using the mobility glove, but ran into less objects while using the white cane.

Conclusions/Discussion
Overall, the mobility glove is a helpful invention for the blind to get a more 3 dimensional idea of their surroundings, and might be the next step forward in blind assistive technology. The next invention I am working in is a pair of kneepads that uses this technology at a lower vantage point so things such as steps can be sensed.

Summary Statement
I invented a mobility glove that uses an ultrasonic sensor and tested it in a controlled environment against a white cane.

Help Received
Neighbor helped write code

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Bharat Kathi

Project Number
J0918

Project Title
Detecto-Bot

Abstract

Objectives/Goals
I take a lot of medications because of a health condition I have. Whenever I eat, I take capsules containing enzymes. Sometimes I used to drop them on the floor without realizing, and would miss out on my required enzymes. I wanted to build a robot that would help me and others in similar situations, by detecting dropped objects on the floor, and alerting when this happens.

Methods/Materials
Materials:
LEGO Mindstorms EV3 Kit; EV3 Home Edition Software; Computer

Method:
1. Build a robot with touch and ultrasonic sensors.
2. Program the robot to:
➢ Back away when it hits an obstacle.
➢ Detect objects on the surface.
➢ Turn around when about to fall off a surface.
3. Test the robot to see if it can properly back away from obstacles and detect objects on the surface.
4. If the robot isn#t able to complete step 3 successfully, then repeat steps 1 and 2 as needed.
5. Test how many times it can detect certain types of objects out of 10 trials for each object.
6. Convert results into a percent to determine the accuracy of the robot.

Results
Using ultrasonic and touch sensors, a robot can navigate through obstacles. It can detect small objects on the floor. But detection rates depend on the size and shape of the objects.

Conclusions/Discussion
My hypothesis is if a robot is equipped with the right sensors, then it will be able to detect the desired conditions and objects, because the robot will be able to use the sensors to avoid obstacles and navigate properly.

I tested my hypothesis by designing an experiment where I built a robot using a LEGO Mindstorms EV3 kit. I observed what objects it could detect, and how it navigates using an ultrasonic and a touch sensor. During my tests I found that the larger the objects are, the easier it is to detect. Sometimes the robot misses an object completely because of its size. Also, if objects have reflective surfaces or have dents, the ultrasonic sensor gives incorrect measurements, and the robot fails to detect those objects.

Summary Statement
Build a robot that can navigate obstacles and detect small objects on the floor.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Patrick Liu

Project Number

J0919

Project Title

D.I.Y. Automatic Dog Feeder

Abstract

Objectives/Goals

The objective of this project is to prototype an automatic dog feeder with several features, such as a dispenser of leftover food that the dog cannot finish, a resettable alarm, and a motion detective camera.

Methods/Materials

I followed the engineering process to prototype the machine. Afterwards, I used a multimeter to measure the power usage of the machine and its components. The main components of the machine are an Arduino Uno, 2 servos, a LCD Keypad Shield, an IP Camera, and a RTC DS1307.

Results

I measured the current and watts of every major component that was controlled by the Arduino. According to my data, Servo #2 consumed a surprising amount of energy compared to the other components. The LCD Keypad + RTC consumed about half the amount of the second Servo at 9V Max, which was pretty unpredicted. In my other measurements, I calculated the total power usage (per run) of my automatic dog feeder, and compared it to other designs on the market. There is a considerable difference in power usage, mine having the lower electricity usage. Compared to the first prototype I created, the second model is tremendously improved in all areas, including the hardware/mechanical and software elements.

Conclusions/Discussion

At the beginning of my project, I made a list of requirements for my future automatic dog feeder. With every new prototype, I achieved more and more requirements. My final design fulfilled all of my necessities, and I even had enough time to add in a few features. With one unsuccessful run after another, I gained knowledge from those failures and improved my prototype. The program code was varied a numerous amount of times due to these tests. Near the end of the completion of my project, I began to measure the power usage of my machine, my number one requirement on the list. I wanted to compete with other automatic feeders that are already accessible on the market, and investigate whether I could enhance my design by reducing the power usage. According to the results, I did overthrow some auto-feeders in power efficiency. Overall, this project was a great experience, and I will continue to engineer several other electronic devices to improve the lives of people. Evaluating my old requirements list, I believe I have achieved all my goals for the machine, and even added extra features to the final product.

Summary Statement

Controlled by the popular Arduino Uno, this project is able to feed pets (dogs) and attain several other conveniences as well.

Help Received

Dr. James Li advised the process of my project. My parents brought me places to purchase materials, and taught me how to use tools to build the "skeleton" of my project.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Isaac Lo; Siddarth Ramkrishnan; Brendan Su

Project Number

J0920

Project Title

Sensory Glasses for the Blind

Abstract

Objectives/Goals

Our project is to create inexpensive glasses allowing the visually impaired to navigate the urban areas efficiently.

Methods/Materials

The sensory glasses has a vibration motor on the side of the glasses and an ultrasonic sensor on top of the frame facing wherever the person is looking. We also have an Arduino Uno chip on the other side of the glasses, which runs the whole program and is essentially the #brain of the whole thing. When an object comes within 53 centimeters of the user, which is a good enough distance for the user the react, the ultrasonic sensor will detect it, thus alerting the Arduino chip. Then, the chip will trigger the vibration motor, which will alert the user and give his/her enough time to move away from the object.

Results

After testing, we found out that our sensory glasses were successful 87% of the time, which is a fairly good percentage, but not good enough. We, however, tested it on ourselves, not on a blind person. Since our senses and reaction time aren't as good as a visually impaired person, the percentage might actually increase into the 90's if they tested it. So, our project was overall successful.

Conclusions/Discussion

In conclusion, we found out that our glasses might actually work well in the real world. With some improvements, our glasses can be a new efficient option for the visually impaired to navigate around their areas. We feel like our glasses might actually make a difference for the visually impaired

Summary Statement

Our main focus is to provide an affordable and efficient option for blind people to use to navigate around their urban areas

Help Received

Some Materials provided from school; Had mentor named Cameron Taylor help a little bit with code and program

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Saurabh Narain

Project Number
J0921

Project Title
Generating Electricity Using a Toy Spinner

Abstract

Objectives/Goals
Approximately 1.3 billion people in the world do not have access to electricity for basic needs, but they do not know they can use simple techniques to generate it. There are many types of generators to produce electricity, but they do not utilize human arm power effectively. My goal is to create a fast and efficient toy spinner generator that utilizes human arm power.

Methods/Materials
A toy spinner rotates at a staggering 3000 RPM and I have harnessed this excessive rotational speed to create a simple generator. My toy spinner generator consists of 3 coils and 2 magnets. I measured the voltage and the RPM of several generators for a comparison of their efficiency. The best solution was to use a toy spinner because of its high rotational speed. A person repeatedly pulls and releases the cord at the ends of the spinner to cut the magnetic field rapidly and generate electricity.

Results
I found that 3 independent variables played key roles in my project. These independent variables were the length of the string on the toy spinner, the number of turns in the coils, and the distance between the magnets and the coils. These independent variables affected the dependent variable which was the voltage produced by my generator. I used a string length of 65 centimeters in my final generator compared to my older version which used a string length of 85 centimeters. By doing this, my generator was able to spin at about 3000 RPM. Normal hand crank generators spin at about 300 RPM. This is a 900% gain in RPM compared to regular hand crank generators.

Conclusions/Discussion
I#m able to design a toy spinner generator to provide more electricity than normal generators utilizing human arm power. The result of my experiment provides a practical solution to my proposed problem. In the future, this toy spinner generator may transform the way in which generators produce electricity to power portable devices.

Summary Statement
Toy spinner based electric generator for powering mobile devices in emergency situations.

Help Received
My science teacher, Ms. Anja Crickmore guided me along my project and Prof Dipendra Sinha of San Francisco State University inspired me to maintain my passion and focus.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Aryan Patra; Anish Singhani

Project Number

J0922

Project Title

Using Human Brainwaves to Control Real World Devices

Abstract

Objectives/Goals

Our goal was to create a solution which could receive data from any brain sensing device, and use it to control external real world devices. As part of our solution, our goal was to create both software and hardware components, which will first receive brainwave signals, process them, and then convert them into useful data, which can then be used to control external real world devices.

Methods/Materials

Our solution is created using the AVR based ATMega chips for our hardware (Arduino based boards) and the software is programmed in C++ language.

Results

We were able to create a solution which met our design criteria, and were able to control different external real world devices using brain sensing. We used brain sensing device to sense brainwaves, and transmit the data wirelessly. Our controller (hardware/software created by us) then receives the brainwave signals and processes the signals, allowing it to control various external devices.

Conclusions/Discussion

The solution we created allowed us to successfully control external real world devices with focus. We concluded that human brainwaves produce distinct electrical signals, that can be captured and used for controlling real world devices. Our future direction is to take our solution to the next level and add new range of devices which can be controlled by our solution.

Summary Statement

Our project is about using human brainwaves to control external real world devices.

Help Received

Parents helped us to buy materials and components

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Jahan Razavi

Project Number
J0923

Project Title
PyroVision: A Detection System for Wildfires

Abstract

Objectives/Goals
The purpose of this project was to create a wildfire detection system to reduce chances of a large blaze. PyroVisions detects the temperature and wirelessly sends it to the fire station. A grid system enables firefighters to know the location of each PyroVision without the need for GPS.

Methods/Materials
The main materials that I used were the TMP37 temperature sensor, Arduino, nrf24l01 Bluetooth transmission module, and red LEDs. I created four transmitters to represent the four corners of an acre, and one receiver to represent the fire station. I lowered the threshold in the code such that touching and holding the temperature sensor can turn on the corresponding LED. I tested the transmitters and receiver in a park that was clear or had trees. I also used both the original and a modified antenna on the receiver to check the range increase.

Results
The transmission range with the original antenna was less than with the modified one. The data showed that the transmission distance in an area with trees with the modified antenna was an average of around 200 feet. In an area without trees, also with the modified antenna, the transmission distance ranged from 300-400 feet. My aim was to reach around 208 feet in range, the minimum transmission distance to allow datahopping.

Conclusions/Discussion
In conclusion, I accept my hypothesis because the system had fairly good transmission distance. If I were to extend this system to hundreds of acres, I would, to save battery, turn on the transmitters for 0.1 second, and off for 2 minutes. I would also add a dipole antenna to the transmitters to increase the range. The transmitters would use datahopping to transmit across hundreds of acres: one transmitter sends its data to the next, which combines the two, sends the combined data to the next, and so on.

Summary Statement
PyroVision senses high heat that corresponds to a fire, wirelessly sends the data to the nearest fire station, alerting the firefighters if the threshold is passed.

Help Received
I got part of code off Arduino Info on how to use Bluetooth module; my father taught me how to solder.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Ryan D. Rusch

Project Number
J0924

Project Title
DIY Fuel Cells: Which Is Mightier: the Pen or the Sword?

Abstract

Objectives/Goals
The U.S. Department of Energy is constantly looking for ways to have power while not polluting the environment. One way to do this is by using fuel cells. Which type of electrode conducts better in water? Electrodes are 2 pieces of metal in water where a current gets sent through in a fuel cell to combine hydrogen and oxygen to make power and water. In the regenerative fuel cell that I am using, the electrodes separate the hydrogen and oxygen in water so that the hydrogen and oxygen will combine again, creating power. My project tests which type of electrode, silver or pencil graphite, will conduct better.

Methods/Materials
I test the conductivity by seeing which electrode's voltage decays slower in a mixture of 1 part salt to 27 parts water. I timed the voltage and its decay rate with a stopwatch.

Results
I hypothesized that silver electrodes would conduct better because silver is a highly conductive metal, and therefore, the voltage will decay slower in water. My results did not agree with my hypothesis, and the pencil graphite conducted better than the silver.

Conclusions/Discussion
The silver voltage decayed faster possibly because of the tarnish build up around the silver. The graphite does not tarnish, corrode, or rust because of the wood surrounding the pencil. I learned from this project that the pen(cil) is mightier than the sword (silver)!

Summary Statement
I learned that pencil graphite is a better electrode than silver when used inside a makeshift regenerative fuel cell.

Help Received
My mother helped attach the cloud wallpaper, and my father helped structure the fuel cell.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Bryan Solis; Tyler Wakatsuki

Project Number

J0925

Project Title

Search and Rescue

Abstract

Objectives/Goals

This project is about building a robot that can efficiently and safely help recover humans or any other life forms from a disater

Methods/Materials

We used tape to make the track for the robot. We needed the receiver and camera to project the image on a television for the remote controlled robot. We used the television so we can control the manually controlled robot through the TV. The remote control we used for the manual controlled robot was a phone with an app to connect through Bluetooth so it controls the robot. We had a robotics kit called EV3 from Lego and we used that to build the robot. We used a laptop so we can program the robot for the automated robot.

Results

The results of this experiment was very one sided as the automated robot average time was 54.33. The first run was 44 seconds, second was 67 seconds, and the third 52 seconds. As for the manual controlled, it took Bryan 39 seconds on the first, 33 seconds, and lastly 35 seconds averaging out to 35.66 seconds. On the other hand Tyler took 32 seconds, 35 seconds, and 33 seconds averaging out to 33.33 seconds.

Conclusions/Discussion

Realistically for this project in life size scale would not be able to pick up people without harming anyone or even carrying anyone. So the robot will be programmed to grab by the collar and it will be soft robotics to prevent any punctures

Summary Statement

This project is about building a robot that can efficiently and safely recover from a natural disater

Help Received

Ms.Sanchez supervised us and gave us the robotics kit

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Nihal Talur

Project Number
J0926

Project Title
A Better, Cheaper Security System

Abstract

Objectives/Goals
The goal of this project is to build a homemade security system that can compete with commercial security systems in features and usability, and to build it in a DIY, (Do It Yourself) cheaper way, releasing the finished code as open-source.

Methods/Materials
Buzzer, Reed Switch, PIR Sensor, Webcam
Raspberry Pi, Arduino

1. The homemade security system was armed from the manage tab on the web GUI
2. A "break in" was performed by walking into a room that was secured by a security system and staying in the room for five seconds, then leaving the room, and the time between receiving the security system's alert (alert from web/alarm) and the break-in was recorded
3. These steps were repeated five (5) times to verify accuracy and to minimize error, recording the data for accuracy, reaction time. Cost was then separately measured.

Results
The Security System with both IR and RS outperformed all other security systems. It made no errors in all its trials and additionally was able to take more pictures because of a faster reaction time and increased accuracy. The IR sensor made one mistake because it triggered on the door swinging shut. The different models of the Homemade Security System cost considerably less than the commercial security system for long-term usage. (10 years)

Conclusions/Discussion
Overall, throughout this project, the homemade security system was able to meet the goal and even surpass it in some ways. For example, the security system was originally intended to provide a simple, working web interface to manage the security system. The final product was a fully secure web application that used HTTP POST along with PHP5 sessions to keep the user authenticated to ensure that this system can only be controlled by a fully authenticated user. The webpage blocks any users that are not logged In and redirects them to the main login page, done using PHP5 sessions.
The homemade security system was able to keep up with the commercial security system#it detected all of the intrusions and took pictures. Additionally, there was an extremely large price margin between the homemade security system and the commercial subscription-based security system.

Summary Statement
The goal of this project is to build a homemade security system that can compete with commercial security systems in features and usability, and to build it in a DIY, (Do It Yourself) cheaper way, releasing the finished code as open-source.

Help Received
Dad helped cut wood with saw.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Samuel C. Wentzel

Project Number
J0927

Project Title
The Utilization of Thermal Electric Junctions to Generate Electricity

Abstract

Objectives/Goals
This project explores the use of thermal electric thermal junctions using different combinations of metals and temperature differences to determine the combination that produces the highest voltage per junction. The best result was combined in a series electrical circuit to show that a cumulative higher voltage can be generated.

Methods/Materials
Pencil graphite, aluminum, iron and copper oxide wire.
Plywood Circle with screws and washers
Heat source
Multimeter

Build and measure junction combinations using the four materials to find the best candidate for thermal electric generation. Then build a series array of 16 thermal junctions and measure the overall resultant voltage.

Results
I found that the combination of pencil graphite and copper oxide wire generated a high voltage, but then found that it was too difficult to construct a thermal pile using the brittle material. I found that Copper Oxide with dissimilar temperatures gave me a combination of good voltage generation per junction and was able to be constructed into a thermal electric pile.

Conclusions/Discussion
I found that a thermal pile which is a series electrical circuit can be used successfully to generate electricity for specialized applications.

Summary Statement
Exploring materials and practices for thermal electric generation.

Help Received
Father supervised construction of array and measurements to assure that I used safe practices.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Elise J. Winward

Project Number
J0928

Project Title
Solar Cycle

Abstract

Objectives/Goals
I tested whether or not I could simulate a solar-powered electric bicycle that could go 0.4 kilometers on one charge of its batteries.

Methods/Materials
I used many regular tools to build the physical project (Ex. Screw-driver or drill) but, the most important things were the back bicycle tire (including gears), electric motor, and an Arduino Leonardo (micro-controller).

Results
In my project I tested voltages sent to the amplifier from the Arduino based upon different programming commands, the speed (in kph) the motor would go at the different voltages, the amperage the motor needed to propel the wheel at certain speeds, and how long the batteries would last at the certain speeds.

Conclusions/Discussion
I was successful in completing my objective of my project. Also, my hypothesis was correct in stating that I would be able to. This project applies to humanity because if many people were able to use solar-powered electric bicycles to get to work instead of cars, we could reduce the amount of pollution put into the atmosphere. Also, because the electric motor on the bicycle would, most likely, only be used as supplemental power, riding bicycles to and from work could increase the overall health of the population.

Summary Statement
My project simulated a solar-powered electric bicycle and tested whether or not it would be an efficient method of transportation.

Help Received
Uncle and Father helped me to learn the programming of the micro-controller.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Jeffrey J. Wisoff

Project Number
J0929

Project Title
Can Mindstorm NXT Parts Be Used to Construct a Prototype Obstacle Alert System to Aid the Elderly and Vision Impaired?

Abstract

Objectives/Goals
The purpose of this project was to create an engineering prototype obstacle alert system using Mindstorm NXT parts to aid the elderly and vision impaired by calculating the closing time of an approaching object and issuing two warnings of increasing urgency in English, Spanish, or Mandarin.

Methods/Materials
Mindstorm NXT parts and software were used to construct a small scale prototype sensor system as the basis for proving a design for a larger scale system. The project included defining requirements, calibrating and constructing the ultrasonic sensor system, programming the warning and language selection logic, building and calibrating the moving test car, and then testing the integrated sensor system with the moving test car using 5 runs at each of three calibrated velocities. For a given calibrated velocity the expected warning distances were compared to the actual distances as read from a measuring tape. The range sensitivity of the detection system was also measured as a function of the angle between the car and the sensor system.

Results
The sensor system logic successfully issued the two warnings in the operator-selected language of English, Spanish, or Mandarin. The first warning was issued within 9 cm of the expected distance and the second warning was issued within 5 cm. The warnings for the slower car speeds tended to be early and the warnings for the faster car speeds tended to be late. These results are consistent with the sources of error present in the experiment. The measurements also indicated that the range sensitivity drops dramatically when the angle between the car and the detection system is greater than 10 degrees.

Conclusions/Discussion
A prototype multilingual obstacle alert system constructed from Mindstorm NXT parts has been successfully demonstrated. Design requirements of being lightweight, low cost, and accurate were all met. There are some shortcomings in the sensor system which would need to be addressed in future work such as limited off-axis detection range and software loop delay. Most significantly, a single approaching target was used during testing. In reality, there could be multiple approaching objects so additional testing is needed to ensure the user is warned of the fastest approaching object.

Summary Statement
My project used Mindstorm NXT parts to construct a prototype sensor system to aid the elderly and vision impaired by calculating the closing time of an approaching object and issuing a sequence of warnings in English, Spanish, or Mandarin.

Help Received
In addition to providing their encouragement and financial support, my parents helped me videotape my presentation and started timers for me when asked.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Kaia R. Yager

Project Number
J0930

Project Title
Using Water Flowing under Bridges to Replace Hydroelectric Dams

Abstract

Objectives/Goals
My objective was to test the feasibility of replacing hydroelectric dams with multiple small turbines in free flowing rivers.

Methods/Materials
A pelton wheel turbine generator was constructed by affixing coiled wire to a board, rare earth magnets to a foam core circle attached to an axle, and hot gluing spoon bowls into a cork, attached to same axle. A bucket and chute system was built for the water to flow down past the turbine with adjustable angle. The speed of the water was calculated by videotaping a floater going down the chute at different slopes, and by dividing the distance it went by the time it took. Finally, the speed of the water was compared to the electricity being made by connecting a multimeter to my turbine generator.

Results
At a water speed of 0.58 meters per second, which is comparable to the speed of the Mississippi River at its headwaters, 0.54 meters per second, I was able to produce an average of 14 millivolts of electricity. At a water speed of 1.37 meters per second, which is comparable to the Mississippi at New Orleans, 1.34 meters per second, I was able to produce an average of 70 millivolts of electricity.

Conclusions/Discussion
My conclusion is that it is feasible to make electricity at speeds comparable to those of a free flowing river. As a continuation of this project, I would like to test it in situ to find how many turbines would be needed to be comparable to a dam.

Summary Statement
My project is about testing whether or not electricity can be made by a turbine generator at speeds of water similar to those of a free flowing river.

Help Received
My dad helped me construct the generator and chute, and he also videotaped me performing the trials. My mom helped me proofread my written components, and helped put my display board together.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Amine G. Adlouni

Project Number
J0998

Project Title
Spark. Ling. Water

Abstract

Objectives/Goals
The objective is to test if water flow affects the electricity produced measured as number of sparks per three minutes using the Kelvin's Electrostatic Battery. I predict that the larger water flow will produce more sparks.

Methods/Materials
A Kelvin's Electrostatic Battery model was built. A straight valve was used to control the water flow. Two water flows, A and B, were chosen, and the electricity produced by each flow was tested by the number of sparks per 3 min. occurring between two brass balls. Each flow was tested three times to find the final results.

Results
Flow B (844 mL/Min), being 13.5% less than flow A (730 mL/Min) generated about 36% more sparks than Flow A (Flow A:14 sparks, Flow B: 19 sparks).

Conclusions/Discussion
I hypothesized that the larger water flow would produce more sparks based on the idea that the more water, the more charge. My results proved my hypothesis false, as the lower water flow produced more sparks. This experiment shows that Kelvin's Electrostatic Battery could be an efficient way to produce electricity which does not require the amount of water usually needed by water turbines. This benefits areas lacking a large supply of water, such as California State going through a period of drought.

Summary Statement
The purpose of this project is to test if water flow affects the electricity produced measured as number of sparks per three minutes using the Kelvin's Electrostatic Battery.

Help Received
My dad helped me with the engineering of this project.

CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Cade Pretorius

Project Number

J0999

Project Title

Brain Controlled Cyborg Arm - Using EEG and EMG Signals to Control a Robotic Arm

Abstract

Objectives/Goals

With technology improving everyday, we are getting closer and closer to true integration with machines that augment our abilities. With this opportunity, we can improve our lives in innumerable ways. The advent of affordable brain reading devices has created a revolution of sorts. These devices can help amputees regain control of their limbs without the cost of multi-thousand dollar prosthetics. 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 includes smoother movements and better Electroencephalogram (EEG) data. By the third phase, I will not only be able to control a simple robotic arm, but other objects and programs that will be able to be integrated into our daily lives. I am currently on the second phase. What I plan on working on next is to further increase ease of use, as well as broadening the applications of my project.

Methods/Materials

After doing some research, I settled on using the Emotiv EPOC headset, whose sensors are similar to those of a lab EEG machine, containing multiple, wet sensors. My project utilizes thoughts and facial movements to control a robotic arm. When a certain thought/facial movement is triggered, a key is #typed# by the program. The keys are then detected by a program that I wrote that runs on the computer, and sends that information on to an Arduino, which I programmed to interpret the signals and send them on to the robotic arm. This robotic arm is then directly controlled by an Arduino which, as mentioned, receives instructions from a separate program running on a computer.

Results

To be able to control the headset consistently, some training is required. With practice, I am able to control my thoughts consistently and, therefore control the robotic arm. Because the headset communicates wirelessly, signal interference is a big issue. This causes difficulty when using the device #out in the wild#, but inside a house or other building where interference is low, the project works very well.

Conclusions/Discussion

I have created an interface between a person and their thoughts and a robotic arm. It uses facial movements to control the motor direction, and thoughts to control which motor is being used. The device can be used accurately by different people, given some time to practice.

Summary Statement

I control a robotic arm using EEG and EMG signals

Help Received

I#d like to thank Cliff Griffin from Griffin Laboratories for being my project advisor. My father helped me to work past one or two spots when I got stuck on programming issues, and my mother helped with the display board.