



# RUTGERS

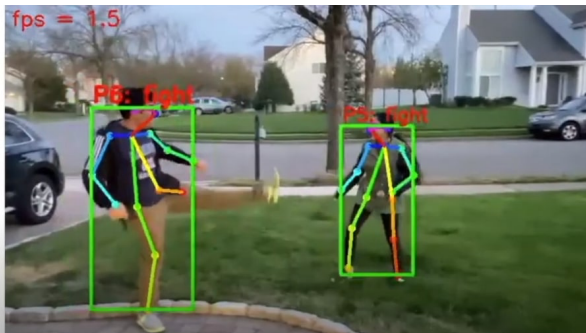
School of Engineering  
Department of Electrical and Computer Engineering

## Capstone Program Spring 2022

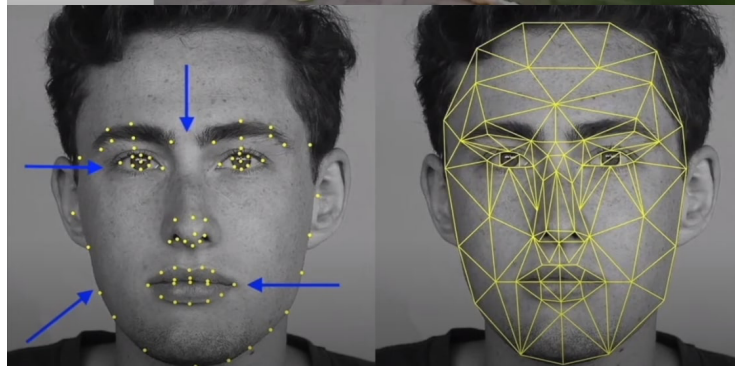
### Senior year Design Projects

#### At a Glance...

Frame:649



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run : 0.00  
jump : 0.00  
sit : 0.00  
squat : 0.00  
kick : 0.00  
punch : 0.00  
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fight : 1.00



**S22-01**     **Title:** *RU Parking*

**Team Members:** *Christine Mathews, Shreya Patel, Yati Patel, Yatri Patel*

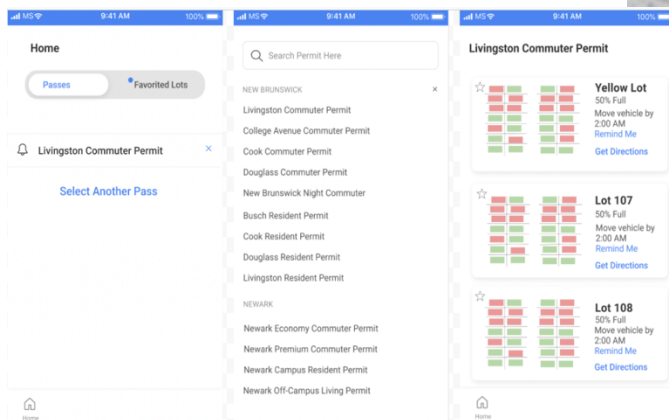
**Adviser:** *Dr. Yao Liu*

**Keywords**

parking, Rutgers parking pass, Rutgers parking lots, YOLO, Android development, Firebase

**Abstract**

At a large university like Rutgers - New Brunswick, finding a parking spot can be a notoriously difficult task. Tens of thousands of students and faculty travel to and from the university each day causing the parking lots to be crowded for the entirety of the day. On top of that, there are many different parking lots in sporadic locations spread across the five campuses, making it difficult to keep track of all the lots that are available to the driver. In addition to this, we find that Rutgers University makes it inconvenient for students to figure out which lots they are permitted to park in, when they are able to park in those lots, and where those lots are located on campus. Our mobile application plans to tackle this issue by providing users access to all this information in one spot. Our goal is to ease and enhance driver experience when searching for a parking spot at Rutgers University.



**S22-02**

**Title:** *Deep Learning Environmental Reconstruction Network*

**Team Members:** *Sean Coleman, Suthikshnan Karthik, Lindsey Staples, Zachary Waynor*

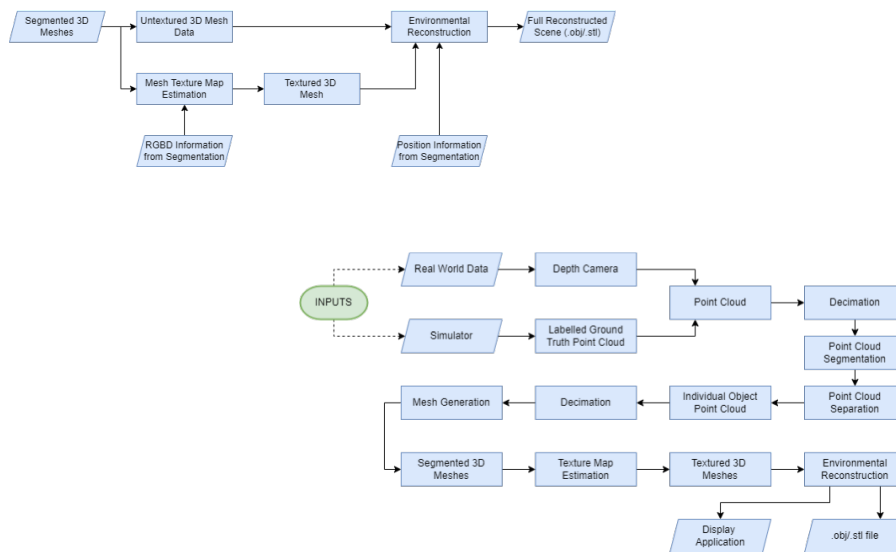
**Adviser:** *Dr. Kristin Dana*

**Keywords**

Deep Learning, Robotics, 3D Reconstruction, Computer Vision, Depth Camera, GANs

**Abstract**

3D Model Reconstruction (also referred to as Multi-View Object Reconstruction) from images is becoming more prominent, albeit quite difficult to do due to the fact that it involves manually solving the stereo-view reconstruction problem for each pair of consecutive images via epipolar geometry and correspondence points. This method of formulating models from images, or rather, point cloud maps, is entirely insufficient and unproductive with the long amount of time it takes for the models to be developed and the points not fitting with the image that is taken or provided (most projects provide images). On that note, point clouds are a method of representing 3D geometry in a simple and flexible way by sampling the environment into discrete 3D points in space. In order to utilize these point clouds and Kinect/depth camera technology in the project, there will be deep learning models that are programmed to capture images of the surrounding area instead of images that are provided; correspondence points found and shown via depth camera and neural networks; and a model constructed taking into account the points found before.



**S22-03**

**Title:** LiDAR Modeling

**Team Members:** Keith Lo, Guilherme Silva, Jason Chan, Justin Chan

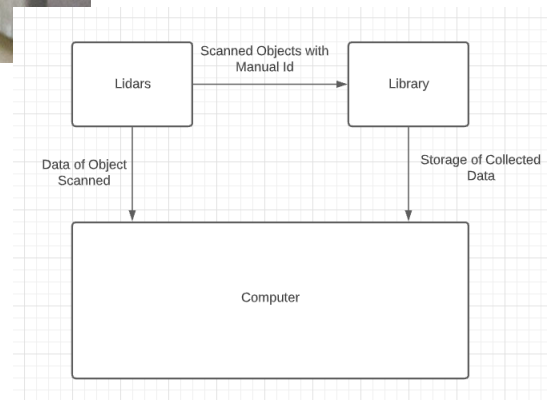
**Adviser:** Dr. Anand Sarwate

**Keywords**

LiDAR, Modeling, Machine Learning, Error Analysis, Quality Assurance

**Abstract**

The problem we are trying to solve in this project is defects in objects created in industry. If a product with a defect is released and sold, it could cost the business a lot of money. To prevent this, businesses use high end technology to detect defects or hire people to manually check to solve this problem, but at very high financial costs. Our goal is to recreate the functionality with a low budget of around 300 dollars, in comparison to the high-end technology costing thousands, sometimes tens of thousands of dollars. For this project, we will implement two Lidars to scan data. The Lidars should be able to scan objects and send data to a computer for processing. The minimum requirement will be to identify objects with simple shapes such as cones, spheres, and cylinders. A library will be used to store information of scanned objects as well as its corresponding ID, which is manually inputted by us. Then, after being able to identify the shape of the object, the computer will then be able to determine the amount of error of the scanned data in comparison to the corresponding data in the library. If there is more time, and we achieve our minimum goal earlier, we can extend the project to being able to scan more complex objects, such as a gear or a wrench. Another implementation would be to identify a type of defect of the object, such as a tooth missing on the gear, or part of the tip of the pyramid cut off.



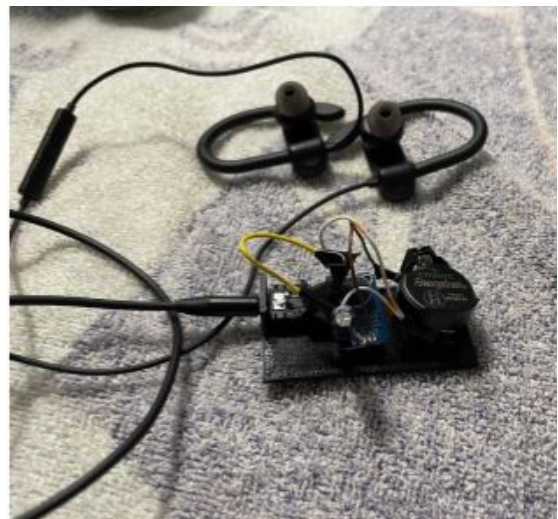
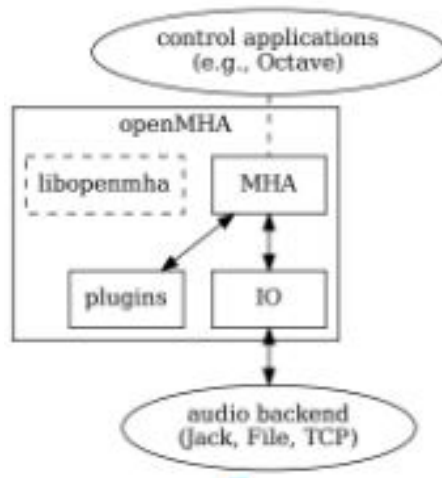
**S22-04** **Title:** *Affordable Self Fitting Hearing Aid*

**Team Members:** *Shawn Muller, Shreyas Murali, Derek Gordon, Osiel Vivar, Vasu Garg*

**Adviser:** *Dr. Laleh Najafizadeh*

**Keywords** Medical, Hardware, Software, Algorithms, Digital Signal Processing

**Abstract** In many countries with robust health infrastructure and higher wealth, the range of hearing aids available for purchase is quite advanced. Modern hearing aids often make use of AI for contextual awareness, have custom ergonomics, and are customizable by prescription of audiologist. However, there are many key global demographics that are prohibited by lack of health infrastructure and economic inequities that prevent modern hearing aid technology from being extended to all the globes. We look to build a completely independent, one-size-fits-all, over-the-counter hearing aid that is completely self-diagnosing and adjusting to accommodate those who cannot afford or find access to higher-quality products. The singular device will be able to conduct a hearing test with user input, apply algorithms to develop a solution, and apply that as a blueprint for the hearing aid device. The materials used to create this device will be simple and cost effective, but reflective of modern hearing aid technology and algorithms to provide the most modernized but accessible self-fitting hearing aid, or SFHA, in the market currently. In this report, we describe our solution to this prolific issue by identifying the global needs at hand, thoroughly describing the technologies we will be using, outlining our design constraints, and breaking down the workload involved in actualizing a prototype for our self- fitting hearing aid.



**S22-05**

**Title:** *FeelingsMutual*

**Team Members:** *Ali Hussain, Christopher Moskowitz, Kaori Moye, Ethan Pangilinan, Maninderjot Singh*

**Adviser:** *Dr. Anand Sarwate*

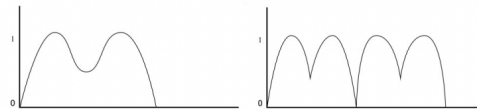
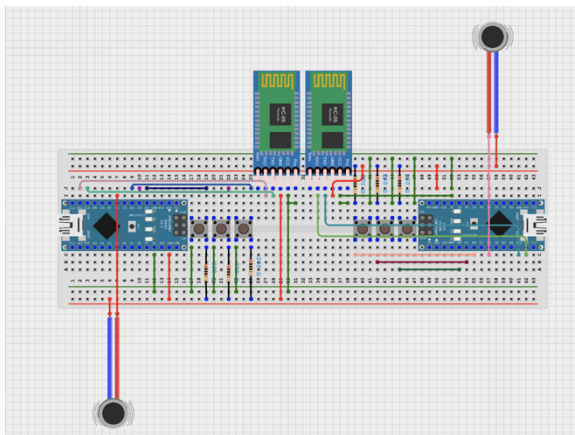
**Keywords**

autism, haptic feedback, bluetooth, wearable, pulse rate sensor

**Abstract**

Autism is a spectrum and it is true that individuals with autism are nonverbal and/or do not like to be touched by other people. People who are not autistic take offense and may mistake this behavior as standoffish, when in reality, people with autism just need a better way to express these feelings. Even those who are generally understanding of these behaviors can sometimes have an equal amount of difficulty addressing them. We propose a device that will make people feel connected to each other while protecting people's personal space, and provide a self sufficient way for users to ease their troubles.

While our device caters to the autistic community, our audience is not limited. During the COVID-19 pandemic, those who quarantined from the rest of their family in the same house may have felt disconnected and signs of affection while taking sanitary measures could have gone a long way. Gestures and signals from a wristband can make those who are secluded feel loved. For those users with mental disorders such as depression and anxiety, they can make good use of our technological implementations for emotional regulation.



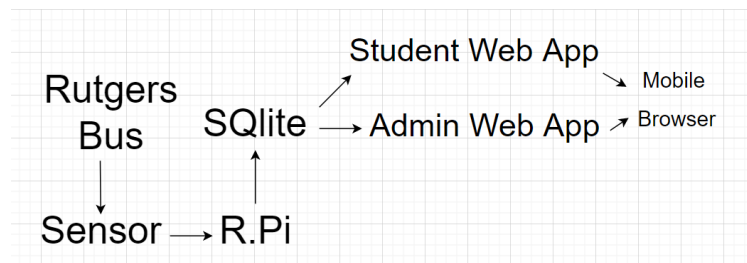
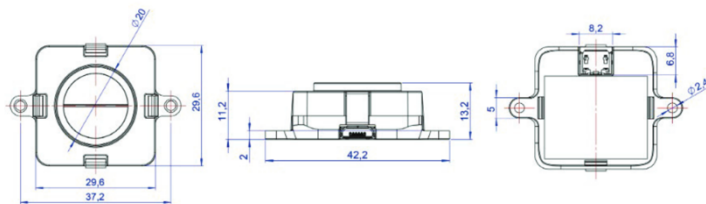
**S22-06** *Title: Monitoring Bus Capacity*

**Team Members:** *Sowmya Balakrishnan, Carla Jaraplasan, Sachin Mathew, Angela Shaw*

**Adviser:** *Dr. Hana Godrich*

**Keywords** Transportation, Monitoring, Contact-tracing, Community

**Abstract** Students and faculty members of Rutgers University heavily rely on the university bus system to get around campus. A large problem with the current system is that people are not able to expect how full a bus may be and if there would still be enough space to get on. This causes problems with being able to arrive at your destination on time and being able to plan an alternate route. Additionally, the restrictions that are in place, due to the COVID-19 pandemic, have limited the capacity of buses. Some people also feel more comfortable riding on a bus that has fewer people to maximize social distancing. By knowing beforehand the capacity of a bus or other transportation modes, people will be able to plan their commute much easier. Currently, Rutgers utilizes the TransLoc mobile application to track bus routes and view the capacity of a bus by percentage. By observation, the capacity shown on the application does not seem to be very accurate, and it does not let the users know exactly how many people are on the bus.



**S22-07**

**Title:** *The Power Generating Footplate*

**Team Members:** *Tint Aung, Jason Nitti, Vatsal Patel*

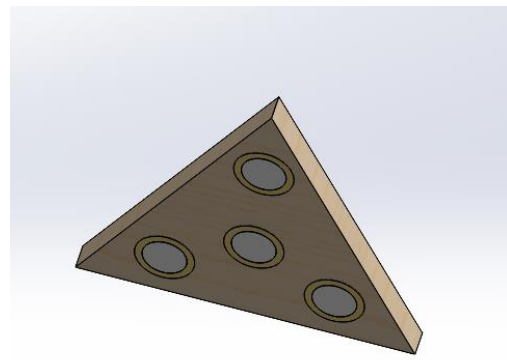
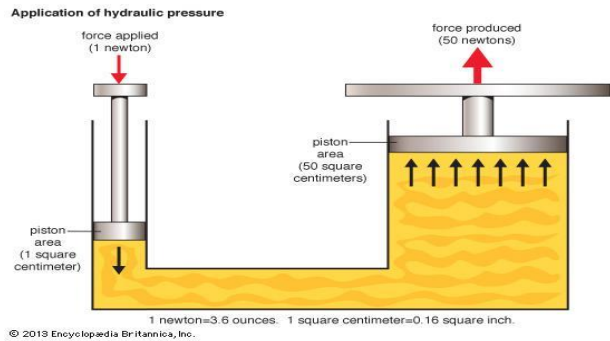
**Adviser:** *Dr. Hana Godric*

**Keywords**

Energy Solution, Electricity Generator, Electro- Mechanical Path, Electric Storage Solution, Sustainable Energy

**Abstract**

The goal of this project is to develop an environmentally friendly way to illuminate the entrances to high-traffic areas. This project aims to capture the kinetic energy from people's footsteps entering and exiting an area and convert it to electricity using piezoelectric sensors. Foot traffic generates hundreds to thousands of small bursts of energy every day through corridors via human weight and compression. Harvesting this energy would make this solution completely renewable, which would provide a clean way to contribute to a greener tomorrow. Current designs have issues with safety as they use a lifting and locking mechanism which makes the plane of energy harvesting (i.e., the footplate) unstable for the general public. This project aims to fix this issue by prioritizing practicality and maximizing energy capture.





**S22-08**

**Title:** Sound Locating Camera

**Team Members:** Robert Kulesa, Lindsay Wisner, Hari Arun Gunachandran, Alec Bakholdin, Saurabh Bansal

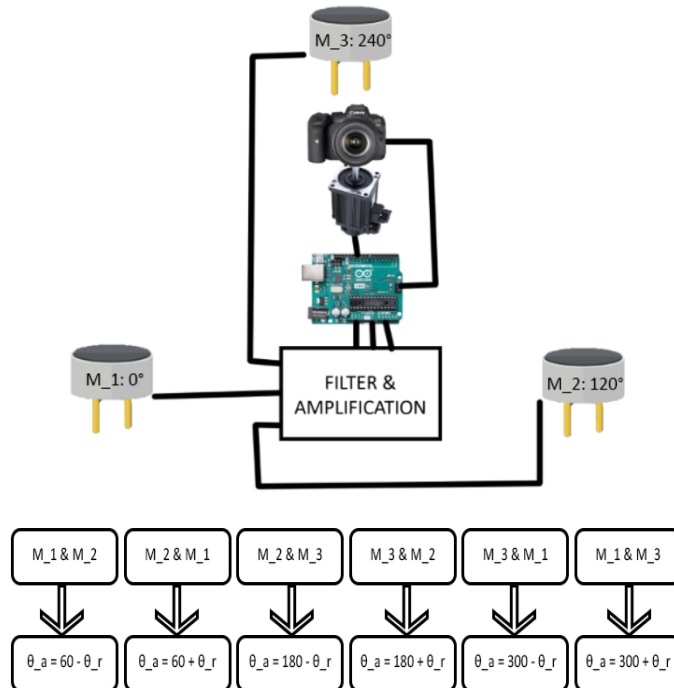
**Adviser:** Dr. Phillip Southard

**Keywords**

camera, sound, locating, security

**Abstract**

The Sound Locating Camera is a system designed to locate the source of a sound and turn the camera system to face the approximate location of the source. The system will primarily be composed of three subsystems: a microphone audio processing system, motor system, and a camera system. Three microphones placed at the three vertices of an equilateral triangle around the motor & camera system will send an amplified and filtered audio signal to the microprocessor. A microprocessor will calculate the direction of the source of sound with respect to the current angle of the camera. This will be done by using the measured time delay between the first two microphones to receive the audio signal, and the known distance between the microphones to calculate the approximate direction of the sound source. The microprocessor will then calculate the PWM signal to send to the servo motor in order to turn the camera toward the direction of sound. Then, the motor will turn the camera to face the approximate location of the sound source.



**S22-09**

**Title:** Smart Car Control System based on EMG Signal

**Members:** Jiacheng Wang, Tianyu Qin, Jiaxi Xu, Zhiyun Qin

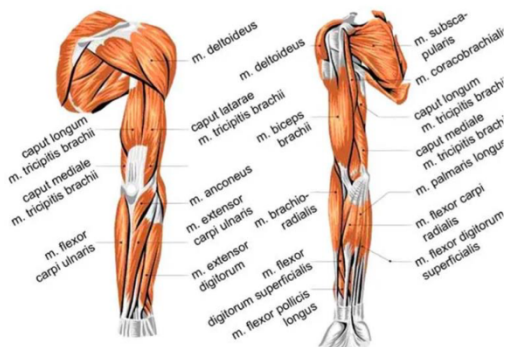
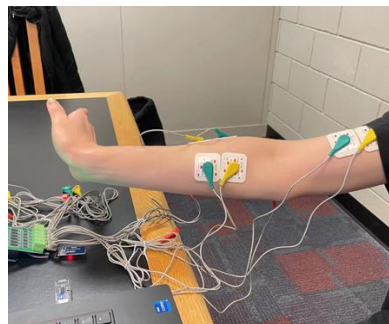
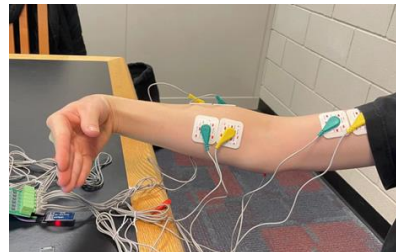
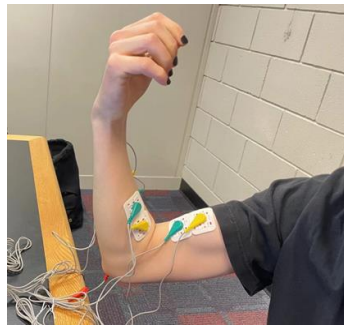
**Adviser:** Dr. Bo Yuan

**Keywords**

Surface EMG signal, EMG Sensor, Smart Car, Arduino (key words)

**Abstract**

Design a smart car control system based on arm surface EMG (Electromyography) signals. When the right arm makes four movements, such as flex arm, left hook, right hook and natural sag, the car will complete four motion states of forward, left turn, right turn and stop. The arm surface EMG signal acquisition module collects the EMG signals under the four movements of the right arm through three channels of a six-channel EMG signal sensors and preprocesses them. Then, do classification and recognition, identify different movements of the arm, and encode the corresponding control instructions. The control command is transmitted to the intelligent car control module. In the next step, the smart car control module drives the motor to rotate according to the control command so as to realize the regulation of the movement state of the car.



**S22-10**

**Title:** *Improvements to the Viability of Solar Panels in the Field*

**Members:** *Allen Chang, Justin Esposito, Elysia Heah, Brandon Luong, Krishna Prajapati*

**Adviser:** *Dr. Wade Trappe*

**Keywords**

web application, geolocation, friends, meet-ups, spontaneous, communication

**Abstract**

Young adults frequently move to new cities and towns for work and college. Uprooting themselves to move into a fresh new environment can leave them feeling anxious, especially since they lack the support system of old friends. The unfamiliarity of a new place causes many to have feelings of isolation, loneliness, and decreased mental health. Our group proposes to create a web application that gives these young adults the opportunity to meet one another based on mutual interests. This project will remedy our target audience's issues by allowing users to advertise their impromptu events to other users of our app, allowing them to meet new people to help replace the support system that they have left behind.



**S22-11**

**Title:** *RMSafe - Remote Monitoring Safety System*

**Team Members:** *Jakub Vogel, Kevin Estabillo, Shahir Ghani, Azim Khan, Nirav Patel*

**Adviser:** *Dr. Jorge Ortiz*

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**Keywords**

Machine learning, Safety, Healthcare, Computer Vision, Sensor, Microcontroller

**Abstract**

RMSafe is a remote monitoring system designed for senior citizens to help keep them safe within their own homes. The system utilizes image and video recognition using cameras alongside vibration sensors for more private parts of the home. This system's primary goal is to monitor the user's health, mainly whether the user falls or not. The system will interact with the user through a webpage on which sensor and video data are monitored and ways to contact medical personnel are provided.

**S22-12** *Title: Soteria Android Mobile Application*

*Team Members: Riya Tayal, Aarushi Pandey, Aarushi Satish, Sahitya Gande*

*Adviser: Dr. Jorge Ortiz*

**Keywords** Soteria, Android Mobile Application, Google Maps API, Development, Safety, Alert(s), Frontend UI

**Abstract** Teenagers, college students, and adults have experienced feeling unsafe in some way throughout their life. This can be because of a mugging, stalking, or an assault. After the attack they are left feeling many different emotions that no one should have to experience. Our group does not condone this type of violence and views this project as an opportunity to create an android mobile application that provides users with help catered to fit the circumstances that users may find themselves in. The application can be used as a way of dealing with the diffusion of responsibility that occurs when such attacks occur. The application will encourage users to help others by sending them personal help requests and will also gather user experiences to aid in keeping other users safe. Our application will show users the unsafe locations and direct them to a different route to their destination, so they can avoid any harmful situation. We want this application to empower our users and provide them with a sense of security when they are in uncomfortable situations. We will also make sure that our application is inclusive of all communities and easy to navigate, so that victims of these different attacks can get help as quickly as possible.

**S22-13**

**Title:** Data Acquisition Module and Processing Unit for Microfluidic Impedance Cytometer

**Members:** Ahmad Abdelrahman, Almuiz Awad, Muhanad Alhayek, Jonathan Ely, Abdul Majid

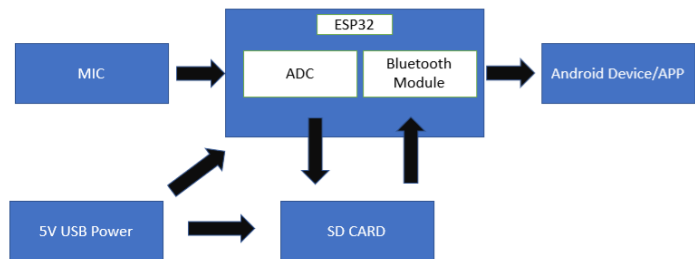
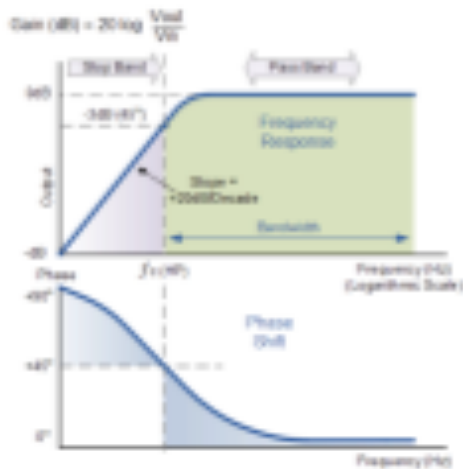
**Adviser:** Dr. Umer Hassan

**Keywords**

Data Processing, Filters, AIDS, HIV, Sensors, Transfer Function

**Abstract**

The purpose of the Microfluidic Impedance Cytometer (MIC) is to help detect irregularities in blood that indicate disease. Using just a finger prick of blood, the cytometer concentrates CD4 cells in both disease and healthy states, and compares them to both other cells, and non-cellular entities in whole blood. The application of this device can help aid in detecting HIV/AIDS, for example. Our goal is to develop a data acquisition module that will take data from the cytometer, apply several digital filters to it, and display it in an easily digestible format.



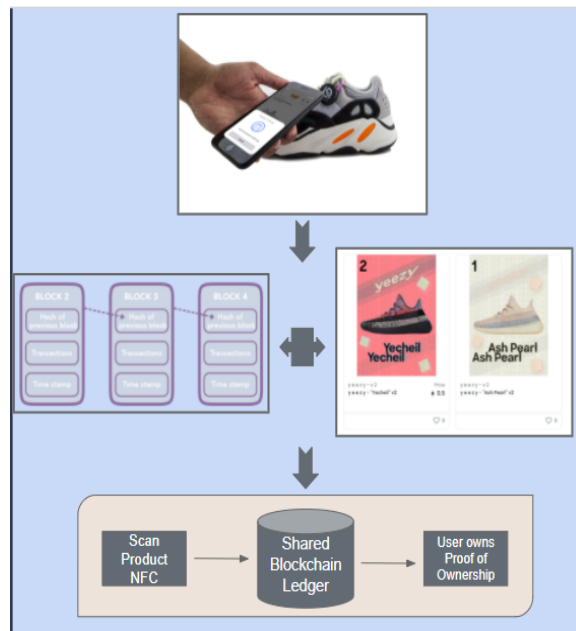
**S22-14** *Title: NFC & Blockchain Based Authentication*

**Team Members:** *Aryan Bindroo, Pavan Kalyan Reddy Meka, Rohan Ravella, Sriram Kannan*

**Adviser:** *Dr. Narayan Mandayam*

**Keywords** NFC, Blockchain, Authenticity, Security, Transparency

**Abstract** Capstone intro template – Our capstone project idea is to give real life products a digital identity. We'll do this through using a combination of the blockchain and NFC chips. Products will be embedded with an NFC chip, which owners and prospective buyers can scan to verify their authenticity: the blockchain will perform a search for that product's digital ID and prove its authenticity. The product will accompany a mobile application that gives users comfort in knowing their item is real and its past history of sales. We believe our solution can be used to counter a huge influx of replica goods such as shoes, garments, bags, and much more where an immutable authenticity check can assure future buyers/sellers on second hand markets that their item is made from the original manufacturer. This can also be applied to existing products, where giving consumers the ability to give their own valuable goods a digital ID will allow them to better protect their assets.



**S22-15**

**Title:** *Facial & Vocal Mapping of Headphones*

**Team Members:** *Max Chien, James Zhang, Vraj Patel, Abhishek Iyer, Srikrishna Narayanan*

**Adviser:** *Dr. Jorge Ortiz*

**Keywords**

Facial-mapping, music, emotional mapping

**Abstract**

For this project, we plan on creating a headphone system that can recognize facial expressions and respond to the user's needs according to the user's facial expressions. The motivation behind this idea is to create a system that can recognize a user's reaction to music and adjust according to the user's requests because of the reaction. Oftentimes, people spontaneously grimace when dissatisfied with a music selection. This system will be intelligent enough to recognize the user's facial expression in order to cater to the user's needs. If the user is listening to music and then reacts with a grimace to the music, the system will be able to detect the user's negative facial expression and ask the user if he/she would want to skip the current selection and move on to the next one. For example, the system may say something like, "You seem dissatisfied with the current selection, would you like to skip it?" Afterwards, the user will be able to use voice control and follow through with a "yes" or "no" command to tell the system to either continue with the current selection or to skip it. If the user doesn't respond with a valid "yes" or "no" response, the system will be able to respond with, "I'm sorry. I didn't quite understand what you said there." Afterwards, it will just repeat the original question again. Lastly, if the user doesn't respond at all after a certain amount of time, the system will just ask the question again, and the process will just keep on repeating if the user continues to not answer..



**S22-16**

**Title:** *Contactless Desktop for Hospital Application*

**Members:** *Nitya Sathish, Sahreen Kaur, Kyle Boyce, Seyma Guleryuz, Angelica Corella Castro*

**Adviser:** *Dr. Hana Godrich*

**Keywords**

Contactless, Medical, Motion-Sensing, Multi-Array, Motion Pattern Interruption.

**Abstract**

Health and hygiene has always been one of the highest priorities of medical institutions, and the COVID-19 pandemic has heightened the extent of this. Constant disinfecting and reducing direct contact with objects and people has become the new normal in recent days. In order to promote sanitization and to create a safer environment for doctors and patients in hospitals, the integration of contactless desktops will enhance everyone's experience. This addition will reduce the frequency of disinfection on high-touch surfaces and will reduce the transfer of bacteria. To achieve this, we utilized the Leap Motion Controller, which is an optical hand tracking module that captures hand movements. The Leap Motion Controller will allow doctors to navigate through the patient portal and review patient data in a contactless manner. Based on current market trends, while analyzing other contactless technologies and applications, there has been a surge in its usage and on its large-scale implementation from the past 5 years, furthermore this same trend is expected to continue for future years as newer innovations are introduced with the contactless feature

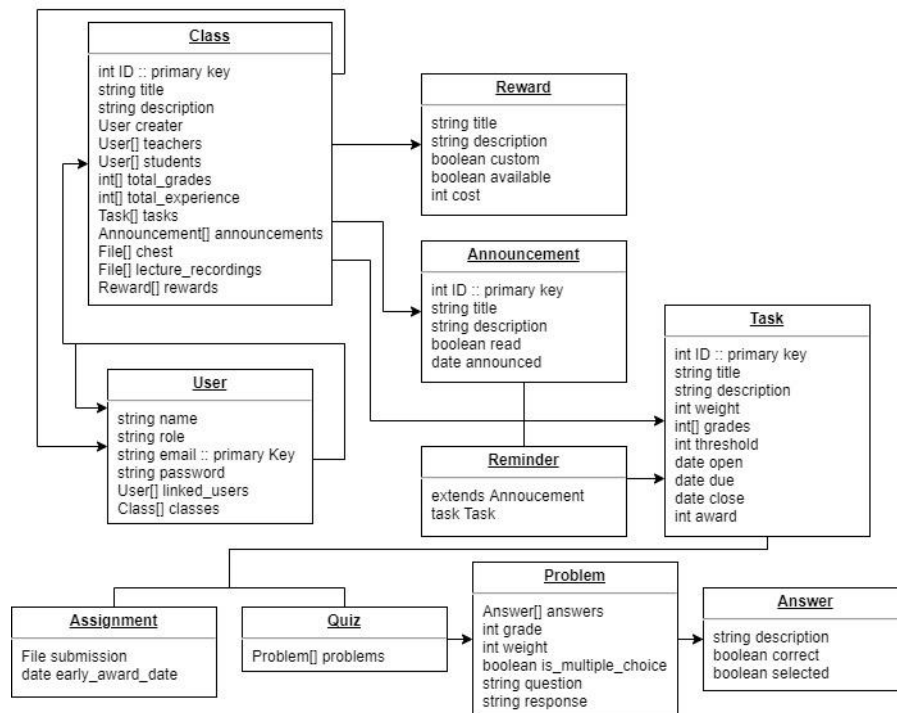
**S22-17** Title: *SchoolQuest*

**Members:** *John Paul Dangler, Ivan Huang, Christian Kline, Hunter Sheng, Gian-Soren Morici*

**Adviser:** *Dr. Jorge Ortiz*

**Keywords** Education, testing strategy, learning platforms

**Abstract** During a transition from in-person to online learning, many k- 6 grade students fall behind and lose engagement in their classes. To gamify the virtual classroom, our project is to build SchoolQuest, a classroom management web application with a built-in reward system. This will allow teachers to manage both their assignments and rewards for their students, to give incentives and re-engage their class.



**S22-18**

**Title:** Classroom Attendance Tracker Using Facial Recognition

**Members:** Sandeep Alankar, Benjamin Lee, Ian Li, Anthony Siu, Jonathan Wong

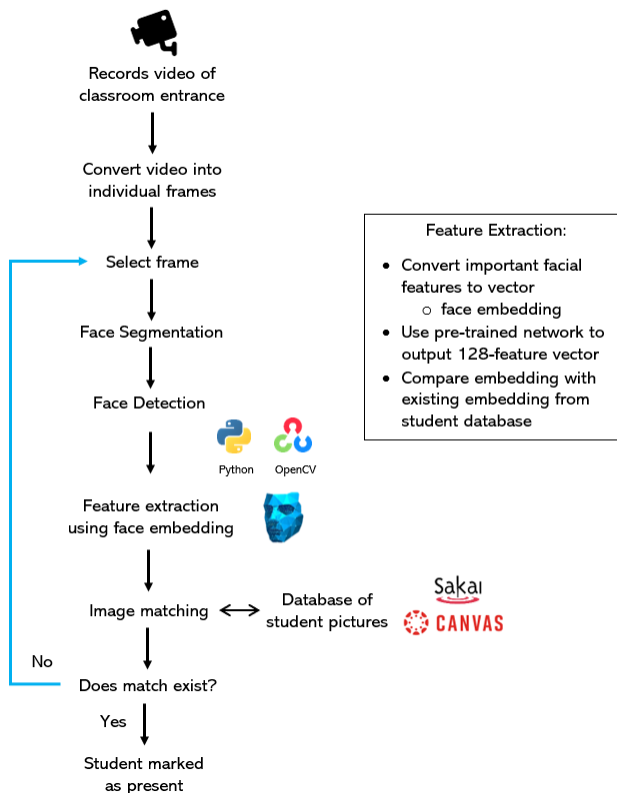
**Adviser:** Dr. Kristin Dana

**Keywords**

Computer Vision, Classroom Attendance, Facial Recognition, Image Segmentation, Image Dataset

**Abstract**

This project aims to use facial recognition to assist with classroom attendance and tracking. As schools begin to transition back to in-person learning, the need for an efficient method of tracking attendance becomes more paramount. Given the large size of certain lectures and the limited manpower available for professors and TAs to be able to take attendance for lectures, in-person attendance is usually not taken by teachers, which leads to students skipping class. The objective of our project is to build a facial recognition classroom attendance system that records a video of the classroom entrance, converts the video into individual frames, segments, detects, and cross- references the recognized face with a database of student pictures. Then, if a match exists between the detected face and an existing face in the student database, that student is marked as present. This kind of system automates the attendance process and eases the load on the professors and TAs to manually call out names, which wastes instruction time. We will be using a facial recognition algorithm to detect faces from the video feed and face embedding to extract the features of each identified face. To test this system, we will be monitoring the accuracy of which the camera is able to detect and recognize faces and then cross- reference those faces with those existing in the student database.



**S22-19**

**Title:** *Color Recognition and Recoloring*

**Members:** *Srinu Koritela, Kevin Lin, Shreyas Heragu,*

*Parth Vora*

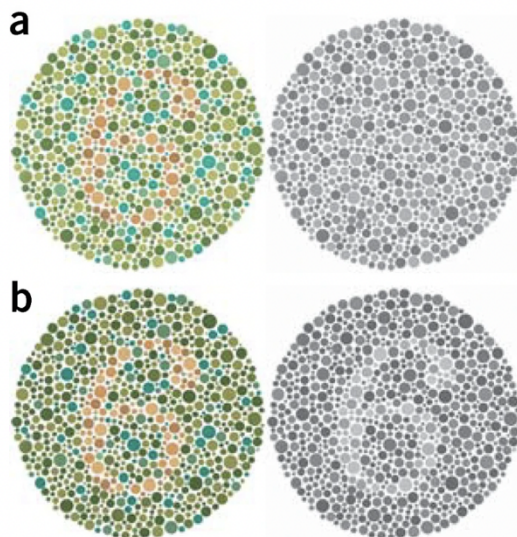
**Adviser:** *Dr. Kristin Dana*

**Keywords**

Colors, Computer Vision, Python, Flask, HTML, CSS, JS, Recognition, Sensor, Classifier

**Abstract**

With colors being such an important factor in our everyday lives, there is a significant issue with over 300 million people being unable to see the world in full perspective due to color blindness [1]. However, using the word “color blindness” is simply a blanket for the various types of vision defects impacting color. Whereas many see shades differently, others cannot see color at all. This, as a result, impacts driving, shopping, and other daily activities. Many people are taught to deal with color blindness by simply adapting and relying on others to assist them when necessary. However, with present technology, the effects of color blindness can be mitigated. Our project aims to do just that, by providing the functionality of automatic image/video color detection, colorblind-perspective based recoloring of normal images/videos (to raise awareness of the issue), and colorblind- perspective based enhancement of images/videos (to make visuals more accessible to colorblind individuals).



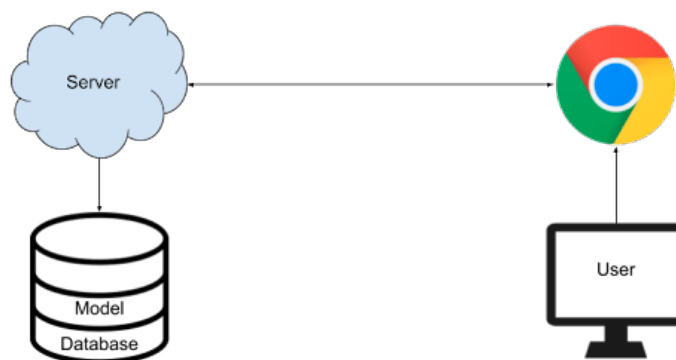
**S22-20** **Title:** *Content Blocking Browser Extension*

**Members:** *David Lau, Jacques Scheire, Milos Seskar, Mark Stanik, Michael Yakubov*

**Adviser:** *Dr. Jorge Ortiz*

**Keywords** browser extension, content filtering, machine learning

**Abstract** With the internet becoming more widely accessible to people from all different walks of life, there also comes many challenges concerning the types of content people wish to view. There have been efforts employed by independent organizations to block graphic or explicit content on their own websites, but this is not always effective and does not block all content that users may find to be troubling. As it currently stands, users are not able to control the influx of content that they consume on a daily basis and are unable to avoid certain types of content that may bring them discomfort or distress. This content blocking browser extension allows users to selectively block certain types of content in their internet browser based on their own personal requirements. There are many reasons to want to block content in a web browser in a portable and effective manner. This product can be used as a form of parental control to protect children from inappropriate content. Victims of past trauma can enable filters to proactively prevent triggers from vivid and distressing imagery. Additionally, those with phobias can block content that may cause an uncomfortable internet browsing experience. This product aims to further normalize personalized content blocking and make the internet welcome to all.



**S22-21**

**Title:** *The Enhancement of Underwater Communications through Machine Learning Techniques*

**Members:** *Christopher Yeh, Wenqian Yu, Zhengdao Zhang, Tianyu Zhao*

**Adviser:** *Dr. Dario Pompili*

**Keywords**

Underwater Internet of Things, Machine Learning, Autoencoder, Convolutional Neural Network, Communications

**Abstract**

The Capstone Design is an application with an ongoing project “Underwater Internet of Things” (UW-IoT) with the advisor from the Electrical and Computer Engineering department at Rutgers University. Specifically, the project focuses on enhancing underwater communication through the Machine Learning (ML) technique, in which part of the goal is to achieve ways that restore signal data and images more correctly throughout signal transmission. By applying Machine Learning procedures, several algorithms and mathematic models will be established and trained, therefore, to test whether the distorted data signals can be retrieved with lower percentages of error. Furthermore, the project also aims to reduce the power consumption during the transmitting/receiving stage, whereas the number of signals can be reduced within the communication system by obtaining correlations and relationships within datasets through Convolutional Neural Network (CNN) and Feature Learning. Additionally, the project will also attempt on establishing possible network security and encryption through Autoencoder including Encoder and Decoder, in which the receiving end can restore the transmitted data without the completed signal data from the transmitting end. As a whole, the group focuses on improving underwater communications through various Machines Learning techniques and models, thus achieving possible solutions toward power reduction, image processing, and data encryption.

**S22-22**

**Title:** IoT Smart Home Device

**Members:** Brandon Yuen, Indrasish Moitra, Harsh Patel, Kobe Lee

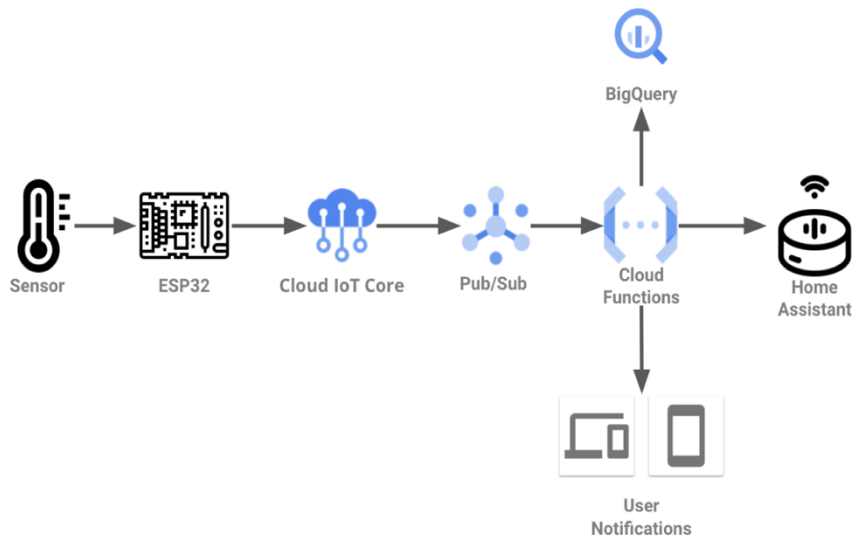
**Adviser:** Dr. Athina Petropulu

**Keywords**

IoT, smart home, automation

**Abstract**

Technology as we know it is being innovated upon at a never before seen rate. Today's progress can be completely obsolete by the time tomorrow rolls around and that is precisely why it is important for us as members of this tech centric society to be up to date with current innovations in order to keep our efficiency high for years to come. One of the ways technology has streamlined our workflow in the [very] recent years has been the shift from employees being at the offices to employees being offered the opportunity to work from home. The more time being spent at home has led to the increase of technology centric smart homes. The purpose of transitioning your home into a smart home is to make your day to day tasks easier to complete, however there is quite a big caveat. The barrier of entry to such smart homes is very high. There is a huge front end investment required to get even the most minimal of Wi-Fi connected/smart homes. This is making it so that only the individuals with higher levels of disposable income are able to enjoy the benefits that come with a smart home. Our IoT device aims to tackle this exact drawback to smart devices. We aim to make a device that not only provides the same autonomous benefits that a lot of the more expensive devices on the market have, but also to launch it at a way lower price point, therefore making it a lot more accessible to the masses rather than just the select few



**S22-23**

**Title:** *IVest*

**Members:** *Michael Fong, Malak Khalifa, Amanda Phan, Edwin Rosales*

**Adviser:** *Dr. Michael Caggiano*

**Keywords**

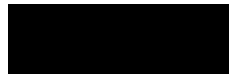
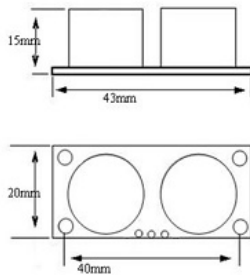
blind, visually impaired, wearable technology, haptic feedback, ultrasonic sensors, detection, assistance. Arduino, accommodating, innovative

**Abstract**

Ever since our generation has dabbled in smart technology, artificial intelligence has played a vital role in changing the lives of millions of people who are blind and who live with severe visual impairments. There have been countless developments for people who are blind or have low vision. These include smart glasses that can use AI to read, braille touchscreen devices that work the same way as our everyday tablets, and even a 3D sound map that creates a detailed drawing of the user's surrounding world, just to name a few. Although it is hard to create sight out of technology, we have decided to attempt to improve the accessibility of people who are blind or visually impaired by developing a wearable technology that protects them from the everyday obstacles that can pose as a potential danger.

Our project, IVest, is an all-seeing vest meant to alert any blind or visually impaired individual if there is an obstacle in their general vicinity. It addresses the problem of visually impaired people not knowing what could possibly be ahead of them or any dangers that they could be facing. With our project, we will be able to alert these individuals with the vest ahead of time and where the imminent danger lurks from all angles within a given radius. IVest takes advantage of ultrasonic sound waves and visuals in order to process and detect all obstacles in their surroundings. With the use of sonar technology, obstacles and dangers will be detected and updated at a quicker rate compared to other methods. This ensures constant reassurance for the user to know what is approaching or what they are approaching. Furthermore, IVest provides a hands-free and safe experience while traveling around. This one of a kind wearable technology will be lightweight and durable for everyday use, planning to eliminate the use of white canes and seeing eye dogs.

- Power supply: 5V DC
- Quiescent current: <2mA
- Effectual angle: <15°
- Ranging distance: 2cm – 500
- Resolution: 1 cm
- Ultrasonic Frequency: 40k Hz





**S22-24**

**Title:** Project V.I.S.I.O.N

**Members:** Justine Catli, Amit Patel, Sumant Pottepalem, Kevin Zhang

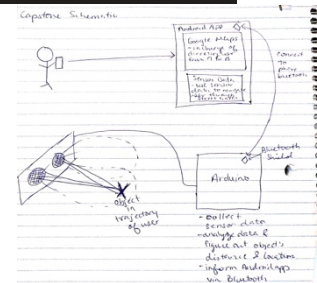
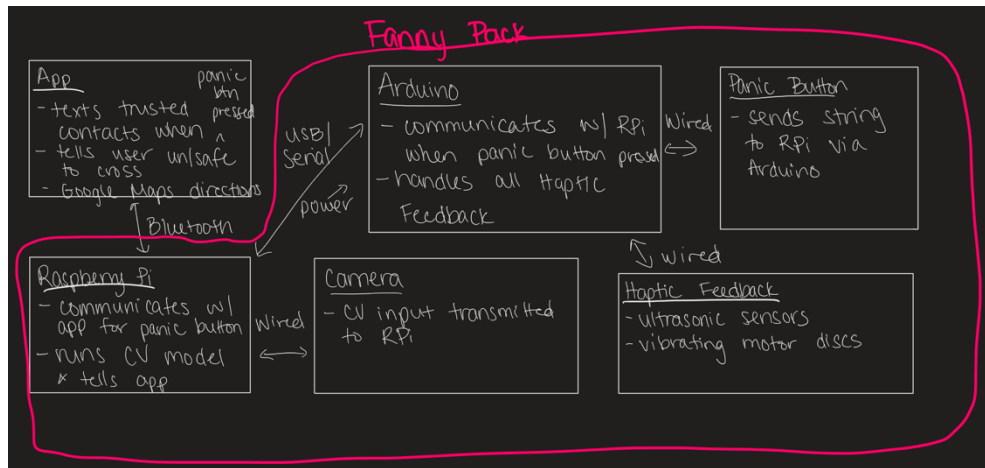
**Advisers:** Dr. Hana Godrich and Don Bachman

**Keywords**

Interactive, Visual Aid, Support Device, User Friendly, Cost Efficient

**Abstract**

Project Visual Impairment Support In Outside Navigation (or V.I.S.I.O.N for short) is a device that aims to assist people with limited to no vision. More specifically, this piece of hardware will be built upon decades of research in the robotics and computer vision field and could help benefit the lives of people across the world with disabilities in eyesight. The device, at its core, will be a wearable device that acts like our eyes, giving the person wearing this piece of technology the opportunity to utilize their sense of sight. The wearable device will track objects in real time and send the data back in the form of vibrations. Moreover, this project was inspired by an older project that was done three years ago in 2019, Project Vins. Project V.I.S.I.O.N aims to construct new and improved software and hardware for a wearable device while keeping the initial integrity and inspiration of the Project Vins intact. With a new alternative option for those who are blind or limited in their ability to see, it could allow people to explore new options in enhancing one of the core five senses. This device will not only be low maintenance and easy to use, but also cost efficient as well, providing those across the world a device that is easily accessible for anyone who needs it. Overall, Project V.I.S.I.O.N can truly be a viable support device that is designed to benefit those who have a sight disability, making for both a brighter and clearer future.



**S22-25**

**Title:** *Digid*

**Members:** *David Joseph, Daniel Samojlik, Hojun Son, Aswathy Aji, Malena Bashar*

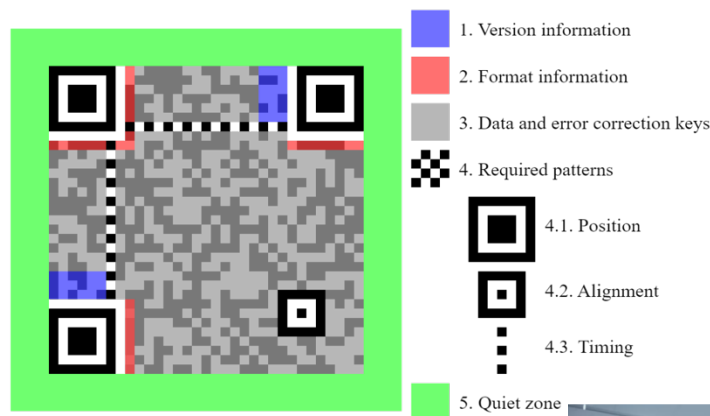
**Adviser:** *Dr. Maria Striki*

**Keywords**

Crowds, space management, digitization

**Abstract**

With the rapid development of technology and digitalization, credit cards, identification processes, and health statuses are becoming virtual. Especially with the existence of COVID-19, health concerns have emerged, especially with regards to social distancing between people in order to minimize the spread of COVID-19. Limiting the number of people that can enter indoor spaces on campus, such as recreation gyms or dining halls, can potentially help the spread of COVID-19 among the students, employees, and professors. By introducing a digital RUID, Rutgers students or faculty members may enter gyms or dining halls using QR technology. Each member in the Rutgers community would create a digital RUID, and each RUID would have its unique QR code. Using the QR technology instead of swiping the card would save time for students or faculty to verify themselves and enter those places. As a result, contact with employees at the front desk of gyms or dining halls would be minimized, ultimately reducing any virus spread that can result from mundane human interaction. The number of people entering and exiting an indoor space would be monitored by using a QR scanner. With this in mind, the crowdedness of those places can be calculated and displayed in the app. Ultimately, this would provide supplementary information for students and faculty members so that they can gauge the risk of exposing themselves to many people and make an informed decision as to whether or not they would want to enter those places.



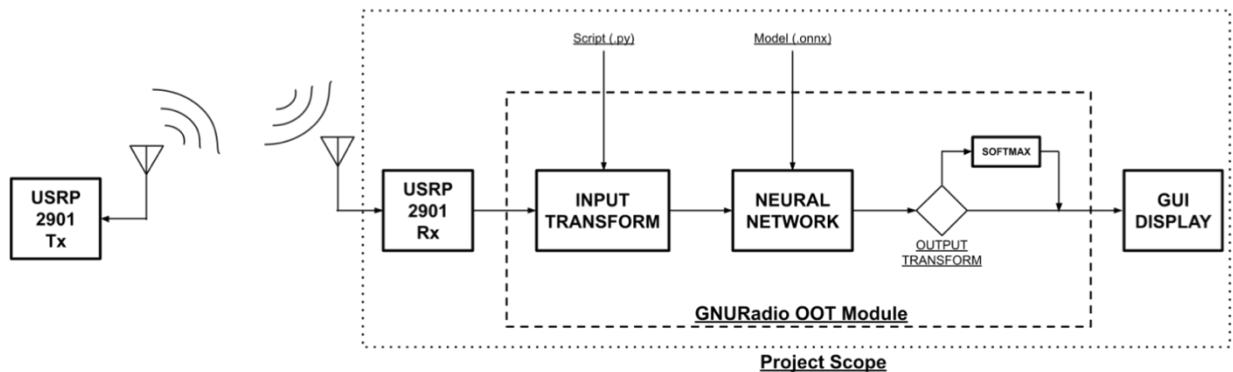
**S22-26** *Title: Streamlining SDR Implementation of Neural Networks Through GNURadio Module Development*

**Members:** Morriel Kasher, Michael Zhao

**Adviser:** Dr. Predrag Spasojevic

**Keywords** radio frequency machine learning, neural networks, software-defined radio, signal processing, wireless communications

**Abstract** Radio Frequency Machine Learning (RFML) is a rapidly growing field capable of performing complicated signal processing operations on experimental, real- world radio data. Examples include Wideband Anomaly Detection, Radiometric Fingerprinting, and Modulation Recognition. While these networks have become powerful and accurate, they are often constrained to offline data processing. Many published neural networks take in a pre-collected or simulated data file as their input, and which while capable of producing an accurate inference result, is impractical for real- world implementation in online, latency-sensitive applications. To that end, several software packages have been recently developed for real-time inference on radio data using pre-trained neural networks. While comprehensive solutions exist for platforms such as MATLAB and LabVIEW, these fail for two reasons: both softwares are proprietary and require high processing power. This makes them inadequate for in-field, small form factor implementations of neural networks on mobile devices or any non-stationary PC without significant basic specifications. By contrast, the GNURadio platform excels in being a lightweight, open-source, easily portable radio data streaming platform. However, there is no one widely accepted module for live radio data inference using neural networks. Our project seeks to develop an Out-Of-Tree (OOT) module for GNURadio that will support the deployment of pre-trained neural networks for real-time inference on live radio data, streamlining the implementation and testing of networks for RFML. Proposed functionality includes support for various pre- programmed user-selected input data transforms, conversion between different neural network format specifications, and C++ variants of all Python code written for performance optimization



**S22-27**

**Title:** *Self-Directing Solar Panel*

**Members:** *Haoxiang Zhang, Jawad Abdussalam, Justin Davis, and Kyle Ross*

**Adviser:** *Dr. Predrag Spasojevic*

**Keywords**

Renewable energy, control, solar panels

**Abstract**

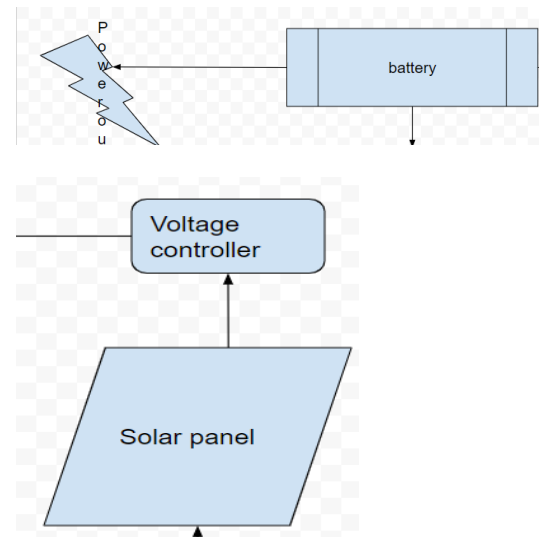
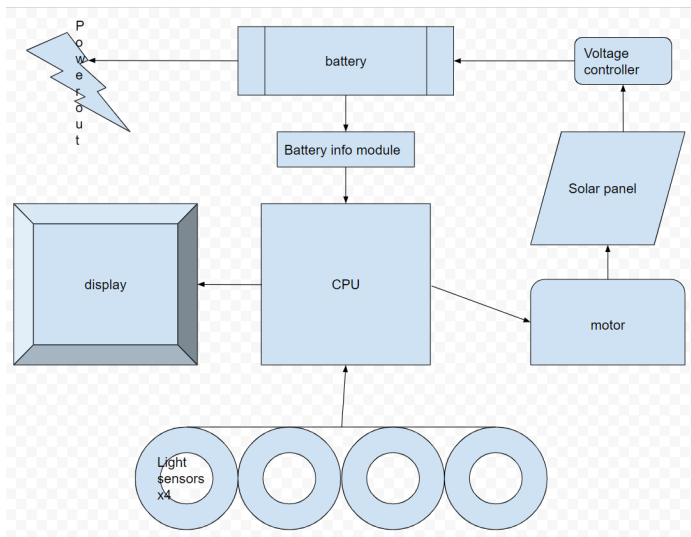
The core problem this project aims to address is the waste of solar energy left untapped by stationary solar panels. Solar energy being the most abundant source of energy on Earth currently accounts for only 2% of the global electricity.

Photovoltaic cells allow for the conversion of solar energy to electricity without any pollution. Recent advances in material science have allowed solar cells to be more efficient and cost less, making them a viable alternative to fossil fuels, the leading global energy source. In the last decade, solar panel usage experienced an average growth of 42% each year. There are now more than 100 gigawatts of solar capacity installed in the United States. This increase in usage makes it even more important to optimize solar panel performance.

The main drawbacks of solar power are timing, positioning and weather. Solar energy can only be harnessed during the daytime in sunny conditions, while also having the solar panels face the Sun for optimal energy generation. Hence, it is important to absorb and store the energy when the conditions allow.

Our main objective is to create a solar panel system that is able to utilize environmental and solar data in order to face the panel in a more optimized direction at any given time.

By increasing the range of motion of a solar panel and utilizing this data, more efficient absorption of solar energy would be possible. This would then lead to a boost in energy production with a significant reduction in both cost and space occupied.



**S22-28**

**Title:** *Transcript Coding for Mental Health Research*

**Members:** *Jack Bessen, Christian Brito, Mohammad Sa'id Kharboutli, William Yubeaton*

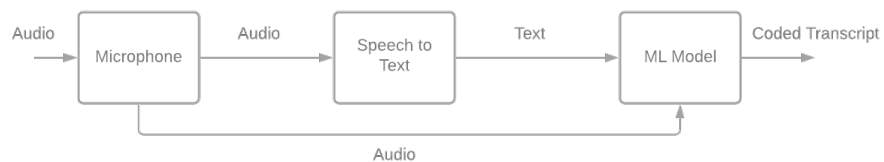
**Adviser:** *Dr. Anand Sarwate*

**Keywords**

Machine Learning, Data Collection, Emotion Recognition, Coding Transcripts, and Privacy

**Abstract**

Around 1 in 4 adults in the United States suffer from a diagnosable mental disorder. Thus, an inquiry into possible approaches towards more accessible mental health solutions is warranted. Mental health is more prevalent than ever in the present day. Its importance has launched mass amounts of research in the area. Discussions with professors and researchers in psychology have been held to better understand what would be considered useful in practice. Recently, the use of technology to enhance medical care has become a major focal point in research and application. In order to aid psychologists in their field, an app is created to collect audio data from patients. Machine learning techniques are used to create a model capable of automatically coding the transcripts of the audio data. Additionally, audio recordings are used to observe intonation and the usage of notable words and phrases. Transcript coding will map terms and the speaker's intonation to an abstracted emotion rating system. Since the data will be concerning patients, privacy techniques must be implemented to protect personal information. A mobile app is created to best implement data collection, processing, and analysis. Mobile apps are convenient to most users due to portability and connectivity to the internet. This app is created with the intent of being used in conjunction with a mental health professional with the ultimate goal of providing more effective care for the patient.



**S22-29**

**Title:** Conceptual Design of Multi-Casting Bluetooth Device

**Members:** Ronak Parikh, Akash Pathuri, Skandan Venkatraman, Akira Brown

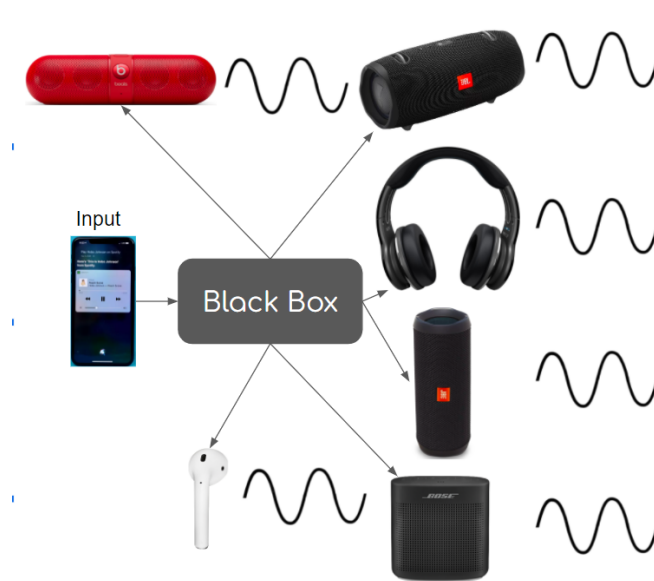
**Adviser:** Dr. Predrag Spasojevic

**Keywords**

Bluetooth, communication

**Abstract**

Current Bluetooth technology allows devices to exchange data wirelessly within a short range, but there are restrictions. The most critical one being that Bluetooth 5 currently only supports simultaneous connection to 2 devices at a time. We propose a solution wherein multiple Bluetooth 5 chips are connected in a cascading manner such that a single source signal is copied to all chips and can thus be distributed to multiple devices at the same time. The scope of this project is to implement this solution on a PCB and have a source signal be transmitted to six speakers which are in sync.



**S22-30**

**Title:** *Affordable Atmospheric Monitoring Unit (A.A.M.U)*

**Members:** *Brianna Solano Aguilar, Felix Shames, Rawad Sayah, Jeremy Kim*

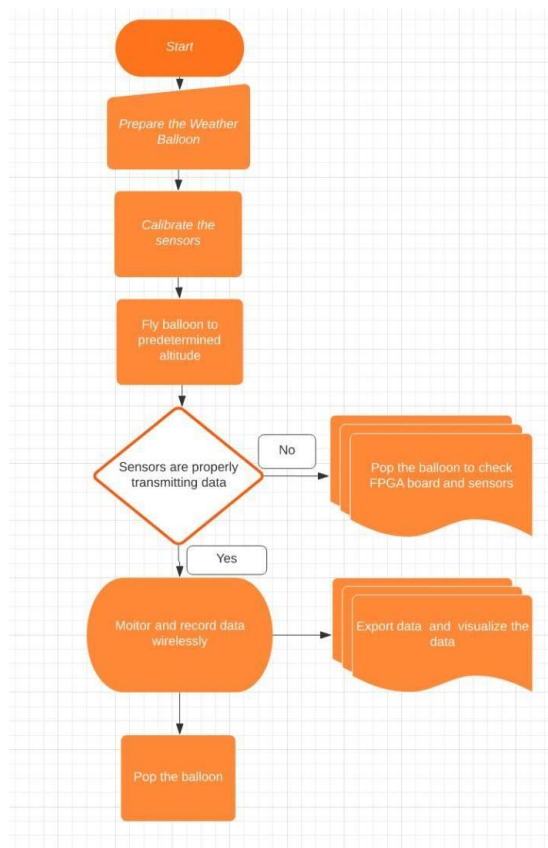
**Adviser:** *Dr. Phillip Southard*

**Keywords**

Global warming, FPGA, PMODs, Atmospheric, Affordable

**Abstract**

Global warming is a topic that impacts every generation, present and future. There are not enough cheap resources out there that provide students with the materials needed to learn about the impact of this growing concern. The Affordable Atmospheric Monitoring Unit (AAMU) provides student with the ability to construct their own weather unit and collect their own data at an affordable price. Equipped with a Field Programmable Gate Array (FPGA) and a variety of Peripheral Modules (PMODs), this project provides a range of customizability and possibility. A prototype unit will be developed, used to collect data, and stress tested to ensure a viable and sturdy final product.



**S22-31**

**Title:** *Occupancy Monitoring System with Computer Vision Algorithms*

**Members:** *Justin Serrano, David Whiteman, Andrew Retana, Patrick Lahey*

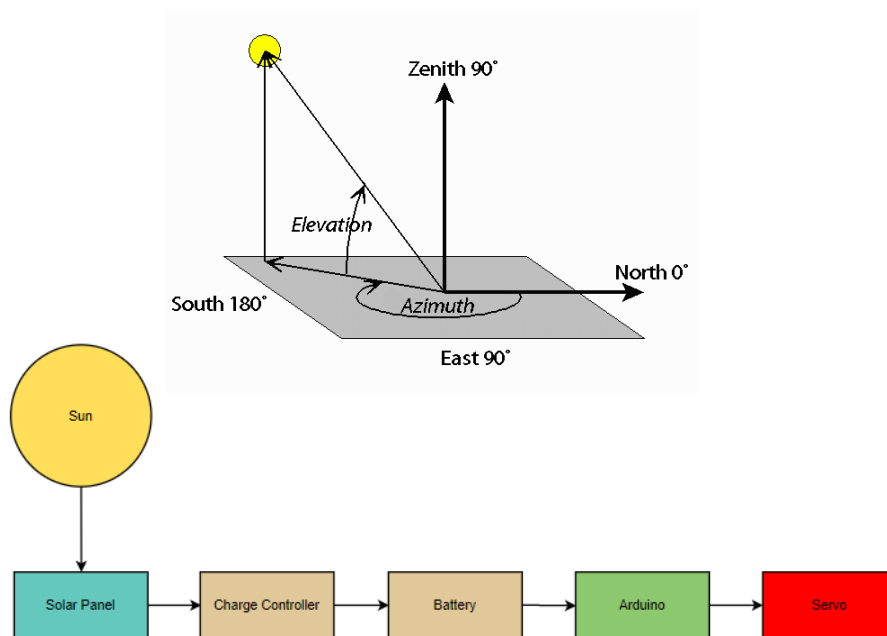
**Advisers:** *Dr. John McGarvey, Dr. Sumati Sehajpal*

**Keywords**

Solar, Power, Heliostat, Reflection, Greenhouse

**Abstract**

Greenhouses are used in order to grow plants year-round due to the ability to control temperature and humidity, while still allowing full sunlight. Since the sun's position in the sky changes throughout the day, a heliostat will be developed to maximize the light plants receive during daylight hours. Two servo motors will control a lightweight reflective mirror that will change its position to ensure that plants in a greenhouse will receive additional sunlight. The servo motors will be controlled by an Arduino microcontroller, and the device will be powered by a solar panel. Power generated from the panel will be stored in a battery to ensure operation on cloudy or overcast days. The angle of reflection will be calculated by a lookup table with sun location data. This information will be used to control the servo motors and will be updated every few minutes. By incorporating the heliostat into a greenhouse operation, the quality and yield of plants will be improved in a sustainable way. The heliostat can be scaled up and used for larger applications such as farms.





**S22-32**

**Title:** *Automated Waste Disposal Bin*

**Members:** *Christine Birkland, Yun Chen, Sami Khan, John Reiner Sloan*

**Adviser:** *Dr. Yuqian Zhang*

**Keywords**

Omnidirectional Wheels, Microcontroller, Ultrasonic Sensor, Wireless Communications, Path Following, Load Cells, Arduino

**Abstract**

Current approaches to waste management and disposal have been relatively stagnant in recent years. Efforts to optimize waste collection still depend on custodial workers manually collecting and disposing of trash. Automation could be utilized to gather and dispose of trash in various settings more effectively. Our project focuses on adding autonomy to conventional waste bins at a smaller scale suitable for desks. This would allow waste bins to travel to a central disposal facility where they can be disposed of instead of the typical method of having a custodial worker go to each bin collecting trash via a trash cart in which they must haul around the premises. This project could apply to individual households or be scaled up to extensive facilities such as schools or office buildings for 32-gallon trash bins. Autonomy can be added without modifying current existing bins but rather by changing the dollies used to transport them.

**S22-33**

**Title:** *Integrated Driving Assistant*

**Team Members:** *Bhusean Lilia, Elie Baaklini, Junior Brice, Venkata Sandeep Dudi, Viswa Vijeth Ramesh*

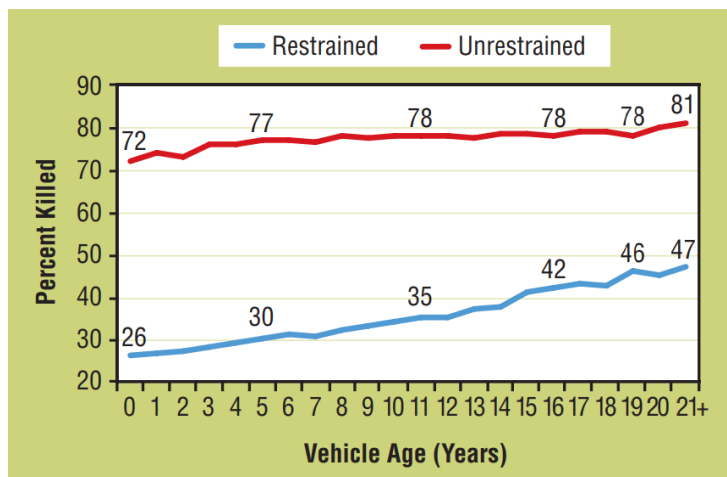
**Adviser:** *Dr. Jorge Ortiz*

**Keywords**

Object Recognition, Eye Tracking, Machine Learning, Video and Data Processing, Automobile Safety

**Abstract**

Due to the significant amounts of automotive crashes on our roads and highways that are mainly resulted from human error, this report delves into a solution that seeks to alleviate the impact of human error while driving with the help of a system called IDA (Integrated Driving Assistant). IDA will be a system of components that could be retrofitted to any vehicle that may lack modern safety features or intelligent driving assistance. It will be a cost-efficient alternative to the expensive self-driving solutions we have today and will serve as a tool that enhances the driver's senses while keeping them in the driver's seat. The main role of IDA will be to alert the driver of unsafe driving behavior and warn them of potential hazards. This will be achieved through the utilization of an array of cameras and sensors that are connected to a minicomputer. This data will then be fed into Python algorithms where it gets processed in order to output appropriate alerts and thus reduce human error.



**S22-34**

**Title:** Heat Recovery Methods to Increase the Thermal Efficiency of the Internal Combustion Engine

**Members:** Christina McLaughlin, Bryan Guaricela, Edward Avkhukov

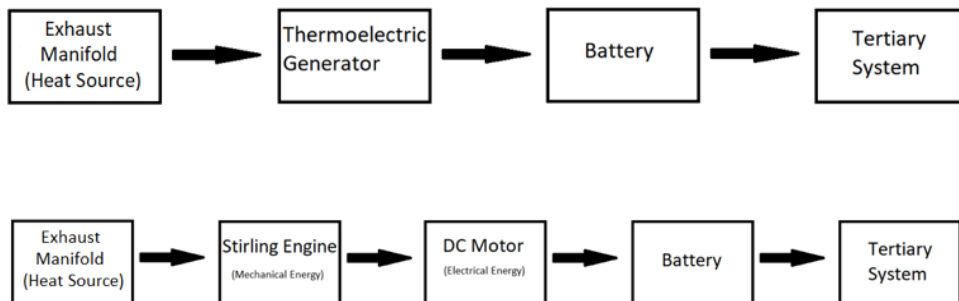
**Adviser:** Dr. Michael Caggiano

**Keywords**

Thermal Efficiency, Cogeneration, Thermoelectric Generators (TEG), Stirling Generator, Automobile

**Abstract**

The goal of this project is to improve the overall performance of an internal combustion engine in an automobile through the investigation of cogeneration methods. Our project will mainly focus on two different waste recovery methods: the Thermoelectric Generator (TEG) and the Stirling Generator (free piston). For each approach we will be assessing their power outputs on a small scale, evaluating their thermal efficiencies, and determining the most effective solution based on the calculations and realistic small-scale model. These solutions would be implemented via the exhaust pipe on the vehicle (in our case, a Toyota Camry). Each alternative would essentially take the excess heat energy from the exhaust and use it to fuel their electrical generation processes. The Thermoelectric Generator contacts would take the heat energy from the exhaust and convert it directly to electrical energy whereas the Stirling Generator would convert the thermal energy to mechanical energy and then to electrical power. We could then use this cogenerated power to power tertiary systems in a vehicle like the brake lights. Once the most viable option is determined we can then turn our focus toward the amount of fuel that the automobile will save based on the implementation of this device. We will be able to determine how much less of a carbon footprint the car will have due to the fact that the engine will not have to power its own tertiary systems.



**S22-35**

**Title:** Design and Development of a Portable Electronic System for a Microfluidic Impedance Cytometer

**Members:** DARWIN ARIAS LIZANO, EMILY GRUBER, NICOLAS RUBERT, TALYA ERBLICH

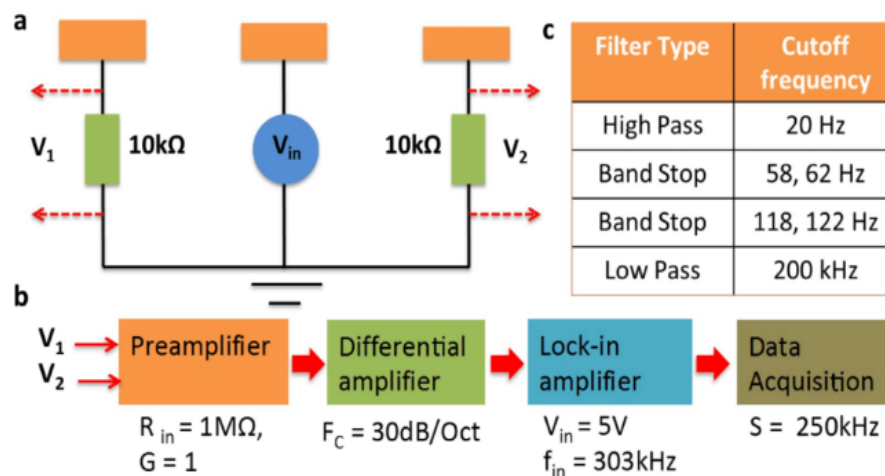
**Adviser:** Dr. Umer Hassan

**Keywords**

design, development, medical, circuits

**Abstract**

Specialty diagnostic equipment needed by physicians are often too expensive or cumbersome due to its size. In turn, this limits accessibility to healthcare and prevents patients from receiving much needed diagnoses. In response to the inaccessibility to cytometers, which are cell counting devices used for diagnostics, Professor Umer Hassan and his lab designed a smaller microfluidic impedance cytometer. This is a significant advancement from the prior art, but there is still room for improvement. The current system is still tethered to a signal generator which limits the portability and cost. If we are successful, this “lab on a chip” can be run off a portable battery bank and cost less than all the equipment in the current setup. Consequently, this will allow blood tests to be conducted in remote regions and in impoverished communities, which will increase access to medical diagnoses and save many lives.



**S22-36**

**Title:** *Landline Phone Obsolescence Prevention*

**Members:** *Confesor Diaz, Sean Hewlett, Randy Roque, Ernesto Heras, Aya Hourani*

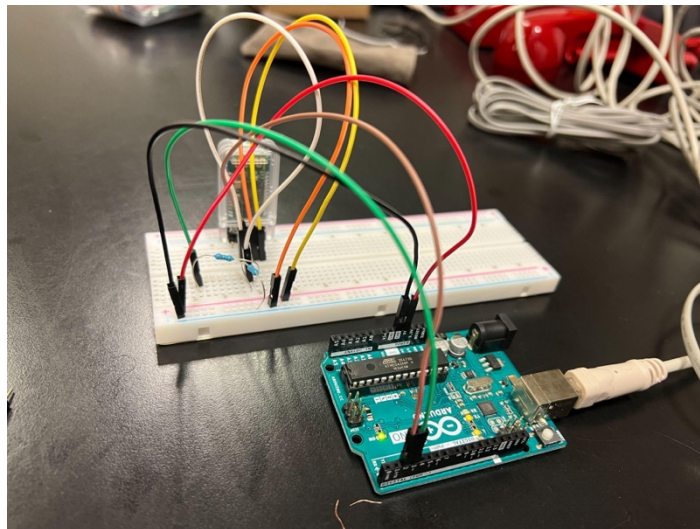
**Adviser:** *Timothy Peterson (L3Harris)*

**Keywords**

Bluetooth, landline, Arduino

**Abstract**

With the advancement in technology over the years, cell phones are taking over and landline phones are being discarded. In more recent years, adults have completely switched to mobile devices, and are changing the way everyday people live. According to the Centers of Disease Control and Prevention, only 40% of U.S. households currently have an operational landline phone as opposed to 90% in 2004. If technology continues to evolve at this pace, landline phones will soon cease to exist. To prevent this from happening, the group plans to successfully connect smartphone devices to Bluetooth-enabled landline phones in order to transmit calls from smartphones to the landline phone. The first step is to connect the smartphone to an Arduino controller and implement the Arduino to act as a media/call receiver. The group then plans to enable digital and analog Landline connections to Arduino and link a smartphone and a Landline phone to transmit phone calls. The final step is to create a smart filter to block calls to the landline phone that are not listed in contacts beforehand. As for the design concept, the goal is to make the cost of production low, as well as custom made design modifications. The design will also be accessible from all ports outside the housing, and both the Bluetooth module and the Arduino will be contained in the same housing.



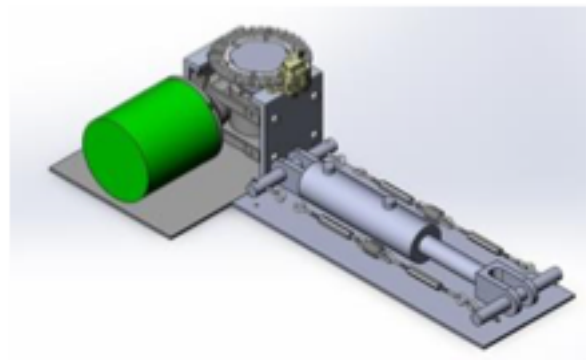
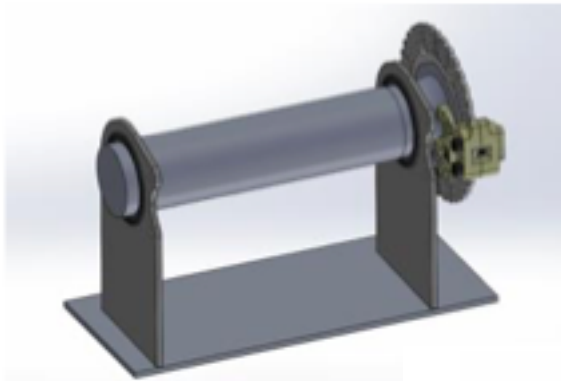
**S22-37** *Title: Brake Dynamometer*

**Members:** *Mazen Abdalla, Kishan Patel, Gregory Scatko, Dahany Choi, Asaad Shaikh*

**Adviser:** *Dr. Assimina Pelegri*

**Keywords** brake, dynamometer, formula, race car, torque

**Abstract** The goal of this project is to design and build a cost-effective brake dynamometer. This device will have the ability to apply a mechanical resistance to a rotating system and measure data that can help identify or very parts of a braking system. Typical use cases for such a device are to measure and collect many types of performance parameters, such as engine power, braking force, torque, and speed for a vehicle. Our intended primary goal of this device is to be able to test brake pads. Using a motor to rotate our brake system and applying the brakes to slow down the system will allow us to collect useful data using sensors to verify the specifications of the brake pads. We want this device to be a cost-effective alternative to existing solutions, meant to be used by small organizations and individual users.



**S22-38**

**Title:** *Digital Scribe: An all-inclusive productivity tool for online learning*

**Members:** *Matthew Avendano, Legend King, Priya Patel, Anagha Prasad, Selena Zheng*

**Adviser:** *Dr. Hana Godrich*

**Keywords**

API – Application Programming Interface, productivity, web application, database, Django framework, Google Vision, Google Speech

**Abstract**

For our Capstone project, we've decided to make a web application that will make note-taking not only easier but much more satisfying and helpful for students. We call it the Digital Scribe, and what it does is transcribes notes that professors write on an online platform into your laptop, or whatever device you are using, hence the name, Digital Scribe. Not only will the Digital Scribe be able to transcribe these handwritten notes, but the application will be able to convert certain speech and voice commands from these lectures and transcribe what is said onto your document, given the case that the one teaching does not write many notes. Because of being able to both transcribe the text and any speech, both verbal and visual learners will be able to use the application without any problems and with ease. The Digital Scribe will include many different tech stacks when it comes to the framework, integrated development plan (IDE), and the database we plan to move forward with. While this will be essentially coded in Python, the use of Google's many different applications and features, such as Google Cloud, and both the Google Vision API and the Google Speech API. Overall, over the course of these next few months, all of us together as a team, along with our advisor, will be working to make the Digital Scribe the best version it could be. It's time to move onto the digital world of listening and learning.

**S22-39**

**Title:** *Geographical Solar Tracker*

**Members:** *JUAN ESCUDERO, PRZEMYSŁAW JUNIEWICZ, SEBASTIAN MATIZ, MATTHEW TOMCZYK*

**Adviser:** *Dr. Michael Caggiano*

**Keywords**

Renewables, solar panels, control

**Abstract**

With the threat of using non-renewable sources being more and more apparent, whether it be through the change in climate or the finite amount of resources, alternatives for attaining energy is a prevalent topic today. There is a large variety of renewable sources of energy, yet some are more accessible to the average individual than others. Solar panels are one such technology, with its simple mechanism and size. Solar panels, more specifically those with photovoltaic cells, attain energy through direct sunlight. The more direct the sunlight, the more energy produced. Without any accessories, the panel would be a static object. It is our project's mission to maximize the potential of a solar panel by having it track the sun from sunrise to sunset. There are two ways to go about this: a light sensor or a tracker based upon geographic location utilizing astronomical calculations. The latter does not use real-time information, which will further increase efficiency as there will be no trial and error when determining positioning. The positioning of the sun in the sky would be able to be determined without any live input, using geographic location and zenith and azimuth angles. The project will consist of two primary portions and will be divided equally among the team members, being that there is an electronics portion and a computer engineering portion. In one sentence: the project will be to motorize amount for a solar panel utilizing geographic location and astronomical calculations.





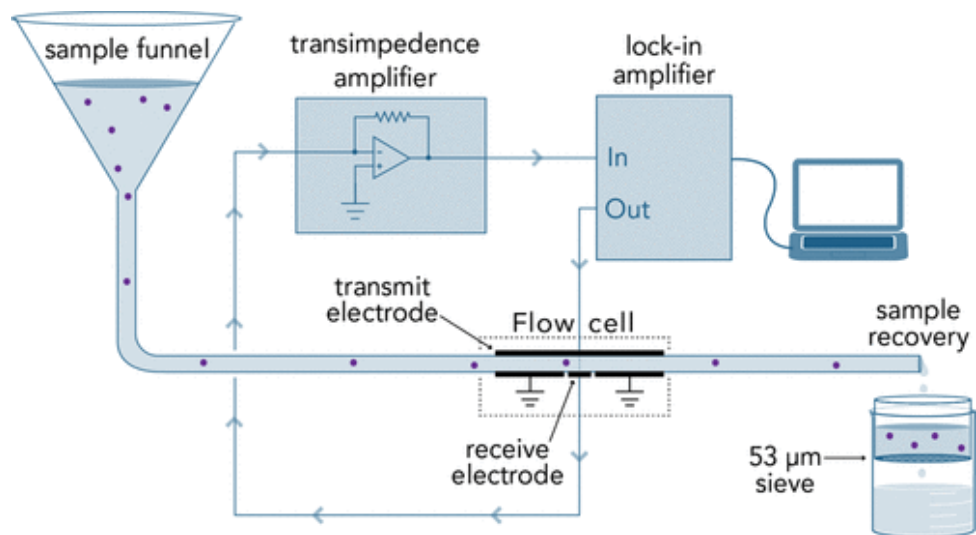
**S22-40** **Title:** *Project Ocean Cleanup*

**Members:** *Esteban Salazar, Vaishnavi Gandhi, Ranea Alghawi, Amber Guthrie, Anthony Apostolides*

**Adviser:** *Dr. Dario Pompili*

**Keywords** Initiative, dedicated, waste, ocean, environment (key words)

**Abstract** Over 5.2 trillion pieces of waste has accumulated over the past century in our oceans. Not only is it harmful to the environment, but it also affects the living creatures as well. There are many projects and initiatives dedicated to tackling ocean cleanup. With our filter design, it will not only take care of floating waste, but also the submerged waste. The filter will be attached to the BlueROVs and will be filtering out microplastics in our oceans.



**S22-41**

**Title:** *Mapster: Collaboratively Mapping Indoor Spaces*

**Members:** *PAARTH GARG, JUAN JIMENEZ, DOMINIK SEPKO, SRIJEET THUMBAVANAM, and ALEXIS BOUZIGES*

**Adviser:** *Dr. Bo Yuan*

**Keywords**

Crypto-Market Prediction Model, Deep Reinforcement Learning, Sentiment Analysis, NLP, Quantitative Trading, Twitter, Reddit

**Abstract**

Our capstone project tackles the problem of generating building schematic maps from camera footage. Solving the problem of producing indoor maps systematically can lay the groundwork for further advances. In digital navigation, routing algorithms lead one to the door of a building. But if buildings were systematically mapped, another can take over in leading the user to the correct room and floor of a hotel, for example.

This outlines the main design requirement for our solution: that the mapping process should be accessible and trivial to the everyday user. If only a team of dedicated cartographers with expensive gear work on the maps, then it makes it non-feasible to map many buildings, namely due to access issues and the sheer amount of buildings that exist compared to roads. However, if it were in the form of a community-driven app, then it would be more feasible as anyone could contribute with the places they are familiar with.

Our capstone project prototype – a combined indoor map-viewing and map-generating Android app – aims to improve already existing consumer-oriented GIS like Google Maps and OpenStreetMap. Google Maps implements some indoor structure for buildings. Yet, it cannot handle multiple, overlapping floors, which is essential in mapping buildings. Even more importantly, as far as our research goes, there is no way for an average user to contribute to the maps. OpenStreetMap is designed with community-driven changes in mind [1], but yet does not incorporate essential features needed to function inside buildings, like floor awareness. Furthermore, contributing to it is not trivial: to our best research, there are no apps where you can generate simplified map schematics from your phone.

**S22-42**

**Title:** *Themis Application*

**Members:** *Chynna Walsh, Bharath Salvaraj, Jason Tong, Ryan Salvatore*

**Adviser:** *Dr. Umer Hassan*

**Keywords**

App, accessibility, sustainability

**Abstract**

In New Jersey there are over 800,000+ people who are in need of assistance in the forms of housing, low-cost medical care, low cost dental care, and access to free food. With over 1,786 people living without shelter on any given night, the need for resources to help those underprivileged is at an all time high. One of the biggest obstacles for people to access aid is to be aware of what resources are available to them. Many charitable resources for underprivileged individuals do not have strong web presences, and as a result, it is hard to get accurate information regarding these services without having to call or visit them. Our goal is to address this by creating an application, called Themis, that will consolidate information about housing, dental, food, and medical resources within New Jersey. Themis will be developed for both IOS and Android to ensure the platform is not a barrier for people trying to access our app. Themis will provide information that can be hard to find such as working phone numbers, current hours of operation, cost, restrictions to who can access a given service, and additional services that may not be advertised. It will also contain lists of emergency numbers and vital information needed. Themis will present this information in a user friendly interface that will allow users to search for the resources that are available based on factors such as proximity, cost, and gender.

**S22-43**

**Title:** *Weight Sensor Technology*

**Members:** *Jonah Temple, Jaydn Serrano, Nkenna Opara, Gagan Kattula*

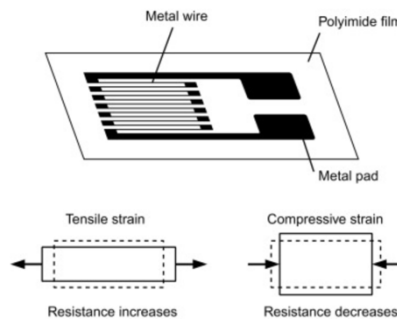
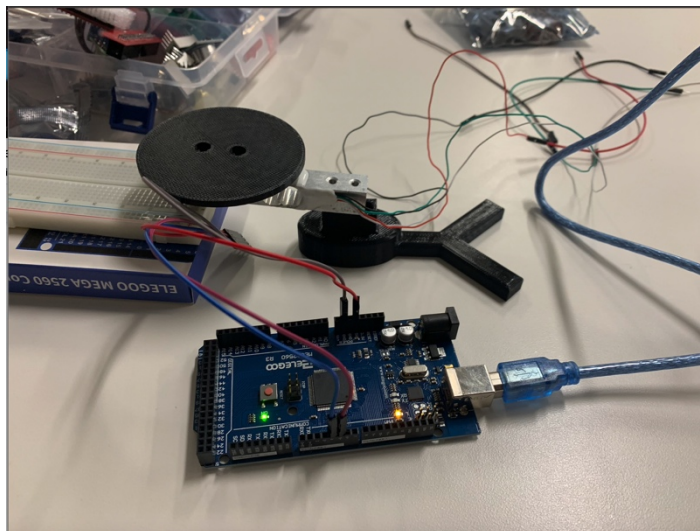
**Adviser:** *Dr. Wade Trappe*

**Keywords**

Sensors, IoT

**Abstract**

The world today is saturated with subpar security systems and storage spaces with insufficient security mechanisms that puts people's private property at risk everyday. The mechanisms that are biometric data-dependent and numerical data-dependent, whilst being a sincere and somewhat durable solution to safety and privacy, do not fare well against today's world of hacking where no data is safe and secure. Our solution is to combine the mechanical fortitude of dial locks with the sensory circuits that interact with the user to validate appropriate and legitimate access.



**S22-44**

**Title:** Smart Wearable Tracking Technology

**Members:** Robert Romano, Nicolas Saint, Danny Canossa

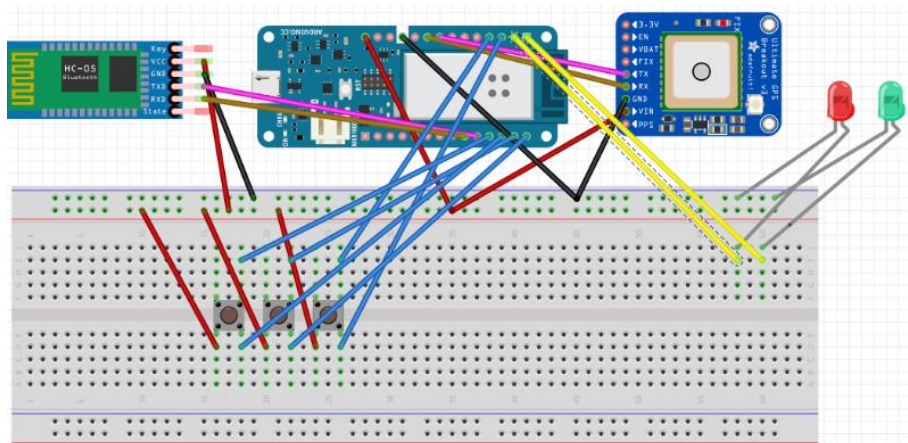
**Adviser:** Dr. Hana Godrich

**Keywords**

Sensors, IoT, wireless communication

**Abstract**

Our Goal for this project is to design a smart wearable device that can send a text message to a pre-assigned set of phone numbers to alert them if the user is in distress perhaps at a variable level of priorities. The key words for this project are reliability and durability. The device should try to be as compact as possible with as little ports and seams as possible. The user interface should be as simple as possible so that anyone can use and understand it. We will use IOT technology so that it can work anywhere within reason without the use of a local area network. The device should not be too visible and should be able to be worn in a variety of fashions and should have safeguards in place so it will not be triggered by mistake.



**S22-45**

**Title:** *Cyclist Navigation Alert*

**Members:** *Josue Montalvo, Bishen Chhatwal, Hilda McSulla*

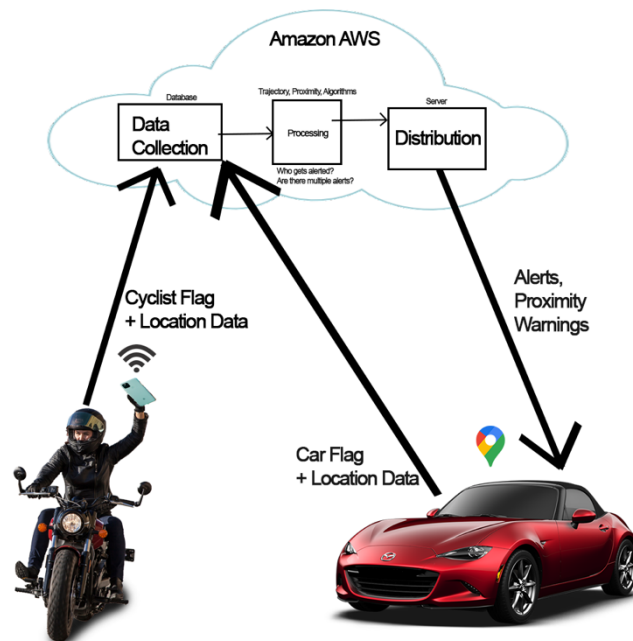
**Adviser:** *Dr. Roy Yates*

**Keywords**

Cyclist, Automotive, Safety, Mobile, Android

**Abstract**

For some people, riding a bicycle was an activity they did as a kid, but it's not something they did much of once they got older and adapted to other forms of transportation such as a car. However, innovations such as motorcycles, electric bikes, and modern bicycles have made cycling a more cost-efficient alternative to automotive transportation. Due to more cars being sold and present in traffic when compared to motorcycles and bicycles, cyclists are more vulnerable to accidents due to limited visibility and awareness. While there may be accessories that improve the visibility of cyclists, we want to develop an affordable and effective solution that is accessible to anybody with a smartphone. Our alert system will alert drivers that a cyclist is nearby to reduce the risk of a collision and collect data from trips to enhance safety and alerts during its operation. This will be done by utilizing various APIs, including the Mapbox SDK, to serve as a base for the navigation function of the application. The collected data from multiple trips by both cyclists and motorists will be held in a server to be analyzed in order to create safer routes and earlier alerts based on patterns of driving observed by the navigation system. The server will be hosted on the cloud using Amazon Web Services and store location and speed data. This solution allows various people from different backgrounds to utilize this safety tool as it simply requires a smartphone without the need for costly sensors or equipment locked behind newer cars.



**S22-46**

**Title:** *Smart Lock System Using Raspberry Pi*

**Members:** *Zhihao Yi, Mustafa Alhelawe, Dylan Okine, Asim Malik*

**Adviser:** *Dr. Hana Godrich*

**Keywords**

IoT, control

**Abstract**

This project lies in the field of audio signal processing and machine learning and consists of the following steps: reference speech setting, speaker's speech collecting, preprocessing, feature extraction, classification, emotion recognition, and emotion management system. The prosodically unexpected speech would be noticed, analyzed, and compared to the reference speech which is implemented through the convolutional neural network. While identifying the speaker's emotion, the project can perform characteristic personalization, allowing to obtain distinct parameters for every licensed individual over a long period of time. In addition, emotion management systems would statistically analyze the variation of recent emotions, to assist one to regulate their emotions, if necessary, suggesting alternatives such as movies, music, or other entertainment recommendations. All statistics would be transmitted to the cloud, and users could view them via smartphone and computers. Optionally, the system could be connected to bluetooth speakers and television for the immediate entertainment play.

**S22-47**

**Title:** Super Solar Panel (SSP)

**Members:** Mohamad Elzoghaby, Hagan Pereira, Maxwell Rothstein, Emmanuel Nwosu

**Adviser:** Dr. Zoran Gajic

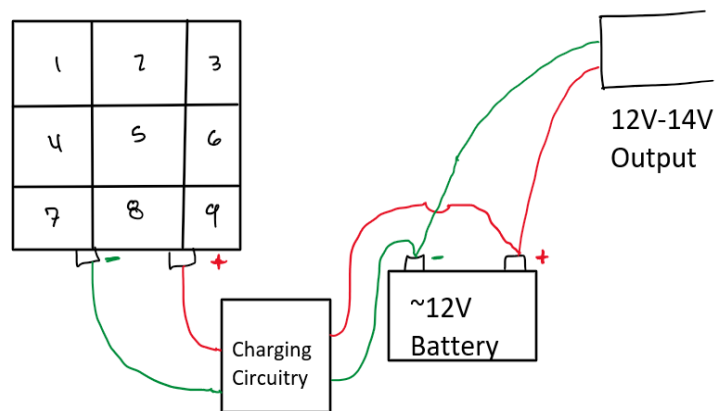
**Keywords**

Control, renewable, solar panles

**Abstract**

Over time, solar panels can go bad and lose efficiency. Specifically, one of the causes of the solar panels degrading is due to shading. When shading occurs, a solar cell becomes obsolete, which is why most solar panel systems are built with solar cells in parallel with bypass diodes. However, these bypass diodes have a few problems, primarily their lack of durability, which can get very costly to replace, as you would need to replace the entire solar panel if even one diode goes bad. As a result, we decided to pursue a project that will allow the user to more pinpoint the location of the solar panel system's problems while also providing a safer, longer lasting solution. With our design we have two primary benefits. The first is to allow for our solar panel to greater efficiency of energy extraction which reduces cost in the long run. Second, our design will also allow for a more fixable and replaceable panel, where instead of replacing an entire panel, you can replace a faulty cell. Our circuit design will consist of a MOSFET based diode that will have a small voltage drop while allowing the system to skip over any nonoperational cells. Overall, we want to build a safer, cheaper, and longer lasting solar panel system. To make the system friendly for users, we want to build a companion application that goes along with the system and displays important information. The application will display an efficiency rating to check the output of the system and will also notify the user if any component isn't operating properly. The companion application will be available on both iOS and AndroidOS to allow for increased compatibility and will interact with the system through bluetooth. The system will have an Arduino with a voltage sensor attached across the positive and negative terminals and will transmit those signals through bluetooth to the companion application.

Objectives: Create a MOSFET designed diode that will allow current to flow nearly uninterrupted with minimal resistance; Create a user interface that will allow the user to locate any inefficient parts of the system, to allow for a cheaper replacement cost; Integrate MOSFET diode solar panels and Arduino module to allow users to access information on the companion application to create a seamless system for users





**S22-48**

**Title:** *TextToStocks*

**Members:** *Adrian Mah, Shrey Joshi, Muhammad Raza, Ryan Van Duren, Suryansh Singh*

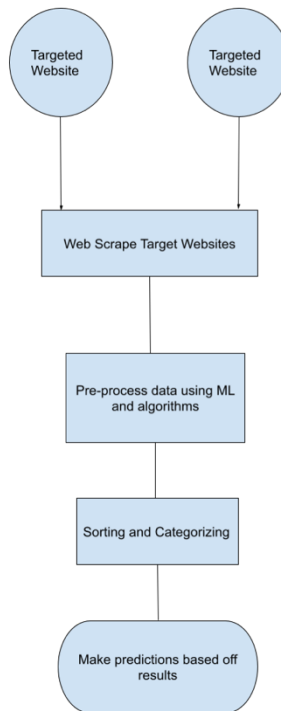
**Adviser:** *Dr. Yuqian Zhang*

**Keywords**

App, investing

**Abstract**

TextToStocks is a tool purpose built to draw conclusion(s) about the future prices of multiple equities based on prior and recent internet discussions regarding the equity, or alternatively, establish that there is no relationship between the two, if that is the case. Our project is aiming to achieve this by developing an analytical framework using neural networks to find connections between internet discussions regarding an equity and its price. Our project was inspired by the “meme stock” trend that took the financial world by storm in early 2021.



**S22-49**

**Title:** *Encrypted Neural Networks*

**Members:** *Andrew Park, August Seiple, Noah Choe, William Basanaga*

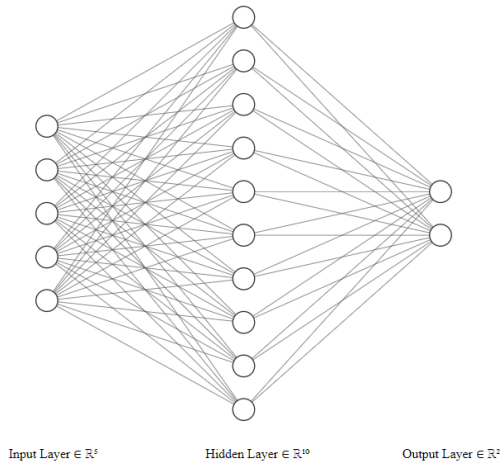
**Adviser:** *Dr. Sheng Wei*

**Keywords**

Machine Learning, Cryptography, Homomorphic Encryption, Data Privacy

**Abstract**

Homomorphic encryption is an advancing field within cryptography with many implications regarding data privacy. Machine learning is one field where data privacy is of high importance. We aim to provide a method for which neural networks are able to perform inference on encrypted data securely without exposing any sensitive information. To accomplish this, we implement a standard neural network with PALISADE, a state-of-the-art encryption library which is able to accomplish homomorphic encryption with arithmetic on approximate numbers. We implement a neural network model which is encrypted and is able to perform accurate inferences on encrypted input data. Using these techniques, we achieve an accuracy which matches the standard network.



**S22-50**

**Title:** UniDrop

**Members:** MEMPHIS CHEN, MORAYOOLUWA D OBAISI, CHARLES TRANGAY, TYRON TUCKER, RANDY J TUMALLE

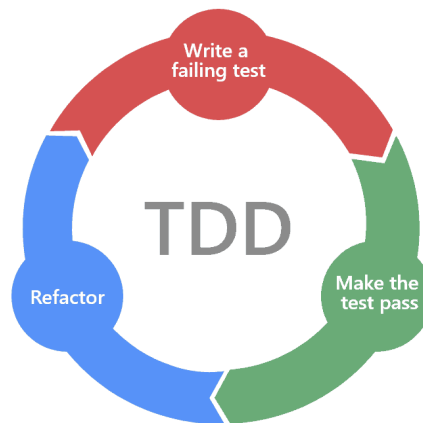
**Adviser:** Dr. Anand Sarwate

**Keywords**

Deep Learning, Machine Learning, Image processing

**Abstract**

Cross-platform file sharing has not been solved optimally for several years now. This problem has affected countless people from different fields, from everyday students to people in their respective industries. Generally, anyone with a form of technology will benefit. With the emergence of technology adoption, this problem will likely affect the majority of people at one point in their life. One of our inspirations for tackling this problem came from our team members knowing the lack of a solid application that delivers cross-platform file sharing. Similar systems that are in production and are fully released attempt to solve this issue, and our team noticed some glaring issues once we investigated further. After some careful and precise research on the effectiveness of some of these systems, we found out that many people were having problems sharing files despite the description of the system that states that it should be able to accomplish cross-platform file sharing, leaving people distraught and misled. From our research, we saw that the most common approach in attempting to solve this issue was using Wi-Fi technology or Bluetooth technology. The target audience would be people aforementioned who own technological devices with capabilities of sharing files, specifically people who utilize file sharing with others using different operating systems. Our application will provide a sense of inclusivity to the audience mentioned previously instead of having people being forced to stick with one operating system. There are many times where a certain operating system user is forced to stick with that same operating system for all devices because of the lack of sharing options and, and we want to change that. There are various reasons why someone would want to share files. Some people would want to share an amusing picture, an important and serious file for business, or have other reasons. Our application plans on helping anyone with sharing their files without any tedious steps or barriers. A common example that was observed was sharing files from a Windows machine to an Apple device.



**S22-51**

**Title:** *Budgeting App*

**Members:** *Kunj Desai, Ashirvadh Bhupathi*

**Adviser:** *Dr. Zoran Gajic*

**Keywords**

Budgeting, debt, financial goals

**Abstract**

As of 2021 the U.S has \$1.73 trillion of student debt which is a 91% increase in debt from 2011. Roughly 70% of college students have student debt with the average American student loan being \$38,791. With so many people graduating college with massive amount of debt, it is vital for them to start getting educated and improving their financial knowledge. Our capstone project is to build a budgeting app that will give its users the tools and knowledge necessary to make sound financial decisions. The objective of this app is to help its users find ways to reduce their debt and start saving money to meet their long-term financial goals.

The budgeting app will accomplish this by providing incentive to its users to build a habit of budgeting. Our objective here is to make our app the one in all go to place for anything relating to their finance. The way our app will incentivize its users is by using a token system. For example, users will be rewarded for adding/changing categories in their budget, or for logging in the app for the day. This keeps the app updated, and tokens are rewarded to users for doing so. At the end of the month, tokens will be added up and winners will receive a prize.

**S22-52**

**Title:** *Braille Teacher*

**Members:** *Ryder Morello, Syedkhizer Ali*

**Adviser:** *Dr. Bo Yuan*

**Keywords**

Braille, app

**Abstract**

In order to get a Braille education, joining a special education school is currently the only option. Only qualified teachers can provide adequate braille education. Lack of resources prevents thousands of people from getting a Braille education which is an essential means for visually impaired people to become autonomous in their everyday life. Our goal is to create a device that is affordable and accessible to visually impaired people so that they can learn how to read and write in Braille language independently without having to rely on a teacher or a school. The Braille teacher device will be capable of teaching Braille language to people who have basic English language literacy.

