Project ID: 651

Junior Division

Engineering: Electrical, Mechanical, and Robotics

Dominic Anello
The Children's School
Gr. 7

Alex Vanderpump
The Children's School
Gr. 7

Improved Turn Signal Gloves

It's hard to tell which direction bikers are turning at night, so people have made gloves with lights on them to signal turns. The gloves that have turn signals only have signals on the back, so these gloves have them on the front to help in case there is a car in the front. For making the gloves, LED kits were the most common, but eventually the gloves ended up having regular LEDs, regular wires, and regular copper conductors, fused together with a soldering iron. The soldering iron would fuse together all the parts to make the electricity from the battery reach the LED and make everything light up. For all the prototypes, the lights got dimmer by about 1 point every 20 or 30 feet, but the second and third prototypes were much brighter because they used a different type of light. The average brightness for ten feet was 7.33, 20 was 6.66, 30 was 6.66, 40 was 5.66, 50 was 5.66, 60 was 5.33 and 70 was 4.66. Most of it is low because the first prototype was bringing the average down by about 30 percent because it was a visibility of one except for 10 feet. The gloves were very bright, scoring an 8 from 70 feet. The results were good and the goals were reached in the end.

Project ID: 652

Junior Division

Engineering: Electrical, Mechanical, and Robotics

Adhiban Arulselvan
Thurgood Marshall Middle School
Gr. 8

Vishwanathan Vinayagam
Pacific Trails Middle School
Gr. 8

GridPatrol: AI Powered Aerial Patrol for Safe Power Transmission

AWARDS:

Thermo Fisher Scientific "Advancing Equity Through Innovation" Award
Armed Forces Communications Electronics Association (AFCEA) Junior Division Winner
CSEF Qualified

Wildfires are the biggest problem to power transmission in Southern California. Almost 25% of the top twenty wildfires are caused by power grid-related issues. Current terrestrial and satellite based monitoring systems have limitations with regards to continuous monitoring, and are not cost-effective. We developed GridPatrol, a drone based grid monitoring system for early detection of wildfires triggered by transformers and power lines. There are three main features to GridPatrol: Our drones have air charging to enable them to fly longer. Next, the infrared and visual light cameras increase accuracy of fire detection. Finally, we are using a deep learning model to automatically detect fire with 98% accuracy. Our prototype includes a DJI Tello drone which provides API function to control the flight path, and retrieve the live video feeds. The deep learning model then detects if there is a fire or not. If the system detects fire, it will trigger alerts. Using GridPatrol, we can easily detect fires early and subdue them before they become destructive.

Project ID: 653

Junior Division

Engineering: Electrical, Mechanical, and Robotics

Ashton Brocious
The Children's School
Gr. 8

AlarmMe: Elevating Your Morning, One Step at a Time

My science fair project is an alarm clock designed to wake up my sister on time to ensure that I arrive on time to school. My sister has a tendency to sleep in, which makes me late for school. The alarm clock, AlarmMe, is designed to force her to rise out of bed to turn it off, reducing her chances of going back to sleep.

Once built, I had my sister test it because she struggles the most with waking up on time. I set the alarm on the floor, and when it goes off, the test subject has to stand up and shut off the alarm. I checked to see whether it worked by keeping track of what time she woke up and what time I arrived at school.

The results proved the hypothesis correct, the study found that using AlarmMe significantly improved her time on waking up and my school arrival time. It made a twelve-minute difference in waking up on time and an eight-minute difference in arriving on time. Additionally, AlarmMe reduced a 20% difference in waking up on time and a 13.3% difference in tardiness. By using the alarm clock, she was able to consistently wake up on time, which improved my odds of getting to school punctually. Based on these results, a further enhancement would be a wheeled alarm clock whereby the sleeper must get out of bed and pursue the alarm to turn it off.

Project ID: 654

Junior Division

Engineering: Electrical, Mechanical, and Robotics

Oliver Cottrell
La Jolla Country Day School
Gr. 6

Automatic Hockey Puck Passer

AWARDS:

Grand Award – Junior Division Physical Sciences
The Mickey Award
CSEF Qualified
Thermo Fisher Scientific Junior Innovators Challenge Nominee

The purpose of the hockey puck passer machine was to improve hockey players' ability to catch passes. As the device was engineered, the idea evolved. Python and Raspberry Pi skills were learned. Using the knowledge of the Raspberry Pi, an LED was programmed. A box to hold electronics with a handle and a lazy Susan bearing on top was put together, topped with a routed circle on top to finish the ideal lazy Susan. Some screws later, the box was assembled. Then the motors were mounted. Using hardwood, aluminum extrusions, and screws there was a place for the rack and pinion to rest, allowing the puck to shoot out straight. The puck holder was mounted with magnets and nails. Coding was started. Testing was then done which showed everything worked except for the buttons which triggered randomly. Once the Raspberry Pi was inserted along with the motor controller, power distribution module, and USB camera it was ready for action. Buttons were fixed, wires were routed, and even a bit of failure happened. Once the trial and error was completed it was time to test and improve the functioning of the machine. The passer can track a blue ball placed upon the player's helmet using computer vision. Tracking it and shooting at the person. It is highly recommended for training purposes; it worked well with both camera tracking and random fire modes. The puck passer could greatly improve passing time in practice.

Project ID: 655

Junior Division

Engineering: Electrical, Mechanical, and Robotics

Nathan Gobiecki
Nazareth School
Gr. 7

Is It Possible to Regenerate a Prius Battery Pack?

This project's objective was to figure out if it is possible to regenerate a Prius battery. I hypothesized that it is possible to regenerate a Prius battery pack to about 5800 out of the 6500 amps of the factory. The control is the factory volts (7.2) and amperage (6500) which was recorded from the new cells. 8 cells out of the 28 are set to 1 cycle of discharge/charge. The cells are discharged/charge for as long as it takes. The data of the cycle is written down on a spreadsheet. This process is repeated for every cell. It might be repeated several times for a cell depending on how degraded its life is. Based on my data, my hypothesis was supported. The mean of the voltage was 7.04 and the mean of the amperage was 5662. These results support my hypothesis of about 5800 amps and around 7.2 volts. The point is to get close to a new battery pack because it is not possible to regenerate all cells to a new cell. In conclusion these results supported my hypothesis that it is possible to restore a Prius battery pack near the factory production.

Project ID: 656

Junior Division

Engineering: Electrical, Mechanical, and Robotics

Dylan Green
The Rhoades School
Gr. 6

Characterization of Residential Environments on Received Wi-Fi Signal Levels

The move to remote work has led to the creation of multiple rooms for home office space, introducing more walls between a typical Wi-Fi access point location and the Wi-Fi user. The trend to work from home has also motivated increased use of materials to improve sound isolation such as the use of ⅝ -inch drywall throughout the home instead of the more traditional ½-inch drywall. My hypothesis is that home building materials in the path between the router and the receiving device will reduce the strength of the Wi-Fi signal received.

To test this hypothesis, I constructed a plywood box to enclose the router. This will serve as the "plywood" condition. The drywall and brick conditions were made by overlaying drywall or brick over the plywood. I downloaded a Wi-Fi analyzer app on a mobile device and used this to measure the received signal levels in dBm (decibels relative to 1 milliwatt) for each of the enclosures and a control "no box" condition. The analysis was performed at multiple locations in my home.

Results suggest that plywood alone has minimal effect on the received wifi signal. The "Drywall" and "Brick" conditions had a much more significant effect on the received Wi-Fi signal than the "Plywood" and "Control" conditions. The signal decreased with distance from the router under both conditions.

In conclusion, this method can be used to study the effects of materials on Wi-Fi signals.

Project ID: 657

Junior Division

Engineering: Electrical, Mechanical, and Robotics

Joie Green
Gillispie School
Gr. 6

It's Roller Coaster Science: How Many Loops Can a Car Make

Each year, almost three hundred million people ride roller coasters in America. Designing new types of roller coasters can bring joy to many people. I really like going on big roller coasters and wanted to try to design and build the craziest roller coaster by making the car do as many loops as possible.

Roller coaster cars are powered by the conversion of potential energy to kinetic energy. Knowing this, I tried the two basic ways of generating energy for my first prototypes: a hill and a launcher. Both designs could do one loop but failed to do the second. I simulated the loops in NoLimits 2 where the car could do 2 loops with these designs.

I tried to reduce the loss of energy so it could make the second loop. I did this by strengthening the supports and changing the shape of the loop and hill. I measured significant improvements in energy loss but the car still didn't make the second loop. Finally, I combined the two ways of making energy to give the car more energy after the first loop.

My redesign successfully got the car to make the second loop. The car gets launched at the beginning to make the first loop then drops down a hill and makes the second. Still, I found out that the car in my simulations lost much less energy. A stronger track material and supports would make my designs more successful.

Project ID: 658

Junior Division

Engineering: Electrical, Mechanical, and Robotics

Declan Henckels
Pacific Trails Middle School
Gr. 8

Guhan Senthil
Pacific Trails Middle School
Gr. 8

Smart Walker

AWARDS:

Grand Award – Junior Division Physical Sciences
Professional Engineers in California Government (PECG) Award Junior Division
American Society of Mechanical Engineers - Junior Division Winner
CSEF Qualified
Thermo Fisher Scientific Junior Innovators Challenge Nominee

Even with the assistive devices like walkers, still there is a significant number of falls among the elderly that has been reported every year. In the case of elderly people who live alone or are in assisted living, it could take hours before the caregiver learns about the fall and takes action. Mounting multiple sensors like Sonar, Laser, Tilt, Gyroscopic etc. on a walker, connecting it to the cloud can help learn customized walk patterns and aid in any anomaly detection, making it a smart walker. Can a smart walker be able to prevent and detect falls and prevent major injuries and possibly save lives? The hypothesis is that by using a smart walker, seniors can avoid falls by more than 10% and in case of falls, it will be detected 95% of the time and the caregivers will be notified right away. As the smart walker keeps track of live walk patterns, we believe it will help with rehabilitation monitoring by providing analytics for physiotherapists and medical professionals. Another key goal is to make the Smart Walker a cost effective add-on that can be fitted to any four legged walker with an affordable target product cost to be around $50.

Project ID: 659

Junior Division

Engineering: Electrical, Mechanical, and Robotics

Elias Hernandez
De Portola Middle School
Gr. 8

How Do Electric Guitars Work

AWARDS:

Armed Forces Communications Electronics Association (AFCEA) Junior Division Winner

The reason I chose this project is because I play guitar and I love it. I immediately thought when I heard about the science fair, Since one of my previous teachers, Mr. W's electric guitar was broken, I could do my science fair project off of that! Then, that whole path changed when my dad gave me a guitar DIY kit. It took me twelve hours and two football games to build and I came up with the hypothesis that if the pickups are closer to the strings, they will emit higher frequencies. I did this project by taking the guitar kit that I built and tested it by strumming as hard as I allowed myself to and I would record the data from a website called Microphone Sound Analyzer. I would measure the peak frequency in kilohertz (kHz) and record it in the spreadsheet I made. I would then review all the data I have and figure out what it all means. When I was done reviewing the data table, I found that my hypothesis was correct. The pickups do this because if you put a magnet closer to one another, they want to pull together even harder than when you pull them farther apart. The same thing happens when you're strumming a guitar with the pickups closer to the strings. I also found out that adjusting the pickups so that they are slightly angled towards the thinner strings helps because then your tone and volume sound much better.

Project ID: 660

Junior Division

Engineering: Electrical, Mechanical, and Robotics

Jumana Kadry
Bright Horizon Academy
Gr. 8

What is the Best Innovative Solution to Clean Space Pollution?

AWARDS:

Armed Forces Communications Electronics Association (AFCEA) Junior Division Winner

The objective of this project is to find the best method to clean space pollution. It was hypothesized that the magnetic tugboat will be the most effective cleaning solution.

This project involved creating an orbiting Lego simulator (with shafts and discs) and a robot brain programmed to spin. Copper wire and screws were hung onto the shafts by string to represent space debris. I then built 3 solutions: a magnetic tugboat with a magnet on a string, a net-like object with rubber bands to represent motors, and a harpoon using a mini screwdriver. Each solution was tested for 1, 2, and 3 minutes to assess its debris collection efficiency.

The results show that the magnetic tugboat collected: 40% of debris in one minute, 60% in two minutes and 80% in 3 minutes. The harpoon system: 0% in one minute, 20% in two minutes and 20% in three minutes. The net: 0% in one minute, 20% in two minutes, and 40% in three minutes. This means the magnetic tugboat collected the most space pollution in one, two, and three minutes.

In conclusion, the results indicate that the most effective method for tackling the problem of space pollution is the magnetic tugboat. Through tests, its shown that it can collect the most space debris in the time given. These results help highlight its effectiveness in cleaning up space junk quickly. As space pollution increases, the magnetic tugboat provides a practical solution in helping better our solar system.

Project ID: 661

Junior Division

Engineering: Electrical, Mechanical, and Robotics

Issachar Miller
San Diego Hebrew Day School
Gr. 8

Creating Stronger Electromagnets with Different Rare-earth Metals

AWARDS:

San Diego Chapter - American Society of Materials International - Honorable Mention

If an electromagnet was tested using different metals, it was hypothesized that aluminum wire with a steel core would be the strongest because a steel core with aluminum wire is a better electromagnet overall.

To test this, an 18-gauge aluminum wire was cut to 90 cm and wrapped clockwise, 39 times around an aluminum core measuring 0.5 cm thick by 7 cm long. Wires with alligator clips were used to connect each end of the wire to the terminals of a battery. A total of 9 electromagnets were made by combining aluminum, copper, and steel wire with aluminum, copper, and steel cores. To test, the electromagnet was placed into a bowl with paper clips for 5 seconds and the attached paper clips weighed. This was repeated 15 times for all 9 electromagnets.

Results showed the steel core to be the best with an average of 5.5 grams compared to 3.63 for aluminum. The copper core did not work at all. Aluminum wire was best with an average of 4.21 grams compared to 3.46 for copper and 1.55 for steel. The hybrid aluminum wire with a steel core proved to be the strongest hybrid electromagnet of all. The aluminum core had an average of 5.48 grams with copper wire, 2.92 with aluminum, and 2.49 grams with steel. The steel core picked up an average of 4.91 grams with copper wire, 9.44 with aluminum, and 2.15 with steel.

Project ID: 662

Junior Division

Engineering: Electrical, Mechanical, and Robotics

Nicholas Ong
La Jolla Country Day School
Gr. 7

Binary Communication Using Lasers

AWARDS:

DRS Daylight Solutions Award for Optical Physics and Engineering Junior Division
Office of Naval Research - Junior Division Winner

The purpose of this test was to find out if laser technology is a faster alternative to radio technology. The goal was to see if laser communication could make space missions cheaper while also making transmitting signals brisk and able to compact more data into one transmission. Astronauts and scientists struggle with long-distance signal delays that could be disastrous if there is a critical issue that could jeopardize the entire mission. The project tested two methods of communication, radio and laser, by transmitting the message "Banana" and timing how long it took each setup to receive the message. For the laser setup, the transmitter consisted of a modified class IIB laser pointer to "blink" binary code at an LDR while transmitting its results to the Arduino Board which converts that data back into binary code and then into characters/numbers. For the radio setup, walkie talkies, a stopwatch, and a computer were used by having a person speak into a walkie talkie, wait for the results, and record the time all at once.
The results suggested that sending a message through laser is faster than sending the same message through radio. The difference between the results is one second which in terms of signal as fast as the speed of light and computer processing speed, one second is a significant difference. These results suggest that laser communication could replace radio but would require more testing on individual parts in order to find where in each system there is an improvement or delay.

Project ID: 663

Junior Division

Engineering: Electrical, Mechanical, and Robotics

Zackaria Ouchmame
Bright Horizon Academy 6-8
Gr. 8

Smart Medicine Cabinet for Dementia Patients 2

The goal of this project is to develop a tool that will help people who take a number of daily prescriptions, mostly aimed at the elderly, remember to take their medication. I constructed a medicine cabinet to record the number of doses taken each day, the time until the next dose, and to ensure the patient doesn't take a medication that wasn't intended to be taken at that time. To enable remote control, the cabinet is constructed on top of an iRobot Create (with the help of the Standard iRobot Remote). The cabinet will then be useful to people who are physically impaired as well.

I utilized a diverse range of tools and materials, such as a KIPR Link Controller, touch sensors, an iRobot Create, and a laptop, to develop the software for the medicine cabinet. The cabinet itself was constructed on top of an iRobot Create that was programmed to be controlled by a remote for effortless accessibility. As a prototype, the cabinet has three shelves, each fitted with a touch sensor beneath it. These sensors are used to monitor the consumption of medication, including the number of times a medication has been taken. If a medication bottle is removed from a shelf during a time when it is not meant to be taken, or if it is removed from the incorrect shelf, the cabinet will emit a constant beeping sound until the bottle is returned to its original location. This feature aims to minimize the likelihood of patients taking the wrong medication or consuming it excessively or insufficiently. Following the programming and construction of the cabinet, the final product demonstrated complete precision.

Along with the cabinet, I created an app to record the data from the cabinet. This app was made using App Inventor, and it will help share the data with other people, such as caregivers and doctors. This app will allow for an easy way to check the patient's medicine intake and respond when necessary. After finishing the program, the app exhibited 100% accuracy.

Project ID: 664

Junior Division

Engineering: Electrical, Mechanical, and Robotics

Joseph Peralta
St. Gregory the Great Catholic School
Gr. 7

How to Decrease or Increase the Wind Turbines Power

"How to Decrease or Increase the Wind Turbine's Power. The hypothesis: more blades added to a wind turbine, then it is expected to increase the power output.

Procedure
Attach wires to the DC motors. Place rubber band to connect the electric motor to the ruler that served as a platform for the wind turbine. Straighten out the paper clips, cut out 3x5 cm pieces of cardboard and attach it. Push the cork into the motor shaft. Rotate the blades in 45 degree angle using a protractor. Attach alligator clips to the voltmeter. Start testing by placing the wind turbine over 9,18 and 27cm away from the wind source. Repeat it by removing or adding blades.

Results
The tests shown that 3 blades had an average of 0.06 volts for 9cm distance, 0.08 volts for 18, 0.12 volts for 27 with total mean average of 0.08666. The 4blades had 0.09 volts for 9cm distance, 0.092 volts for 18, 0.09 volts for 27 with a mean average of 0.090666. The 5blades showed 0.10 volts for 9cm distance, 0.18 volts for 18, 0.10 volts for 27 with total mean average of 0.12666. These showed that 5blades generated highest electrical energy in voltage.

Conclusion
My hypothesis was supported with my data. My experiments showed that 5 blades had the highest voltage of 0.1266. The wind turbine with 5blades compared to the 4blades had a 3.5994% difference higher. The wind turbine with 5blades compared to the 3blades has 4% difference higher.

Project ID: 665

Junior Division

Engineering: Electrical, Mechanical, and Robotics

Ayelet Ron
La Jolla Country Day School
Gr. 6

LED Headboard

Sleep is vital for the health of the human body. Sleep improves happiness, dexterity, and the brain's capacity to function. Many components are included in a good night's sleep and have stayed constant throughout the decades. However, there is one thing that has not stayed the same. Bedroom sizes in the US are decreasing exponentially. Despite attempts to make furniture smaller, necessities that most people require require more space than is available. In this project, a headboard will also serve as a bedside table, saving room in a bedroom. The headboard must be 40 watts, 4.53592 kilograms, and 0.9144 by 1.0668 meters in size.

A brief overview of the process used to create this headboard follows. The planks can be glued upon gathering materials to form a 0.9144 by 1.0668-meter rectangle. Then, the varnish must be applied in three coats to ensure a bold outcome. The next step is to wrap a block of upholstery foam in linen, secure it to the wood, and attach the LEDs and cup holder. Next, code the website with Wix using a one-tick-per-second Java code for the LEDs.
The projects' results compared to the design criteria are positive. The project passes all the criteria except one, as the headboard cost exceeds $150.

To improve the project, measures could be taken to decrease the cost, such as using other materials for wood and foam. The project could also be improved by including a speaker acting as an alarm clock.

Project ID: 666

Junior Division

Engineering: Electrical, Mechanical, and Robotics

Yusra Salem
Bright Horizon Academy
Gr. 6

A Vibrating Exercise Band for the Deaf

AWARDS:

Grand Award Runner Up – Junior Division Physical Sciences
BD "Advancing the World of Health" - Junior Division 1st Place
Professional Engineers in California Government (PECG) Award Junior Division
CSEF Qualified
Thermo Fisher Scientific Junior Innovators Challenge Nominee

The objective of this project is to create a vibrating band that will be programmed with different vibration beats to compose musical vibrations for the deaf to experience while exercising. Deaf individuals face various challenges when experiencing music due totheir inability to hear or perceive sound. Deaf individuals do not have access to the auditory elements of music such as melody, rhythm, and pitch, which are crucial for a full appreciation and understanding of music. The device is specifically designed for deaf individuals to utilize vibration feedback synced to the beat of music. Using Arduino code, various songs can be "composed" by changing the frequency and intensity of outputsignals that communicate with vibration motors, connected to a wristband that users can wear. In this way, they will feel the vibration with each beat of the song being played. If worn during exercise, the deaf individual's experience is enhanced, they will feel more included, and they can stay motivated to exercise and stay active. In conclusion, the wristband vibrated and lit up with the beats of the various songs that were composed using code. Users felt the vibrations, which corresponded to the tempo (beats) of the songs. The users shared that they believed this device would help them experience music through sensory feedback and help them use it during exercise.

Project ID: 667

Junior Division

Engineering: Electrical, Mechanical, and Robotics

Aiden Sanford

St. Gregory the Great Catholic School

Gr. 7

Determining the Amount of Electrical Current

Determining the amount of electrical current produced by a nail. The purpose of this experiment is to design the most effective electromagnet so that it could be used in the real world to find iron in dirt and many other things. If a nail is wrapped 50 times, 100 times, 150 times, and 200 times all in copper wire, the 200 wrapped nail should conduct the most amount of volts. The purpose of this experiment was to see if there is a better design for an electromagnet so that it could help us gather materials from sand and dirt with less effort.

The procedures for this experiment are to first wrap all the nails each amount of times listed above, then connect alligator clips to each top metal coil of the battery, and the end of the copper wire hung off the side of the nail. Next, obtain a multimeter and turn it up to 20 volts. After that, put each part of the multimeter on the top of the alligator clips to measure its volts (15 trials).

The results that were analyzed from this experiment were that the 200 wrapped nail conducted the highest amount of electric volts at a high of 3.56 and an average of 2.3113 volts. I received different voltage measurements because the battery was draining while I was testing each nail's voltage.

The researcher noticed that the least wrapped nail (50) came in last and the highest wrapped nail (200) came in first. In conclusion, my hypothesis was supported because the 200 wrapped nail conducted the most amount of electrical current out of the other three nails.

Project ID: 668

Junior Division

Engineering: Electrical, Mechanical, and Robotics

Ahran Thaper
The Rhoades School
Gr. 6

Can Household Vent Currents Be Harnessed to Produce Energy?

Can household vent currents be harnessed to produce energy? I conducted this experiment because my parents still pay an electrical bill even though our house is equipped with solar panels. I wanted to find a way to harness some form of energy around the house and utilize it to generate electrical energy to decrease the bill. I found that I could harness air conditioning vent currents to generate electricity via a model wind turbine. My hypothesis was that the turbine would produce enough energy to power an LED light.

A model wind turbine kit was obtained and a digital anemometer along with a volt meter. The turbine was placed with its blades angled so that the turbine rotated in the presence of the vent currents. The turbine was elevated to be near the vent, and a helper connected a multimeter to the turbine output. I then read the multimeter and recorded the readings.

I found that the on average turbine generated 0.9 volts of electricity, which was enough to power an LED light. According to the anemometer, I found that the more the air conditioning or heating was "cranked up," the faster the vent currents became.

Overall, the model turbine was able to generate electricity in the presence of vent currents, but the amount of energy generated might not impact the electrical bill. Further studies and experiments might include adding turbines to all air conditioning vents around the house and measuring the output and to use larger or smaller turbines.

Project ID: 669

Junior Division

Engineering: Electrical, Mechanical, and Robotics

Virginia Zhu
Oak Valley Middle School
Gr. 8

Smart Watering System: Electronic Sensor

AWARDS:

Thermo Fisher Scientific "Advancing Equity Through Innovation" Award
Armed Forces Communications Electronics Association (AFCEA) Junior Division Winner
BIA Cares - Junior Division 1st Place
San Diego County Water Authority - Junior Division 2nd Place
Society of Women Engineers - San Diego County Section - Junior Division 2nd Place
CSEF Qualified
Thermo Fisher Scientific Junior Innovators Challenge Nominee

This smart sensor design is based upon soil resistivity to provide automation on a need-based watering decision, to conserve water and reduce the irrigation water runoff.

First, I researched water detection methods and selected a resistivity-based detection design. I then built the circuit on a breadboard. To check the prototype, I tested with sun dried soil and wet soil from our home garden bed. The Circuit functioned with wet soil but didn't always work with dry soil. After reviewing and confirming that the circuit was built per plan, I suspected the circuit was not configured correctly for dry soil. Secondly, to investigate the problem, more soil was taken from our garden bed. I baked it at 350F for about 10 minutes to remove the moisture. Then, I weighed the soil, divided it evenly into four cups, and watered separately to get 2%, 5% and 10% moisture levels. The resistances of the dry, 2%, 5% and 10% moisture level soil were measured by a multimeter. Each data point was collected after 10s of insertion of the two test probes into soil, with 1.5 inches distance between the probes. Thirdly, I noticed the 10M ohm pull down resistance, compared to the dry soil resistance, is too large to pull the terminal B input voltage LOW. By paralleling a 1M ohm with it, I reduced the pull-down resistance. This design change optimized the sensitivity of the sensor. And I was able to implement the optimize circuit on a perfboard. Lastly, the 9V battery was replaced by a 12V Solar panel.

Result: Soil resistivity, measuring how strongly the soil resists electricity flow, reflects its moisture content. Based upon our experiment, even when the moisture level was as low as 2%, our sensor could still sense it.

Project ID: 670

Junior Division

Engineering: Electrical, Mechanical, and Robotics

Ryan Zhuang
La Jolla Country Day School
Gr. 6

Testing Performance of a Rotating Solar Panel versus a Flat Solar Panel

The goal of this project is to determine whether rotating solar panels are more effective at generating voltage than flat fixed solar panels. The primary objective of this project is to enhance the efficiency and performance of solar panels. To achieve this, a mechanism was designed to rotate the solar panel around and code was written to identify the position that produces the most voltage. Once identified, the mechanism would move the solar panel to that position, wait a few hours, and then search again. The mechanism was constructed using 3D printed parts, servos, an Arduino, a voltage regulator, two resistors, wires, and a diode. To test the rotating solar panel, the lights in a room were turned off except for one in the corner. The Arduino was then connected to the computer, and the program was started to rotate the panel and find the best spot. The voltage generated by the rotating solar panel was compared to that generated by a flat solar panel in the same situation. The voltage from the rotating solar panel was 4.68 volts, while the flat solar panel generated 3.61 volts. Further tests can be done to test whether rotating solar panels are better for long-term use, considering the possible failures, such as rain damaging the Arduino the 3D printed base breaking, or it getting knocked over by strong winds. To improve this experiment, better and larger solar panels can be used and more testing can be conducted in actual sunlight, and test it for more hours.