CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Daniel Alivov; Diana Alivov

Project Number

J1001

Project Title

Bluetooth Controlled, GPS Guided Robotic Car

Abstract

Objectives

The purpose of our project was to create a driver-free car that is GPS navigated, road following, and avoids obstacles when equipped with an Arduino Uno microcontroller. In addition, our car reacts to traffic lights similar to real street traffic lights: it stops on red, slows down on orange, and goes on green.

Methods

We used a microcontroller called Arduino, which interfaced with other electronic devices we used such as a GPS (Global Positioning System) module, line following sensors, ultrasonic sensor, color sensor, DC motors, and a Bluetooth module. We were programming the microcontroller in Arduino IDE to detect signal from sensors and to control car motion using Bluetooth communication and GPS. Bluetooth communication was achieved using a smartphone. There were 4 DC motors moving the car, which were paired with a motor shield.

Results

The robotic car was successful. Our car is GPS guided, follows a road, avoids obstacles, reacts to traffic lights, and communicates with Bluetooth. A problem we faced was unstable connections in the circuit with the DC motors, but that was fixed by using an Adafruit motor shield.

Conclusions

This project demonstrated a self-driving car using an Arduino Uno microcontroller that is navigated by GPS, follows a road, avoid obstacles, reacts to traffic lights, and controlled by Bluetooth. In today s world, driver-free cars are becoming a reality. This saves much man force and time, and would reduce the number of car accidents that happen in our world. The idea of self-driving cars could impact our future tremendously.

Summary Statement

Our project is a robotic car that is controlled by Bluetooth, is GPS navigated, follows a road, avoids collisions, and obeys traffic lights.

Help Received

Help was received from our father who taught us the basics of electronic devices, the building of electrical circuits, and programming. However, everything in this project was done by ourselves.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Ayat Alwazir

Project Number

J1002

Project Title

Health Band

Abstract

Objectives

The objective of this project is to build and program a Health Band to be worn like a watch to help predict and prevent heart attack, cardiac arrest, and strokes. This band is designed and built to be more affordable to more people around the world. A key fact from the WHO is that these cardiovascular diseases (CVDs) are the number one cause of death globally. Statistically that translates to an estimated 17.9 million people who died from CVDs in 2016. The WHO also states that 80% of CVD deaths take place in low- and middle-income groups GLOBALLY.

Such risks associated with heart attacks, cardiac arrest, and strokes can be predicted by using the Health Band that has a connected app determining the patient's heart rate and body temperature.

If the patient is experiencing low/high heart rate and unusual body temperature the app will send notifications to the phone of the patient, relative and doctor with the installed app alerting them of the warning vital sign values. It also alerts them if the person were to fall.

After testing the band on 10 subjects, and comparing the results to the Apple Watch, the Health Band worked with the same accuracy.

The Health Band is affordable, under twenty-five dollars, and therefore can reach more people around the world saving more lives.

Methods

Attached to the wrist band is the arduino micro, the ioT and pulse sensor, body temperature sensor, accelerometer sensor and I used the Mit App Inventor 2 to build the app.

Results

The Health Band was tested on 10 subjects and results showed it worked with the same accuracy and dependability as the Apple Watch monitoring a person s vitals and relaying the information to the app.

Conclusions

The Health Band is dependable and affordable (under twenty-five dollars) and therefore more accessible to people all over the world to capture vitals that warn of imminent heart attack, cardiac arrest or stroke. It is especially useful to those that have compromised access to urgent medical care and thus preventing cases of disability and death from CVDs.

Summary Statement

The Health Band is affordable to middle and low-income people who make up 80% of people with Cardiovascular Diseases, to raise their survival rate by capturing the warning signs to prevent heart attacks, cardiac arrests and strokes.

Help Received

Ms. Najwan Naserelddin, teacher and mentor, to learn to code and Mr. Mahmoud Belbese to learn electrical engineering skills.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Solaiman Alwazir

Project Number

J1003

Project Title

Disaster Drone

Abstract

Objectives

The objective of this project is to increase the survival odds in the first moments of victims in a natural or man-made disaster by designing and equipping a drone with a programmed microcontroller and sensors to scan for cell phone tower signal, water and air quality in the vicinity of the survivors as well as provide a live-stream video to the ground station. The Disaster Drone would zoom in to outlying areas to identify and assess the extent of the survivors emergency situation to inform them and prioritize the call for first-responders. The 3G-4G/LTE Base Shield V2 sensor is built in to detect the cell-phone towers' signal strength. The Disaster Drone will alert the ground station via an application called ThingSpeak (ioT application). The second set of sensors are the pH and turbidity sensors built in to detect water quality of the compromised area where people would want to know if their water source is still safe to drink, while awaiting first-responders, as it may have become contaminated from displaced waste of livestock, human sewage, chemicals, and other impurities. The third set of sensors are programmed to detect the air quality at the site of the disaster where pollution can reach significant levels from the huge amounts of waste generated in a very short period of time, and survivors need to steer away until the arrival of first-responders. The MQ5 sensor is used to detect combustible gases: H2 , LPG, CH4 , CO and Alcohol. Humidity and temperature sensors are built in as humidity and heat increase fuel flammability. The drone is built to be light and efficient to conserve battery life for travel time.

Methods

To the drone body, I attached the following sensors: MQ5 gas, pH , turbidity, humidity, temperature, Base Shield V2 and attached an arduino IDE to program the sensors and an arduino uno for the microcontroller. I then ran trials of testing the water quality and cell-phone signal strengths in different environments. I didn't test air quality for combustible gases for safety reasons.

Results

The readings from the sensors generated accurate values that matched the ground station readings necessary to relay situation.

Conclusions

I equipped and programmed the Disaster Drone to test with different sensors that I researched from which the parameters are relevant to the vital safety of survivors in the immediate moments after a natural or man-made disaster before first-responders can reach them. The readings from these sensor generated accurate values and matched the reading on the ground station. The Disaster Drone was durable and dependable to

Summary Statement

I equipped and programed a drone to zoom in to survivors of a disaster to measure cell phone signal, water and air quality and communicate with the ground station before first-responders are able to arrive.

Help Received

Ms. Najwan Naserelddin, teacher and mentor, to learn to code and engineering skills to build. Dr. Ahmad Bani Younes, SDSU Aerospace Engineering Professor, about space robotics and applications in dynamical systems and the ioT technology I applied.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Rishabh Ambavankar

Project Number

J1004

Project Title

Laser Communication

Abstract

Objectives

Laser communication is meant to solve the problem with radio wave communication in space. Radio waves degrade over long distances, can get messed with by interference, and cannot hit a single target (everyone can catch the signal). Laser communication solves all of this by using light not radio waves. It has been seen as so far the best way to communicate in space. Laser communication is based on the idea of fluctuations in the energy output of a laser, this can be read by a solar panel or other special equipment. When I was building this I created a simple circuit, on the transmitting end, made of an input, an amplifier, a transformer, batteries, and a laser. On the receiving end I put a solar panel, capacitor, and an amplifier. I concluded by saying that this type of technology will be very useful in the future and that it can be built very easily.

Methods

2 Amplifiers
Wire
Laser
Batteries
Solar panel
Cardboard box
Microphone

Results

Laser communication is based on the idea of fluctuations in the energy output of a laser, this can be read by a solar panel or other special equipment. To create these fluctuations you need to limit the power going to the laser at certain times. I watched the flow of electricity and saw the energy output measured by a multimeter to see if each part of the machine works. I built this using a simple circuit. It starts with the input like a microphone or music, then it goes through an amplifier so the signal can be amplified and read, then it goes through the transformer to boost the voltage, after that it passes through 2 LEDs (this makes sure that their isn t too much power and the laser doesn t melt), then it goes through the batteries which push the power to the laser, but it gives power depending on the message, so the signal can be carried through the fluctuation of power. In the receiving end the solar panel catches the signal, sends it through a capacitor, and finally through an amplifier so it can be read and spoken (the amplifier also acts like speaker).

Conclusions

Summary Statement

My project is about trying to send sound at the speed of light through lasers.

Help Received

Vijay Ambavanekar and Meredith Sievers

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Noah Barlahan; Ryan Co; Jeremy Flint

Project Number

J1005

Project Title

Making Hydropower More Environmentally Friendly

Abstract

Objectives

The purpose of this project is to make hydroelectric generators more environmentally friendly and contribute to energy production. The U.S. gets 81% of its energy from fossil fuels, which contribute to air pollution and climate change. Hydropower is one way to become less reliant on burning fossil fuels for energy. However, dams currently harm downstream ecosystems, emit 403 metric tons of methane every year, and prevent 97% of fish from reaching upstream breeding grounds due to sedimentation, still water, stratification, and pond scum. Our hydropower design should be able to convert 75% of the potential energy into electricity, not harm the environment, and work the same or better when scaled up and under the force of water.

Methods

We constructed our prototype using wood for the fish ladder. Our turbine is made of 3D printed materials, Legos, a coil of copper wire, magnets, cardboard, and a plastic tube. Our generator works by converting rotary to linear motion. When the water wheel spins, another wheel (Wheel 2) that is connected to it by a shaft and located on land also spins. When Wheel 2 spins, a coil of wire moves back and forth over a tube with magnets inside. Since we couldn't test our design in water (cardboard and wood parts), we first tested the speed of just the water wheel under a faucet at various rates (15, 25, 47, 69, 200 mL/s). We then mimicked the revolutions per second (rps) generated by these rates (0.6, 1.4, 1.7, 2.1, 3.4 rps) by turning the water wheel with a drill. We recorded the voltage (V) and current in amps (I) produced from our generator using a voltmeter. Finally, we used the formula: P=I*V to find out the Energy (P in mJ/s) produced. We calculated Gravitational Potential Energy using the formula GPE = m*g*h, where m is the mass of water, g is gravity, and h is the height of the water above the wheel.

Results

The generator converted 17% of the potential energy at 15 mL/s of water, 33% at 25 mL/sec, 22% at 47 mL/s, 19% at 69 mL/sec, and 11% at 200 mL/s (average of 3 trials each). This means our device was on average 20.4% effective, far off from the modern day dams which are 90% effective.

Conclusions

Our project met most of our criteria, but fell short in generating electricity. On average, our generator was able to convert 20.4% of the available energy into electricity. This is not as efficient as modern day generators (90%). However, we can add gears to increase the number of times that the coil moves back and forth for one rotation of Wheel 2. If improved, our design can revolutionize the green energy industry and

Summary Statement

We created an environmentally friendly hydroelectric generator that will be able to match those that are used today.

Help Received

We designed, created, and tested our prototype ourselves, but obtained help form internet research on creating an electric generator.

Name(s)

Harjaisal Brar

Project Number

J1006

Project Title

A Novel Approach to Detecting Fires

Abstract

Objectives

Fires are one of the deadliest natural disasters. Employing an efficient fire detection system can help save lives and property. This experiment is testing the efficacy of a fire detection system which employs an Arduino and a temperature sensor. The question is that can this Arduino-based fire detection system decrease the response time to fires. The hypothesis is that this fire detection system will decrease the response time to fires.

Methods

To conduct the experiment, first the Arduino 1.8.8 software, the Dallas Temperature and OneWire files were downloaded to the Arduino library. The code was created in the software editor and was uploaded to the Arduino IDE. The Arduino was then wired to the temperature sensor. The temperature was monitored on the serial monitor in the Arduino software. The temperature sensor was dipped in water heated to 130 degrees. The time taken by the sensor to heat from room temperature to 120 degrees was recorded. The experiment was repeated two more times. The data was analyzed. The control was the response time to major US fires.

Results

In this experiment, it was observed that the response time was much less using the fire detection system employing Arduino and temperature sensors compared to the control major US fires (The Camp Fire, the Woolsey Fire, and the Hart Lake Fire). With this detection system, the average time was 150 times less than the detection time for the Camp Fire, about 14 times less than the detection time for the Woolsey Fire, and about 164 times less than the detection time for the Hart Lake Fire. This shows that this Arduino-based fire detection system drastically reduced the response times.

Conclusions

In conclusion, the hypothesis was supported. This technology is viable for use in the future in the firefighting industry. In future, a system can be designed to link all these units and spread them in wilderness and connect to the monitors in fire stations or police stations. A fire detection system using drones and a color sensor, or a carbon dioxide sensor can be designed as well. Docking points for these drones and charging them using solar panels can further help. Finally, a system design that alerts when the temperature is above a baseline in an area can help locate areas that are at risk of a fire.

Summary Statement

I created and tested an Arduino-based fire detection system employing a temperature sensor.

Help Received

I would like to thank my Mom and Dad for supervising and providing me with money so I could buy supplies. I would also like to thank my science teacher, Mr. Rathe, for guiding me.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Noah Cain

Project Number

J1007

Project Title

Making Air Quality Monitoring More Accessible and Affordable through IOT Devices

Abstract

Objectives

My goal was to create a portable, accurate and affordable air quality sensor, that integrates with a fast loading web app, that runs on any device, in order to assist people in monitoring their air quality. Air quality sensors today are not necessarily designed for the general public, with most manufacturers intending that scientists are using the sensors, and with that, the sensors are complicated to use, expensive. My goal is to increase the role of citizen scientists in environmental monitoring and study. This approach is adaptable to other uses beyond air quality, where efficiency, offline local monitoring as well as public data sharing, and a comprehensible user interface are required.

Methods

I built an open source air quality sensor, using an Arduino Nano, that was modified to have a ch340 USB control chip, so that I could have more control over the Arduino Nano, and not have to use closed source drivers. A Shinyei ppd42ns measures PM10 & 2.5. I calibrated by running it next to a PurpleAir PA-II and modified the potentiometer until the data was within 0.02 points of each other. I used a DHT11 sensor for temperature & humidity. I developed my own software for collecting and comparing the data and published my app to the Google Play Store. I also developed the custom ch340 chip drivers, and developed my own Linux distribution for the raspberry pi that boots quickly, runs my data collection software, and provides advanced networking tools for interfacing with the app. For performance, I used the Google Lighthouse performance test tool, and ran it using my customized device configuration.

Results

The total price is $32.99, with the most expensive component being the $21.99 PM sensor. The application scores a 96 in performance on Lighthouse, and a 100 in accessibility, best practices, and SEO. It also works offline on most modern devices. The sensor is still too large for small pockets, but is certainly more portable than it s 7x6x5 inch predecessor and a smaller case could be printed. It is accurate within 2 data points of the PurpleAir (for PM 2.5).

Conclusions

The application functions well, but I plan to rewrite it, to move away from its legacy codebase, so that I can bump its 96% performance score to 100%. Along with rewriting the app, I would like to redesign the sensor case, so that is is more portable and ergonomic and upgrade the sensor module to a Plantower PMS 5003.

Summary Statement

I built a portable, accurate, and affordable air quality sensor, and an efficient web app, that runs on any device, in order to assist and connect people monitoring air quality.

Help Received

None. I assembled the sensor and developed the application by myself. I conducted all testing and compared the data by myself.

Name(s)

Basim Cheema-Sabir; Katherine Robertson; Michael Shen

Project Number

J1008

Project Title

A Cost-Effective Prosthetic Hand for Transradial Amputees

Abstract

Objectives

The goal for the project was to create an inexpensive prosthetic hand for transradial amputees capable of performing daily tasks. The team wanted the prosthetic hand to be user-friendly and proportional in size to a human hand.

Methods

All the prototypes used 3D printed pieces designed in Fusion 360. The first two prototypes used a glove to control the prosthetic hand. The glove would be worn on the user s functional hand while the prosthetic hand would be worn on the user s residual limb. Using flex sensors, an Arduino Nano detected which fingers bent. Using this information, the glove would send data to the prosthetic hand via bluetooth. When the prosthetic hand received this information, another Arduino Nano bent the appropriate fingers. In the first two prototypes, the fingers bent when continuous N20 motors pulled fishing line. The position of the fingers in these two prototypes were detected by potentiometers. In the third prototype, the continuous motors were replaced by MG90S servos, so there was no need for potentiometers. Rather than a glove controlling the prosthetic hand, the third prototype used a voice recognition module paired with an Arduino Nano. By recognizing specific vocal patterns, the prosthetic hand performed specific gestures. For the experiment, the independent variable was whether the functional hand or prosthetic hand were being used. The dependent variable was the time it took for hand to complete each task. The testing procedures involved the hands performing diverse daily tasks. The control was the time it took for the functional hand to perform the tasks. Katherine used her hand and the prosthetic hand for the testing while Michael timed and recorded the results and Basim videotaped the procedures. All programming was done using the Arduino IDE. Some code was written as inspiration from other sources. The code for the bluetooth modules used knowledge from code posted by Riftliger, the code for the voice recognition used knowledge from JiapengLi, and the team learned how to program the Arduino to work with servos by looking at code from Scott Fitzgerald. However, the entirety of the code wasn't modified, instead, the team merely used simple statements

Results

The first prototype was a failure because it was unable to close or open its fingers. For this reason, it was not put through the testing procedures as the team knew it didn't work. The second prototype was put through the testing procedures, and it succeeded at three out of four procedures. Out of the three procedures it completed, the time difference for each task between the prosthetic hand and the functional hand was on average 27.55 seconds. For the third prototype, testing is ongoing. However, the third prototypes has

Summary Statement

The team successfully created a prosthetic hand for transradial amputees that performed everyday tasks. The cost of the hand was a mere $200, this cost is a fraction of the cost of the current functional hands on the market.

Help Received

The programming, 3D modeling, research, and construction of the prosthetic hand were done entirely by the team.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Joseph Dadlez

Project Number

J1009

Project Title

Engineering an Independent Robotic Sidewalk Weed Killer

Abstract

Objectives

GOAL: My objective was to engineer and program an automatic self-driving robot that can destroy weeds with a minimal amount of weed killer.

Methods

METHODS/MATERIALS:
Laptop computer, Makeblock software (Scratch coding - I developed by own code for independent line-following, collision avoidance, and weed-killer delivery), arduino board, Makeblock parts (I used a variety of Makeblocks kits to design and create my own unique robot which included ultrasonic distance sensor, light and dark line following sensor, and 3 servo motors.) wood (I had to build a wooden basin and drill holes the proper size for the salt delivery bin), and black electrical tape for creating a line to test the robot on.

Results

RESULTS: My robot is coded to independently follow a 4-cm. line, detect a break, and deliver salt, killing the weed, and continue on. This robot is coded to independently turn and follow curves. It is also able to detect an object in front of it, thus stopping and avoiding a collision. Multiple iterations (apprx. 20+) in coding and building were done until the robot could reach the objectives 99% of the time.

Conclusions

CONCLUSION/DISCUSSION: After approximately 20 trials, I reached my goal of successfully building a functional robot that independently follows a line, delivers salt at line breaks, and does not collide with anything. Future iterations need to include color or shape recognition in order to reach to goal of weed killing independently. I also need to engineer a waterproof cover, a docking station, and an app to monitor the robot. This robot will save time and labor for consumers, as well as potentially reduce the amount of toxic weed-killing chemical run off.

Summary Statement

I invented and programmed an automatic self-driving robot that independently follows a straight or curved line, delivers salt at line breaks, and can destroy weeds with a minimal amount of weed killer (salt) without collisions.

Help Received

Thank you to my dad for buying robotic parts, and my mom for editing my report.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Hrishikesh Deshpande; Adarsh Krishnamurthy; Sachit Murthy

Project Number

J1010

Project Title

FiresNearYou: Detecting Wildfires Using Smoke Sensors

Abstract

Objectives

The objective of this project is to create a widespread smoke detection system that can rapidly detect wildfires while consequently alerting firefighters and citizens about the imminent threat of forest fires.

Methods

We used an Arduino circuit and its compatible modules, as well as a computer with integrated Arduino "C" language. We used the computer to write our own program for the system. We also utilized the MIT App Inventor to develop an application that is compatible with our Arduino system.

Results

For a distance test, we had a safe median of 2 inches (the smoke sensor detection range was about 2 inches). However, when we pushed to 3 inches, only one trial out of three was successful. We then scaled this according to our project real-time ratio(24) for a total of 4 feet around the sensor. We next conducted a timed test; our criteria for this was 30 seconds. On the contrary, all of our timed results fell under 5 seconds (4.36, 3.8, 2.62).

Conclusions

All points considered, the wildfire smoke detector is an ideal method for rapidly detecting and alerting people about the status of wildfires. This implementation is not only extremely effective, but simple to scale and manage as well.

Summary Statement

This project is based on an innovative and widespread smoke detection system that can rapidly detect wildfires while consequently alerting firefighters and citizens about the imminent threat of forest fires.

Help Received

We were assisted in this project by our mothers and fathers, along with our local Folsom Fire Department and its Division Chief, Mr. Ken Cusano.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Alexander Diaz-Cruz; Mylah Punla

Project Number

J1011

Project Title

Sensored White Cane

Abstract

Objectives

Our goal is to help the visually impaired feel safer when using our cane rather than a regular white cane.

Methods

Wood dowel, paint, tape, glue gun, hot glue, breadboard, charger, portable charger, 3 sonar sensors, wires, solder, and a soldering gun.

Results

Several trials were tested to make sure our cane worked better than the regular white cane. We had our friends put blindfolds on and test out the white cane in a maze. The sensored white cane had improved the time that they finished the maze. In conclusion, the sensored white cane helps the user feel safer and move quicker while walking.

Conclusions

After many trials, we had found that the sensored white cane was much more accurate and easy to use. The cane was much more accurate than the regular white cane. The cane vibrates when you get close to something. In conclusion, the sensored white cane helps the user feel safer while walking.

Summary Statement

The Sensored White Cane was created to help assist visually impaired people feel safer while walking.

Help Received

None, we created and experimented our project be ourselves.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Ron Freeman

Project Number

J1012

Project Title

ZeroAQI: An Affordable, Portable, Open-Source Air Particulate Matter Sensor

Abstract

Objectives

Recent wildfires resulted in unhealthy and hazardous air quality conditions with the recommendation to shelter in place. However it was uncertain to me if the air quality in my home or public locations in my neighborhood were safe. This led me to develop ZeroAQI, with the objective to prove the feasibility of a low cost Air Quality Index particulate sensor system for reporting the concentration of particulate matter smaller than 2.5 microns and the goal of creating a portable, affordable, and open-source system.

Methods

The Raspberry Pi s GPIO interface cannot handle the 5v logic levels generated by the sensor. A voltage divider created from three 10K Ohm resistors level shifts the 5v logic to 3.3v logic. To read data from the sensor, code is imported from the PIGPIOD example set. The user interface is based on the Flask Python web server framework. As an additional user interface and to make the project more interactive, I implemented a chatbot with a command interaction list via the telegram chatbot API. For portability, I utilized a 5v 2.1 A phone battery to power the entire system for several days per charge. To test the accuracy of the system, I compared results of the ZeroAQI AQI-PM2.5 with the Bay Area Air Quality Management District Redwood City Regional Station AQI-PM2.5 as reported by airnow.gov.

Results

I found that ZeroAQI has a 12% accuracy when compared to the regional station allowing it to deliver to the user accurate enough results to make an educated decision on the health of the air.

Conclusions

ZeroAQI has a few limitations. The controller board relies on an internet connected Wi-Fi network to be able to communicate. This can be solved by connecting to a mobile hotspot, but it is not perfect. The particle sensor relies on still dry air to function, rendering it useless in windy or wet conditions. The sensor is also vulnerable to sunlight, as it functions by detecting reflected infrared light from particulate in a darkened chamber. Clean healthy air is crucial to life and everyone should be able to access localized and instant air quality measurements to make informed decisions for their health and safety. ZeroAQI's dedicated GitHub page with source code and build instructions facilitates ease of assembly. ZeroAQI's $23 affordability and portability is useful in many applications such as detecting microparticles from 3D printers and other unexpected polluters.

Summary Statement

I developed ZeroAQI, a $23 portable, open-source personal air particulate matter sensor system that is accessible to everyone.

Help Received

I would like to thank my parents for purchasing the parts I identified as necessary for the project.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Sindhu Gokaraju; Sneha Gokaraju

Project Number

J1013

Project Title

The Dangers of Technology: How Much Radiation Do Household Devices Emit?

Abstract

Objectives

The purpose of this science fair project is to determine the amount of radiation that different types of household devices emit.

Methods

This project tested ten devices (such as a microwave, cell phone, smart speaker, wireless router, etc.) in thirteen different scenarios (like active/idle states, a cell phone on call, etc.). The radiation readings were taken by a device called a RF Meter (Acoustimeter AM-10) at various distances. Base readings were taken before turning the devices on and subtracted later from final readings.

Results

During this experiment, it was discovered that the wireless router emitted the most radiation while the Amazon Firestick (a streaming device) emitted the least amount of radiation. A common theme found was that the farther away the device was, the less amount of radiation was detected. The devices that are the most commonly used such as the cell phones and laptops emit some radiation, but not considered a lot when compared to a wireless router or microwave. The devices that were idle such as the idle smart speaker and idle cell phone with no Wi-Fi and Bluetooth emitted the least amount of radiation compared to their active forms.

Conclusions

It was determined that the results followed the inverse square law, which states that the amount of radiation is inversely proportionate to the square of the distance from the device. The experiment proved that the wireless router emitted the most harmful levels of radiation compared to the other devices at all of the distances.

Summary Statement

When measuring the radiation of household devices at certain distances, it was proven that the further away the devices were, the less amount of radiation was detected.

Help Received

Our professional contact, Ms. Liz Menkes, an E.M.R. specialist, helped us by answering our interview questions and reviewed our procedure and results.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Sandul Henry

Project Number

J1014

Project Title

Which Type of Capacitor Charges the Fastest?

Abstract

Objectives

The objective of this experiment is to see which type of capacitor charges the fastest.

Methods

3 types of capacitors, breadboard, 1 resistor, digital multimeter, power supply, stopwatch and wires. Tested time taken to charge capacitor to maximum capacity using 1.5 volts as an input.

Results

Each capacitor was tested 3 times, and an average time was calculated.

Conclusions

A mylar/film capacitor charged faster than a tantalum or ceramic capacitor. It was concluded that this is because the mylar/film capacitor's metal plates, inside the capacitor, had the largest surface area and the dielectric was thinner.

Summary Statement

As measured by the time taken to charge the capacitors, it was concluded that not only the material, but other internal features made the difference.

Help Received

I did all the research by myself, and used the equipment in one of the electronic labs at the California State University, Northridge, under the watchful eye of the electronic tech.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Braedyn Hutchison

Project Number

J1015

Project Title

Powered Infrastructure: Reducing Electric Vehicle Range Limitation and Charging Downtime via Resonant Inductive Coupling

Abstract

Objectives

The objective of this project was to determine the feasibility of reducing the range and charging downtime limitations of electric vehicles by embedding electrical infrastructure for wireless power transfer via resonant inductive coupling into automotive transportation infrastructure. A key determinant of feasibility is the degree to which wireless power transfer between circuits that are in relative motion is equivalent to wireless power transfer between circuits that are relatively stationary.

Methods

Built and optimized primary (transmitter) and secondary (receiver) circuits for wireless power transfer via resonant inductive coupling using inexpensive and widely available electronic components. Embedded primary circuits into a model road. Embedded secondary circuits into a model vehicle. Measured distances over which wireless power transfer was effective. Built motorized structure to move the model vehicle over the model road at varying speeds. Tested both instantaneous power transfer and total power transfer over time through multiple trials for multiple movement cases (stationary, slowly moving, quickly moving).

Results

Results for instantaneous power transfer and total power transfer over time revealed that, as hypothesized, the degree to which the primary and secondary circuits are in realistic relative motion does not significantly affect the efficacy of wireless power transfer via resonant inductive coupling. Further, it is more likely than not that observed differences in power transfer resulted from imprecision in test design, instrumentation, or a combination of both.

Conclusions

Construction of circuits to enable wireless power transfer via resonant inductive coupling was straightforward and inexpensive, as was construction of a realistic model wherein primary circuits were embedded into a road and secondary circuits were embedded into a vehicle. Tests revealed that power transfer between the model road and the model vehicle in realistic relative motion was similarly effective to power transfer between the model road and the model vehicle when relatively stationary. All indications suggest that the proposed powered infrastructure could significantly improve the utility and appeal of electric vehicles by increasing range and reducing charging downtime, and thus help achieve the benefits associated with their increased use relative to fossil-fueled vehicles.

Summary Statement

I showed that wireless power transfer via resonant inductive coupling between primary road circuits and secondary vehicle circuits could charge batteries in a moving electric vehicle, and thus reduce range limitation and charging downtime.

Help Received

None. I designed and built the equipment and circuitry myself, as well as designed and conducted the experiments myself.

Name(s)

Neel Jagdish; Siddharth Phatak

Project Number

J1016

Project Title

Blue Light Exposed

Abstract

Objectives

Our objective was to find out which mobile device produced the most blue light. We used a few makes and models of cell phones and tablets for this projects. There is evidence that blue light emitted from devices such as cell phones and tablets are harmful to human eyes. We were curious to find out which devices could be more harmful than others.

Methods

Blue colored film, Magnifying lens, Photo-resistor and Multi-meter.
Constructed a cardboard box to house the lens and the photo-resistor (at the focal point of the lens). Tube with blue colored film on one end. Placed 7 different mobile devices in front of the blue film, turned the devices to max brightness, and displayed white image on its screen. Measured the resistance generated in the photo-resistor by the blue light.

Results

Performed 10 trials, using the 7 devices, and then analyzed the data. We measured the amount of blue light emitted from the mobile devices by measuring the resistance in the photo-resistor in Kilo-Ohms. More the resistance less the amount of blue light. After doing the experiment with multiple devices and multiple trials we found out that the iPhone 7 produced blue light the most with an average measurement of 143 K-Ohms. The mobile device with the least blue light was the Fire HD with an average reading of 536 K-Ohms.

Conclusions

In the sample of 7 devices that we tested, the iPhone family of phones produced the most blue light while Fire tablet produced the least.

Summary Statement

As measured by the resistance in the photo-resistor, the iPhones produced the most blue light while Fire tablet produced the least.

Help Received

Kanchan Bhandare (Merryhill School); Anand Phatak (Siddhart's dad); Jagdish Arumugam (Neel's dad)

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Jade L'Heureux

Project Number

J1017

Project Title

Infinity Rover

Abstract

Objectives

My objective was to build a car that would run on itself using a generator attached to the axle. My goal was to have it run forever using its own power.

Methods

Materials:
1. A radio controlled (RC) car with a battery   2. A DC motor generator   3. 20 alligator clips   4. Module boost USB. 5. Wire extenders. 6. Rubber band. 7. Soldering iron. 8. Hot glue gun.

Method:
Buy all the materials listed in materials. Glue the generator to the car. Solder the wires to the module boost USB and then attach it to car. Charge the batteries. Test the car without the generator three times. Use a rubber band and put it around the wheel and the generator. Strip the wires on the battery and attach them to the charger. Put the charger in the module boost USB. Test the car with the generator three times.

Results

For my science summit project I rebuilt a radio controlled car by attaching a generator. The generator was powered by a belt attached to one of the car s axles. My hypothesis was that the generator would increase the length of time the car would run on a single charge. This did not turn out to be the case. Instead, the energy it took to run the generator (friction, etc) was more than the power generated. So, it ended up running for a shorter period of time.

Conclusions

For my science project I decided to build a car that partially runs on itself using a generator attached to the rechargeable battery. I tested the car without the generator to see how long it would last on a single charge. I also tested the car with the generator to see how long it lasted. I used a RC car I bought online. I put the car on a stand and let it run until it stopped. When it stopped I looked at the time and recorded it. Although it turned out that my hypothesis was incorrect and the generator did not increase the battery life , I still learned a lot.

Summary Statement

My car will help the environment by being powered by itself and not having to use gallons of gasoline.

Help Received

My STEM teacher Mr. Reeder let me use his soldering iron.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Nicholas Lee

Project Number

J1018

Project Title

Stop, Slow, Go!

Abstract

Objectives

My goal is to develop a traffic light system that will do just that while ensuring the safety of lives and properties at the intersections of the roads. I intend to combine commercial softwares and sensors built under the surface of the road to make intersections smarter. My hypothesis is to make the current traffic light smarter so that the flow of the traffic will be quicker. The detector could do this by sending a message (by program) to the Central Processing Unit (CPU) and saying, Hey, there is a car here, turn on the green left turn signal! And then the output of PLC would turn on the green left turn signal.

Methods

Colored LEDs (Light Emitter Diodes) are used to indicate the actual colored traffic lights. A micro-logic hardware producing a 24 DC (Direct Current) voltage is used to energize these LEDs for a safe required electrical operation. One kilo-Ohm, one Watt-resistor is connected in series to each LED to split the produced 24-volt output from the micro-logic to safely operate the LED which requires no more than 2.5 volts to operate. Small switches are used in place of metal detectors cut and placed in the asphalt/concrete for left turns to determine if any car(s) are waiting to make a left turn. When there is a car waiting to make a left turn on south or north of an intersection, the switch (metal detector) picks up the existence of the car and input that to the CPU (Central Processing Unit). Then, the green light allows left turns from south to west and from north to east while the green light allows right turns from east to north and from west to south. These lights will turn to yellow and then to red after the timer runs out. When there is a car waiting to make a left turn on east or west of an intersection, the green light allows left turns from east to south and from west to north while the green lights allows right turns from south to east and from north to west. These lights will turn to yellow and then to red after the timer runs out. The green lights allow cars to go straight when the left turn lights turn Red. An additional timer is added to the program which extends the time for straight through from south to north as well as north to south if there was no left turn from south to west and/or north to east. Likewise, another timer perform the same function for extending the time for straight through for east to west and west to east in the case there was no left turn from west to north and/or east to sout

Results

This innovation worked, but can still be made better. My traffic light model can still be made better and will need some future fixes. A copy of the program controlling the traffic light along with its data such as input/ output and timers will be attached to the poster. Active inputs/outputs and timers are highlighted in green

Summary Statement

My project is a model of a traffic light on oak plywood that was programmed using Ladder Logic on a computer which was connected into a series of wires to the PLC that shows how a traffic light works and how we can innovate it.

Help Received

I designed the model, programmed my traffic light, and assembled all the components onto the model. My dad helped me with connecting the series of wires from the PLC(Programmable Logic Controller) to the LED lights/switches. I learned how to program this language from a teacher, Haj Mohamad, at Boston

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Julia MacAvoy

Project Number

J1019

Project Title

Miniature Wireless Charging: The Future of Charging Hearing Aids

Abstract

Objectives

The goal of my engineering project was to create a functional miniature wireless charger that could be modified for a lithium-ion button cell battery in a hearing aid. Currently, hearing aids batteries are disposable zinc-air button cells that contribute to e-waste and are required to be changed often. I use hearing aids and understand their limitations so I wanted to engineer for the deaf and hard-of-hearing community.

Methods

To transmit power, both receiver and transmitter circuits need iterative designs. The transmitter circuit first uses a PICAXE microcontroller that I coded to generate a 100 kHz (resonant frequency) square wave at 5V. This is necessary to run the coil so that it produces the electromagnetic field to transmit power. The code I used to run the PICAXE was found on a free online source, then slightly modified. From the PICAXE, the signal is sent through a transistor circuit that turns on a MOSFET transistor. The MOSFET turns on and off from 0 to 12V, producing the square wave. Finally, the square wave is sent through the transmitter coil and a 0.1uF capacitor in parallel to produce the electromagnetic field and complete the transmitter circuit. The receiver circuit starts with a bridge rectifier after the receiver coil to convert the incoming AC into DC. Then, a series of capacitors and a linear voltage regulator regulate the voltage to 5V which leads to an LED that turns on when power is transmitted. All of the prototyping was done on breadboards and then soldered on PC boards.

Results

After five design iterations, the miniature wireless charger was able to transmit 15-20 watts at a maximum distance of 3 mm. Throughout the design iterations, the receiver circuit stayed very similar, but the transmitter circuit required many changes. In the transmitter circuit, one challenge was designing a circuit to allow enough voltage to turn on the MOSFET. Finally, a transistor circuit was used, and many components were traded for similar ones that would perform better in different conditions.

Conclusions

The amount of voltage transmitted, 20 V, is quite a lot for a homemade charger and acceptable for overnight bedside charging of a hearing aid. On the downside, most coils can be at least a centimeter apart and still be able to charge. The circuit still has performance limitations. One of the major issues with the charger is the inductive kickback coming from the MOSFET on the transmitter side. To counteract this problem, a small heat sink was built with an aluminum block. In the future, the project would be continued by modifying it to charge a Li-ion battery and the receiver control board would be customized to fit onto a hearing aid.

Summary Statement

I created a miniature wireless charging circuit that was designed to eventually be modified for a Li-ion button cell battery on a behind-the-ear hearing aid.

Help Received

The adult help received was purchase of all electronics parts on parents credit card and some guidance from a robotics coach, Mr. Saidin. When I was working on my final design, he gave some tips on soldering and also allowed use of his oscilloscope.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Affan Mala

Project Number

J1020

Project Title

LiFi, A Bright Idea: Using Sound Output to Analyze the Effect of Distance on Data Transmission through Light Waves

Abstract

Objectives

Using sound output to analyze the effect of distance on data transmission through light waves.

Methods

To do this, I first made a Li-Fi model (Li-Fi is a wireless optical networking technology that uses LEDs for data transmission.) imitating real Li-Fi concepts which consist of a transmitter and a receiver. The transmitter in my model includes an LED, a resistor, wires, a 9v battery, and a phone. The receiver includes a solar panel, a PAM 8403 amplifier and a speaker. I then used a ruler to measure 25.4cm, 91.44cm, 182.88cm, 985.36cm. then I measured how many lux were hitting the solar panel, the sound produced in decibels and the width of the light beam from each distance.

Results

As we increased the distance between the transmitter and receiver, signals started to weaken. However, I could still get strong signals by using a small 10mm LED to transmit signals to distances of up to 985.36cm and still be able to receive sound up to 55 Db.

Conclusions

I used a small circuit and 10mm LED and I was able to transmit audio to as far as 975.36 cm (10.6 yards). Imagine how good Li-Fi would work if it were outfitted in LEDs in our homes. Imagine networking speeds of 224 Gbps. If I were to have the facility and the equipment, I would have done my project on a grander level by transmitting video and recording the (DTR).

Summary Statement

I measured the efficiency of data transmission through light waves by transmitting data from various distances to see how far I can transmit via a 10 mm led and recorded the output in decibels

Help Received

This project was done entirely by myself and was based on research I performed. All the experiments, research were performed by myself without any help.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Colin Manfredo

Project Number

J1021

Project Title

Can a Low Head Hydroelectric Turbine Be Placed in Weirs to Create a Substantial Amount of Electricity?

Abstract

Objectives

The purpose of this project is to create enough usable energy from my hydroelectric weir design to be used throughout our California stream and canal systems as a viable alternative source of clean energy. This project was very close to reality in California but was pulled due to rising oil prices. I decided to prove that through minimal head of 3.5 feet and 5 feet one can create enough electricity through a small scale model and numerous trials. After researching and meeting with Jim Wegley from Keller/Engineering, I showed how this could theoretically be put to place in the Kings River at different weir types. With the flow rates of the Kings River and using my three hydroelectric turbine designs, the project could potentially save homeowners and the state of California hundreds of thousands of dollars annually.

Methods

Created a small scale model that shows elevation drops of 3.5 feet and 5 feet. Measured voltage, amperage, slope, and flow rates through numerous trials. Met with Keller/Wegley Engineering on designs and theoretical outcomes for the Kings River. Proved that a low-head hydro-electrical turbine could produce energy at 3.5 feet head and 5 feet head. Designed three low-head hydroelectric turbine models that could be used at different existing weirs in the state of California, all simulating a drop of elevation of 3.5 feet or 5 feet. Monitored flow rates of Kings River and visited different types of weirs. Created a theoretical example of potential savings using data from the Kings River.

Results

After numerous trials found that a small scale hydroelectric turbine with head of 3.5 feet and 5 feet will produce electricity with minimal flow rate. Calculated amperage, voltage, slope, and flow rate. Proved that energy can be produced at a small scale with minimal head and flow rate. When converting data taken from the Kings River, my theoretical example shows substantial savings of 2040 kWh per day, which is enough hydro power to serve approximately 70 homes per day. Typical rivers in California have numerous weirs and could use several turbines at each weir depending on the existing design. Designs are created for all different types of weirs at low-head ranges.

Conclusions

This project idea came close to happening in California but was stopped due to design, money issues, and increased oil prices. I've proven that my 3 designs could work at all types of different weirs in California. My small scale design was efficient enough to produce electricity, proving that there is enough head at 3.5 feet and 5 feet in canals and at a stream's weir to produce substantial amounts of clean energy.

Summary Statement

The purpose of this project is to create enough usable energy from my hydroelectric weir design to be used throughout our California stream and canal systems, where there is a drop in elevation, as a viable source of clean energy.

Help Received

Jim Wegley Engineer for Keller/Wegley Engineering

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Jessica McWilliams

Project Number

J1022

Project Title

Crash Avoidance System

Abstract

Objectives

Design, build, and code a remote-control car that automatically stops when it senses an object in front of it. The automatic stopping should engage when it senses an object that is half as tall and a fourth as wide as the car.

Methods

Three candidate sensors (Maxbotix, Ultrasonic, and VL53LOX) were obtained and tested using a non-motorized platform. A prototype vehicle was made by wiring into a remote-controlled car, attaching a sensor to the front of the car, and programming a controller to turn the car s motor off when an object is detected a meter away from the sensor. I observed that the car coasted forward after the motor was turned off. The prototype was revised by adding two relays that made the car s motors turn in reverse before turning off when an object was detected 20 cm away. This new prototype was tested using wall heights and positions, and cylinder diameters and positions with three sensors.

Results

With the VL53LOX sensor the car stopped prior to hitting walls 5.7 cm or taller, the Maxbotix sensor avoided walls as short as 3.8 cm, and the Ultrasonic sensor could detect walls as short as 0.6 cm. The VL53LOX sensor stopped for a cylinder 3.8 cm or wider and offset no more than 5.1 cm from the center of the sensor. It could avoid a wall as long as the edge of the wall was offset no more than 4 cm. The Ultrasonic sensor could only reliably detect a cylinder that was 6.4 cm in diameter and offset no more than 5.1 cm. It could only avoid a wall with a portion directly in front of the sensor. The Maxbotix sensor could always detect cylinders 3.8 cm in diameter and sometimes 1.3 cm in diameter and stop before a cylinder offset as far as 12.7 cm. It could detect a wall with an edge offset 3.75 cm and sometimes 7.5 cm.

Conclusions

My design met the project objectives. The VL53LOX and Maxbotix sensors stopped the car before hitting a cylinder one fourth the width of the car. The Ultrasonic sensor automatically stopped prior to hitting a wall five percent the height of the car. The Maxbotix sensor could detect objects offset as far as the edge of the car. For maximum performance, all three types of sensors could be mounted on the front of the car.

Summary Statement

I modified a remote-controlled car, adding a proximity sensor and additional control circuitry, so that it automatically stops when it senses an object in front of it.

Help Received

I built the car, conrol circuit, and wrote the code by myself. I got help from my dad learning the basics of coding and understanding how some of the electrical componants work.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Abhiram Mogali

Project Number

J1023

Project Title

IOT Based Fast Wildfire Detection System

Abstract

Objectives

The goal of the project is to detect a wildfire within first 5 minutes and send alert messages to the fire department and emergency service officials. If a wildfire can be detected quickly, then human lives and property losses can be prevented. Continuous monitoring of a fire outbreak is needed in critical fire-prone forest environments. Placing a smart sensor system every square mile allows an alarm to be generated as soon as a small fire ignites anywhere within this monitored area. The received alarm will enable a dispatch center to quickly mobilize a coordinated response, thereby reducing the probability of this small fire growing into a devastating wildfire.

Methods

Raspberry Pi as host cloud PC, Arduino module as sensor connect device, rechargeable battery, 3 different sensors to capture temperature, flame, smoke readings. Miniature WiFi/Zigbee module for wireless communication. Installed "MeshCentral" software agent on Raspberry Pi to remotely monitor/control via IOT Cloud service. MeshCentral is a open source cloud service software managed by Intel Corporation. Tested sensor module circuits in a controlled fire environment.

Results

This design was tested in a safe and controlled fire environment. Sensors were calibrated and repeated testing trails have shown that a fire can be detected with in a minute as long as fire is within the sensor range. Fire alert messages were generated and verified over the internet. Through IOT cloud (Meshcentral) service demonstrated that sensor modules can be remotely monitored and managed.

Conclusions

In this project, the results demonstrated that a network of smart sensor modules will detect an increase in the amount of temperature and smoke in less than a minute. Using MeshCentral cloud service the wildfire alert messages can be sent to first response teams in a matter of seconds. This experimental project idea can be further expanded into full blown Forest fire detection system. When Wireless sensor networks are integrated into IOT cloud then multiple sensor modules will join the internet, this will help monitor large forest areas in California.

Summary Statement

I developed a smart wildfire detection and alerting system which can detect a fire within first 5 minutes.

Help Received

I designed and built the prototype after searching internet on techniques. My dad funded the project and my science teacher Mrs. Dina Nelson helped reviewing the results.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Kirolls Moussa

Project Number

J1024

Project Title

Wifi Signals

Abstract

Objectives

Since my project is about Wifi signals, my objective was to find what materials block a Wifi signal either entirely or partially.

Methods

In my project, I tested what materials block a Wifi signal partially, in this project I needed to use each material and put it around the router. Then I took my device and took a speed test 10 times and found an average. I used the materials of glass, aluminium foil, wood, metal, and clear plastic. I also tested the original speed 10 times with no materials blocking it.

Results

I tested the materials of clear plastic, wood, clear glass, metal, and aluminium foil. I first tested the signal without any materials. I also tested each material 10 times and found an average. First, with nothing blocking it, I got an average speed of 45.19 Mbs per second, with clear plastic, I got an average speed of 26.978 Mbs per second, which is about 60% of the original. With wood, I got an average speed of 36.48 Mbs per second, which is about 80% of the original. With aluminium foil, I got an average speed of 45.49 Mbs per second, which is about 100% of the original speed. With glass, I got an average speed of 23.39 Mbs per second, which is about 52% of the original speed. And finally, with metal, I got an average speed of 33.37 Mbs per second, which is about 74% of the original.

Conclusions

In Wifi signals, some materials block the signal slightly. So, what materials block a Wifi signal? Some slightly change it while others block the signal a lot. I first test the signal without any materials blocking it. Then I test wood, clear plastic, metal, clear glass, and aluminium foil.

I reject my hypothesis because things that cannot go through light is not faster than materials that block light. According to my graph, plastic, which light can go through, got an average speed of 26.978 Mbs per second, and with wood, it got an average of 36.48 Mbs per second.. Since the higher Mbs per second is the faster, the wood which does not go through light is faster than plastic which does go through light.

The router could have probably got a better signal all by itself when it was being tested with the wood more than when it was testing with the plastic. Also, the device could have gotten a better signal at the time that the wood was being tested. I would also add more materials and test more things like cement.

Summary Statement

My project is about Wifi signals and what materials slow it down.

Help Received

My parents, Mina and Mary supported me and helped me with my display board.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Drew Peterson

Project Number

J1025

Project Title

The Road Safe: A Box to Lock Up Your Phone while Driving

Abstract

Objectives

At any given moment there are approximately 660,000 people on the phone behind the wheel, and also 35% of teenagers text and drive even though they know it is dangerous. This is causing twenty-five percent of all car accidents, leading to the result of severe injuries and even some deaths. The purpose of my project is to make a contraption that will only allow a car to start when you put your phone in a box and close it. This is to avoid the distraction and risks of being on the phone while behind the wheel. In result, many fewer car accidents will occur and also many fewer parents will fear the safety of their kids on the road.

Methods

1 rectangular Wireless Charger (with LEDs and cable), 1 Lever switch, 1 Car to USB plug adapter, 1 Box At least 17cm ~ 13cm ~ 10cm, wire, 1 Arduino Uno, Thin Wood Sheets, Dummy Car For testing (Works using a USB fan and ignition switch.), 1 5-Volt Relay, Arduino Programming Software, QI Receiver, One Metal elbow bracket, Small one-inch relay.

Results

During the process of collecting data, I discovered the majority of the data was successful. In the testing phase, the box had no issues due to the electronics, and it didn t break since it was finally put together proving the durability of the design is sturdy and would last a long time in regular use in a car. According to the data that I collected the only issue that appeared during the data collection phase was user error and not the box itself once again probing the box is built well. The average percentage for success is 96.25% chance leaving only a 3.75% chance of fail that most likely will be user error.

Conclusions

Through my engineering process, I have discovered how to use a wireless charger LED connected to an Arduino with a switch to start a car. The way the box works is by having wires connected to the LED that turn on when the wireless charger is charging then lead those wires to an Arduino. The Arduino is programmed to sense when a voltage is flowing from the led then allow voltage to flow through the car. Then before the wires get to the car there is a switch that only is closed when the box is closed. This box could help make the road even safer and save many lives. With this box hooked up in a car, it makes the risk for drivers to text on the road disappear. I had some setbacks while building this project but in the end, I made it all happen successfully.

Summary Statement

In my project I made a box to get rid of the issue of texting and driving, the box makes it so the car can only turn on when a phone is placed inside the box, starts charging, and is closed.

Help Received

I designed and built the box myself, but I got help understanding how to program and understand how to use some of the components from my dad and older brother.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)	Project Number
Adhip Raghunathan	J1026

Project Title

Novel Electrochromic System to Regulate Internal Lighting

Abstract

Objectives

The objective of this project is to create a smart window to maintain indoor light levels within 20% of 45 lux when external light levels are between 150 and 700 lux. This system would automatically increase the opacity of a window to prevent an indoor space from being excessively bright from direct sunlight. Although this system could be recalibrated to maintain any light level, approximately 50 lux is recommended for most indoor spaces by National Science Foundation.

Methods

A test apparatus was constructed to enclose a small volume, such that all internal light had to enter through a window. Two layers of insulated electrochromic film were carefully layered together and placed over the window. A photoresistor was placed outside the test apparatus to measure external light levels. Similarly, a photoresistor was placed inside the test apparatus to measure internal light levels. Based on the lighting levels, an Arduino microcontroller and relays turned the smart windows on or off. Data was collected from the Arduino serial monitor and exported to an Excel spreadsheet.

Results

In the control group, we observed that for a 1 lux increase in external light levels, internal light levels increased by 0.396 lux. As external light levels increased above 200 lux, internal light levels passed 45 lux. In the first trial, internal light levels stayed between 40 and 50 lux (11%) for external light levels between 150 and 700 lux. In the second trial, internal light levels stayed between 38 and 50 lux (16%) for external light levels between 150 and 700 lux. In the third trial, internal light levels stayed between 38 and 50 lux (16%) for external light levels between 150 and 700 lux.

Conclusions

This method of using computer-controlled electrochromic film to gradually increase the opacity of a window is effective in maintaining the internal light levels at within 16% of 45 lux. This meets the goal of maintaining internal light levels within 20% of 45 lux.

Summary Statement

A smart window to maintain indoor light levels.

Help Received

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Agam Randhawa

Project Number

J1027

Project Title

A Cheap Adjustable Distance Sensing Electric Cane to Help the Blind

Abstract

Objectives

To help the blind, make an affordable electric cane that will beep if an object is within an adjustable range controlled by the user.

Methods

HC-SR04 ultrasonic sensor for calculating distance, potentiometer for controlling range, piezo-buzzer for alerting the user and an Arduino Uno Microcontroller for connecting all the components. Prototypes were tested on wood, metal, and cloth at varying distances. An Arduino library called NewPing by Tim Eckel was used for distance calculation.

Results

Three different prototypes were created over the duration of the project. The first and the second model had issues with random beeping which were fixed by changing the Arduino code to ignore any zero output readings from the HC-SR04 sensor. My third and final model worked on all materials without any random beeping from the full range of 0-200 cm.

Conclusions

My final model's testing shows that the cane was reliable as it worked on all of the materials from 0-200 cm. I was able to meet my goal of affordability by keeping the total cost under six dollars.

Summary Statement

My project is about making a cheap electronic distance sensing attachment to a white cane that helps blind people stay safe.

Help Received

I designed, created and coded the project myself with guidance from my Dad and help from the internet.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Kaushik Salem

Project Number

J1028

Project Title

A Target Acquisition System for Landing Auto-Pilot Aircrafts in Constrained Spaces Using Modified Hough Transform

Abstract

Objectives

The objective of this project is to design an auto search and target acquisition system for landing auto-pilot aircrafts and drones in constrained spaces in search and rescue missions. The design uses modified Hough Transform to identify and locate landing coordinates. This will help locate survivors faster and with better precision during natural disasters. This system can also be used to drop food and medicines to people at remote locations.

Methods

The main components of the prototype are Raspberry Pi, camera, and red bingo coins to represent a landing pad.

Hough Transform is a feature extraction technique used in image processing that uses a voting procedure to find similar shapes. In this project, a modified version of the Hough Transform is used to detect a specific pattern of landing pad (4 red circular pattern of the pad) for aircrafts or drones. First, edge detection is applied on an image of the ground to get an edge-map of the landing pad. Then, modified Hough Transform is applied to the edge-map to get Hough peaks. The landing coordinates is the centroid of the Hough peak clusters (Hough pegs).

Results

Based on data from 4 scenarios with varying aircraft height simulation and varying objects surrounding the landing pad, the software algorithm was able to find the landing coordinates within the landing pad. This was true even when only 3 Hough pegs were identified. Therefore, a minimum of 3 Hough pegs are required to locate landing coordinates. The algorithm executed in under 30 seconds.

Also, based on the data of the relationship of prototype measurements to real world use, the landing pad diameter for algorithm use was within 10% of expected diameter.

Conclusions

The prototype for auto search and target acquisition system using modified Hough Transform was able to find and locate landing coordinates that can directly be used for auto-pilot aircrafts and drones in search and rescue missions.

Summary Statement

I designed and created a prototype for an auto search and target acquisition system using modified Hough Transform for landing auto-pilot aircrafts and drones in constrained spaces in search and rescue missions

Help Received

My dad explained image processing techniques and taught me how to use MATLAB. I verified my algorithm in MATLAB first, and then ported my code for Raspberry Pi environment with camera.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

William Shen

Project Number

J1029

Project Title

Most Effective Coilgun

Abstract

Objectives

The objective of this study was to test the effects of a number of changes in a coilgun s electrical system and the projectile on the distance traveled by the projectile.

Methods

Projectile, measuring tape, capacitors, magnet wire, ferromagnetic projectile, camera.
Started with a standard coilgun design as control parameters. Changed different parts of the electrical circuit and measured the distance traveled by the projectile. A hypothesis about the most effective setup for the circuit was formed using data from the previous experiments and tested. Continued testing after hypothesis was disproved.

Results

Tested the effects of changing the number of capacitors, the projectile mass (same material), the position of the projectile, and the number of turns in the wire of the coil, as well as the effect of multiple variables together. Found that more capacitors and projectile positions farther from the center of the coil launched a projectile farther. Projectile mass was found to have no significant effect. The number of turns in the coil had no clear cut relation with the distance traveled by the projectile; rather, a certain amount of turns was the most effective.

Conclusions

For the farthest firing coilgun, a design would use as many capacitors as possible and have the projectile far from the center of the coil. The number of turns would have to be optimized for the other components to accelerate the projectile the most because of changed interactions when many variables are modified at once.

Summary Statement

I measured the effects of different variables on the distance traveled by the projectile and found the most effective combination.

Help Received

Basic coilgun design based on the Mark 2 design from the website Barry's Coilgun Designs. Received help on construction and theory of the coilgun from my father.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Daniel Siegel

Project Number

J1030

Project Title

Surround3: The Design and Construction of a Sensor-Enhanced Probing Cane to Help the Visually Impaired

Abstract

Objectives

The objective of this project is to create a blind cane with sensors that is simple to use, operates on a rechargeable, low-power battery, and detects objects at a distance of more than one meter. In addition, it should be easily mounted to a variety of canes, and fairly inexpensive.

Methods

Ultrasonic sensors, an Arduino Nano microcontroller, rechargeable batteries, a cane, and vibrational motors. Sensors are used to measure distance from objects. The microcontroller converts distance into vibrational feedback on the handle of the cane.

Results

The final design was measured against other products on a comparison chart, which included categories such as price, weight, and detection range. It outperformed all of the competitors by an average of 51%. Surround3 was successfully able to detect objects from a distance of over one meter away.

Conclusions

My project, Surround3, worked as I had envisioned when I started the designing. The final prototype is simple to use, runs on a low-power battery, and detects objects over one meter away. In addition, it can be easily mounted to a variety of canes, which makes it more compatible with the user s needs. Surround3 cost about $40 in parts, and does not take up too much space on the cane handle. It is rechargeable through a micro-USB cable. All of these aspects make Surround3 ideal for visually impaired users, so that they can navigate safely and confidently.

Summary Statement

I created a ultrasonic sensor-enhanced blind cane that helps visually impaired individuals navigate safely and confidently.

Help Received

I designed and built the electronic circuits myself. I created 3D models and printed the components and assembled the cane myself. I received help from a friend's parent to debug my initial microcontroller code.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Agastya Sridharan

Project Number

J1031

Project Title

A 3D Autostereoscopic Quasi-Static Volumetric Display

Abstract

Objectives

My objective is to create a 3D Display that does not require glasses and can transition between images or states (albeit slowly). A 2D screen can be thought of as an array of square pixels. For a 3D screen to be constructed, each of the pixels should be a volumetric pixel (voxel). These voxels have to either be invisible (off state) or colored (on state) to create a 3D pattern or image.

Methods

Materials:Peristaltic Pump, Solenoid Valve (10), H-Bridge Circuit, Arduino board, Breadboard, Transistors (10), Acrylic Voxels (8), Tubing (Acrylic, Silicone, Airline), Wesson Vegetable Oil, Colored Water, Beakers

Methods/Procedure:

1.Choice of Materials for Voxel & Liquid: When two materials have the same index of refraction (like Veg. Oil and Pyrex: 1.47), one is invisible when placed in the other. This is the genesis of the 3D Display s off state. After many tests, it was found that acrylic and Wesson Vegetable Oil were the most practical choices.
2.Choice of Tubing/Pump/Valves: A pump with various tubings was used to transport the fluids. Valves were used to direct the fluid to the correct voxel.
3.Voxel Design: After many iterations, a large acrylic voxel with an independent air-release tube was used.
4.Motor & Valve Control: Since the Arduino could not provide enough power to the motor and valves, a transistor and diode circuit was constructed for the valves and an H-Bridge circuit for the motor.
5.Arduino Software Design: Arduino code and a GUI controlled all the components.

Results

I successfully constructed an eight-voxel set-up which has an off and on state. By transferring oil or colored water to each voxel, the state can change. The total time to change the state is 2m:30s (1m:30s for removing fluids and 1m to add) per voxel. All voxels work consistently. Note that after each state change, there was a small residue left over that could not be taken out simply because the tube does not extend to the edge of the voxel.

Conclusions

The display worked! Since this display contained only eight voxels, it could not display any meaningful images. However, this project serves as a proof of concept that can be expanded in the future to include a larger number of voxels, a faster voxel change time, more colors, and smaller voxels. If a larger display were constructed, real 3D images such as 3D MRI scans or airplane positions can be accurately displayed.

Summary Statement

I designed a glasses-free 3D display which can slowly transition between images.

Help Received

My dad helped me with drilling holes in the voxel and with soldering and debugging the electronics. My mom helped me with the Arduino GUI.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Nathan Tran

Project Number

J1032

Project Title

Robotics Preserving Our Natural Environment through Recyclable Objects

Abstract

Objectives

The objective is to determine if the designed built robot can aid the cause to remove recyclable objects from human and natural environments.

Methods

Programming site, robotics parts, two phones, gaming controller, stopwatch, variety of testing variables. All parts were made by robotics manufacturing companies. The design, building, and programming was all done by two bare hands. No help was given on designing the robot, building the actual robot, and programming the robot. To access the programming website the two phones must be connected through a direct wifi connection, while also connected through an app called FTC Driver Station and FTC Robot Controller. Then a computer needs to join the wifi direct signal to access the programming site called FIRST robot controller console. Upon this site programming can either be done using Java or blocks, which later can be downloaded onto the robot in order to control it. Five units of a variable is set onto a field where the robot will be timed on how fast it can gather these variables, with each variable being tested ten times.

Results

Testing the robot upon the variables of plastic water bottles, cans, and plastic bags a conclusion was made noticeable upon each and every trial. The design of the claw made it difficult to pick up variables that had a smaller mass, how ever on the other hand the claw made it easy to gather variables with a larger mass. The design of the robot makes it easy to grab larger objects, like plastic bags, rather than smaller objects, like crushed objects.

Conclusions

Smaller masses have grown as a problem for the robot as it has grown difficult to gather into its storage system. This is known as the variables with larger masses had took less time to gather with the robot. With the knowledge that objects with smaller masses are difficult to pick up it shows that future designed robots missioned to gather trash off from the natural environment must efficiently gather the smaller objects while still having the ability to gather the larger objects too.

Summary Statement

I built a robot to see what object would take the least amount of time to gather, which I found out to be the objects with the most mass all the way to the least mass.

Help Received

I designed, built, programmed, and tested each trial myself without any help. My Science Fair Mentor reviewed all paperwork upon the board and notebook of my project.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Anirudh Venkatraman

Project Number

J1033

Project Title

Tremor Monitor: Detecting Signs of Parkinson's Disease Using Piezoelectricity

Abstract

Objectives

Due to the limited availability and high prices of devices that measure body tremors, I developed a cheap, portable device that can measure vibrations in the hand. This can be used by patients who have Parkinson s disease to monitor tremors periodically and follow the progression of the shaking. Using the principle of piezoelectricity, or the conversion of kinetic energy into electrical energy, I was able to monitor tremors by tracking the output voltage of the sensor relative to my input of tremors. In order to simulate the Parkinson s tremor, I referred to The Clinical Evaluation of Parkinson s Tremor, and attempted to mimic the vigorous shaking by building a simulator that clamps on your wrist. The simulator could be run at different speeds to simulate different levels of shaking in Parkinson s disease and was intended to replace testing on actual patients.

Methods

The tremor monitor device was put together using the piezoelectric sensor, Arduino board, breadboard, and LED lights and would also display results on the computer through a wired connection. The LED lights would show green for normal or red for high, based on a preset threshold. Moreover, I developed an algorithm that waits for the input to become stable before accumulating tremors from the pointer finger placed on the device for fixed time and computes the score based on this data. To make the device self contained I designed a custom box using Tinkercad, a 3D printing software so that all parts of the circuit would fit and allow access to users to place finger and observe results.

Results

The results of my testing showed that scores reflected the progression of Parkinson s shaking as score value was directly proportional to the vibrations in the Parkinson s simulator attached to my wrist. When the readings of the essential tremor are compared to the readings of parkinson s tremor it shows that the device is accurate in detecting an increase in tremor activity as the average score of parkinson s tremor is 309.5% higher than the average of Essential tremor. The device is also capable of detecting change or Progress of parkinson s tremor as the parkinson s tremor simulation at 100 power or 2.5 HZ produced 73.55% higher score than Parkinson s tremor simulation at 1.5 hz

Conclusions

My device was also able to meet all the constraints of being portable using the custom box, accurate (in terms of being sensitive to minor vibrations), cost-effective (under $100) and was easy to build as it had only 4 basic components.

Summary Statement

The objective of my project is to detect signs and progression of Parkinson's disease based on the principle of Piezoelectricity, or the conversion of kinetic to electrical energy.

Help Received

Mita Mallik (Mom), Swapna Mayya (Teacher), Jason Reynolds (3D Printing Assistant)

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Paulina Xu

Project Number

J1034

Project Title

A New Way of Travel

Abstract

Objectives

This experiment does testing on Elon Musk's hyperloop using a smaller representation with copper wire, a battery, and magnets. It tests to see what allows the battery to move the fastest by changing the diameter of the wire the battery is traveling through and the air pressure.

Methods

Copper wire, batteries, 2ft tube, and a flat surface used to create a track for the battery to travel through. Electric wire, Raspberry Pi, breadboard, SD card, Python, display, Infrared Emitter, and an Infrared Receiver used to create a program to calculate time taken by the battery. Vacuum, electric wire, Raspberry Pi, Python, and an air pressure sensor used to calculate the air pressure.

Results

The wire was wrapped with different diameters. As the diameter got larger, the battery took longer to travel through the tube based on a concept called magnetic flux. With the vacuum on and constantly taking out air, the battery was able to move faster due to reduced air pressure.

Conclusions

Since a larger diameter causes the battery to move slower, for the actual hyperloop, a tube correctly sized for the pod that will be traveling through it should be used. Reducing the air pressure helped the battery to move faster through the tube.

Summary Statement

I tested on Elon Musk's hyperloop and found that a reduced air pressure and a correctly sized/smaller tube will allow the vehicle to move faster.

Help Received

I tested and created the setup myself. My father helped me with the Raspberry Pi. My science teacher helped me review my experiment.