CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Adarsh S. Ambati

Project Number

J0801

Project Title

Low-Cost, Cloud-based, Contactless Vital Signs Monitor Using Photoplethysmographic Imaging & Infrared Sensing Techniques

Abstract

Objectives/Goals

To design and develop a low-cost, contact-free, continuous monitoring (CFCM) prototype using Raspberry Pi that detects and logs surface body temperature and heart-rate (HR). It should have the ability to provide remote monitoring and the ability to alert the guardian of any abnormalities detected.

Methods/Materials

Designed and built a prototype using Raspberry Pi, MLX90620, and Raspberry Pi camera to detect, transmit, and display real-time temperature and HR information on a mobile device. The temperature data and the video recording are uploaded to the Cloud. The algorithms running on the Cloud server process the IR thermal sensor data and video of the subject to extract temperature and HR data. Developed an app to display temperature array, still image, and HR on a mobile device after downloading relevant data from Pi webserver.

Temperature: MLX90620, infra-red sensor, reads the temperature profile of the subject. The app displays it as a 16X4 thermal map.

Heart-Rate: Measured by Photoplethysmographic technique. The algorithm processes the video feed by using OpenCV to locate the face and distinguish the forehead region. The dominant frequency of pixel intensity variation from the green channel of the video in the forehead region (which is a result of optical absorption changes caused by alterations in blood volume due to pumping of the heart) is extracted using Fast Fourier Transform (FFT) to determine the HR.

Results

A total of 496 tests were conducted with 62 participants, and 8 tests were performed on each participant. An oximeter and non-contact electronic thermometer were used to validate the results. For temperature, my prototype had a very high accuracy rate of 99% within the specified error margin. For HR, the accuracy of my prototype was 69% within an error margin of ±10 bpm.

Conclusions/Discussion

I concluded that primary reasons for errors are lighting conditions and participant#s motion. In good, natural light, the accuracy increased by 10% - 15%. In artificial light, any subtle flicker interfered because it becomes the most dominant frequency and decreases accuracy. My future plans are to improve HR detection accuracy by adding green ambient light and higher quality video compression format. I want to add night vision camera to work in low light to detect sleep apnea and bruxism. Triggering interventional actions is another enhancement I am looking into.

Summary Statement

At a total cost of $70, my prototype is a cost-effective solution for detecting, monitoring, continuously logging and alerting the guardian of any irregularities in vital signs without even touching the subject.

Help Received

Mrs. Chung & Mr. Takemoto reviewed my project and provided general guidance. Johan Sosa, a DIY science enthusiast, helped with Cloud integration.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Akshay Attaluri

Project Number

J0802

Project Title

Tsunami Guard: Finding the Most Effective Wave Breaker Design

Abstract

Objectives/Goals

Coastal cities are constantly at risk from waves that can cause serious damage to structures. The aim of this project is to find the optimal wave breaker design that will ensure that these cities are no longer under a threat from waves. This is done by testing various designs of wave breakers using a simulation software that I designed, to see which is the most effective at reducing potential damage. I will evaluate the success of the barrier design by calculating the ratio of the energy transferred into the barrier to the amount of stress on the barrier. My goal is that this ratio for a certain barrier should be at least 10% higher than this ratio for the control, which is a plain wall.

Methods/Materials

I wrote my simulation in Python using the libraries "matplotlib", "pandas", "numpy", "math", and "random". I am also using the "tkinter" library to display the simulation in a GUI. The simulation is essentially a 3d graph with a particle at each point on the graph. This particle is either air, water, or is part of the barrier. As the simulation progresses, these water particles move towards the barrier in a wave, thus simulating a wave hitting a barrier.

Results

Of all the anchored designs, the "ditch" design has proven to be the most effective at reducing potential damage caused by waves. Even though it didn#t absorb as much energy from the wave as the control, it was under less stress, meaning that it would last for a longer time than the wall. When comparing the anchored grid and the floating grid designs, the floating design performed very well compared to the anchored design. The floating grid design was the only design that met the objective design criteria.

Conclusions/Discussion

According to the results, only the floating barrier met the engineering goal. This is due to the fact that the floating design is less susceptible to stress, as it has no defined axis of rotation, and therefore is subjected to a reduced amount of torque, leading to less stress. This shows that floating designs will last longer than anchored designs, and can be made using less durable and less expensive material that may or may not be buoyant. The only requirement is that it must not be fixed or anchored to the ground. My work suggests that fast, simple, and accurate models can be made to model complicated hydrodynamic simulations. This allows for faster research and development, which could save time, money, and lives.

Summary Statement

Using a simulation that I designed, I evaluated the effectiveness of different wave breaker designs and found the one that is the best at reducing potential damage.

Help Received

I designed and programmed the simulation software on my own after educating myself on the physics concepts using various websites.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Nishita S. Belur

Project Number

J0803

Project Title

A Tele-Health Amartphone App to Virtually Prescreen and Connect Rural Patients in Underdeveloped Countries with Doctors

Abstract

Objectives/Goals

The goal is to develop a telehealth, nonprofit app that virtually connects patients in rural parts of underdeveloped countries with volunteering doctors and mobile hospitals, with the help of a health care worker or volunteer. The app will prescreen a patient to diagnose if the patient's condition requires professional personal medical (surgical/non-surgical) attention or not. Lack of health care in rural, poverty-stricken areas of underdeveloped countries in the world is a serious problem that requires immediate attention. 10 million rural children, who did not have access to doctors nearby, died last year from illnesses which could have been treated or prevented if they had been diagnosed early. Many developing countries usually do not have enough access to staff and healthcare equipment to offer healthcare to the patients most in need. The doctor to patient ratio in underdeveloped countries is 6 times less than in developed countries. In poor regions, pregnancies and deliveries are often very risky and unhygienic, due to lack of local physicians. Furthermore, many mothers die leaving behind a newborn who will be 10 times more at risk of dying before his/her fifth birthday.

Methods/Materials

The materials used in this project are: the App Inventor 2 programming language, a MacBook Pro Version 10.12.2, and a Nexus 7 Android Tablet.

First, I created a flowchart and an algorithm for the app. I developed the app using the App Inventor 2 tool and the laptop. I then created test cases to test the app on a smart phone, and listed all the bugs in the app. I then debugged and fixed the program and uploaded the app onto Google Play Store.

Results

The prototype app was used in real-time at Mobile care unit of M.M. Joshi Eye Institute, India where the app proved fully functional. The file size of the application software was 1.97 MB. The cost of developing the prototype was $145. The loading time was less than 5 seconds and did not drain a considerable amount of battery power. The estimated time to design and test this product was 3 months.

Conclusions/Discussion

My science project was successful. I was able to develop a novel, innovative, tele-health, nonprofit, smartphone application to virtually connect rural parts of underdeveloped countries with volunteering doctors and mobile hospitals, with the help of a health care worker or volunteer, to prescreen patients in need of professional, personal, medical attention.

Summary Statement

My project is a tele-Health smartphone app to virtually prescreen and connect rural patients in underdeveloped countries to volunteering doctors and mobile hospitals, with the help of a health care worker or volunteer.

Help Received

None. I developed and tested this smart phone application on my own.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Elliott Kim

Project Number

J0804

Project Title

VibSpeech: A Communication Device for Both Visually and Aurally Impaired

Abstract

Objectives/Goals

The main objective/goal for this project is to create a successful communication device for the aurally and visually impaired. This is being done to help the thousands upon thousands upon thousands of blind AND deaf people, otherwise known as the deaf-blind. The mini goals to achieve this large goal consists of creating a speech recognition program, speech to text program, text to morse code module, morse code to vibrations module, TCP/IP connection, OLED display control, etc.

Methods/Materials

Method/Materials: In order to achieve this project, many mini goals had to be completed. This section will be going over how these mini goals were completed. Speech to text and speech recognition was done by taking out parts of a speech recognition library called "SpeechKit". The others parts of code (listed in the objectives and goals) were all mostly created by the experimenter himself, however, there are a few more libraries assisting here and there. Some of the very important materials consisted of a Raspberry Pi, circuit parts, computer, soldering kit, and several program editors.

Results

Overall Device Results: The device results showed a very high success rate in translating speech to morse code. The only error in the overall device is when the speech recognition fails to tell the difference between words that sound similar (such as "two", or "too", or "to", etc.). In the first experiment, (this experiment is testing how well the speech to text worked) the results were on the less successful end (notebook has specific numbers). In the second experiment, (which is testing how well people decoded Morse code) the results were on the very low (notebook has specific numbers).

Conclusions/Discussion

Overall Device: As stated above, the overall success of the device is good and the only problems is with words that sound similar to once another. The reason for the low success rate in the first experiment is since many of the families the experimenter tested learned english as their second language, the speech to text and speech recognition program itself worked without many flaws. The results of the second experiment was expected to be low as well since the many families that were tested didn't know Morse code, but had the assistance of a Morse code table. Again, these repeated trials shows that the programing itself barely makes any flaws however, the errors in the results is due to human error.

Summary Statement

A communication device for the aurally and visually disable that uses a tactile sense based communication system.

Help Received

Some of the people that helped me consisted of Elaine Gillum (gave me tips/advice), and the people that were test using the experimenter's program that he built

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Alexander T. McDowell

Project Number

J0805

Project Title

Neural Espionage: Can Adversarial Neural Networks Learn to Apply Encryption to Images?

Abstract

Objectives/Goals

To determine if two neural networks, a Provider and a Receiver, can successfully encrypt and decrypt an image while preventing an intercepting neural network from deciphering the original image.

Methods/Materials

I started with three Adversarial Convolutional Neural Networks as a framework and developed them so that they could perform encryption to images instead of matrixes. I then trained the neural networks on 13 different tests. The variables I changed in my experiments were the number of training iterations, image and key sizes, types of images and keys, the rate at which the network learned, and the message and key lengths.

Results

The neural network achieved its training goals of minimizing guess error between the Provider and the Receiver. However, the intercepting neural network always managed to decrypt the image into a faint outline, which was decipherable to a human observer. As well, the image encrypted by the Provider wasn't cryptographically secure and was easy for a human to determine. In 12 out of the 13 tests, the Receiver successfully decrypted the message while in 8 out of the 13 tests the interceptor had an accurate outline of the encrypted image.

Conclusions/Discussion

Neural Networks can learn to apply encryption to images. However, the encryption being applied by the networks was not cryptographically strong. The data suggested that changing the loss function I was using would significantly improve the neural networks' ability to encrypt and decrypt images. Changing the architecture of the networks could also improve that same ability.

Summary Statement

I tested if Adversarial Neural Networks could learn to apply encryption to images.

Help Received

I designed my experiments myself. I received help understanding the scientific paper I used as a basis for my project from Cybersecurity Expert Chris K. Williams.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Michelle M. Nazareth

Project Number

J0806

Project Title

ASD Alert! A Novel Low Cost Device to Help Predict and Mitigate Oncoming Autistic Episodes

Abstract

Objectives/Goals

My objective is to build a low-cost device that can measure galvanic skin response and heart rate, reduce stress, and mitigate an oncoming autistic episode by playing music until help arrives.

Methods/Materials

Laptop with Arduino IDE and Processing 3+. Attached galvanic skin response (GSR) and heart rate (HR) sensors to an Arduino Uno R3 using a variety of pins and wires. Created an Arduino program that reads sensor data, a processing program that measures the user#s average heart rate, and a program that took data from serial port, parsed it, graphed it, analyzed it, and played music at the appropriate time. Average heart rate of each tester was recorded and entered into the program. A constant horror video was played to spike GSR and HR readings of the user.

Results

Currently, this device was tested on 20 people using their average heart rates as a basis for the system. 10 people were used as controls with no music playing at the end of their video to monitor the amount of time it took to calm the user down to their average heart rate. The same was done to the other 10 people- this time with the music. The device met my objective as it read, graphed, analyzed data, and played music. The music I chose did not have an effect on reducing heart rate. The group with the music took an average of 15.02 seconds and the group without music took 15.33 seconds.

Conclusions/Discussion

This cost effective device can help mitigate oncoming autism episodes by playing music to help calm the user. It met my objective when I tested it against real test subjects, even though the music did not calm my participants down. In the real world, this device could aid autistic children by helping them gain independence from their caretaker. It would allow caretakers a little more time to come to the aid of the child, if they are not currently with the child during an episode.

Summary Statement

I created a low cost device that accurately measures GSR and HR and plays music to help mitigate an autistic episode.

Help Received

I worked with my dad and Mr. Williams to understand the basics of code in my experiment. Erik Perkins from Kirby School was my project advisor.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Zoe K.S. Osborn

Project Number
J0807

Project Title
What Organisms Other than Ideonella sakaiensis Have the Ability to Digest and Degrade PET? A Bioinformatics Project

Abstract

Objectives/Goals
The objective of my project was to see how widespread the ability to digest and degrade PET (polyethylene terephthalate) is among organisms.

Methods/Materials
I used a bioinformatics approach to answer my question:
1. Search original article by Yoshida et al. for the accession codes to both the PETase and MHETase enzyme (the two enzymes allow Ideonella sakaiensis fully degrade PET)
2. Conduct BLASTp searches for PETase and MHETase in NCBI#s GenBank database
3. Put enzymes/organisms that are close matches for the PETase and MHETase amino acid sequences into spreadsheets for further analysis
4. Research each organism to find what environment they live in; summarize in spreadsheets
5. Identify organisms with enzyme abilities close to PETase and MHETase as candidates for use in PET bioremediation

Results
My results showed there are over 200 organisms (mostly bacteria) that have either an enzyme with an ability close to PETase or an ability close to MHETase. There was one bacterium that had close amino acid matches to both PETase and MHETase.

Conclusions/Discussion
The ability to degrade PET is more widespread than may commonly be assumed. Only one organism (the bacterium Acidovorax delafieldii) was identified in the BLAST search with enzymes close to both PETase and MHETase. This bacterium, like Ideonella sakaiensis may have the complete ability to degrade and digest PET. However, the same effect could be achieved by pairing two organisms, one from the PETase search with another from the MHETase search, that live in the same environment (such as soil). The results of this project could be used to identify candidates for bioremediation of PET plastics in landfills and other sites where PET has accumulated.

Summary Statement
My science fair project used bioinformatics to see what organisms other than Ideonella sakaiensis have the ability to digest and degrade PET.

Help Received
Advice on using GenBank to run BLAST searches from Dr. Mark Wilson, Humboldt State University.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Sanjita Pamidimukkala

Project Number

J0808

Project Title

Combatting Cardiac Arrest through a Compact and Portable Heart Rate Monitor and Analyzer

Abstract

Objectives/Goals

The objective of this project is to create a compact and portable heart rate monitor that visualizes pulse into waves, allowing for an easier user experience, and to provide the device with the capability to notify certain persons in case of issues, so that action can be taken faster than through waiting for a medical team to arrive.

Methods/Materials

The materials needed are: breadboard, Polar T34 Heart Rate Transmitter, pi Cobbler, Polar Heart Rate Receiver, 1K ohm resistor, 10mm red LED, portable charger, jumper cables, smartphone. The device was tested by allowing 2 healthy persons of different ages to perform 4 activities and comparing the collected pulse to target pulse for accuracy. Then notifications were tested to make sure that the device could easily send alerts to selected people.

Results

Tests were run on two different people doing four activities, two times for each activity. The results indicated that the collected pulse was at most, only 3 beats per minute away from the average target heart rate, proving to be extremely accurate. Notifications were successfully sent fast and easily.

Conclusions/Discussion

I built a compact heart rate monitor and analyzer that visualized the pulse of the wearer in waves and could notify others when help is needed. The various tests and trials conducted proved the efficiency and accuracy of the design. This device could potentially save thousand that die from cardiac arrest annually.

Summary Statement

I designed and built a compact and portable heart rate monitor and analyzer that displays pulse in real-time and notifies chosen people when help is needed.

Help Received

I designed, built, and programmed the device myself. My uncle helped me troubleshoot the code when needed.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Tejal Patel

Project Number

J0809

Project Title

Cellular Factors Involved in the Progression of DCIS to Invasive Breast Cancer Using Computer Based Simulation

Abstract

Objectives/Goals

Breast cancer is the second leading cause of cancer death in women. A deeper understanding of how breast cancer grows and spreads can help in the development of life saving treatment. Ductal Carcinoma In Situ (DCIS) is a non-invasive breast cancer, where abnormal cells are contained in the breast ducts. The progression of DCIS to invasive breast cancer is still not well understood. Many cellular factors seem to play a role like Mitosis, Apoptosis and Adhesion between cells(Myoepithelial and Luminal). This project proposes a novel computational approach to investigate which important cellular factors play a dominant role in the evolution of DCIS to invasive breast cancer.

Methods/Materials

I used the computer based simulation CompuCell3D to create a 2D cross section of a breast duct, which contained a Luminal Epithelial Layer (LEP) and a Myoepithelial Layer (MEP). Modifying plugins using Python and XML scripting and based on the Cellular Potts Model, various factors including mitosis, apoptosis, and cellular adhesion were set to mimic the growth of luminal epithelial cells in DCIS. I modified each factor independently of each other, at rates of 12.5%, 25%, 50%, 100%, 200% 400%, and 800% of their baseline rate (the control rate). Each trial was run until invasion occurred, and the time until invasion was recorded on a spreadsheet. I compared each modified rate to its baseline rate, and used standard statistical analysis to determine trends within the data.

Results

The results showed a strong correlation between mitosis and likelihood to invasion. A weaker but still strong correlation was seen in the adhesion between LEP and MEP cells. A weak correlation was seen in adhesion between LEP and LEP cells and in adhesion between MEP and MEP cells. No correlation was seen for apoptotic rate.

Conclusions/Discussion

Of the factors tested in my project, mitosis was shown to play the key role in the progression of DCIS and invasive breast cancer. This corresponds to clinical data which shows a relationship between a higher grade of DCIS and progression to breast cancer. The moderate correlation between LEP cells suggest that luminal epithelial factors such as E-cadherin levels relate to tumor progression.

Summary Statement

I used a computational approach to study the factors involved in the progression of DCIS to invasive breast cancer, and this suggests that mitosis rate and luminal epithelial cellular adhesion in DCIS have significant roles in how invasive breast cancer progresses.

Help Received

I would like to thank Dr. James Li for introducing me to CompuCell and helping me narrow down my research topic.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Leif P. Rudling

Project Number
J0810

Project Title
iWB APP: Aircraft Weight and Balance Calculator

Abstract

Objectives/Goals
My project was to design and create an application for determining weight and balance for general aviation aircraft that would be faster and more accurate than calculating it manually.

Methods/Materials
I spent 55 hours doing on-line tutorials to learn how to write code, and over 30 hours to write the code. Apple computer, Microsoft Excel, programs Swift2 and Flash, calculator, Pilot's Operating Handbook, Gleim Private Pilot Handbook, and stopwatch. I performed eight different test scenarios which included total weight and location placement on the aircraft, both manually and using the iWB app, and timed them.

Results
The iWB application proved to be much faster than the manual tests, and just as accurate. The iWB app determines if the aircraft's weight limit and center of mass has been exceeded and will issue instructions to recalculate for safety.
The iWB app is effective in solving math problems based on the weight in the aircraft in the positions of fuel, pilot, passenger, and cargo, and for the center of mass.

Conclusions/Discussion
As a student pilot, my prior knowledge of the vital importance of proper weight and balance in an aircraft was re-emphasized to me while working on this project. Improper weight and balance can cause slower speeds, increased fuel consumption, difficulty in taking off and landing, stress to the engine, stalling, spinning, crashing, and ultimately, loss of life. The practical lesson I learned from this project was how to develop and create code for a convenient computer app that can be applied to my interest in aviation and help in the pursuit of becoming a pilot. This knowledge of writing code can be applied to any field of interest of mine in the future.

Summary Statement
I designed and created a computer application for determining weight and balance, and center of mass, for the general aviation pilot.

Help Received
I learned how to write code by doing on-line tutorials. I then designed and created the app myself after my father purchased a new Apple computer that was compatible with the code writing software.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Gregory V. Saldanha

Project Number
J0811

Project Title
Building a Driverless Toy Car

Abstract

Objectives/Goals
The aim of this project is to construct a driverless toy car that must avoid obstacles and proceed autonomously from its current location to a target location using a map of available paths.

Methods/Materials
The vehicle is built using Lego Mindstorm pieces and is equipped with two standard servo motors, one for movement and the other for steering, controlled by an onboard Arduino Uno microcontroller. The car is equipped with sensors used to detect and avoid obstacles. I have written the software programs which run on a laptop and an Arduino in C++ and Python. The software uses a map to compute the best path to reach the destination and generates the necessary steering commands. It uses artificial intelligence algorithms such as a steering angle computer known as PID control; I have devised a few algorithms myself, including the trajectory generation and evaluation. Steering commands are sent wirelessly from the computer via Bluetooth to the Arduino Uno.

Results
The vehicle is able to successfully navigate to target locations without colliding with obstacles. The map routes include multiple feasible paths and turns. The software and hardware are able to communicate seamlessly over Bluetooth and the servo motors correctly control the mechanical systems.

Conclusions/Discussion
I was able to program an autonomous vehicle system composed of a server program running on a laptop and an Arduino (client) program. I built a car chassis with working mechanical modules including a steering system, and connected servo motors to these systems. This project demonstrates the practicality of building a self-driving vehicle with a small budget.

Summary Statement
I built and programmed a self-driving toy car that uses a map for navigation, and is able to drive and avoid obstacles.

Help Received
I wrote the software myself and built the car entirely from scratch. The only supervision I needed was for soldering pins to the circuit boards.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Shlok R. Shah

Project Number
J0812

Project Title
Autonomous Vehicle Crash Avoidance Algorithms

Abstract

Objectives/Goals
My objective is to figure out which method of crash avoidance, communication or sensing, will be better at avoiding crashes between autonomous vehicles. I hypothesized that communication will be better at avoiding crashes because it takes less time to detect communication signals than detecting events with sensors. If any other vehicle is turning or not can be determined with more certainty with communication.

Methods/Materials
First, two robots were constructed using a Raspberry Pi, ultrasonic sensors, and a gyro sensor. Then, three programs, a UDP communication, ultra sonic sensing, and control algorithm, were written in Python. The turns were decided from a randomly generated sequence based on a seed. Each algorithm was tested for ten different sets of seeds; every time the robots crashed, the time was recorded using a stopwatch.

Results
The results showed that the control consistently crashed on the first turn, sensing took longer to crash on average, and communication never crashed during the run time.

Conclusions/Discussion
Because control had no way of detecting turns, it would always crash on the first turn. Sensing successfully detected the first turn most of the time, but, in certain cases it could not detect next turns. For example, when one robot was a little bit ahead, this robot could not sense the other robot's turns, while communication could detect turns anywhere in the room. Therefore, my hypothesis was supported, because communication did the best out of all the algorithms.

Summary Statement
My project is about figuring out which crash avoidance method, sensing or communication, is better at avoiding crashes in autonomous vehicles.

Help Received
I designed and implemented the algorithms myself. I built and conducted experiment myself. My teacher helped me review the results and display board.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Aryansh Shrivastava

Project Number
J0813

Project Title
Microcontroller Based, Elderly Activity Monitoring System with Intelligent Data Analytics for Early Emergency Detection

Abstract

Objectives/Goals
There is a need for a microcontroller-based, proactive, intelligent healthcare activity monitoring system for seniors and other people that monitors healthcare activities, reporting and alerting any irregularities for preventive care. This system can be deployed for seniors and other people at home or assisted living by caregivers.

Methods/Materials
First, finding cost-effective, open-source, microcontroller-based sensors that can passively monitor daily routine activities, e.g. sleep, medicine dose, bathroom visits, etc. Next, designing, calibrating, and connecting the different sensors to the Arduino microcontrollers. Then, using a Raspberry Pi to connect to the microcontrollers, getting minute data from the sensors, that is aggregated to hourly data, and, once a day, daily data is created with intelligent analytics for the activities, then posting the daily data to the caregiver, for monitoring and detecting any irregularities for preventive care.

Results
The bed monitoring with the FSR sensor is tested for 17 days, and the daily data collected, i.e. the daily hours in bed and the number of wake and sleep hours in the wake and sleep zones, is validated. The pill monitoring with the Hall Effect sensor is tested for 10 days, and daily pill reporting is validated to determine if the pill was taken at correct time. The bathroom visit monitoring with the break beam sensor is tested for 10 days, and the reported data for bathroom visit frequency and time are validated in the sleep and wake zones.

Conclusions/Discussion
My project provides very meaningful information about the healthcare activities of seniors to the end users, making it useable for preventive care.

Summary Statement
My project is a microcontroller-based, elderly activity monitoring system that can be deployed for seniors at home or assisted care livings in order to take care of them.

Help Received
My dad helped me solder some of the parts to my Arduino Pro Minis, and he also bought an Udemy course for me to learn the basics of iOS programming.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Anjali Singh

Project Number

J0814

Project Title

Predicting Formality of Written Texts Using Machine Learning Algorithms

Abstract

Objectives/Goals

My project goal was to create a program that could automatically classify a given text document with >80% accuracy into three levels of Formality: Formal, Casual and Semi-Formal.

Methods/Materials

Python program, Natural Language Tool Kit (NLTK) Library, 8 kinds of machine learning algorithms, 2 kinds of feature extraction methods, and 130 pieces of documents as labeled data. 10 experiments were conducted. The classifiers were trained using 100 labeled documents. The model was tested using 30 documents and accuracy was measured against the correct labels.

Results

5 of the 8 classifiers were able to successfully predict the levels of formality with an average accuracy of 88.6%. Bag-of-Words feature extraction method was found more accurate (92.28%) than Part-of-Speech feature extraction method (84.5%).

Conclusions/Discussion

In conclusion, the project achieved its goal and successfully demonstrated a working program that used machine learning algorithms to predict levels of formality of any given text with >80% accuracy.

Summary Statement

My project goal was to analyze the levels of formality of a given text with >80% accuracy using machine learning algorithms and natural language processing.

Help Received

I created this program by myself with guidance from my parents.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Ziyad Soliman

Project Number
J0815

Project Title
Train that Brain

Abstract

Objectives/Goals
The objective of this project is to develop a computer program application to help people diagnosed with Attention-Deficit Hyperactivity Disorder (ADHD) to strengthen and prolong focus and attention.

Methods/Materials
Downloaded a software called Unity to create the app. Programmed the Main Menu on the first screen. Created buttons that the user clicks to transfer to different screens. Developed a screen for each game where each subsequent screen corresponded to a game. After creating all of the games, the Main Menu was linked to all the screens and then an exit button was created for each screen except the Main Menu screen. A 15 second timer and a scoreboard to calculate the score for all the games were created. Finally, an unlock\lock system was devised to unlock levels when successfully completed.

Results
As the results for creating an application consist of runs, many runs were taken. Levels were unlocked when the user effectively completed a previous level. The application was successful and was able to accomplish its task.

Conclusions/Discussion
This application allowed the user to successfully play five brain training games to improve focus and attention. After selecting the desired game from the Main Menu, the user played the game under the constraint of a timer. If successful, subsequent levels were unlocked. Otherwise, the user may choose to try again or to play a different game.

Summary Statement
I programmed a brain training application to help people diagnosed with ADHD to strengthen and prolong focus and attention.

Help Received
My computer science teacher, Ms. Najwan Nassereddin, honed and refined my programming skills.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Annika Viswesh

Project Number
J0816

Project Title
Oculus Patch Assistant

Abstract

Objectives/Goals
2.5 M children in the U.S. have vision impairment due to Amblyopia. Treatment can take many months or years. Treatment is cumbersome, unorganized and inefficient. Doctors are NOT able to recommend the right duration and frequency of eye-patching due to poor measured correlation with visual acuity. The objective of this project is to make the treatment of Amblyopia, efficient and effective.

Methods/Materials
Macbook computer running the iOS operating system with an XCode IDE for programming using the SWIFT programming language. RFduino microcontroller development kit with an arduino IDE on a macbook computer. Fluid UI software on macbook computer for user-interface prototyping.

Results
I successfully created an iPhone application to manage and monitor Amblyopia treatment. The application successfully logged patient's historical patching data and emailed it to the doctors.
I performed 3 different trials; 20 test cases in each trial with simulated data
95% of the time, the application loaded within 10 seconds
95% of the time, the screen transitions took less than 10 seconds
90% of the time, the data was accurately saved and restored
95% of the time, email with the data was sent successfully

I also built a cheap, portable RFduino device that communicates with a smartphone application to sync patch logs. This device is useful to log patching data, when a smartphone is not available during the patching activity

Conclusions/Discussion
Doctors currently treat Amblyopia using a trial and error approach to recommend a regimen for daily eye patching. The Oculus Patch Assistant smartphone application logs patient patch logs and sends all the data records to the doctor via email. By collecting data across multiple patients, it is now possible to correlate improvements in visual acuity to factors such as age, sex, activities performed during patching, hours of patching per day. This paves the way for new treatment protocols to make the treatment of Amblyopia much more efficient and effective.

Summary Statement
I created a smartphone application to make the treatment of Amblyopia much more efficient and effective.

Help Received
I designed and built the smartphone application by myself.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Jonathan W. Weakliem

Project Number

J0817

Project Title

How Secure Are Your Passwords?

Abstract

Objectives/Goals

The objective is to see what makes a password hard for password cracking software to recover and what variables of a password make it most secure.

Methods/Materials

Laptop, John the Ripper software, Python software, Command prompt. Encrypted sample passwords with python and ran John the Ripper against them while timing it.

Results

Adding anything to a password makes it harder to crack. I found that adding symbols was the variable that made passwords most secure.

Conclusions/Discussion

The data showed that adding anything to a password made it (on average) take longer to crack. It also showed that adding symbols made passwords the hardest to crack on the order of several hours.

Summary Statement

I showed that adding anything to your password makes it harder to crack.

Help Received

I got some basic information about encryptions and passwords from a grad student in computer science and some basic computer assistance from a family member. I ran the programs, created the lists of passwords, and analyzed/ recorded results.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Saida M. Woolf

Project Number

J0818

Project Title

Using Stylometry Combined with an In-Class Writing Sample to Detect Plagiarism

Abstract

Objectives/Goals

Classroom teachers sometimes put student essays through a plagiarism detector to search the web for any matching sentences and paragraphs. But this doesn#t detect if the paper was written by ghostwriters. I came up with a system where the teacher uses a one-time in-class writing sample and compares it to future essays with stylometry. This will detect unusual changes in style or vocabulary. The writing sample could be an autobiography, which could be quickly written by most students on the first day of class. The purpose of my experiment is to test my system.

Methods/Materials

I did two preliminary experiments to test a JavaScript tool I made to count letters per word and words per sentence to determine authorship. Preliminary Experiment 1 tested two chapters by the same author. Preliminary Experiment 2 tested two chapters by different authors. The success rates for two chapters by the same author was 10% and the success rate for two chapters by different authors was 50%. My conclusion was that counting letters per word and words per sentence were unreliable for determining authorship, so I tried using Most Frequent Word analysis with Stylo, an open-source library for R. While my JavaScript tool had a success rate that was worse than guessing, Stylo succeeded 70% of the time. I decided to use Stylo in my Final Experiments. In my Final Experiments, I wrote an autobiography and compared it with 10 writing samples I wrote in the past using Stylo to perform Most Frequent Word Analysis.

Results

My Final Experiments had a success rate of 40%. Counting words per sentence and letters per word was not accurate for determining authorship. Analyzing most frequent words worked 70% of the time when testing English authors against each other, but worked only 40% of the time when testing on my own writing. My hypothesis was partly incorrect.

Conclusions/Discussion

I came up with a system where the teacher uses a one-time in-class writing sample and compares it to future essays with stylometry. This will detect unusual changes in style or vocabulary that could indicate plagiarism or ghostwriting. It was this system that my experiment was designed to test. Although the stylometry methods that I tested did not give me the desired accuracy, I believe that further testing with other stylometric methods could make this a useful classroom tool.

Summary Statement

I developed and tested a system to detect plagiarism in the classroom setting using an in-class writing sample and stylometry.

Help Received

My father, Reagan Woolf, an aerospace engineer, helped me learn JavaScript, data analysis, statistics, and stylometry.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Albert Zhang

Project Number
J0819

Project Title
A Probabilistic Network Model of Neural Systems

Abstract

Objectives/Goals
This project seeks to propose a simulation-based model of synaptic development, with special focus on two features which are crucial to the process of learning: synaptic plasticity and synaptic pruning. Synaptic plasticity is the strengthening of the active synapses and weakening of the less active ones, and synaptic pruning is the elimination of the rarely used synapses.

Methods/Materials
A laptop computer with a MATLAB compiler was used to code the model.

Results
The simulations generated from the model indeed display the key features of synaptic plasticity and synaptic pruning. In addition, the adjustment of various parameters within the model can roughly account for the various levels of intellectual or creative ability in each person.

Conclusions/Discussion
This model captures several key features of synaptic development, and provides huge flexibility for future revisions so as to incorporate more features of neural systems. Moreover, this model is easy to understand, and due to the simulations it is easily verifiable.

Summary Statement
This project proposes a probabilistic model which effectively captures important features of synaptic development in neural systems.

Help Received
None. I conceptualized, coded, and analyzed the model myself.