

Abstract: Science and Engineering Fair of Houston

1102

Prosthetic hands

Bethany Andrade

Houston ISD /BCM Academy at James D Ryan - MS

Category

Biomedical Engineering

My project is about prosthetic hands. The purpose of this investigation is to build and design a robot hand using regular materials that will mimic a human hand to grasp small objects. This topic caught my attention because prosthetic hands can improve the quality of life for people who have lost their hand due to accidents, injuries, illness, or were born without a hand by allowing them to perform their everyday tasks. The problem I am trying to solve is how the prosthetic hand works similar to the human hand. My objective is to construct a robotic hand that will replicate the movement of human fingers and to grasp small items. I was able to build a prosthetic hand that mimics the human hand. During my testing, Prosthetic hand should be able to curl its finger and pick up objects. For this project I used a Cardboard box, ruler, markers, plastic straws, strings, hot glue gun, and scissors. The results from creating a prosthetic hand resolves the hypothesis and confirms that prosthetic hands are able to accomplish the same basic functions as a human hand such as: picking up items, making hand gestures, and pointing. The finding matter because it will help me find some important details about the prosthetic hands

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

1103

Regenerative Tissue in Biomedical Engineering

Julie Vasconcelos

Conroe ISD /McCullough Junior High

Category

Biomedical Engineering

I used planeria to model regenerative tissue. I cut the planeria in half and took data from the time it took for them to regrow. I did research on the planeria and tissue regeneration in the medical field and compared them.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

1104

Training and Developing a Computer Vision System to Prevent Drowning

Katelyn Zahner

Clear Creek ISD /Seabrook Intermediate School

Category

Biomedical Engineering

People, especially children, die every day from drowning in pools, often even when adults are present. This project designed and trained a computer model to differentiate between normal swimming and drowning. Computer vision models are often difficult to develop because they require large datasets to train. However, the largest publicly available source of videos (YouTube), had many normal swimming and drowning videos that were used to train the computer model. When used with a camera or cellphone, the program (with the computer vision model) is simple and efficient to use. Ultimately, it was found the model that was trained for the longest (125 epochs vs 10, 30, or 50 epochs) was most effective. The hypothesis was that if the computer vision model is trained with sufficient data and for long enough, it will be able to detect drowning easily, potentially saving lives. Using drowning videos and a video anoting system (Roboflow), one can train a model and use it in a program (potentially deployed on cell phones, security systems, etc.) to detect drowning. The data showed that the program worked well. The program was able to detect drowning behavior when compared to normal swimming behavior. It was also able to differentiate between other items that can be in a pool (pool floats, volleyballs and golf balls) and humans, resulting in fewer false alarms. The designed system worked very well and would be effective if employed in the real world.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

1105

Protective CGM (Continuous Glucose Monitor) Snap Bracelet

David Terzyan

Clear Creek ISD /League City Intermediate School

Category

Biomedical Engineering

Continuous glucose monitors (CGMs) are essential medical devices for children with Type 1 diabetes, helping them maintain blood sugar control. However, the constant wear of these devices can lead to skin issues such as allergic reactions, irritation, and rashes. Active children may also struggle with CGM adhesion, as sweating and physical activity can weaken the adhesive, causing the device to peel off. Additionally, existing adhesive-free options are limited, and current CGM bands are often difficult for children to apply independently, requiring parental assistance. Inspired by the simplicity and fun of snap bracelets, this engineering project designed an innovative, easy-to-use solution to improve CGM's length of wear and skin comfort for children. The proposed design involved creating a snap bracelet-style device that securely holds the CGM on the arm without additional adhesive-based overlays. The device features a plastic CGM cover and a flexible band (like a snap bracelet) that a child can easily put on by themselves. The design is based on the dimensions of the Dexcom G6 sensor, with the final prototype produced using 3D printing. The current prototype of the device is still a work in progress. The design of the band needs to be reevaluated to ensure a snugger fit on the arm so that the continuous glucose monitor (CGM) stays securely and properly in place.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

1106

Development of a home-based, stage-specific diagnostic kit for the detection of protein biomarkers to enhance diagnostic capabilities and improve treatment precision for Cancer

Anvitha Gottipati

Category

Biomedical Engineering

Cancer continues to be a major global health burden, with incidence rates having tripled over the past two decades, underscoring the critical need for advancements in early detection and therapeutic strategies. Traditional invasive diagnostic methods are often costly and uncomfortable for patients, further highlighting the demand for non-invasive techniques capable of detecting cancer at its earliest stages. Early diagnosis is essential to prevent irreversible organ damage and the spread of cancerous cells. This study aims to develop an affordable, rapid, at-home lateral flow assay for early cancer detection using colorimetric technology. Biomarkers were selected by analyzing expression profiles from GEO datasets of various cancers, with data sourced from the NCBI database. Statistical analysis in R Studio identified biomarkers that met predefined criteria for significance and reproducibility. These biomarkers were integrated into the design of the diagnostic kit, ensuring optimal sensitivity and specificity for accurate cancer detection. The assay targets biomarkers associated with early-stage cancer and employs nitrocellulose membranes and gold nanoparticles, both of which are well-established for their effectiveness in colorimetric assay systems. To enhance performance, the kit was further optimized by adjusting nitrocellulose membrane binding capacities, antibody loading concentrations, and nanoparticle sizes. This innovative approach holds great promise for providing accessible, cost-effective cancer detection at the point of care. Using our prototype lateral flow kit, we successfully achieved a lower limit of detection of 1 µg/mL of the biomarker in the provided sample.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

1107

Sensor Walker

Charlotte Warner
Keinan Sherrod
Stafford STEM Magnet Academy

Category

Biomedical Engineering

Our science fair project is called the "Sensor Walker". The purpose of our model is to help a problem the blind community faces which is not being able to see their surroundings, in result, they don't know an object is in front of them, so they hurt themselves in the process of doing a simple task. We have three basic sensor models one for the head, and one for each foot, in addition we have one vibrating sensor belt for the waist. We wrote all of our codes using the arduino app. Our materials consist of 3 buzzers, 4 ultrasonic sensors, male to female wires, dc vibration motor, 3 plastic containers, 1 belt, and a computer. Our hypothesis is we think that a person wearing all of the sensors will be able to successfully navigate through the set obstacle course without hitting any obstacles. After testing with 3 set obstacles and 3 testers our hypothesis was correct and on average the testers hit 2-3 obstacles with the sensors and without sensors they hit an average of 4 obstacles. Using the vibrations the users were more successful and they could pin point where the object was. our hope is that the sensor walker will help the blind community and not get injured as frequently.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

1108

What type of lotion has the most moisture content?

Asher Hsieh
Leejay Kim
Spring Branch ISD

Category

Biomedical Engineering

Moisturizer Analyzer is a project with a goal to provide the general public with information on which lotion has a greater impact on their skin. Thus, our scientific question is "When tested on fake skin, which brand of moisturizer will retain a higher percentage of moisture at different time intervals?" From many different research studies, we have gathered that due to the composition and balance of ceramides and hyaluronic acid, as well as just pure popularity as well, that CeraVe would yield the best moisture contents. This experiment was conducted by splitting the the fake skin into different sections, applying an even layer of lotion onto the skin, then measuring the moisture content using a moisture tester at the start, 5 minutes after, 30 minutes after, and then after 1, 3, and 24 hours respectively. The results provided quite a surprise, as we have concluded that Vanicream - which also has ceramides and acids - performed better than all others in the beginning, while at the end, Eucerin took over as other lotions dropped significantly at the 3-hour mark, so thus as Eucerin, who stayed consistently near the top, was declared our winner for daily applications. Our hypothesis was not supported as we suspected that CeraVe would win, but in the end it turned out to have two consistent winners: Vanicream for often application, and Eucerin for daily ones.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

1109

UnaPEELING Fruit

Matthew Ramsey

Clear Creek ISD /Seabrook Intermediate School

Category

Biomedical Engineering

The question of this project was to see if an AI sensor can help blind people determine if fruit is ripe or not. The hypothesis was yes, this sensor will be able to detect if a fruit is ripe and a sound could be played. The project used a HuskyLens (AI sensor), an Arduino board, and a mini buzzer. The HuskyLens was trained with different fruits with different ripeness, with and without a stand. The Arduino board (was coded before testing), HuskyLens, and Buzzer were wired together to create a machine. The machine was tested with a stand (to hold up the HuskyLens) and without a stand scanning 30 bananas and 20 oranges with fruits of varying ripeness. The results were recorded. With the stand the HuskyLens properly detected the color of all the fruits 100%, but with no stand the HuskyLens detected 80% of the ripe bananas, 100% of the over ripe bananas, 40% of the unripe bananas, and 100% for the ripe and “unripe oranges” (limes). The hypothesis was proven mostly correct. Some real-world use from the data is blind people can use a sensor like in this project to know what fruit is good to eat. If a sensor is used to detect color, it is recommended to use a stand so the lighting from the training process will be the same as the testing process and the sensor will not move around.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year’s work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

1110

Sweet Sweat: Non-Invasive Glucose Monitoring

Anjali Balne

Conroe ISD /Irons Junior High

Category

Biomedical Engineering

Sweat glucose sensors have the potential to offer a non-invasive alternative to traditional blood glucose monitoring. This innovation could eliminate the discomfort and inconvenience of frequent finger-prick tests, improve real-time glucose tracking, and empower users to make more informed decisions about their health. For millions of people living with diabetes, such technology could drastically improve their quality of life, reduce the burden of daily glucose monitoring, and potentially lead to better long-term health outcomes. This study evaluates the accuracy of sweat glucose measurements in estimating blood glucose levels following the consumption of varying amounts of sugar. Results showed a positive correlation between sweat glucose and blood glucose at lower sugar intakes, but accuracy decreased as sugar consumption increased. Statistical analyses, including correlation coefficients and error metrics (MAE, RMSE), indicated that factors like sweat rate and sensor sensitivity affected the sensor's reliability. The findings suggest that while sweat glucose sensors show promise for non-invasive monitoring, their accuracy may be influenced by the amount of sugar consumed.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

1111

Staying Salty

Maddilynn Scott
Central Middle School

Category

Biomedical Engineering

My project tested the amount of electrolytes in certain sports drinks to determine the best drink for athletes during exercise to replenish lost electrolytes. I started with researching information about electrolytes to learn the types and functions of electrolytes. I then gathered my materials and built an electrical circuit to measure the milliamps (electrical current) in the individual drinks. Next I collected my data and found that LMNT a sports drink with a high amount of sodium held the most amount of electrolytes. My data also showed that Propel, a leading sports drink brand held the lowest amount of electrolytes.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

1112

Helping Hands: Future of Prosthetics

Bhavana Thambireddy
Conroe ISD /Irons Junior High

Category

Biomedical Engineering

Prostheses have developed the lives of many with missing limbs, reestablishing independence and strength. In recent years, 3D printing technology has advanced creating new opportunities for amputees to personalize prostheses at a lower price. However, the capabilities of 3D printed prostheses compared to a normal human hand is unknown. This research examines the flexibility, grip strength, and dexterity of 3D printed prostheses contrasting them to those of normal human hands. In the end, the results of this study revealed that 3D prostheses have incredible flexibility and great grip strength but lack dexterity compared to a human hand. Ultimately, further cultivation will be needed in the evolutions of 3D prostheses that can help improve quality and mobility of an amputee's life.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

1113

Best Source of Electrolytes for Athletes

Aaron Yakubovich

Conroe ISD /McCullough Junior High

Category

Biomedical Engineering

This project is important because electrolytes have a huge impact on athletes in their daily activities. Various drinks such as water, juices, coconut water, and various energy drinks contain abundant electrolytes. Electrolytes are essential for all athletes because they support their physical performance, increase energy, improve mental health, and prevent body injury. Athletes benefit from drinking electrolytes because it keeps them hydrated. Electrolytes have a positive or negative electrical charge when dissolved in a liquid. The electric charge helps the heartbeat, body function, and blood flow. Which drink has the most electrolytes to keep athletes hydrated? The experiment was done to test how many electrolytes were in each drink by using a voltmeter. The three drinks with the most electrolytes per 10 oz were coconut water with 38.6 amps of electrolytes, hydration drink with 33.15 amps of electrolytes, and milk with 32 amps of electrolytes. This data helps athletes choose the drink with the most electrolytes. Athletes need electrolytes to help them stay hydrated and have physical strength during practice. Without electrolytes, athletes could be at risk of their health while playing the sport.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3084

A Low-Cost, Non-Invasive Wristband for Continuous Monitoring of Deoxygenated and Oxygenated Hemoglobin Levels in Sickle Cell Patients

Anyulina Arias Delvaty
Alief ISD

Category

Biomedical Engineering

Approximately 90% of children diagnosed with Sickle Cell disease (SCD) in low-income countries die each year before turning five years old. SCD is an inherited blood disorder that distorts the shape of red blood cells. SCD causes blockages in blood vessels, leading to complications such as hypoxemia, infections, and vaso-occlusive events. Normally, patients with SCD monitor their vital state utilizing transmissive pulse oximeters or thermometers. Although transmissive pulse oximeters and thermometers are relatively cheap, limitations such as inaccurate readings frequently occur due to personal or environmental factors. Therefore, having a monitor in the form of a wristband that is low-cost, non-invasive, accurate, and highly accessible could apply to the lives of these patients. This innovation is centered on determining a patient's oxygenated to deoxygenated hemoglobin, heart rate, and temperature by mainly using an Arduino Uno (\$27), an MLX90614 Temperature Sensor (\$12), and a MAX30102 Pulse Oximeter Sensor (\$4) to provide a high estimate of vital health signs. The wristband was tested on 53 volunteers, two with Sickle Cell Disease, and one with Sickle Cell Trait. To test for accuracy, wristband readings were compared to those of a regular transmissive pulse oximeter and a digital thermometer, confined with a margin of error of +-2%. The patient's vital signs were deemed ordinary, even for those compromised by Sickle Cell. Moreover, the wristband displayed an overall accuracy of 96.72% regarding the vital signs; and a cost of approximately \$60 to construct. Undoubtedly, the wristband effectively demonstrated accuracy, non-invasive usage, and cost efficiency.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3085

Utilizing a Computational Model to Optimize the Separation of Microplastics from Blood by Centrifuge

Joshua Staub

Conroe ISD /AST: Academy of Science and Technology

Category

Biomedical Engineering

In recent years, as technology has advanced, plastic has become a massive problem by polluting the oceans and introducing these plastics into humans in the form of microplastics. These microplastics can be found anywhere and very easily enter even the bloodstream of a human, carrying chemical additives or diseases that can cause fatalities. In this experiment, the researcher aimed to test how a centrifuge could pose a proper response to this influx of microplastics. The experimenter utilized synthetic A antiserum, as well as isotonic saline, both mimicking the properties of human blood, mixed with a combination of multiple plastics of different sizes, but mainly polystyrene. A centrifuge was used to separate these throughout multiple trials, with the researcher adjusting the settings of the centrifuge each time. Following the use of the centrifuge, the separated plastics were counted and compared to the beginning in which they were mixed. The experimenter encountered several issues during their experiments, including a density issue that they attempted to fix. This project was not successful in proving a centrifuge could help with separating microplastics, although a computer program was developed with this experiment to help optimize the settings of the centrifuge, with the results of this program being verified even though the trials were not successful. In a real-world setting, the results of this experiment could be used for doctors and scientists to develop new technology, like an automated centrifuge that continuously centrifuges blood, which would help with this incoming plastic crisis.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3086

A Non-Invasive Cholesterol Detection Method Using NIR Spectroscopy

Joel Blessan

Ky-Minh To

Friendswood ISD /Friendswood High School

Category

Biomedical Engineering

Cardiovascular diseases remain the leading cause of death in the United States, with cholesterol as a major contributing factor. Current cholesterol detection methods are invasive, costly, and inaccessible to many. This project aims to develop a non-invasive and cost-effective method to detect cholesterol levels using Near-Infrared (NIR) spectroscopy. The proposed method employs a device that uses IR and tri-color LEDs, photodetectors, and microcontrollers (Arduino Uno and ESP32) to measure light absorption through store-bought animal blood spiked with a cholesterol surrogate (phytosterols). The Beer-Lambert Law guides the spectroscopic analysis, correlating light absorption at various wavelengths to cholesterol concentrations (150–200 mg/dL). Data is collected from serial monitors and compiled into a CSV file, which is analyzed using machine learning models. Initial results are promising, demonstrating the potential of this method for cholesterol detection. Future steps for this project include optimizing the device's sensitivity, expanding the dataset for the models to train on, and improving prediction capabilities by testing various machine learning algorithms. This study lays the foundation for an affordable, accessible, and non-invasive cholesterol detection tool, addressing a critical gap in cardiovascular health monitoring.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3087

Cost-Effective PPG Sensors for Detecting Heart Arrhythmias 24/7: A Portable Alternative to EKGs

Henil Parmar
Aamod Apte
Aryan Ayyanger
Seven Lakes - HS

Category

Biomedical Engineering

According to the CDC, heart arrhythmias, including atrial fibrillation account for approximately 158,000 deaths in the United States each year. These types of cardiac arrhythmia are often difficult to monitor due to the limitations and costs attributed to traditional methods of ECGs and Holter monitors. These detection devices may not be equally accessible, can be costly, and require expertise from health professionals. Therefore, our project aims to develop a cost-effective, portable device using a novel approach of Photoplethysmography (PPG) sensors to detect and assess heart arrhythmia in real-time, offering a viable alternative for 24/7 monitoring. Our research study incorporates analysis of the distance between relative maximums, identifying slopes of certain intervals, and determining the mean absolute deviation of these distances to determine normal sinus rhythm or other underlying cardiac conditions. We will refine and iterate our device through the testing of human participants for data collection and evaluate performance, while efficiently visualizing data on a Poincaré graph. The portable and cost-effective device utilizes an Arduino microcontroller, a PPG sensor module, and a comfortable design for usability and accessibility. This innovation could drastically benefit cardiac patients, by allowing real-time detection in a non-healthcare environment, reducing hospital dependence, and diagnosing specific cardiac arrhythmias earlier ranging from tachycardia, bradycardia, atrial fibrillation, and more.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3088

Dealing with T1D: Building an Artificial Pancreas

Hazel Stubbert

Fort Bend ISD /Hightower High School

Category

Biomedical Engineering

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



3089

OpenLTDRiP: A Novel Computational Framework-Based Approach for the Identification of Ligand-Based Drug Solutions to Progressive Drug-Resistant Mycobacterium tuberculosis Strains

Andrew Zhang

Message To: [redacted]

Category

Biomedical Engineering

Tuberculosis was the cause of death for 1 billion people in the last two centuries, with over 2/3 of deaths being concentrated in developing countries. This can be attributed to mycobacterium tuberculosis' (M. TB) infectiousness, and, more recently, progressive drug resistance. Also, the fact that many patients in developing countries use outdated medications due to shortages of medicine options result in a concerning amount of MDR (Multidrug resistant) M. TB strains. To combat this, an approach that produces more ligands-of-interest in a shorter time is required to increase the quantity and variety of drugs. An ensemble of Molecular Docking (AutoDock Vina), Dynamics (GROMACS), QSAR, Inverse-QSAR (ACoVAE), Machine Learning, and variant-calling (Galaxy) workflows were combined with python to create automated scripts to calculate molecular descriptors of ligands based on ligand-protein interactions (taking mutations into account as well using the variant calling workflow). The framework is structured chronologically to allow for 5 protein-ligand complexes to be inputted, returning datasets with descriptors from QSAR, AutoDock, and GROMACS. The resulting dataset is used by the Machine Learning model to predict each complexes' time to drug resistance (including mutated proteins). The resulting dataset is passed into an Inverse-QSAR model with a seq2seq architecture, which generates SMILES strings to optimize ligand structures, maximizing the time to drug resistance. This approach, which takes 30 hours as compared to an industry standard of 3 years for a single complete run, returns new ligand structures that can significantly aid in identifying new drugs to combat M. TB.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3090

SpiroSense: A 3D Printed Arduino-Based Device for Assessing Lung Capacity and Respiratory Function

Adil Mansury

Krishna Somasundaram

Conroe ISD /AST: Academy of Science and Technology

Category

Biomedical Engineering

This study aimed to evaluate the accuracy and reliability of a 3D-printed Arduino-based spirometer device compared to a professional-grade spirometer. The device Spirosense, functions by utilizing an HX710B differential low-pressure sensor, an Arduino Microcontroller, and an LCD Display, powered by a lithium-ion polymer battery, all being merged within a 3D printed case. Additionally, the device will incorporate an Arduino BT, displaying measure key respiratory parameters, including Vital Capacity (VC), Forced Vital Capacity (FVC), Forced Expiratory Volume (FEV), and Forced Expiratory Flow (FEF). The device will be tested via a DIY Lung Model which will be used to simulate various respiratory conditions, with data being collected and analyzed over multiple trials to ensure accuracy and statistical significance. Data from the trials will be compared to a professional-grade spirometer using statistics such as t-tests, and standard deviations to demonstrate how capable Spirosense is at assessing lung capacity. Spirosense offers to be a low-cost, accessible solution that will provide accurate statistics on lung capacity and represent respiratory health, serving as an alternative method for respiratory diagnostics and lung health assessment. It can further be used to track recovery speed for respiratory illnesses and monitor chronic conditions such as asthma and COPD.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3091

OncoAI: Integrating a Computationally Efficient Deep Learning Model into a Multi-Platform Universally Accessible Application for Accurate Detection of Multiple Cancers Across Diverse Imaging Modalities

Kavin Elangovan

Cameron, Maryland US / Houston, TX

Category

Biomedical Engineering

INTRODUCTION: Cancer claims nearly 10 million lives annually, necessitating transformative diagnostic solutions. Artificial intelligence (AI) is revolutionizing oncology by enabling early and precise cancer detection. AI-powered biomedical devices offer real-time, scalable solutions that reduce diagnostic time, operational costs, and human errors while enhancing global accessibility. **AIM:** To develop a universal, generalizable, transferable, and efficient deep-learning model for accurate cancer detection and precise tumor classification across multiple cancer types, diverse populations, and various imaging modalities. **METHODOLOGY:** We evaluated the computational efficiency of deep learning architectures, including EfficientNets and ResNets, for tumor detection across multiple imaging modalities such as radiology (CT, MRI, mammography), histopathology, funduscopy, and photography. Datasets were sourced from diverse populations spanning six continents. EfficientNetB0 was integrated into a multi-platform application, "OncoAI", due to its exceptional performance and superior computational efficiency. **RESULTS:** EfficientNetB0 demonstrated >99% accuracy in detecting malignancies of the brain (MRI), breast (mammography, histopathology) and skin (photography), >97% in lung histopathology, and >93% in lung radiology. It achieved an 80% reduction in runtime compared to competing models while maintaining diagnostic precision in the OncoAI application. **CONCLUSIONS:** EfficientNetB0's streamlined design demonstrated superior diagnostic accuracy (>99%) with reduced computational demands and high efficiency (<80% runtime), making it ideal for "OncoAI" application. These findings illustrate a paradigm shift in biomedical AI, where minimal computational resources yield maximal diagnostic performance. **APPLICATIONS:** Our "OncoAI" application offers a scalable solution for global cancer screening programs. Its adaptability across platforms positions it as a universal tool for cancer care.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3092

Microfluidic Test Bed for Analyzing Shear-Mediated Platelet Adhesion: A Platform for Drug Development in Coagulation Regulation

Isabelle Chan

Houston ISD /DEBAKEY HIGH SCHOOL FOR HEALTH PROFESSIONS - HS

Category

Biomedical Engineering

Thrombosis is a condition of uncontrolled blood clotting in vessels, blocking circulation and blood flow. With 10 million people affected annually, developing medication to regulate thrombus formation is critical. In the initial stages of coagulation, shear stress from blood flow causes platelets to flip on their edge before adhering to vascular surfaces, followed by activation and aggregation to form a stable clot. The peak flipping velocity indicates the extent of platelet adhesion, offering insight into clot formation risk. As such, this study aims to design a test bed to assess drug effects on platelet flipping under flow conditions. One promising strategy to prevent thrombosis is inhibiting phosphoinositide 3-kinase (PI3K), a hub for mechanotransduction, potentially preventing coagulation. Custom polypropylene microfluidic channels measuring 1 mm in width and 100 μm in height were coated with von Willebrand factor to simulate human conditions. Gel-filtered platelets (GFP) from healthy adults were separated into control and treatment groups, with the latter receiving TGX-221, a PI3K inhibitor. GFP were flown under a constant shear of 15 dynes/cm² through the channels, and flipping incidents were imaged with an inverted DIC microscope. Video frames were binarized and segmented using a semi-supervised learning system. Key geometric parameters and peak flipping velocity were determined, showing that PI3K inhibition led to a 49.28% increase in flipping velocity compared to untreated samples. This suggests PI3K inhibition reduces platelet adhesion and clotting while demonstrating the efficacy of the experimental design for testing drug delivery on vascular surfaces.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3093

How Endoplasmic Reticulum Stress Affects Diabetes

Aaron Raj

Conroe ISD /AST: Academy of Science and Technology

Category

Biomedical Engineering

Diabetes, affects approximately 537 million people globally, this is projected to rise to 643 million by 2030. There is no know cause of diabetes besides lack of insulin. This study explores how elevated ER stress in pancreatic beta cells, central to insulin production, may increase the risk of diabetes. ER stress occurs when misfolded proteins accumulate within the ER, leading to an Unfolded Protein Response (UPR) that, causes beta-cell apoptosis and reduces insulin production. Previous studies have shown a connection between obesity, hyperglycemia, and ER stress, particularly in pancreatic beta cells. This research hypothesizes that higher levels of ER stress correlate with reduced insulin output and an increased likelihood of diabetes onset. Through laboratory experimentation using pig pancreatic cells, this study measures insulin production and ER stress levels, tracking UPR factors such as phosphorylated PERK, ATF4, and BiP. The data will be analyzed to develop a predictive computational model and application that analyzes the correlation between Endoplasmic Reticulum (ER) stress levels and insulin secretion in pancreatic beta cells. By offering potential insights into early detection and prediction of diabetes risk prevention of long-term complications like cardiovascular disease and blindness will be possible. This study aims to contribute valuable knowledge to the medical field by linking ER stress levels with insulin secretion and potentially improving the early diagnosis and treatment of diabetes.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3094

ShinSavers

Nachiketa Gulati

Martin Izquierdo

Conroe ISD /TWHS: The Woodlands High School

Category

Biomedical Engineering

In light of the widespread epidemic of shin splints in the athletic community, and inefficient solutions present, it was necessary to research sustainable alternatives that would continue participation in sports regardless of shin splints. The cause of shin splints is repetitive impacts and brunt force wearing down the tibialis muscles, which then transfers more impacts to the shin bone, creating small fractures. By lowering the impact inflicted, we could help reduce shin splints or better redistribute vibrations into the muscle. In accordance with this we were able to apply Newton's second law of motion along calculation in change of momentum to correlate the force inflicted upon the shin bone with that of accelerations. In order to create an experimenting process the WIT Motion WT901 LEVEL 9-axis BLE Accelerometer was used to measure and record accelerations. In order to create a baseline of measurement and controlled system for our experimentation we ran 10 tests of each category spanning from no device present (to measure accelerations excluding any devices meant to deter shin splints) then a generic shin splint sleeve (to determine the base effects of the "on-market" solutions) and finally a trial using the given ShinSaver device. This device was constructed using a combination of silicon rubber sheets and Natural latex rubber gum in order to combine both the biodegradable qualities of rubber and greater shock absorbance of synthetic rubber to create a device that is more efficient in minimizing impact force on the shins along with serving sustainable missions.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3095

The Effect of Treatments on various forms of Eczema

Doga Ozecik

Clear Creek ISD /Clear Creek High School

Category

Biomedical Engineering

This project is extremely important because eczema is a very common condition effecting, on average, one in ten Americans. There are seven main types of eczema and they each are caused by various factors which may include stress, allergens, weather, genetics, and etc. Because there are various causes, there must be a variety of treatment as well. For example, there are two main types of eczema and those are intrinsic and extrinsic eczema which have major differences, so they can never be put on the same level and try to get treated in the same way. In order to truly understand what kind of treatment a patient should receive, they must first know what triggers their eczema, and that is exactly why they need a treatment calculator to determine what options they have for their treatment. I wrote a program in Java which calls for the user to input their diagnosed eczema type and gives details on the causes, symptoms, and treatments options for that specific kind of eczema. Through my research, I saw that there are a variety of stimulus that have the potential to trigger skin conditions like eczema. The kinds of eczema produced by these stimulus is usually grouped into categories, and depending on the severity and other relevant factors, treatment options are provided. I saw that generally; ointments were main forms of treatment for all of the seven different kinds of eczema. In general, this project helped me learn more about eczema and how to formulate treatment plans given the diagnosis of a specific condition.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3096

SimpleSuture: Semi-Automated Laparoscopic Knot-Tying and Suturing Device

Henry Aceves

Conroe ISD /AST: Academy of Science and Technology

Category

Biomedical Engineering

The motivation behind the development of LS is perhaps best described by the Hippocratic oath, Primum non nocere: at its core, laparoscopy is a means by which surgeons minimize the surgical trauma undergone by patients. To that end, LS holds many benefits over traditional open surgery even beyond small, porthole incisions: laparoscopic procedures often possess significantly decreased blood loss, shortened recovery rates, reduced perioperative morbidity, and minimal postoperative infection and scarring. However, widespread adoption of LS has been limited by the complexity of laparoscopic suturing and intracorporeal knot tying, contributing to lengthy operation times, mental strain, and surgical fatigue syndrome, increasing operation costs as well as the risk of unexpected complication. To solve this problem, the engineering goal of this project was to create a single specialized laparoscopic needle driver that reduces surgeon stress and minimizes time to complete laparoscopic suturing tasks by automating suturing and knot-tying. The project successfully created a computer-simulated CAD mechanism that accomplishes the major tasks associated with this procedure: creation of a knot loop and knot tightening. To further expand this project, a physical model should be created to verify the CAD design.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3097

HCSN: A Hierarchical Machine Learning Pipeline for Accelerated Tumor Segmentation and Cellular Analysis in Biomedical Imaging

Samir Kassam

Houston ISD /Carnegie Vanguard HS

Category

Biomedical Engineering

Accurate image segmentation is a cornerstone of biomedical imaging, enabling insights into cellular behavior and tumor localization. This study builds upon the Hierarchical Cellular Segmentation Network (HCSN), a novel pipeline leveraging a hierarchy of specialized machine-learning models fine-tuned to segment individual cell types with greater accuracy. HCSN's anchor-free object detection paradigm and instance segmentation approach address challenges of low contrast, overlapping cells, and variable image quality, outperforming traditional models on the LiveCell dataset. To validate the versatility and efficiency of HCSN, the pipeline was adapted to a new frontier: glioma detection in intraoperative Magnetic Resonance Imaging (iMRI). Gliomas, a malignant brain tumor type, often resemble healthy tissue and grow at an alarmingly fast rate, complicating surgical resection. Traditional preoperative MRI images are rendered unreliable during surgery due to brain shift—caused by tissue deformation during surgery—and the rapid progression of gliomas, which can significantly alter tumor boundaries. Leveraging HCSN principles, we developed a deep learning pipeline combining YOLOv8 for detection and SAM ViT-b for segmentation, optimized for noise-augmented MRI images simulating surgical conditions. Our model achieved a Dice Similarity Coefficient (DICE) of 0.79, while operating several times faster than state-of-the-art models like NVIDIA's, which rely on computationally intensive methods. This speed advantage ensures real-time applicability during surgery, enabling precise tumor localization without delays. This research highlights HCSN as a scalable, high-performance framework with broad applications. By bridging cell and tumor imaging, it demonstrates a paradigm shift in biomedical imaging: achieving faster, more efficient segmentation without compromising reliability.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3098

Electroencephalographs and Healthcare AI in Mental Health Diagnosis and Treatment

Jedidiah Obomanu
Spring Branch ISD

Category

Biomedical Engineering

The Use of EEGs and Healthcare Intelligent AI in Mental Health Diagnosis Mental health disorders greatly impact a significant portion of the U.S. population. According to the National Institute of Mental Health, as of 2020, approximately 40 million adults in the U.S. suffer from mental health conditions such as generalized anxiety, depression, and panic disorder. Within mental health diagnostics, misdiagnosis is a significant concern, with 20% of mental health patients being misdiagnosed. Accurate treatment for these disorders is inefficient without proper diagnosis. This results in patients receiving medications or therapies that do not target their actual condition, which can do further harm to their mental state. Electroencephalographs (EEGs) and Artificial Intelligence (AI) can enhance diagnostic accuracy for mental health conditions, and improve treatment. EEGs are non-invasive devices that measure brainwave activity. By using data collected from EEGs, medically trained AI algorithms can accurately identify patterns that indicate mental health status. Applying AI techniques, such as convolutional neural networks (CNNs), AI algorithms can be developed and trained to produce precise and swift diagnostic results. By training AI algorithms to analyze patterns in EEG data, I assessed various datasets, verifying reliable input for model development. The use of EEGs and healthcare intelligent AI improved diagnostic accuracy by 90%, and specificity by 92% in distinguishing healthy individuals from those suffering from mental health conditions. Integrating EEG technology with AI improves mental health diagnostics, reducing misdiagnosis and allowing for accurate, high-quality treatment.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3099

Development of Human IGF-1 Encoding Plasmid Vector for RNA Vaccine Targeting Facial Wrinkles

keya joshi

Harmony Public Schools - Houston North District /Harmony School of Discovery

Category

Biomedical Engineering

Skin aging is characterized by thinning, loss of elasticity, and wrinkles, as well as constant exposure to UV Light, gravity, and declining levels of IGF-1 (Insulin-like Growth Factor). IGF-1 helps in DNA synthesis, tissue repair, and collagen production - all of which decline with age. This project aims to make a mRNA vaccine encoding IGF-1 to prevent facial wrinkles, restore these processes, and promote tissue regeneration. The methodology involved in this project was designing and constructing an IVT or in vitro plasmid vector optimized for IGF-1 expression. The important steps in this experiment were codon optimization, bacterial transformation using E. Coli, plasmid purification, linearization with restriction enzymes, and sequence verification via using Sanger sequencing, and In-fusion Cloning and Transformation. The positive clones were analyzed to confirm the presence of IGF-1. The findings confirmed that all 5 clones contained plasmids with 100% alignment to the designed IGF-1 gene, showing successful vector construction. The plasmid template was validated for RNA synthesis and can be used to produce IGF-1 mRNA. Future research can be done involving transfecting epithelial kidney cell lines (HEK) and quantifying IGF-1 production using ELISA to confirm functionality. In conclusion, this research shows the successful development of an IGF-1 mRNA vaccine template, advancing RNA technology applications in tissue regeneration and prevention of facial wrinkles. The project offers a novel, non-invasive therapeutic approach for combating skin aging, with potential to improve and impact cosmetic dermatology and RNA therapeutics.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3100

Portable Pathogen Detector

Mira Pemmanda
ST. JOHN'S SCHOOL

Category

Biomedical Engineering

a. purpose of the experiment The purpose of my experiment was development of a portable pathogen detector that employs a microscope (³1000x magnification) and AI-based image analysis to rapidly and accurately detect protozoa and large bacteria. b. procedure/methodology used For my experiment, I tried out three different microscopes to see which one would meet the desired specifications for magnification, ease of use, and picture transfer. While one had the best magnification (4000x) it was not portable. One was cute and handy with 1000x zoom and picture display but would require the user to take a picture of the display to upload. The one I picked was a microscope with 1000x zoom, easy to carry and could transfer images using WiFi. We tested many sample slides to assess single-cell detection. Working in Google Colab, I was only able to find a data set for amoeba detection, so for now I decided to focus on detection of amoeba via the AI algorithm. I decided to use 6 samples to begin with to test the prototype. I used clear tape to sample 3 surfaces and 3 sterile plastic containers for water samples. Glass slides were used for easy mount of samples. c. most important/significant results you found Of the 6 samples collected from the park & school, only the dog park water sample tested positive for amoeba. The positive and negative controls were read correctly. I confirmed all 6 samples using the higher magnification microscope. d. conclusions/research applications* The experiment taught me that this gadget is potentially feasible. I will need expert help for a more complex AI algorithm to detect different organisms. Additionally, integrating an autofocus feature on the microscope will make it easier for the user to transmit clear pictures.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3101

OsteoBrace: A Novel Hand Orthosis Incorporating Pulsed Electromagnetic Field Therapy for Chondrocyte Regeneration in Osteoarthritic Joints

Sivang Hari Nair

Conroe ISD /AST: Academy of Science and Technology

Category

Biomedical Engineering

Osteoarthritis affects 32.5 million adults in the US with global numbers reaching 528 million. Significant ailments are limited to simple braces providing pressure and basic painkillers such as Ibuprofen. Research shows that an alternative, PEMF, or post-electromagnetic field therapy, represents a viable solution to this problem. In this, electromagnetic waves are transmitted through copper coils around the affected area in order to relieve pain and stimulate the regeneration of chondrocytes, the cells that make up cartilage. However, current PEMF therapy device models are restricted to the knee and elbow. This research looks to design a novel brace for the hand and forearm in order to alleviate pain in these regions. Onshape, an online CAD software, was used to design a brace and connected PEMF device. The brace was designed specifically to the researcher's hand with the PEMF device being specialized for treatment of a localized area. After synthesis, this device would be able to provide a high efficiency solution for osteoarthritis allowing for the regeneration of chondrocytes in the hand, yielding relief throughout the region for the user. Although such regeneration is not a permanent solution, it gives users the capability of performing everyday tasks that they otherwise are not able to complete.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3102

BioAware: Efficient Assessment of Risk of Chronic Illness Using Machine Learning Analysis of Gut Microbiome Composition

Sanvi Bala

Conroe ISD /AST: Academy of Science and Technology

Category

Biomedical Engineering

Chronic diseases, such as cardiovascular disease, diabetes, and metabolic disorders, are leading causes of illness, death, disability and healthcare costs in the United States, with their prevalence increasing three-fold since 1975. This project developed a tool capable of predicting risk or status of chronic disease by combining Model-Agnostic Meta-Learning (MAML) with a Multilayer Perceptron (MLP) Model to analyze shotgun metagenomics of the gut microbiome. By leveraging microbial composition as biomarkers, the model accurately assesses risk for chronic conditions such as cirrhosis, type 2 diabetes, ulcerative colitis, and obesity. The MLP, integrated into an application, classifies stool sample data as “healthy” or indicative of specific diseases based on microbial diversity. The model achieved a general accuracy of 95% and an AUC of 0.93, displaying its proficiency in distinguishing true positives from false positives across the testing dataset. Metrics such as precision, sensitivity, specificity, and F1 score all exceeded 0.9, validating the model’s robustness. The application features a user-friendly interface for healthcare professionals, offering a streamlined tool for preventative screening or routine checkups. Overall this project was able to reveal the potential of combining machine learning and metagenomics for personalized healthcare, supporting early detection and management of chronic illnesses in the form of a software that can be utilized in check-ups or preventative checks.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year’s work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3103

Solar Medical Device Disinfecting Prototype

Sophia Hou
Amrita Kumar
Abigail Wang
Seven Lakes - HS

Category

Biomedical Engineering

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3104

Novel mRNA Vaccine Plasmid Encoded PD-L1: Development of an IVT Vector for RNA Vaccines Targeting Reactive T-Cell Inhibition in Multiple Sclerosis

Edwin Sorto Reyes

Deven Villegas

Chiamaka Aknati

Category

Biomedical Engineering

Multiple Sclerosis(MS) is a neurodegenerative disease that is classified as an immune disorder. The reason symptoms are experienced is due to a degradation of the myelin protective sheaths over neuron axons, weakening the neuron's ability to communicate with the rest of the brain and nervous system. The usage of the protein PDL-1 has recently emerged as a means for stopping the immune system from attacking the neurons, due to its ability to regulate immune responses. The objective of the research forthcoming is to successfully create an IVT plasmid vector encoding the extracellular domain of PD-L1 that will later be used to create a RNA vaccine against MS. The methods that will be used for the experimentation outlined above are Purification of UH-IVT Plasmid, Linearization of UH-IVT Plasmid by digestion, Designing of PD-L1 gene keeping in mind Codon Optimization for humans, 15 Bp Homology for In-fusion Cloning and Transformation, Gel Electrophoresis and Sequencing of Positive Clones in order to confirm the success of the cloning. After these steps, all clones replicated from the original colony containing the plasmid DNA share the same plasmid DNA sequences, therefore, a host for RNA production has been successfully created. The success of replicating DNA plasmid samples via bacterial methods for the transcription of RNA encoded with the PD-L1 gene has been measured to be satisfactory. Therefore, future research can utilize this DNA as the foundation of transcription for an RNA candidate vaccine

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3105

Morphometry Analysis Workflow for Micro-Computed Tomography Images of Osteochondral Defect Repair

Emmy Shulman
EMERY WEINER JEWISH SCHOOL

Category

Biomedical Engineering

A variety of methods to repair focal articular cartilage defects are being studied. Characterization of repair efficiency has traditionally relied on invasive techniques such as histology and immunohistochemistry. Micro-computed tomography (microCT) provides a non-invasive alternative for visualizing tissue structures, particularly when enhanced with Hexabrix contrast. Alone, contrast-enhanced microCT images of osteochondral repair may be difficult to interpret, as regions of high opacity may either indicate mineralized or fibrous tissue that has taken up contrast. However, combined analysis of registered non-contrast and contrast microCT images can, in principle, help distinguish the three types of tissue: mineralized, cartilaginous, and fibrous. This study aims to develop a Python-based automated image processing workflow to quantify tissues. Initial masks created from non-contrast images separate mineralized tissue from soft tissue, while Hexabrix-enhanced scans enabled differentiation of fibrous and cartilaginous tissues. The automated workflow analyzes tissue composition, providing metrics such as relative percentages of tissue types. This approach offers a non-invasive, quantitative assessment of cartilage defect repair. By automating and enhancing tissue characterization, this study can advance cartilage repair strategies.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3106

How can app development help aid the curing/recovery process of a lung cancer patient

Catherine Lin
Ananya Cheri
Amarechi Okorafor
Bridgeland - HS

Category

Biomedical Engineering

Early detection of lung cancer remains a pressing concern, with current diagnostic methods often failing to identify the disease at its most treatable stage. Building upon the foundation of deep-learning models for CT scan analysis, this project introduces an innovative, complementary approach: AI-augmented biosignature analysis for predicting lung cancer risk. By integrating machine learning algorithms to identify and classify specific biosignatures, such as blood biomarkers, genetic mutations, and metabolic patterns, this approach enables the prediction of an individual's likelihood of developing lung cancer, facilitating even earlier intervention. The project investigates the feasibility of combining biosignature information with CT scan data to enhance the accuracy and robustness of lung cancer prediction, resulting in an all-encompassing diagnostic tool. Furthermore, the study assesses the potential of integrating this novel approach into existing clinical workflows, focusing on the ethical and legal considerations associated with risk assessment and early intervention. The proposed AI-augmented biosignature analysis is also adapted to distinguish between various subtypes of lung cancer during the early stages, providing crucial information for tailored treatment plans. Additionally, the project evaluates the transferability of the developed models across diverse demographics and examines the cost-effectiveness of the AI-augmented biosignature analysis in comparison to existing diagnostics.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3107

Accuracy of Heart Rate Monitors

Ishaan Chaudhary

Fort Bend ISD /Hightower High School

Category

Biomedical Engineering

In today's world, many people are attracted to fitness and specifically running. This congregation in the running community initially seems to be a healthy and positive hobby for a lot of people, but there lies a great problem and that is heart rate monitors. Heart rate monitors are shown to be very inaccurate. In fact, heart rate devices are shown to underestimate heart rate 62% of the time. Having an accurate understanding of one's heart rate is a crucial component of exercise. This experiment aims to compare the accuracy of different heart rate monitors: a chest strap, watch, and a mobile app. It was hypothesized that the chest strap would be the most reliable because of its proximity to the heart. Through the use of both high and low intensity phases, the experiment collected a wide range of heart rates to ensure that a fair comparison was being done. In order to achieve these different heart rates, participants would perform various activities. After holding a certain range for a minute, the participant would stop so a medical professional could measure their heart rate through the use of a stethoscope and a reading could be recorded through the other three mechanisms. The results demonstrated the chest strap, as hypothesized, was the most accurate with the least amount of variation between the professionally determined heart rate. This information is extremely valuable to athletes and provides meaningful context of the tools that they use on a day to day basis.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3108

Decoding PDAC: A scRNA-seq Omics Analysis to Unveil and Inhibit Key Protein Using a Novel In-Silico, Structure-Based Drug Design Pipeline

Sriram Susarla

Fort Bend ISD /Dulles High School

Category

Biomedical Engineering

Pancreatic Ductal Adenocarcinoma (PDAC) is responsible for 90% of pancreatic cancer cases and is characterized by late diagnosis and a 13% five-year survival rate. CA 19-9, the only approved diagnostic biomarker for PDAC, a blood-based biomarker, suffers from false positives and low specificity, emphasizing the need for a highly specific PDAC tissue-based biomarker. This experiment analyzed single cell RNA sequencing (scRNA-seq) data of three PDAC and three healthy tissue samples and identified calcyclin (S100A6) as significantly upregulated in both ductal- and acinar-originating instances of PDAC. S100A6 is implicated in key pathways such as the epithelial-mesenchymal transition (EMT) and promotes PDAC metastasis by activating β -catenin, which then activates proteins such as N-cadherin that facilitate invasive properties in PDAC tumors. To propose an inhibitor of S100A6, we employed structure-based in-silico drug design and docking studies on a calcium-bound form of S100A6. LEA3D generated 20 novel small molecules, of which the two top candidates based on a user-defined score were evaluated based on binding affinities in AutoDock VINA. The leading compound demonstrated favorable interactions with S100A6 without predicted off-target effects. Normal Mode Analysis confirmed stability of the protein-drug complex and binding motions associated. ADMET (Absorption, Digestion, Metabolism, Excretion, and Toxicity) analysis revealed favorable pharmaceutical properties, including drug-likeness, and values in optimal ranges for lipophilicity, flexibility, size, saturation, solubility, and polarity. Predicted retrosynthetic pathways propose the ability to biomanufacture the developed compound for future studies in vitro and in vivo.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3109

Wearable Assistive Technology for People With Hearing Loss

Ethan Praisoody
Friendswood ISD /Friendswood High School

Category

Biomedical Engineering

According to the ACS, about 3.6% of the U.S. population consider themselves to have major hearing loss. One of the main challenges of hearing loss is loss of situational awareness. Not being able to identify and locate sounds makes it difficult for people to have meaningful interactions with their environment. Currently the only device that can aid people with sound localization are hearing aids, which don't work for everyone and can be expensive. Thus, many people are lacking the technology to assist them with sound localization. This project aims to solve this by creating a wearable, cheap, and non intrusive device that improves people's situational awareness. To accomplish this the student researcher developed a smartwatch that shows the user the direction of sounds and alerts them to important sounds like their name and emergency sounds. The device consists of 4 evenly spaced MEMs microphones, a LCD screen, and a microcontroller. The device runs two algorithms. The first algorithm finds the DOA (direction of arrival) of a sound using phase shift to determine when the sound arrived and trigonometry that finds the direction of the sound based on that information. The other algorithm sends sound data to an external device to run it through a machine learning algorithm to determine what kind of sound is being recorded. After creating the device the student researcher tested its accuracy and functionality and determined that the device was effective at improving the situational awareness of the user.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no



Abstract: Science and Engineering Fair of Houston

3110

RadAI: A Multimodal Machine-Learning Based Radiology Teaching Software

Neel Heblkar

Kavish Mehta

Veeraj Sirivolu

Fort Bend ISD /Dulles High School

Category

Biomedical Engineering

Radiology demands precision and focus, which can eventually lead to diagnostic fatigue. Additionally, the need for enhanced radiology teaching is prevalent in the medical world today. Our software, RadAI, develops a multimodal, machine learning-based teaching assistant, that uses eye-tracking data and a radiologist report to analyze a radiologist's diagnostic intent, and also provides real-time personal feedback. This will improve efficiency, accuracy, and the overall learning experience of first-time medical trainees. The AI system integrated publicly available radiology and eye-tracking datasets, like EGD-CXR, and MedGaze. A machine learning model was developed to correlate Diagnostic region's of interest (ROI's) with the radiologist's eye gaze data. The model also extracted key regions from the report using a language model, and matched it with the corresponding region's of interest. Preliminary results demonstrated an 85% overall model accuracy, and a reduced diagnostic time of 17.5%, compared to a control group. Analysis of Variance (ANOVA) confirmed the statistical improvement. Our model aims to successfully enhance radiology education by improving diagnostic speed and accuracy. This software can have larger applications in medical training and support future advancements.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human participants potentially hazardous biological agents
 vertebrate animals microorganisms rDNA tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

- yes no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

- yes no

4. This project is a continuation of previous research.

- yes no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

- yes no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

- yes no

