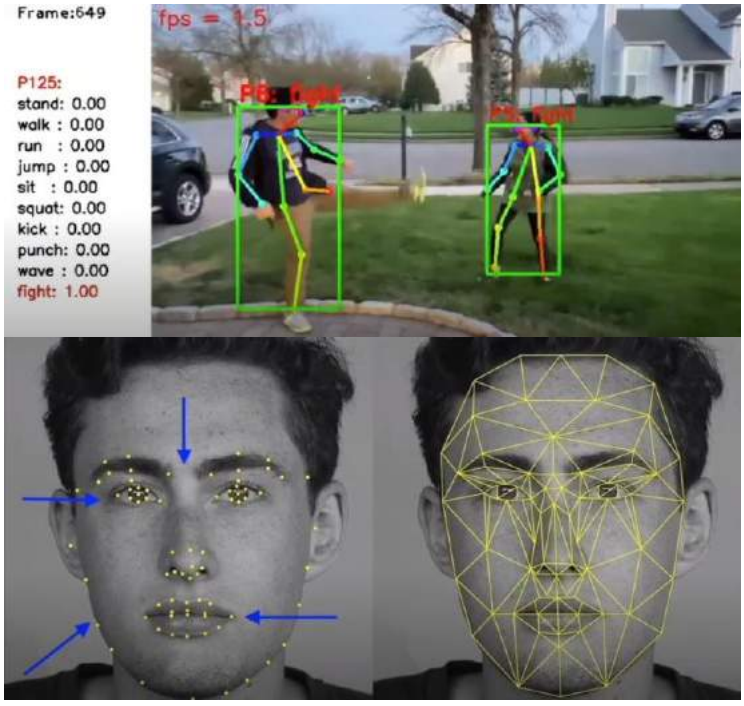
School of Engineering
Department of Electrical and Computer Engineering

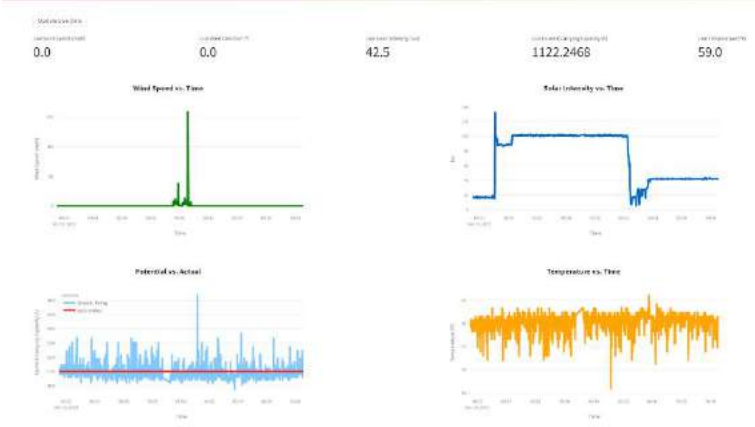
Capstone Program Spring 2023

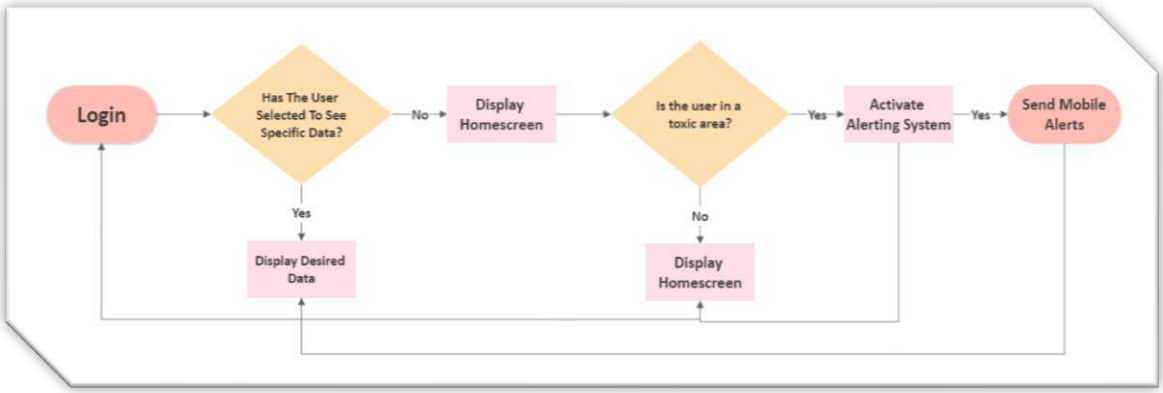
Senior year Design Projects

At a Glance…



S23-01	***Title***: *NJ ShorePower* ***Team Members***: *Andrei Dumitriu, Brian Dorobis, Chirag Rana, Sam Sayles* ***Adviser***: *Professor Caggiano*
Keywords	Offshore wind, Dynamic line rating, Transmission constraints ,Renewable energy, Weather monitoring
Abstract	New Jersey has set a goal of adding 11 GW of offshore wind electric generation to its energy portfolio, which presents significant transmission challenges due to transmission constraints and congestion. Congestion occurs when transmission constraints limit current-carrying capacity, leading to increased electricity prices. Traditional solutions to alleviate congestion, such as upgrading or expanding transmission lines, can be expensive and time-consuming. However, dynamic line rating (DLR) systems provide a low-cost and near-term solution to congestion by monitoring a transmission line's thermal limits based on weather conditions. This paper presents the NJ ShorePower project, which aims to develop a low-cost DLR system using Arduino sensors and other products to create an extensive weather monitoring network. The NJ ShorePower project will monitor weather conditions such as ambient temperatures, convective cooling by wind, or sunlight warming of the line, which significantly influence thermal limitations. The DLR system will maximize the transmission line's current carrying capacity while maintaining safe and reliable operating conditions. The project will also develop a python dashboard that displays the instantaneous transmission capacity of a line in an easy-to-read format. The NJ ShorePower project addresses the challenges of transmitting offshore wind energy to the onshore grid, which is crucial to achieving New Jersey's renewable energy goals. By increasing the transmission capacity of coastal transmission lines using DLR technology, offshore wind units can generate more power, reducing the possibility of curtailment during times of high grid congestion, making the state's offshore wind electric generation more reliable and cost-effective.



S23-02	***Title**: Multipurpose Wireless Toxic Gas Leakage Sensing Bracelet* **Team Members**: *David Arevalo, David Falana, Jose Guanipatin, Kamsiyochukwu Osigwe-Daniel* ***Adviser**: Umer Hassan*
Keywords	Real-time monitoring, Mobile App, Thermal Sensing, Heart Rate, Toxic Gas Detection
Abstract	Every day, we are exposed to chemicals and pollutants - in our air, food, and water. As a result, individuals must be aware of the chemicals they are exposed to daily. For this project, we created a gas-sensing bracelet, a device worn on the wrist to alert the wearer of toxic gases within the area. The sensor-enabled solution helps prevent the risk of gas explosion casualties within an enclosed environment due to potential gas leaks. Furthermore, gas sensors will help detect the concentration of toxic gases in the atmosphere. The bracelet will alert an individual through vibration and noise when the threshold of the gas sensors is met. There will also be a touch screen that allows values and urgency levels to be displayed. The bracelet also includes a heart rate monitor so individuals can monitor their health and a thermal camera so that the user can detect and measure the infrared energy of objects if placed in a dangerous situation. As for a power supply, the bracelet will be powered by a rechargeable 9V battery. The battery will have enough charge to last one full day of use. Lastly, the bracelet will send continuous data from the watch to a mobile app that will alert proper authorities if the app deems an individual is in trouble. 

S23-03

***Title**: Lift Tracker*

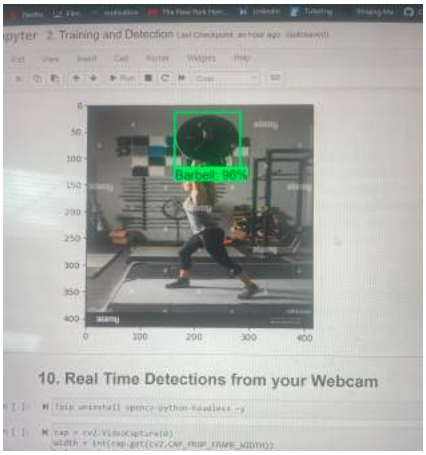
***Team Members**: Kedar Padki, Milan Trivedi, Tanish Tatrakal*

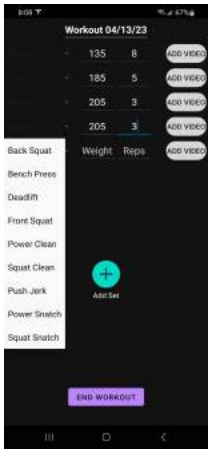
***Adviser**: Athina Petropulu*

Keywords Computer Vision, Android, ML Kit, TensorFlow, Fitness Tracking

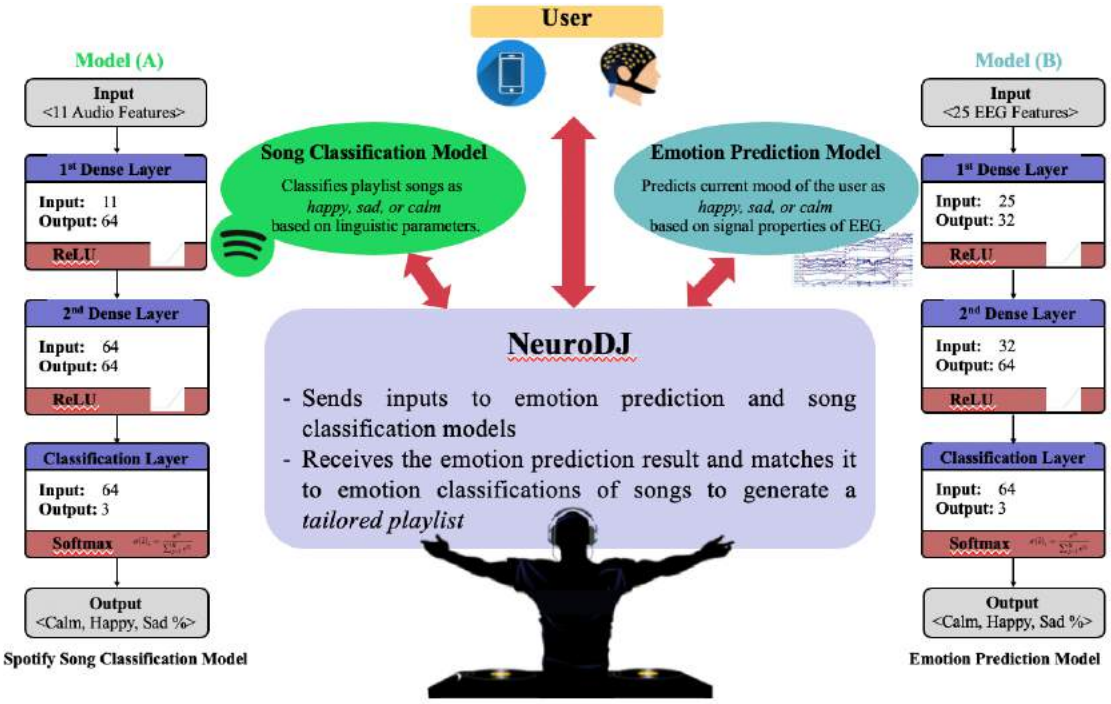
Abstract

Our proposal is one that capitalizes on the growing Health & Wellness industry. We noticed that many fitness trackers excel at tracking certain workouts, such as running and swimming, but were lacking when it came to tracking weightlifting workouts. To solve this problem, we have developed an Android application that utilizes Computer Vision, enabling a smartphone camera to identify and track a moving barbell. Frame by frame calculations were implemented for the user recorded videos, allowing users to track the barbell's velocity and acceleration throughout a lift. This information allows users to track their progress aside from using just weight and repetitions. Not only does this data give the user more information to track progress, but it also can be used to scale the intensity of a given workout, which can be used to prevent injury. In the Android application we have created, the workout data is stored locally in a database on the device, using the Room Persistence Library, which can be queried using SQL. In terms of object detection, we have created our own object detection model via the TensorFlow Lite Model Maker and implemented our custom model using Android ML Kit. Furthermore, to strengthen the dataset used to train our model, we have included over 300 pictures of barbells in different settings along with multiple angles for proper and accurate object detection. With ML Kit API's, the moving barbell can be tracked and the application conducts calculations using kinematic equations to provide useful metrics, which stores the relevant information regarding the workout in the local database. This data is shown to the user when they playback the video of their lift in the app.

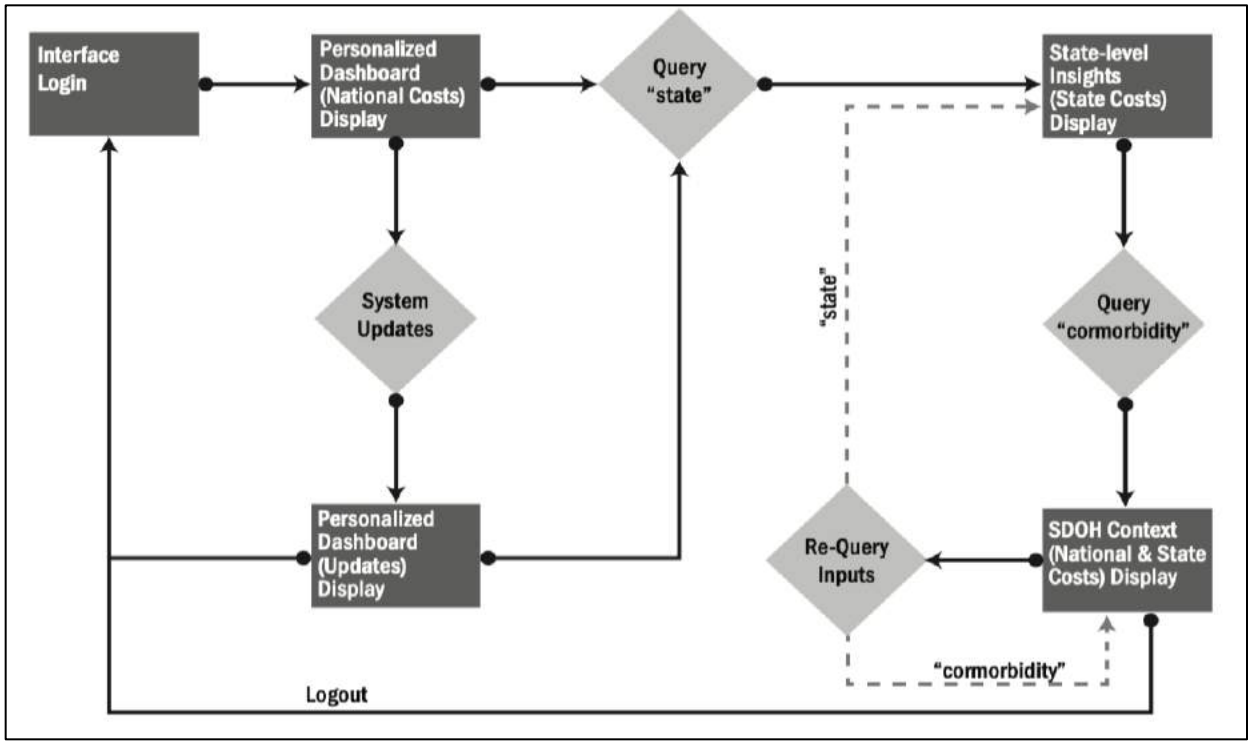




S23-04	***Title***: *NeuroDJ: Redefine How You Listen to Music* ***Team Members***: *Jaydeep Singh, Rohit Gupta, and William Milne* ***Adviser***: *Dr. Laleh Najafizadeh*
Keywords	Electroencephalogram, Brain-computer interface, Emotion-based music selection, Machine Learning
Abstract	An estimated 10% of the general population has alexithymia, which is a neuropsychological condition characterized by significant challenges in recognizing one's own emotions. Furthermore, research has shown that emotion matching music improves cognitive performance in adults and young children for both positive and negative emotions. Motivated by these issues, by utilizing brain computer interfaces (BCIs), signal processing and machine learning (ML), this project presents "NeuroDJ" , to redefine how we experience listening to the music. NeuroDJ will allow the users to control song choices based on their current emotional state, so that the music selection more accurately represents the user's mood. This will be accomplished by a ML algorithm, trained to recognize the emotional state of the user from his/her electroencephalogram (EEG). The model will then apply its prediction to a selection of music predefined by emotion using a second ML model that is trained on the Spotify audio features of the music in a user's playlist. These will be available to the user from the NeuroDJ GUI, developed from a flask application. We expect NeuroDJ will assist people who have difficulties expressing emotions, as well as will improve the cognitive performance and emotional states of general users.



S23-05	***Title***: Data Insights Application for Obesity ***Team Members***: *Harini Senthilkumar, Abdul Uddin, Sahej Bansal, Taqiya Ehsan* ***Adviser***: *Dr. Sasan Haghani (Rutgers), John Canevari (Novo Nordisk), Shabana Motlani (Novo Nordisk)*
Keywords	Healthcare Market Access, Software Development, Data Analytics, Data Visualization
Abstract	Comorbidity risk is an ever-present concern in patients with obesity, leading to chronic illnesses such as type II diabetes, hypertension, respiratory disease, cancer, stroke, etc. The comorbidity risks in patients with obesity are correlated with their physical, social and economic situation, and other underlying health issues. Novo Nordisk, a leading global pharmaceutical company, has built a machine learning model that analyzes the comorbidity risks and costs associated with obesity based on input information from a patient's clinical data, social determinants of health (SDoH), and other diagnosed health conditions. Our goal is to build a data insight application tool that provides a quantitative view into the comorbidity risks of patients and their cost associated with treatment based on state and national level costs. We are developing a working prototype of an end-user platform accessible from iOS devices, primarily iPads. The application tool will primarily be used by market access representatives at Novo Nordisk in their outreach to healthcare payer programs, such as state-funded insurance companies, employers, etc. to ensure equitable access to medical solutions for all patients with obesity, staying true to the pharmaceutical industry's market access standards. Ultimately, Novo Nordisk market access representatives will be able to visualize and filter national and state data, which will help guide them in having accurate conversations/discussions with data available to ensure patients are given an opportunity to treatment without cost barriers.



S23-06

***Title**: Pocket Chef*

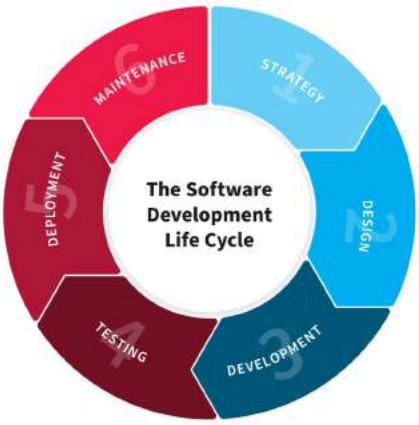
***Team Members**: Mohammad Awais Zubair, Akanksha Arun, Mihir Shah, Devan Patel*

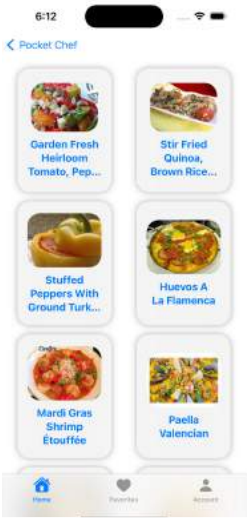
***Advisor**: Sasan Haghani*

Keywords Application, User Interface, User Experience, Accessibility, Recipe

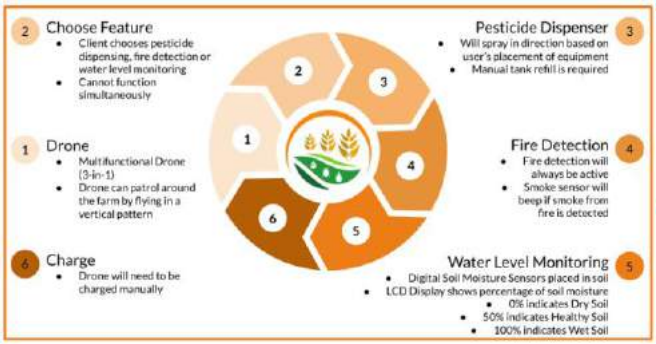
Abstract

Pocket Chef is a mobile application designed to address the growing problem of meal planning and cooking with limited ingredients. The app aims to make cooking accessible and user-friendly by allowing users to input a set of ingredients available on hand and generate a recipe that requires most of the ingredients. The primary function is to provide an easy-to-use recipe generator that produces healthy and delicious recipes based on the user's dietary preferences and restrictions. The app allows users to input specific ingredients that they have available, including those that are unique to a particular cuisine or craving. This feature makes the app a valuable tool for those who are struggling with meal planning and cooking, or for those who are seeking new and exciting recipes to try. The user-experience (UX) and user-interface (UI) are among the top feature priorities for Pocket Chef and relies heavily on user interaction, and thus prioritizing UX and UI ensures that users can quickly and easily input their ingredients, find recipes, and navigate through the app. To determine which cuisines to prioritize in Pocket Chef, we conducted user research and gathered information about our target audience's favorite cuisines and the cuisines they find most challenging to cook for. This allows us to create a database of recipes that caters to our users' preferences and needs. The app's easy-to-use interface, customized recipe generator, and incorporation of user preferences make it an ideal tool for anyone who wants to make meal planning and cooking more enjoyable.





S23-07	***Title**: Agriculture Maintenance & Crop Monitoring Drone* ***Team Members**: Justin Carew, Olivia Duong & Jason Rea* ***Adviser**: Maria Striki*
Keywords	Agriculture, wildfires, pest control, inadequate water management, drone
Abstract	Agriculture covers approximately 40% of the Earth's land surface and is an indispensable component of human survival. However, farmers are confronted with a myriad of challenges, including the menace of wildfires, suboptimal pest control, and insufficient water management. Wildfires threaten crops, resulting in substantial losses in revenue for farmers and food quality. Improper pest control can lead to excessive use of pesticides, which can inflict damage on crops and environment. Inadequate water management can cause a reduction in crop yields, wastewater, energy, and trigger pollution. Given the significance of agriculture, effective solutions to these challenges are critical to ensure the continued success of the industry. The objective of this project is to address the aforementioned challenges by developing a multifunctional three-in-one drone. The drone is capable of detecting fires, providing alerts aurally, dispensing precise amounts of pesticides, and monitoring soil moisture to regulate water levels. The drone is equipped with an MQ-2 smoke LPG Butane Hydrogen Gas sensor detector module to detect fires and is paired with a piezo buzzer module that simulates a smoke alarm. The drone features a 12V DC Dosing Pump (powered by a 9V battery) connected to a 2mm ID x 4mm pure silicone hose tube to dispense the appropriate amount of pesticide. The percentage of soil moisture levels is displayed using a soil moisture sensor along with an LCD display module. The smoke detection and soil moisture monitoring components are connected to Arduino UNOs and require code uploaded through the Arduino IDE software. The drone must be charged manually. By addressing these issues, the drone has the potential to enhance the efficiency and effectiveness of farming operations.



S23-08

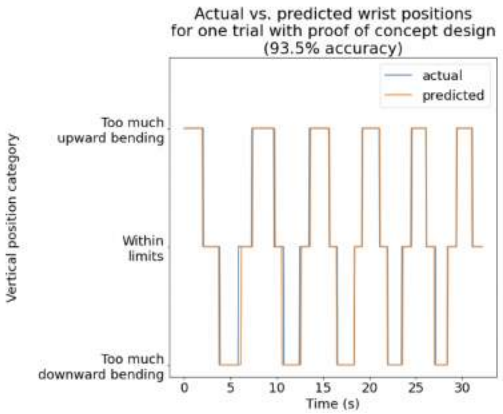
Title: *Twisty Wristy: Wrist Position Monitoring*

Team Members: *Dhvani Kakabalia, Shivangi Rohilla, Jonathan Ackerman, Ritika Rao, and Anisha Barde*

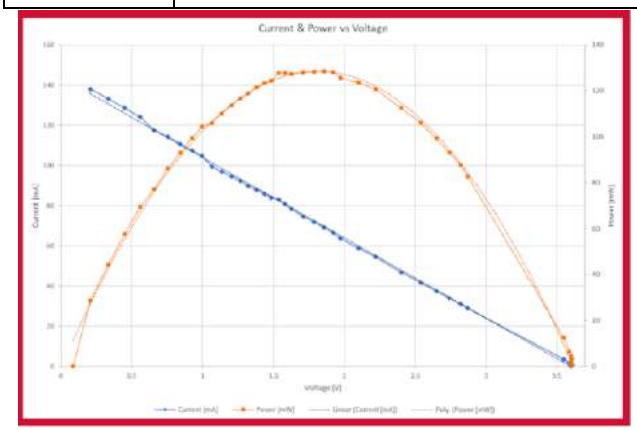
Adviser: *Professor Waheed U. Bajwa*

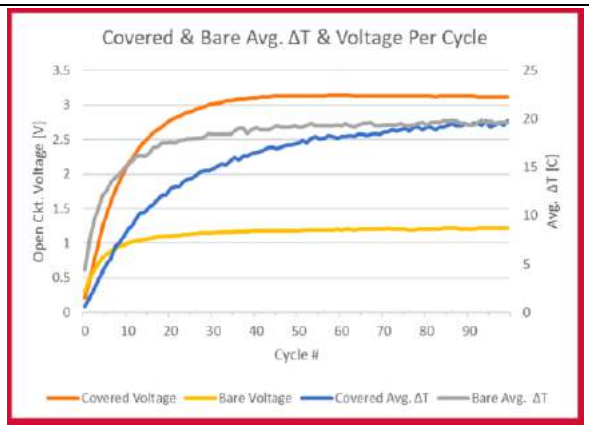
Keywords Arduino, flex sensors, machine learning, wearable technology, wrist health

Abstract Increased technology usage can correspond to an increase in wrist injuries, which is relevant to young people who use phones and laptops for prolonged periods of time. To prevent these injuries, our team is creating a wearable device to monitor a user's wrist position and detect potentially harmful positions that cause strain. When conducting research, a device made by Mack and Min from the University of St. Thomas, which detects positions leading to carpal tunnel syndrome, was the only similar idea we found. However, their approach only used one flex sensor per glove, with the goal of detecting vertical wrist bends of over 90 degrees. Our device is a glove with four flex sensors attached, letting us monitor wrist bending in all vertical and horizontal directions. Additionally, our research has yielded more specific and evidence-based safety thresholds for each bending direction. Our glove follows a non-intrusive design using flexible conductive thread and a small Arduino LilyPad board that aids in portability. After designing and constructing our glove, different group members performed different movements while wearing it, allowing us to build a model that takes in flex sensor data and determines whether the wearer has exceeded our chosen threshold angles. Furthermore, a user interface can display current position status and summary data regarding how often a user exceeds bending thresholds over time. This data visualization will allow users to understand the quality of their wrist positioning. Overall, we aim to create a user-friendly, non-invasive, and cost-effective system to promote wrist health.

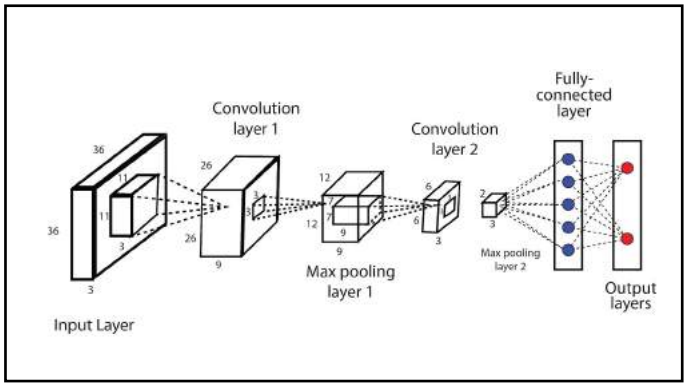


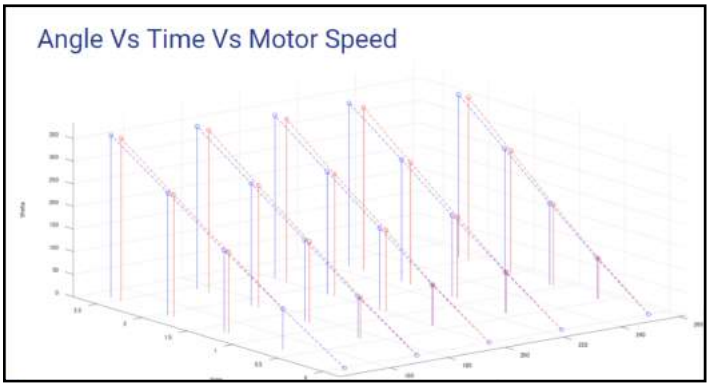
S23-09	***Title***: *Implementation of Thermoelectric Generators Within Mission-Critical Facilities* ***Team Members***: *Jonathan Golba, Ashwin Gokhale, Ashwin Anand* ***Adviser***: *Wade Trappe*, *Don Bachman*
Keywords	Thermoelectric Generator, Mission-Critical Facility, Thermoelectric Potential, Seebeck Effect, Heat-Electric Conversion
Abstract	The excessive heat accumulated by mission-critical facilities, such as server rooms and data centers, has the thermoelectric potential to support energy harvesting. The numerous implementations of heat dissipation methods within such facilities grant multiple opportunities to configure a system to take advantage of the resulting heat to produce electricity. By fitting thermoelectric generators (TEGs) between opposing cold (input) and hot (output) air currents present within such facilities, power can be generated. TEG modules use a phenomenon, called the Seebeck Effect, in which a buildup of electric potential results from a temperature gradient between different electrical conductors/semiconductors. As one side of the TEG module is heated, the other side is cooled, thus creating a temperature differential, and thereby producing power—the greater the difference in temperature between both sides, the greater the power output. TEGs can be used in reverse as thermoelectric coolers (TECs) using the Peltier Effect by applying a voltage that, in return, causes one side to become cold and the other hot. The implementation of such modules would be non-intrusive as they are "set-and-forget" solid-state devices and have no moving parts, thus making them maintenance-free. The large and continuous nature of mission-critical facilities, in conjunction with the ease of installation associated with TEGs, provide the opportunity for significant returns on investments associated with their installation. Produced electricity can be returned for use in multiple processes, such as charging a local battery bank, powering wired or wireless sensors, lighting, or other low-powered applications.

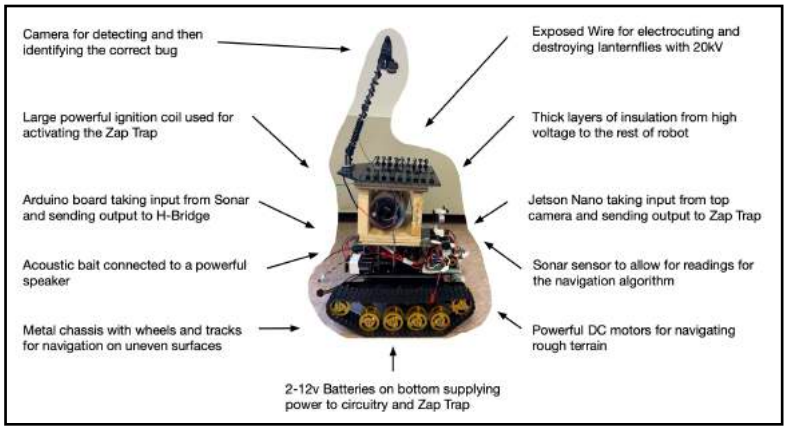


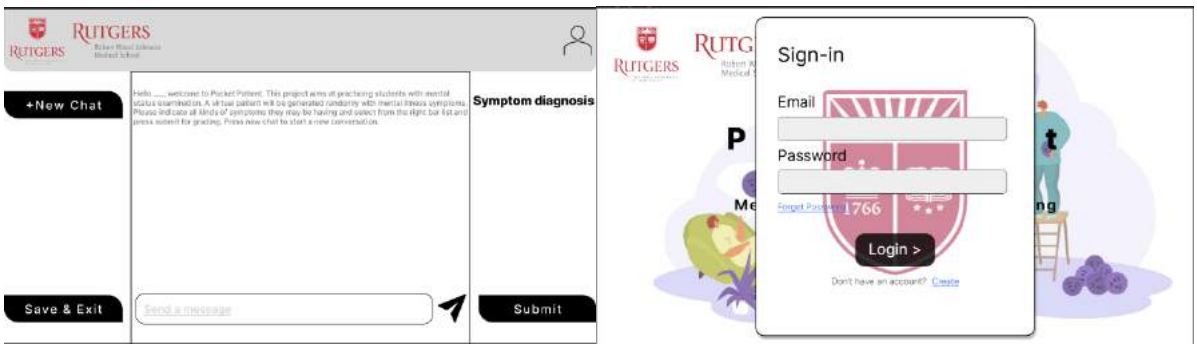


S23-10	***Title***: *LanternPredator* ***Team Members***: *David Banyamin, Wei Gou, Mark Rezk, Wictor Fedorowiat* ***Adviser***: *Professor Daniel Burbano*
Keywords	Autonomous Navigation, AI Classification, Sonar, Acoustic Stimulus, Zap Trap
Abstract	Lanternflies are an invasive pest species that can cause significant economic damage to agriculture by affecting plants and crops and disrupting the balance of natural ecosystems. These insects have a fast reproduction cycle, can withstand high-temperature variations, and have no natural predators in the US, making it very difficult to control their spread. Motivated by this environmental issue, we designed the LanternPredator, an autonomous pest control robot to help control the population growth of lanternflies. The proposed solution integrates machine learning algorithms for detecting the right insect species, an acoustic stimulus to attract the insects to a zap trap, and sonar for autonomous navigation.







S23-11	***Title**: Pocket Patient* ***Team Members**: Rui Zhang(POC), Zhihang Liu, Jihao Yang, Yuxi Yang, Mingkun Sun* ***Adviser**: Anthony Tobia, Hajar Shirley, Sasan Haghani, Chung-Tse Michael Wu*
Keywords	AI, Language Model, website
Abstract	The Pocket Patient is designed to be an interactive webpage accessible in the browser of mobile devices. This application mimics live patient communication and will help medical students identify and treat simulated patients with mental illness. With vertical integration, course directors are challenged with furnishing "bedside" experiences (episodic experiences) that integrate with large lecture and small group learning (semantic learning). To address this practice gap, our virtual patient will simulate live patient encounters through texts that include information about a diverse range of mental disorders. The Pocket Patient generates texts to communicate symptoms of singular or multiple mental disorders. Users can enter the treatment they propose by directly typing into the chat box. In response to users' input, subsequent texts may demonstrate "improvement" (if the response entered by users is correct). Alternatively, texts from the Pocket Patient may be of increasing complexity if the medical student's input is incorrect. The above steps are repeated until there is either successful resolution of the patient's episode or illness progression resulting in patient morbidity (the phone must then be synched thus allowing the student to access a module mimicking inpatient psychiatric hospitalization). To achieve this goal, a language model is necessary to make the conversation more natural and understandable. Conceptual figure of pocket patient: 

S23-12

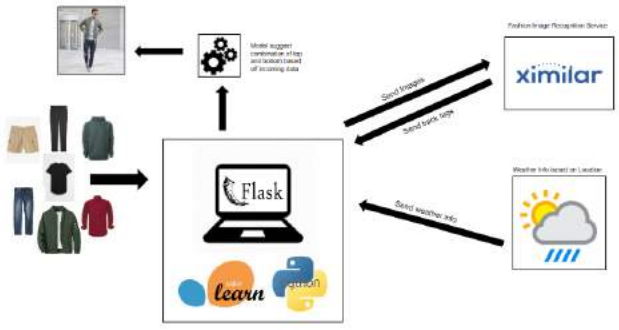
***Title**: Wardrobe Geek*

***Team Members**: Ashish Shenoy, Viraj Patel, Mervin James, Pavanganesh Kolisetty, Viraj Patel, Divyesh Nemam Baskaran*

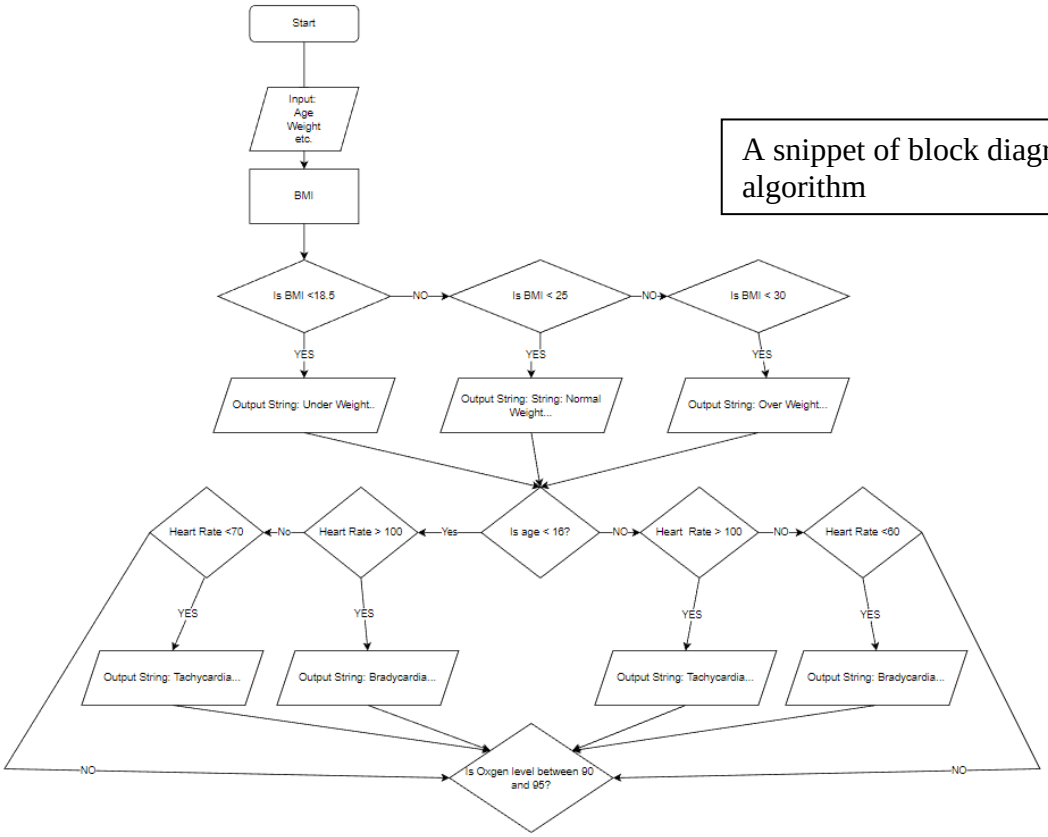
***Adviser**: Dr. Bo Yuan*

Keywords Machine Learning, Image Recognition, Software Engineering , Fashion Sense, Live Recommendations

Abstract Do you often find yourself spending too much time deciding what to wear, overwhelmed by the mountains of clothes in front of you, only to eventually pick the top t-shirt and pants in your closet? Our project solves this by providing outfit recommendations quickly and comprehensively. It takes the weather into account, so you'll always be dressed appropriately for the day's weather. At the heart of the project is a machine learning algorithm trained on an outfits dataset so that it can capture valid combinations and current fashion trends. The project uses image recognition software that generates feature tags to identify the clothes being passed in so it can provide a tailored recommendation to them. While we have the machine learning algorithm at work behind the scenes, we also have a simple and intuitive UI that the user can easily navigate through without any trouble. Along with the feature of recommending outfits, our project can act as a clothing catalog tool where the user will be able to see their entire wardrobe with a simple click. So, when it comes time for the user to request an outfit, our project will be able to take the current weather and the user's available clothing to generate a fashionable outfit combination almost instantly.



S23-13	***Title**: Health Monitoring Analysis* ***Team Members**: Joel Usita, Xinyi Sun, Yisai Wang* ***Adviser**: Hana Godrich*
Keywords	Health, Monitoring, Suggestions, Metrics, Red Flags
Abstract	Health metrics are very important numbers that people should know about within themselves. Knowing one's health metrics can help individuals make informed decisions about their lifestyle and health. However, not that many people know what their health metrics mean or even if they need medical attention by a health professional. To fix this problem we created a web application that lets you know what your health metrics mean to you and if there are any red flags to be considered. The metrics that are being inputted by the user are weight, height, blood pressure, oxygen level, sleep (in hours) and exercise (in hours). With these inputs, the web application will collect the data, insert it into our database, and give out a health report that will include your BMI and any health suggestions that are based off the data. The health suggestions will be given if there are any red flags from your data. For example, if your blood pressure is less than what it should be (less than 80 mmHg), then our final report should tell you that your blood pressure is too low and what you should do. The final report, however, is not here to replace a medical professional for advice but to steer you to one if any significant red flag occurs.



A snippet of block diagram for algorithm

S23-14

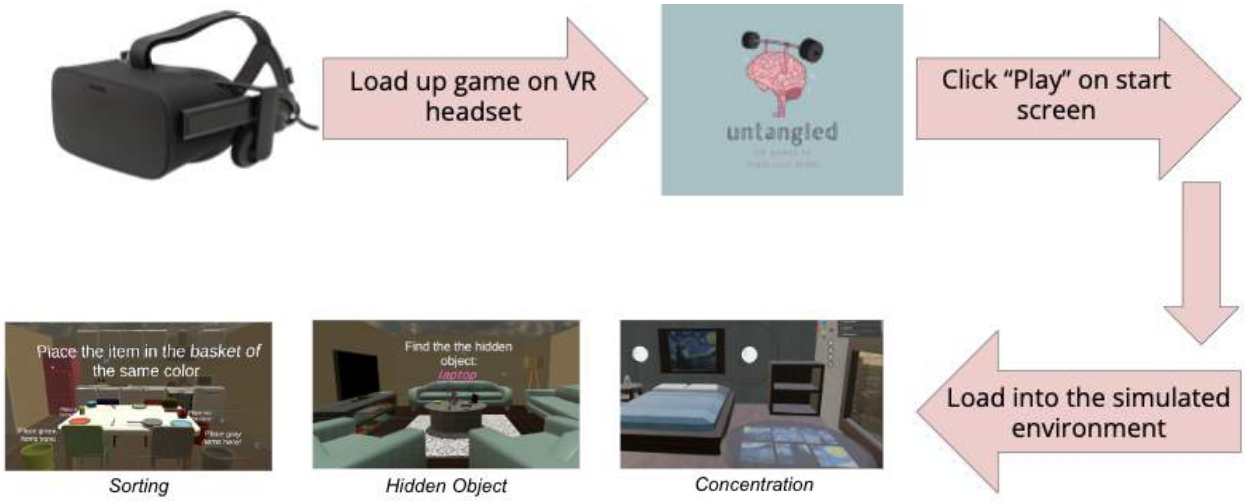
Title: *Virtual Reality Cognitive Training for Alzheimer's & Memory Impaired*

Team Members: *Shreya Suresh, Niharika Kompella, Shivam Patel, Matthew StaAna, Khushi Kadakia*

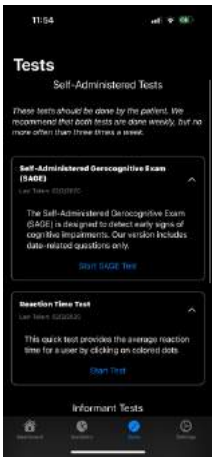
Advisor: *Yao Liu*

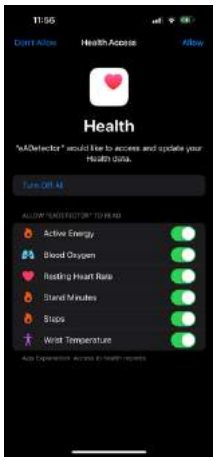
Keywords Alzheimer's Disease, Virtual Reality, Cognitive Training

Abstract This project aims to develop a virtual reality platform to help improve the cognitive functioning of patients with Alzheimer's disease and other forms of memory loss. Alzheimer's disease is the most common type of dementia, affecting an estimated 6.5 million Americans age 65 and older. The disease refers to the loss of memory, problem-solving, and other thinking abilities to the extent that it is severe enough to interfere with daily life. Our goal is to potentially help reduce disease development and ease the daily struggles caused due to memory loss in those who have already been diagnosed with Alzheimer's. Past research yields that brain games and exercises positively affect the quality of life and cognitive functioning of patients with Alzheimer's. Furthermore, research into virtual reality's ability to aid in enhancing the quality of life for those with Alzheimer's and other types of dementia has pointed towards the positive benefits the tool can have in improving the well-being of those who are at risk of developing or have been diagnosed with Alzheimer's. Therefore, this project will combine simple brain training games with the immersion capabilities of virtual reality to create a form of cognitive rehabilitation therapy. This project will focus on the following memory and reasoning games: Find the Hidden Object, Sorting, and Concentration. These three, combined with the VR headset that's used to play them, provide an immersive experience that can help people with Alzheimer's Disease and other forms of memory loss to mediate the symptoms of their illnesses.



SP23-15	***Title***: *eADetector* ***Team Members***: *Eshaan Mathur, Sidhu Arakkal, Eoin O'Hare, Allen Davis-Swing, John Yeh* ***Adviser***: *John Canevari*, *Sasan Haghani*
Keywords	Alzheimer's, Dementia, Mobile Application, Health Metrics, Data Analytics, Early Diagnosis
Abstract	Alzheimer's disease is a progressive neurologic disorder that results in the progressive loss of brain cells over time. Existing methods of diagnosing require extensive medical attention and are often unreliable. Our group is aiming to make an accessible way to identify the onset of Alzheimer's with a mobile application, eADetector. Using SwiftUI, we created an app to do just that. When signing up for the app, the user will go through a series of onboarding questions such as name and age. After the onboarding tests, the user will give eADetector access to their health data. We used Apple HealthKit to record the data from each user. The app will track certain metrics overtime: resting heart rate, step count, etc. A separate tab will also have "tests", or interactive activities to measure mental acumen. There are a variety of tests, including a reaction test and a memory test. The user will be expected to take these interactive activities either every day or every week. After the answers from the onboarding questions, the user's health data, and the results from the tests, the data will be compiled into an algorithm to determine the user's risk of early onset Alzheimer's. We used a machine learning algorithm to take in these data points, and in turn, output a value (0.0 – 2.0) that determines the user's risk. With our application, we hope to help patients detect the onset of Alzheimer's so they can take preventative measures to decrease their risk and live longer, healthier lives.





S23-16

Title: CogniCare

Team Members:, NIKHIL MHATRE , Ishika Mukerji , Jay Rajan

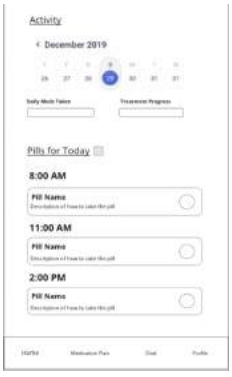
Adviser: John Cenevari, Sasan Haghani

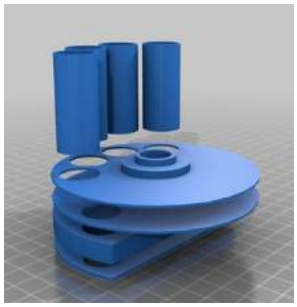
Keywords Medication Management, Pill dispenser, Mobile Application

Abstract Alzheimer's disease is a growing public health challenge that affects millions of people worldwide. Patients with Alzheimer's often have multiple comorbidities, including diabetes, cardiovascular disease, and Coronary Artery Disease. Comorbidities can complicate medication management and increase the risk of adverse events. In this study, we aim to develop a novel solution to improve medication management for Alzheimer's patients using a combination of machine learning and hardware design. Specifically, we will design a mobile application and hardware pill dispenser IOT device that can be used by patients or caregivers to manage medication schedules, track adherence, and dispense medication. Our approach will leverage machine learning to personalize medication regimens based on patient-specific factors, such as diagnosis, comorbidities and medication contraindications. The mobile application will communicate to the pill dispenser, to properly dispense the correct medication based of the generated medication plan. The app will be developed using react native, openAI's API, and firebase will be used as our database. This project has the potential to improve health outcomes for Alzheimer's patients, reduce the burden on caregivers, and ultimately improve the quality of life for those affected by this devastating disease.

Percentage of Medicare Beneficiaries Age 65 and Older with Alzheimer's or Other Dementias Who Have Specified Coexisting Conditions

Coexisting Condition	Percentage
Coronary artery disease	46
Chronic kidney disease	46
Diabetes	37
Congestive heart failure	34
Chronic obstructive pulmonary disease	20
Stroke	13
Cancer	10





S23-17

***Title**: Smart Pen*

***Team Members**: Geoffrey Kassis, Kiernan King, Robert Reid*

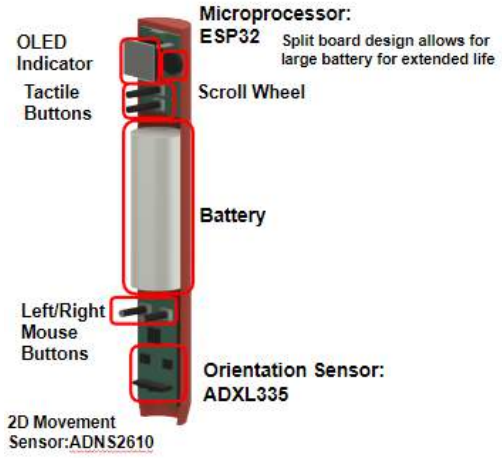
***Adviser**: Dr. Sheng Wei*

Keywords Low Energy, Machine Learning, Embedded Systems, Optical Character Recognition, Accessible

Abstract

In our time in the IT Service industry we have noticed that many users who are older, have disabilities, or are simply not as technologically inclined have not been utilizing their computer to its fullest potential or at max efficiency. That is why the heart of our project is accessible technology.

The Smart Pen is an alternative to the typical keyboard and mouse setup that consumers are offered today bundled into one hand held device. By harnessing machine learning algorithms we can dictate the user's handwriting in real time to machine readable text. Leveraging the comfortability and familiarity that the majority of users have with a standard pen or pencil we believe this can be a viable alternative to other device peripherals. Our team seeks to truly break the mold and provide consumers an out of the box alternative to the keyboard and mouse.



S23-18

***Title**: Virtual Projection Pool Trainer*

***Team Members**: Kevin Ge, Youssef Kaba, Rohan Narayan, Rishav Pradhan, Rishika Sakhuja*

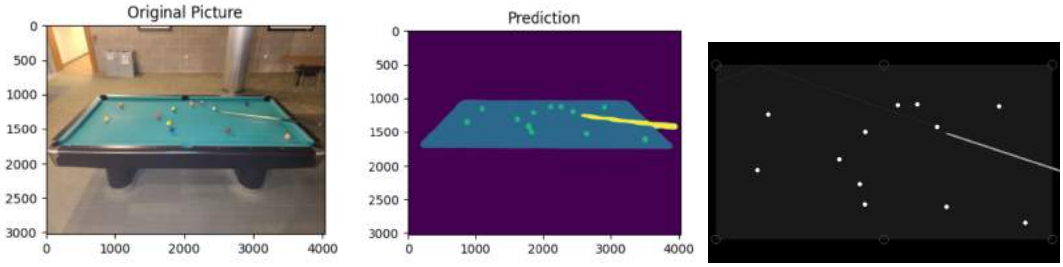
***Adviser**: Sasan Haghani & Demetrios Lambropoulos*

Keywords Computer Vision, Semantic Segmentation, Deep Learning, Homography, OpenCV, Linear Interpolation

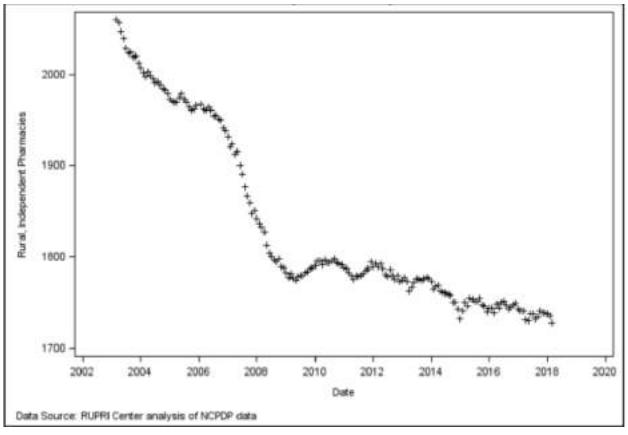
Abstract

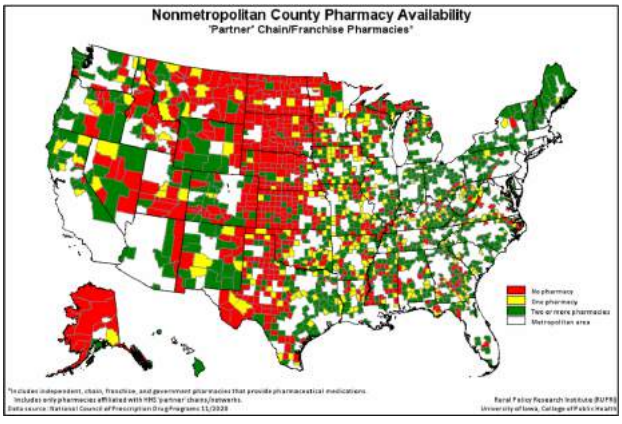
Pool has become a ubiquitous pastime activity for engaging with people around the world. The game has become more popular with the advent of mobile games that allow players to play pool virtually. Video game settings provide more aid to players by displaying ball trajectories, angle of cue stick, score keeping, etc. This project presents the idea of a pool trainer that will help players improve their skills on the physical pool table. The solution is a software application that uses a camera to capture the physical table, then converting the image into a virtual environment displaying all the elements, i.e.: balls, table, cue stick, pockets. This streamlined process involves a sequence of steps that take advantage of various computer vision techniques and linear algebra to accomplish the conversion of a real image to a virtual environment.

The main purpose of the pool trainer application is to serve as a visual aid to players so that they can improve their pool skills. However, the methods used in this context also serve as a proof of concept for commonly accessible neural networks such as ResNet18 to perform tasks applicable to real-world scenarios. Furthermore, the filtering techniques used in the conversion process are transferable to other computer vision problems. We expect that while this app has relatively innocent implications for pool, the computer vision techniques carry impact in a diverse range of fields, such as medicine and robotics.



S23-19	***Title**: Autonomous Medicine Delivery Drone* ***Team Members**: Ayleen Durasno, Andrew King, Bobby Putra, Kieran Burns, Sunit Pradhan* ***Adviser**: Bo Yuan*
Keywords	Drone, Autonomous flight, Rx, Application, Accessibility
Abstract	As the rate of independent pharmacies in rural areas continue to decline, millions of Americans are affected due to lack of accessibility. These individuals can be over 15 miles away from their nearest pharmacy and without access to a vehicle, obtaining medications can seem daunting or near impossible. Here comes in, Valkyrie, our autonomous medicine delivery drone system. Valkyrie allows these individuals to order their medications on an iOS application that connects to the nearest pharmacy, with ease. Once the application is connected to the pharmacy, the individual may view the medications, separated by category, and order as they deem appropriate. After the order is sent, the coordinates of the destination are sent to the drone's autopilot software, in which the flight begins. The user who placed the order will have access to live-tracking of their order once the pharmacist triggers the delivery. The drone will descend to the ground in which its door opens, allowing for the individual to take their medication. After the drone has delivered the order, the individual's phone will receive a notification, prompting them to verify that the order was completed. With Valkyrie, we aim to allow for these millions of Americans to feel reassured that their medications are not a near-impossible task, and they're able to still receive them, especially in the case that they don't own a vehicle. Valkyrie will revolutionize the world of prescription delivery, and has the capability to make a tangible difference in the lives of those who may not be able to obtain prescriptions.





S23-20	***Title****: The Cube* ***Team Members****: Ruojia Yang, Pengcheng Chen, Xikang Song, Alan Yu, Drini Gjoni* ***Adviser****: Anthony Tobia, Guosong Yang*
Keywords	Virtual reality, Teaching Platform, Personality Disorders, 3D Design
Abstract	The National Comorbidity Study (2003) estimates that approximately 9% of US adults aged 18 years and older have a personality disorder (PD). The American Psychiatric Association (APA) has recently proposed an alternative model of PDs where personality traits are organized around 5 domains (the 5-factor model of normative personality structure). The goal of this project is to develop an alternative platform to teach PDs along 3 of these domains: negative affectivity (cognitions), antagonism (dysregulation), and disinhibition (impulsivity). The Cube plots a personality order on several points on an xyz graph based on severity. The Cube aims for the user to visit those coordinates to diagnose a "character" who embodies a PD aligned with their point on the graph. By linking these characters to these PDs, one may gain a better understanding of what having these personality traits entail and how the model works. In the case that the user's heart rate gets too high as a result of interacting in virtual reality, there is a sensor which will lock out the user after sensing that the heart rate approached a maximum limit.

S23-21

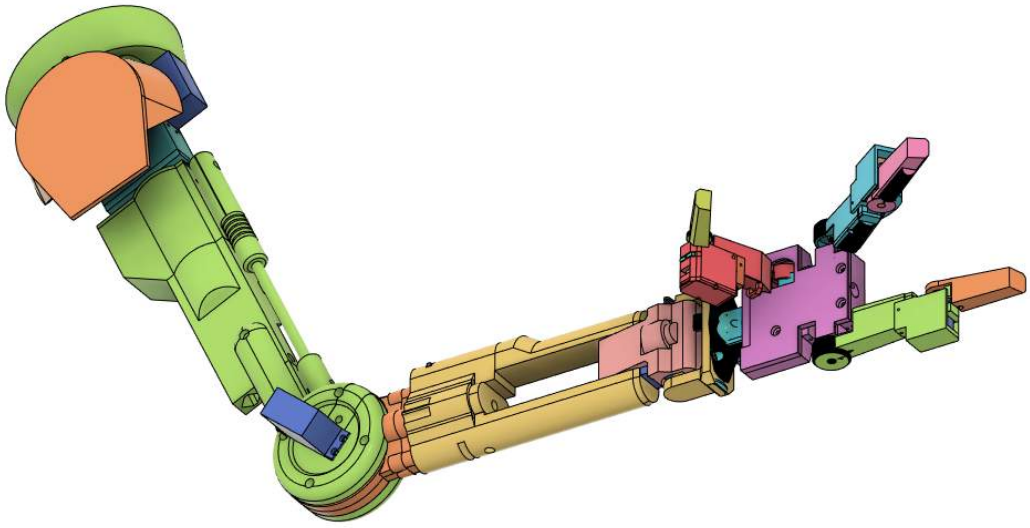
***Title**: Affordable Virtual Reality Robot Avatars (A-VRRA)*

***Team Members**: Steven Smith, Hamza Ali, Noah Merrits*

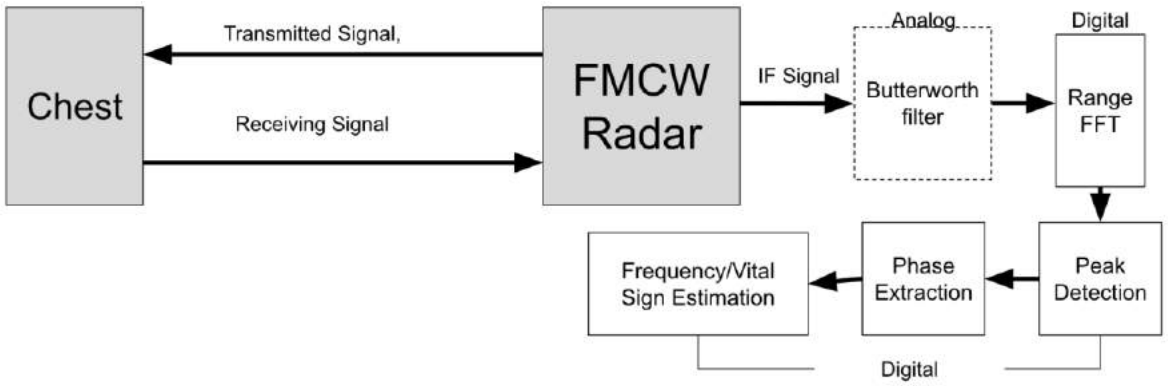
***Adviser**: John McGarvey*

Keywords Affordable - Virtual Reality Controlled - Robot Avatar - Robust Robot - Remote Human Interaction

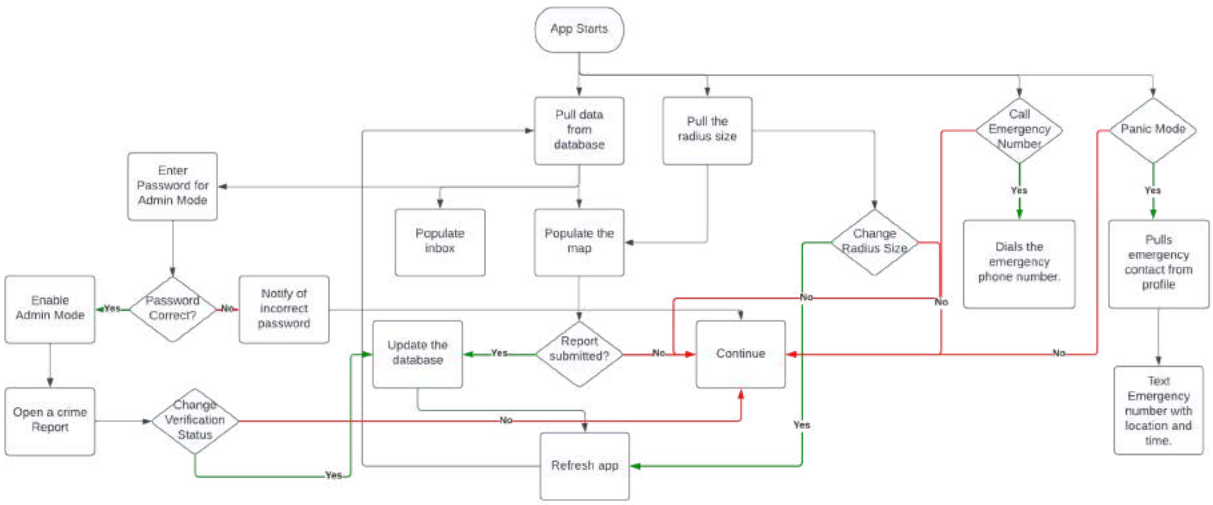
Abstract Currently there are no commercially viable options for VR controllable robot avatars as the only market is created by industry giants like Google or Toyota whose avatars cost more than most people make in a year. We propose a low-cost alternative to this, using 3D printed parts, inexpensive hobby servos, and some low-cost circuits. Our prototype we built is the Arm & Hand of a Star Wars B1-Battle Droid to show the capability and customization options with our approach. The cost incurred in our building of this arm is $177 for non-printed parts. Paired with the inexpensive but sturdy printing material the robot will be affordable to anyone with a 3D-printer. The printing material itself is PLA and using 3D modeling software anyone can modify a design for a differently shaped arm or improve the avatar to perform specific function. Using rapid prototyping and simulations we iterated through multiple designs of arm components which results in parts being able to withstand over 10kg of force (some more than 30kg). Our design features big servos in the arm and smaller servos in the hand, the electronics account for other things like the power requirements of the electronics. A user controls the arm using a Virtual Reality headset using the Unity Engine. The engine reads the inputs from the Virtual Reality equipment and communicates with the robot hand to reciprocate those movements with millisecond response time. Utilizing this system enables enhanced accessibility and safety for tasks such as intricate safety inspections and remote work, all while preserving the invaluable human touch contributed by the workforce.



S23-22	***Title:*** Monitoring Vital Signs via Radar System ***Team Members:*** Nicole Hipolito, Anushka Pathak, Gabriel Ybanez, Sana Noushad ***Adviser:*** Athina Petropulu
Keywords	FMCW radar, respiration rate, frequency, signal, Fourier transform
Abstract	Vital signs are an essential part in monitoring one's health condition during hospitalization. Vitals signs include body temperature, pulse rate, respiration rate, and blood pressure. These different measurements have the ability to indicate body status and/or prevent health issues. Vital signs are measured through a variety of different medical tools. However, radar is a system that can be an advantageous and simpler way to monitor these vital signs. Radar has the ability to use radio waves to find the distance and direction of two subjects. The radar being applied in this project, the Frequency Modulated Continuous Wave(FMCW) radar, was borrowed from another professor. In this project, we will apply the radar system in order to measure vital signs and provide alerts to signify abnormal vital signs. To be specific, our project will measure the respiratory rate of an individual. In accordance with Rutgers policy, an actuator that simulates a human chest was used as the test subject when measuring the breathing rate of an individual in order to obtain the frequency signal data. Then, this data will be processed and analyzed via MATLAB code along with mathematical concepts like FFT, peak estimation, wavelength, frequency, and sampling in order to ultimately calculate the breathing frequency rate. In addition, the project will also detect and notify the user of when there is an unusual change to one's vital signs through an alert. In essence, the FMCW radar system and chest simulator feed the data into the MATLAB algorithm to estimate respiration rate without any physical contact with the device, which would lead to promising applications in the medical field.



S23-23	***Title**: RUSafe* ***Team Members**: Nick Lluen, Adams Perez, Rohan Gorajia* ***Adviser**: Maria Striki*
Keywords	Public Safety, Crime, Mobile App, Map, Database
Abstract	Rutgers University is made up of five large campuses with a large population of students and staff and citizens that encompass the campuses. Crime is likely to occur and the safety of students, staff, and faculty can be at risk. Currently, the main method of informing students where crimes have occurred is Rutgers Crime Alerts, which are wordy texts and emails that students miss or gloss over and easily ignore. Our solution to this problem is RUSafe. This application will allow students, staff, and faculty to easily see where the crimes occur on a map and will help them avoid the more crime ridden areas. The map will have data points that show where crimes have occurred so people are able to take the active steps necessary to avoid those areas or plan their routes better. This map is going to be interactive so that people are able to click on the data points and see the statistics as well. The user will be able to report crimes that they have witnessed through the map as well. There will be an inbox where that keeps relevant information of the crime stored in one place for any user to access. Other features include an emergency screen that contains important phone numbers and customizable settings such as the radius adjuster. This is a significant upgrade to the current system and will allow users to be more informed about their surroundings and in turn traverse the Rutgers campus with more safety and security.



S23-24

***Title**: NeighboRent*

***Team Members**: Thomas Bargoud, Ariel Olovyannikov, Guramrit Singh*

***Adviser**: Gousong Yang, Sudarsun Kannan*

Keywords renting, sharing, users, community, items

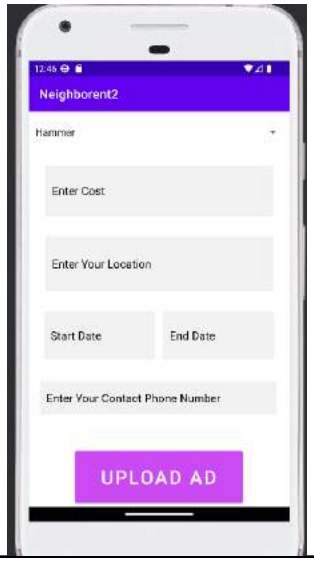
Abstract

In recent years, the sharing economy has gained significant traction, promoting sustainability, community engagement, and efficient resource utilization. This project introduces NeighboRent, an innovative Android application designed to enable users to rent everyday objects, such as tools, speakers, and various gadgets, within their local communities. By fostering a culture of sharing and minimizing the need for purchasing seldom-used items, NeighboRent aims to reduce consumerism, waste generation, and environmental impact.

NeighboRent utilizes a user-friendly interface, seamless navigation, and location-based services to facilitate efficient sharing of everyday objects. Users can browse available items, filter results based on preferences, and communicate with owners to coordinate rentals. The app incorporates a secure payment system, a rating and review mechanism, and a conflict resolution process, ensuring a trustworthy and reliable experience for all parties involved.

The project's primary goals are to promote environmental sustainability, strengthen community bonds, and encourage cost-effective practices among users. NeighboRent addresses the issue of underutilized resources, as users can monetize their idle possessions while providing affordable rental options to others. The app fosters social interactions and cultivates a sense of belonging among community members, leading to a more collaborative and resourceful neighborhood.

Future development plans for NeighboRent include expanding the range of available items, incorporating a multi-platform approach, and exploring potential partnerships with local businesses. By continually refining and adapting its features, NeighboRent aims to become an indispensable tool in the sharing economy landscape, contributing to a more sustainable and connected world.



S23-25

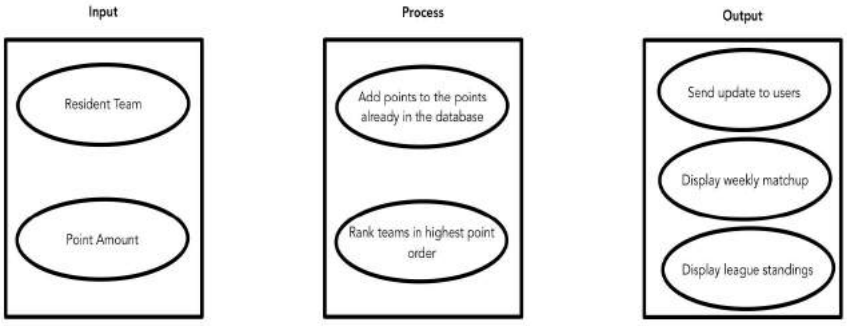
***Title**: T.H.E.S.E.U.S. 2.0*

***Team Members**: Heather Quinn, Vincent DeCaro, Evan Collins, Yair Conde, John Corcoran*

***Adviser**: Professor Yang and Dr. Anthony Tobia*

Keywords UI Redesign, Web Application, Industry Standard, iOS Compatible, Streamline

Abstract T.H.E.S.E.U.S. is an acronym for, 'teaching house staff to enhance student education using sports' and was developed as an interactive learning tool. The website is written in WordPress while some of the incorporated algorithms are achieved through code written in PHP. The origin comes from Rutgers University and Robert Wood Johnson Medical School and was intended for the residents and medical students. The goal of T.H.E.S.E.U.S. was to incentivize residents to teach the medical students about various topics found within the field on a daily basis. The program is modeled after a fantasy football system, in that residents will be awarded a respective amount of points as a reward for educating medical students on a wide range of topics. The residents are organized into teams which compete with each other for set terms. While T.H.E.S.E.U.S. has the foundation for a groundbreaking learning experience, the original execution has not been the most successful. Retaining users has been the primary issue which is due to the website based design, lackluster user experience and unappealing interface. The redesigned website will be fully automated to ensure a more user-friendly, accessible experience for the desired organization. The goal of the team is to completely overhaul the existing T.H.E.S.E.U.S. website in such a way that promotes users not only within Rutgers University and Robert Wood Johnson Medical school but globally.



S23-26	***Title***: *R U OK App* ***Team Members***: *Victoria Hong, Tara Saadati, Angelica Armstrong, Kamille Sabio* ***Adviser***: *Dr. Wade Trappe, Dr. Illene Rosen, and Sabrina Starkman*
Keywords	*mental health, medical, appointment, accessibility, software*
Abstract	Three in five college students struggle with mental and/or emotional health arising from the stress of their new independent lives and from the challenges of preparing for the real world. At Rutgers, there is a program, called CAPS, that focuses on offering Counseling, Alcohol and Other Drug Assistance Program & Psychiatric Services for free. Unfortunately, the program is not advertised well enough and as a result many students who need their services do not utilize the program. A mobile application that would support access to these services is greatly needed because it would conveniently advertise their services to students, thereby making students aware of CAPS and all they offer. While there is a website dedicated to CAPS, it needs to be updated. Therefore, the mobile application must go beyond implementing everything on the website to offer more information and more seamlessly integrate with how students live their lives. An ideal implementation of a mobile application will allow students to book appointments easier, allow access to resources to deal with stress, get notifications of upcoming CAPS events, speak with someone via a hotline, find a therapist nearby, and keep track of their mental health. Further, each student will be able to create their own profile dedicated toward their preferences and needs. Ultimately, the application will not only help advertise the CAPS program, causing more students to be aware of the help that is around but will also help students to better their mental health.

Fig. 1 R U OK App – Home Page

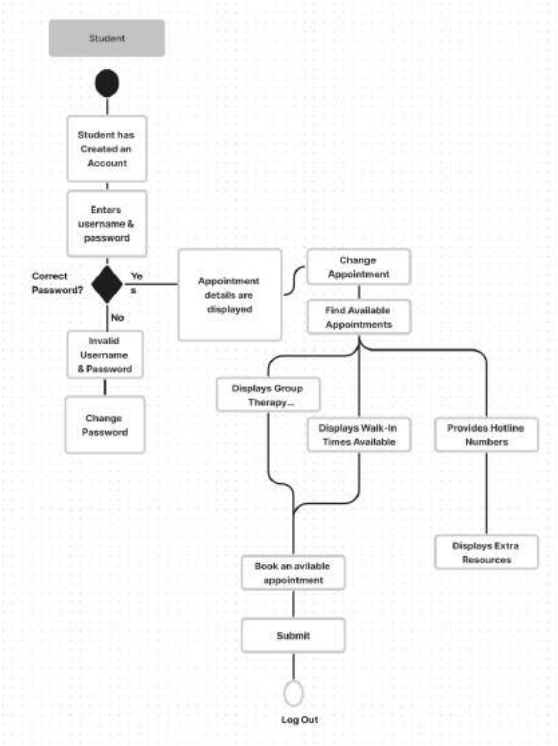
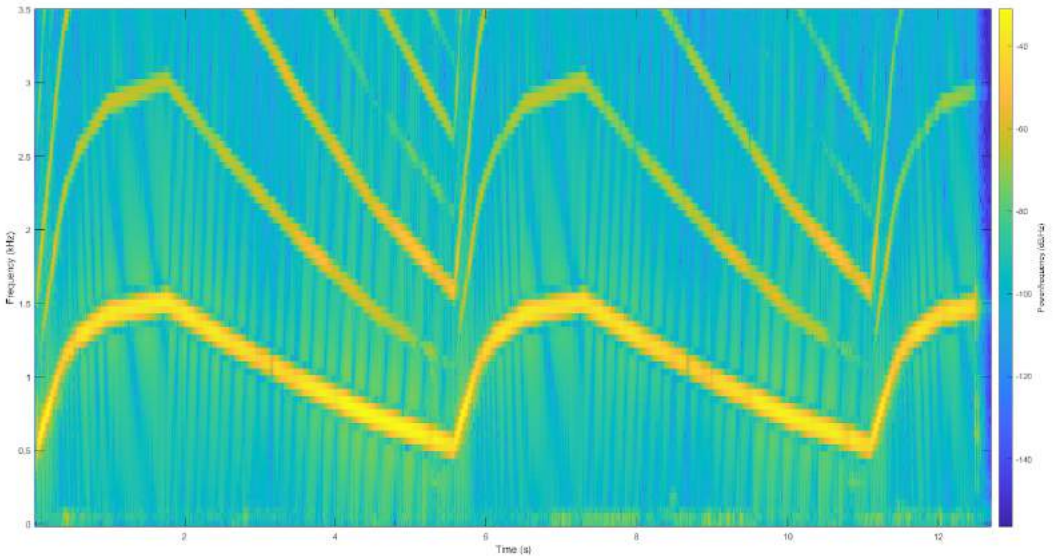
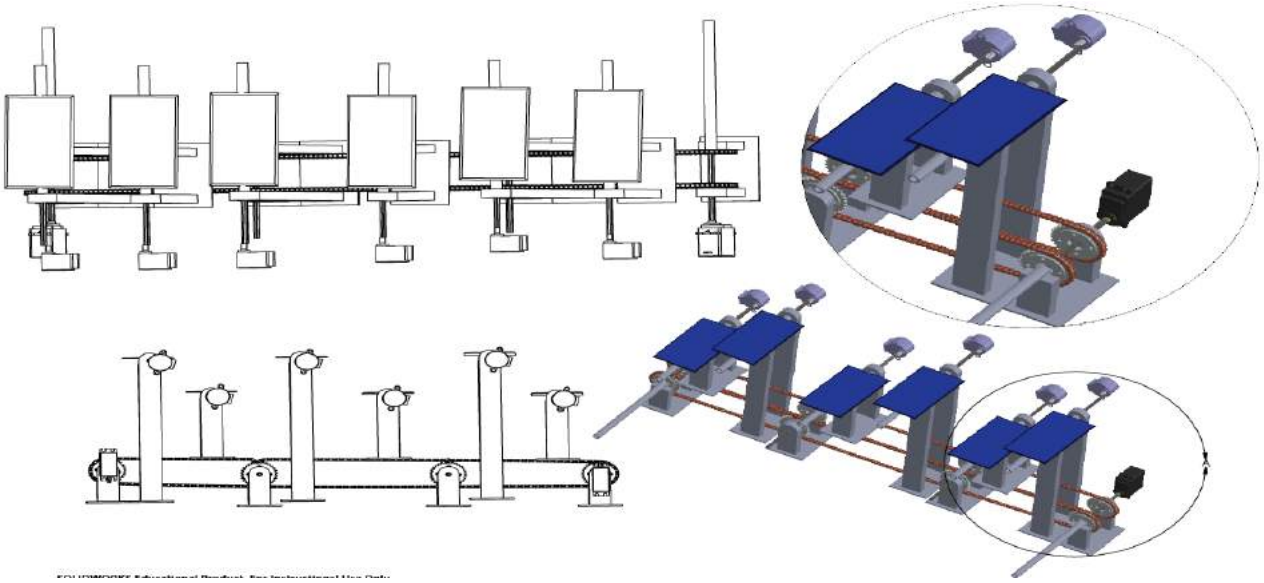


Fig. 2 R U OK App Activity Diagram

S23-27	***Title**: Emergent-See* ***Team Members**: Orion Kress-Sanfilippo, Thomas Ling, Jack Lowry, Rohan Rahalkar, Georgina Tamburro* ***Advisors**: Prof. Yuqian Zhang, Timothy Petersen*
Keywords	Digital Signal Processing, Audio Processing, Arduino, Analog Filters, Signal Identification
Abstract	Emergent-See was conceptualized as a method of ensuring a safer driving experience in the presence of emergency sirens and vehicles. Team 27 has focused on a transition from simple to complex with particular attention being paid to the analysis of the merits of each step. Emergent-See begins with a simple microphone input, the specific component having been judged on the characteristics of cost, amplifier gain, and size. The analog signal obtained from this microphone requires processing, for which we designed and implemented several possible solutions. From both theoretical and In-Lab frequency-domain analysis, we settled on a 4th Order Butterworth Low Pass Filter to prevent any higher-frequency audio noise from causing any interference, while still keeping the power draw and number of active components to a minimum. The crux of the project, however, lies in the algorithm we have developed to identify sirens with the microphone. Once again, we examined a number of ways to proceed in this regard, including Machine Learning, nested Fast Fourier Transforms, and Sequence Correlation. However, with the help of Prof. Zhang and Timothy Petersen, we developed a method that relies on taking a set of Short-Time Fourier Transforms (much as one would in creating a spectrogram). This provides us with the set of frequencies which are, at each discrete point in time, passed with the highest power. By finding the rate at which these peak frequencies change, we established identification criteria for a select set of sirens, and finally designed an LED system to alight when those criteria are met.  Fig 1: Siren spectrogram serving to create identification criteria

S23-28	***Title**: Solar Retractable Solar Tracking Panels* ***Team Members**: Zach Knightes, Kelly Adamski, Mhdey Alhayek, Andrew Potts, Alec Zheng* ***Advisor:** Prof. Caggiano*
Keywords	Photovoltaic, Renewable Energy, Solar Tracking, Power Efficiency
Abstract	One of the main complaints about solar tracking panels is the minimal improvement compared to a static solar panel system. This is because modern solar panel rows are being designed to be closer together. Since the solar tracking system prioritizes zero shading over having the perfect tilt angle, the overall efficiency is similar to a regular stationary solar panel. Our solution is to have retractable sections of the solar panel. These sections will slide underneath a fixed panel to create space between each row as the length of the shadows casted changes with their respective tilt angle. This could be accomplished by using an arduino uno, some stepper servo motors and measuring the estimated shadow casted on the panel behind it. The idea is to have a mock solar farm, in which we have two columns of panels, the first having fixed panels and the second having our retracting and solar tracking design. With the data collected, we have given a prediction of the additional amount of power our retractable design would produce compared to a stationary, fixed angle solar panel system. The potential impact of this project is significant because the transition to renewable energy could combat the surging climate crisis. Economic factors make it difficult for a full transition. An improvement of efficiency to single axis tracking panels could help with affordability. There is also potential for agrivoltaics with this design. The retracting motion leaves opportunities to grow plants that thrive in shade underneath the solar panel systems.



S23-29

Title: *Strawberry Disease Detection*

Team Members: *Matthew Milano, Anisha Jagdeep, Ankita Jagdeep, Vishal Patel, Timothy Pupalaikis*

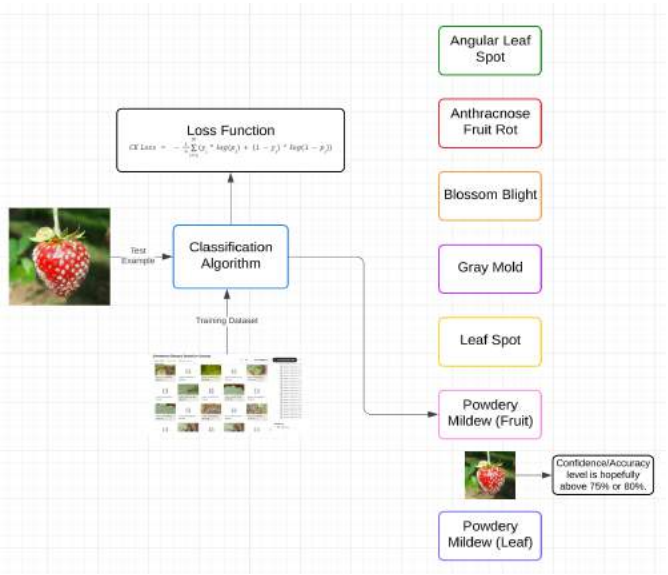
Adviser: *Dr. Bo Yuan*

Keywords

Computer Vision, Image Processing, Drones, Convolutional Neural Network, Agriculture

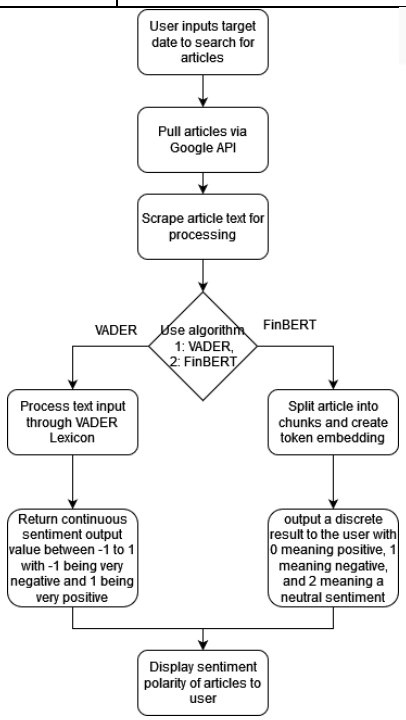
Abstract

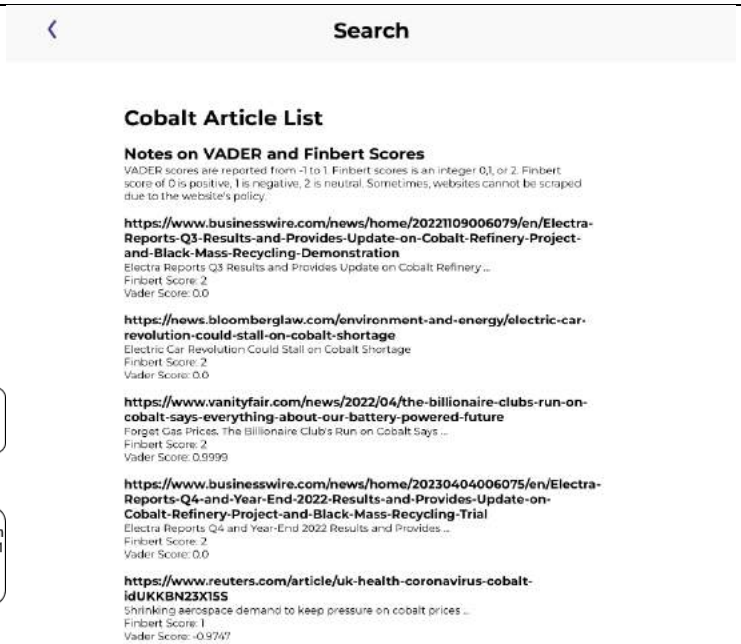
The goal of our project is to detect areas of ill health, disease, or infection in a farmer's field by using a drone as a monitoring device and applying computer vision and image processing technology. While strawberries have not been specifically the most profitable crop in New Jersey, the US strawberry market has consistently been commercially successful. In 2021, strawberries were considered the most valuable crop, and according to the American Society for Horticultural Science, the US produces almost 20% of the world crop and leads the world in production per unit area. Furthermore, as we researched, we found that the diseases that infect strawberries were the simplest to observe in a farm. While the complexity of detecting these diseases with a classification algorithm can still pose a challenge, sufficient and quality strawberry images will allow the algorithm to "understand" and classify with greater accuracy. The drone will survey the field and collect images and/or videos of certain areas of the field. These images or videos will be fed into our object detection model which will be able to detect various strawberry diseases that may be present. Once this stage is successfully completed, the drone will return to its base of operation and upload its captures to a YoloV7 object detection model. The end result is the object detection algorithm computing various probabilities and bounding boxes of potential diseases it may have detected. More specifically, a farmer can make an executive decision to inspect the infected quadrant and remove the potentially unhealthy strawberries, as some plant diseases can spread to healthy strawberries that are surrounding the unhealthy ones and potentially affect the net yield of healthy strawberries. Greater efficiency and convenience in strawberry farming is the desired outcome.



Ryze Tech Tello Mini Drone

S23-30	***Title***: *J.E.D.I – Join, Educate, Discover, Invest* ***Team Members***: *Anis Chihoub, Stanley Chou, Noam Hirschorn, Irfan Peer, Dharma Wijesinghe* ***Adviser***: *Shirin Jalali*
Keywords	Commodities, Regression, Natural Language Processing, Machine Learning
Abstract	To evaluate the potential of a stock in the future, it is vital to understand its history. While there are many applications that provide insight into financial markets, there is no one tool which can capture all facets of a stock. This can make it hard for retail investors to make smart and informed decisions. J.E.D.I seeks to change this paradigm. In addition to displaying a basic graph of a given stock's history, J.E.D.I fetches the text of news articles and uses the VADER lexicon and FinBERT to approximate expert's opinions on matters. This combination allows investors to reach conclusions based on both raw data and the opinions of knowledgeable pundits. Moreover, J.E.D.I. also provides a component to demonstrate a commodity stock's potential exposure. It uses an ARIMA machine learning model to predict how stocks may perform under certain conditions, which will help investors lower the variance in their portfolio. This will help users to limit their exposure, which is nearly as important as predicting performance. Additionally, this is a task which is often particularly difficult for retail investors, as there are no easy and publicly available tools to help balance exposure to different events. Finally, J.E.D.I then packages these useful metrics using Flask and React frameworks to produce a streamlined user interface.





S23-31

***Title**: ErgoAlert*

***Team Members**: Justin Tong, Kenny Sun, Andrew Xie*

***Adviser**: Prof. Maria Striki*

Keywords productivity, utility, health, wellness, windows

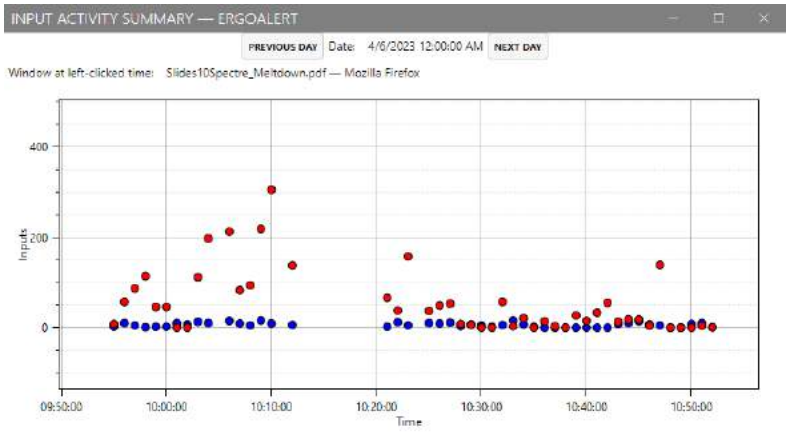
Abstract

Sitting down for long periods of time is a hidden pandemic, which can greatly hurt one's health. ErgoAlert is an app for Windows to address this issue. It can minimize to the system tray, so the user can use their computer normally, while it runs in the background.

ErgoAlert has the following features:

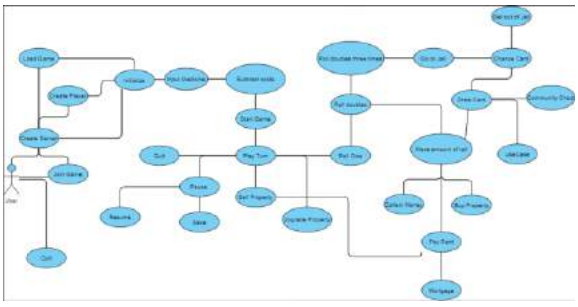
- Track the user's window activity, so they see how long they use certain programs for throughout the day (like an app summary page)
- Track the user's keyboard/mouse activity, and the user may view a graph over each day to see any patterns in their behavior
- Monitor control panel, to quickly adjust an external monitor brightness/contrast
- Notifications (on a Windows-native level), to remind themselves of any tasks (e.g. to drink water)
- Achievements to motivate the user
- Parental controls, so parents may block certain programs from running

ErgoAlert is written in C#, using WPF and various NuGet packages (notably Entity Framework + SQLite, OxyPlot for generating graphs, and SharpHook as a wrapper for WinAPI).



S23-32	***Title***: *MEDOPOLY – Medicinal Monopoly* ***Team Members***: *Christopher Elezi, Griffin Dabritz, Quan Nguyen, Jayanth Sivakumar* ***Adviser***: *Dr. Anthony Tobia*
Keywords	App Development, Software Engineering, Game Development, Monopoly, Medicine Prices
Abstract	The rising cost of prescription drugs in America has become a serious concern for patients, healthcare providers, and policymakers alike. Efforts have been made to try and control prices, but Americans continue to struggle with these high costs and lead them to difficult choices between necessary prescriptions or paying for other basic needs. This issue is something that goes under the radar but is now extremely relevant for residents and students, as they are soon to be on the front lines of patient care and will need to navigate under the landscape of drug pricing. Understanding the factors that contribute to high drug prices and the tools available to mitigate these costs must now be an essential part in their teaching, and what better way than Medopoly. The in-person workshop has now been turned into a software application to help engrain medicinal prices into the minds of Americas current and future healthcare workers. The game is a fun and interactive way for residency students to learn the effects of a medicines cost on a patient through subtracting their total medicine costs from their initial Monopoly money sum, affecting the way that the players will play the game to win in the long run. Decisions made on what medicines these players will use will be the deciding factor for how they decide to spend their money in the best way to support themselves, similar to the real-world issue of medicine prices on patients worldwide.

Antidepressants	Strength	Average Wholesale Price per Pill	30-day Supply Average Retail Price
Amitriptyline	25mg	$0.63	$31.43 (30 pills)
Amoxapine	50mg	$1.29	$42.13 (30 pills)
Bupropion SR	150mg	$1.94	$38.04 (30 pills)
Citalopram	20mg	$2.28	$17.91 (30 pills)
Desipramine	25mg	$2.00	$114.52 (90 pills)
Desvenlafaxine ER	50mg	$11.47	$215.40 (30 pills)
Doxepin	10mg	$0.62	$18.08 (30 pills)
Duloxetine	60mg	$7.85	$130.32 (30 pills)
Escitalopram	10mg	$4.72	$57.22 (30 pills)
Esketamine	n/a	n/a	n/a
Fluoxetine	20mg	$2.51	$26.52 (30 pills)
Imipramine	50mg	$1.22	$82.62 (90 pills)
Ketamine	n/a	n/a	n/a
Levomilnacipran ER	20mg	$19.10	n/a
Maprotiline	25mg	$1.15	n/a
Mirtazapine	15mg	$2.72	$34.64 (30 pills)
Nefazodone	100mg	$4.80	$179.73 (60 pills)
Nortriptyline	10mg	$0.73	$13.30 (30 pills)
Paroxetine	20mg	$2.73	$25.13 (30 pills)
Protriptyline	10mg	$5.73	$147.47 (30 pills)



S23-33

Title: *Real Time Autonomous Drone Navigation using LiDAR*

Team Members: *Parth Malhotra, Prayag Patel, Eric Xu, Roya Abdulrazeq, Maliha Yeasmin*

Advisor(s): *Dr. Dario Pompili, Khizar Anjum*

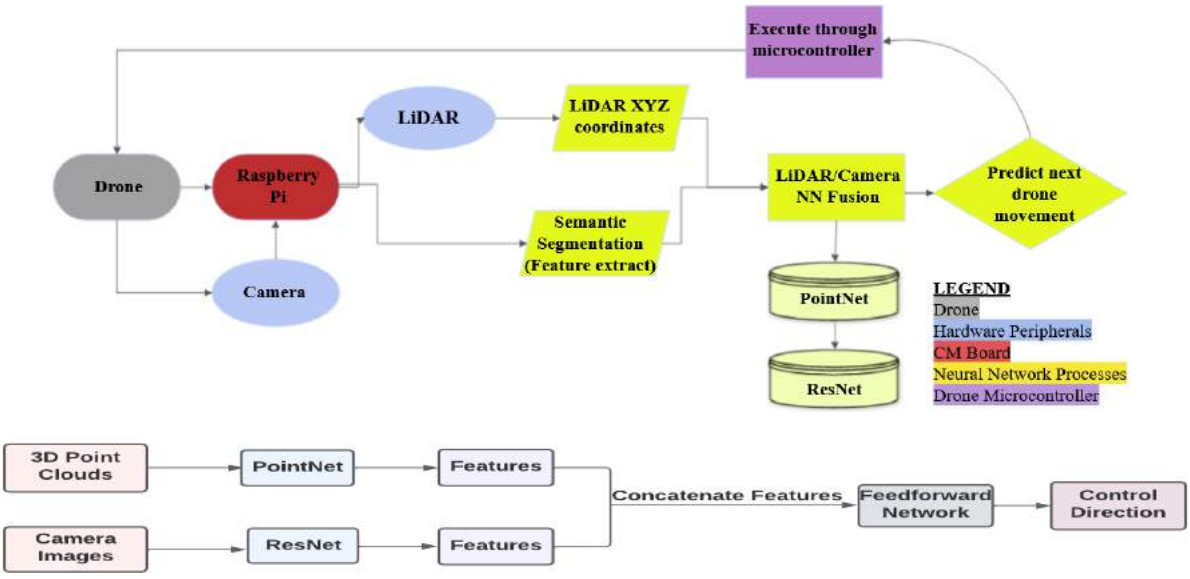
Keywords

LiDAR, Autonomous Drone Navigation, Obstacle Avoidance, Semantic Segmentation, Neural Network

Abstract

Our project aims to tackle the problem of autonomous drone navigation without the use of GPS. Drones typically rely on satellite navigation to know where they are going; however, in cases where GPS may not be available, our drone would be able to rely on LiDAR and camera to safely navigate to its destination. We use AirSim to simulate 3D environments and collect LiDAR and camera data to train/test our Neural Network. We then validate our simulated results with real-life drone experiments to measure how well our drone can navigate against these simulated results.

Our drone has a built-in camera which can capture 2D pixel high-resolution images and color information, which can help in object recognition information and provides more context of the environment the drone is navigating through, allowing us to extract features through camera frames, to highlight objects to avoid. However, cameras cannot provide 3D information unless we use a stereo system camera. We have also attached a LiDAR sensor to the drone that will be used to scan an accurate 3D representation of objects and gather depth information and structural features of obstacles. However, LiDAR does not provide any information about the appearance of objects which can make recognition more difficult. We will combine the LiDAR and camera to identify obstacles and features around it using semantic segmentation through neural network and LiDAR data. The point cloud data and the image data are independently processed by a PointNet architecture and a ResNet model respectively. The resulting features are then concatenated and fed into a feedforward network that outputs control direction.



S23-34 **Title**: *Household AI*

Team Members: *Raul Guerrero-Mendoza, Alexander Lin, Kevin Liu, Vinicio Morera, Anuj Venkatesan*

Adviser: *Yuqian Zhang*

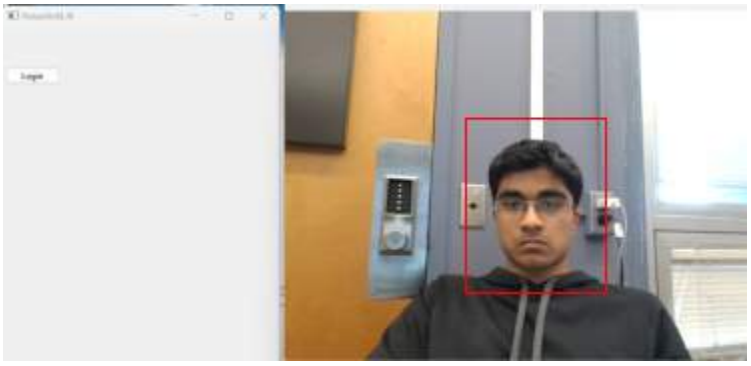
Keywords Smart home control, Gesture control, Facial recognition security, Convenience

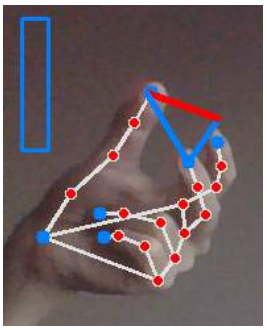
Abstract

Household AI is a system that provides smart home control. The system uses facial and gesture recognition via computer vision and machine learning to provide an alternative to existing solutions that is both simple and intuitive. Our software utilizes various Python libraries such as OpenCV and MediaPipe, which offer us tools to detect objects from images and video feeds.

An advantage that AI gives us is security within our homes. Our system detects and recognizes people entering and exiting a home, while acting as a way of logging into the system. The user is prompted to take a picture through the camera. This picture is compared to those stored in the database using face encodings in order to verify if the person is authorized to access the system.

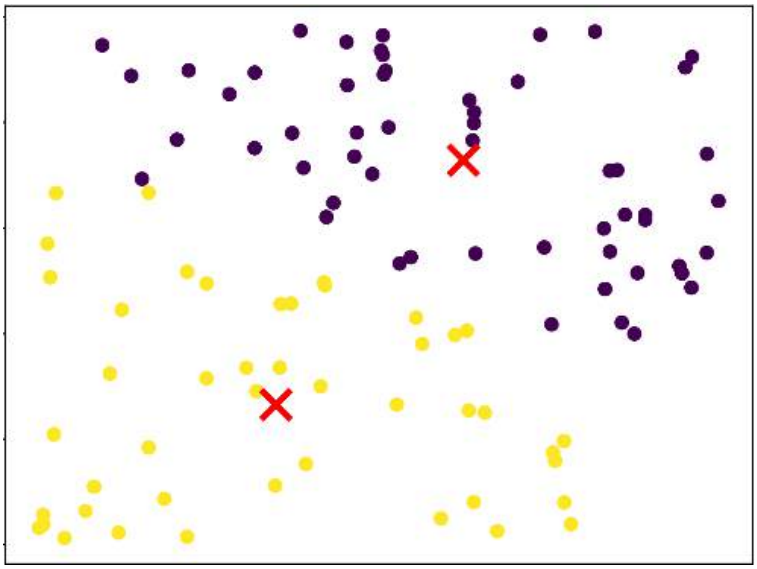
To implement gesture control, our system utilizes MediaPipe to detect hands in a camera feed and custom software that implements the gestures. Each gesture is given an ID and stored into a database. This database also stores connected devices and an action on that device, each given a unique ID. Gestures are detected based on a threshold; the gesture is tracked while the threshold is satisfied and stops once unsatisfied. These thresholds differ based on the gesture, but all rely on data from a class that processes the orientation, handedness, and landmarks of a detected hand. When a gesture is recognized, it references the database to obtain all devices registered to it and executes the related action.



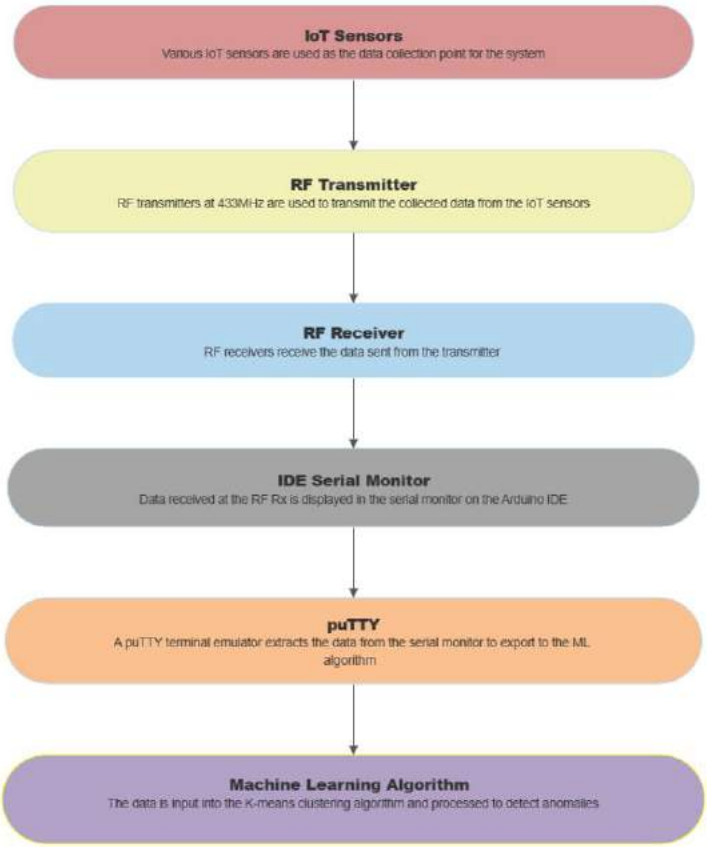


S23-35	***Title****: IoT Intrusion Detection System* ***Team Members****: Christian Kushnir, David Boisvert, Hector Saavedra, Imad Khaleel* ***Adviser****: Dr. Sasan Haghani*
Keywords	IoT, Machine Learning, Anomaly Detection, Intrusion Detection
Abstract	Simple IoT devices combined with machine learning can provide extremely useful knowledge with simplistic data. One of the many uses for IoT devices is security or intrusion detection. Using this model, we can develop intrusion detection systems that can provide immense information with simple yet quality data. The main issue with commercial intrusion devices is that they continue to be expensive and simply rely on one method of intrusion detection. Our goal for this project is to create a home security network that would use simple IoT sensors and machine learning to enhance security cost effectively. This system would detect anomalies in behavior and flag them. This design also allows for flagging absences, rather than just what is viewed through a camera. The project involves developing three main parts - sensors for data collection, a backend for classification using a semi-supervised forest of trees classifier model and an unsupervised k-means clustering algorithm, and a frontend website application to alert anomalous behavior, with data collection and precision guided by performance and fairness metrics such as sample sizes and selection categories. The project involves developing machine learning models using open-source libraries to handle heavy computations, using a range of IoT sensors to improve the performance of the home security system, and testing the design through several phases to achieve high accuracy in recognizing and categorizing anomalies, with a constraint on budget and availability of open-source machine learning information. For example, if a child didn't return home from their walk from school, that would be flagged by the system and reported because it is an anomaly in their everyday behavior.

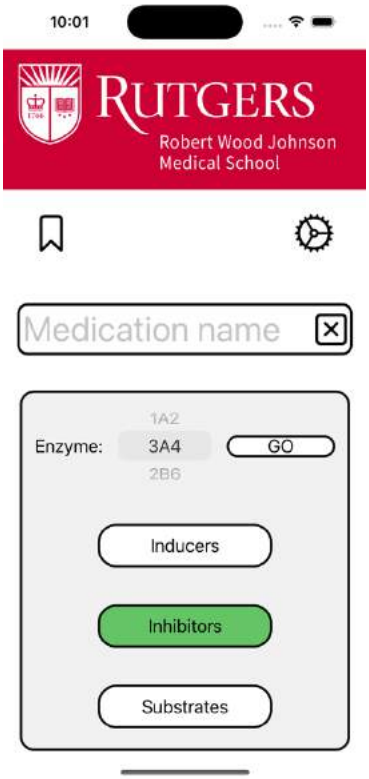
*Early iteration of unsupervised density-based method to identify anomalies (yellow).



*Flow Chart of our system



S23-36	***Title**: Medication Interaction Online Tutorial: Acronyms to improve User Retention (Mobile Edition)* ***Team Members**: Haochen Ji, Jingyi Wang, Yi Tang, Xinyuan Shao, Yinuo Cao* ***Adviser**: Dr. Anthony Tobia & Dr. Guosong Yang*
Keywords	Medication Interaction; Tutorial; Application; Medical; Training
Abstract	Using acronyms to help doctors remember medication interactions can be an effective way to prevent prescribing errors and improve patient safety. By creating mnemonic devices that use acronyms to represent the interactions between different medications, doctors can quickly and easily recall important information at the point of care. This can be especially useful for complex or high-risk medication regimens, where the potential for adverse interactions is greater. Using images that represents the words used in acronyms can help doctors to remember those words deeper. The most frequently used portable device for people is the mobile phone. By making an application that can make phones as mnemonic devices it can help doctors to access them easily and frequently. Doctors will be able to access that acronym on their mobile devices without any constrains.



S23-37

***Title**: Stock Trading Bot*

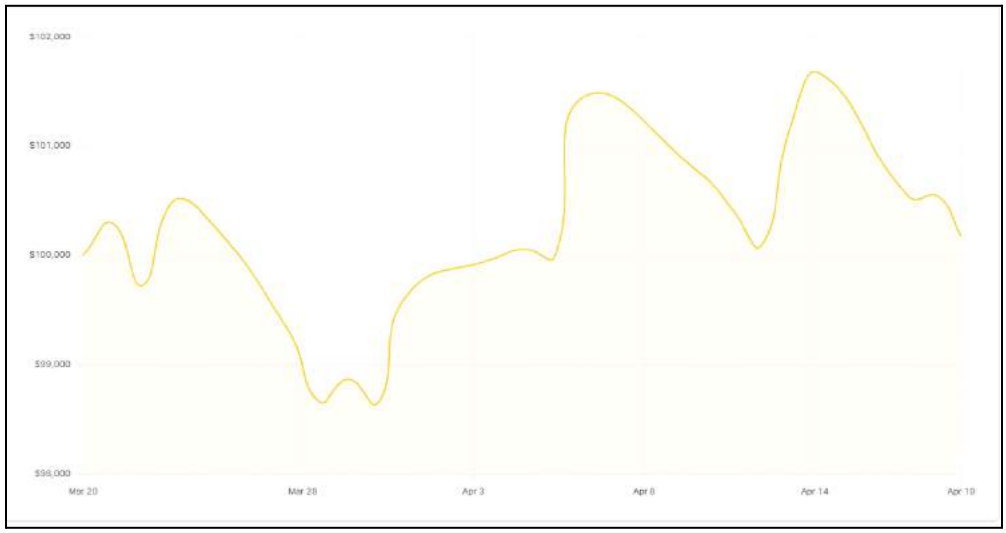
***Team Members**: Adideb Nag, Beaman Negash, Joseph Barr, David Valverde, Avery Turnbull*

***Adviser**: Narayan Mandayam*

Keywords stock, trading, bot, automated, budget

Abstract

The Stock Trading Bot (STB) is an algorithm controlled bot that implements industry standards to maximize profits. STB will purchase stocks based on users' interests and automatically sell these stocks when they reach a certain percent profit. STB will be using multiple indicators to decide when to buy and sell. These indicators are based on the shapes and behavior of the stocks. These shapes have been observed to follow predictable behaviour afterwards, giving odds for our bot to become more profitable. STB will let users establish a predefined stop loss and have an exact quantitative measure of the risk being taken in a particular trade. There will also be some other counter measures to ensure that in the case of too much loss, the bot limits its trading. All of these features are in place for one main goal. We wanted to make sure that the problems that come along with human investing are inhibited as much as possible. These include lack of knowledge, treating the stock market like a casino, being impatient, and being emotional. However, with a machine that can make logical decisions and follow patters, it has provided promising results:



Our next steps are to tinker with the algorithm to trade more cautiously and perhaps invest with a more diverse portfolio.

S23-38

***Title**: RU HOME*

***Team Members**: Alexander Rijo Cedano, Akshat Patel, Kevin Su, James Lee, John Crespo*

***Adviser**: Bo Yuan*

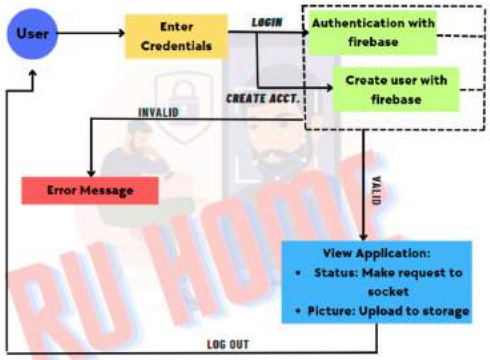
Keywords *IoT, Computer Vision, Raspberry Pi, Python, Flask Server*

Abstract

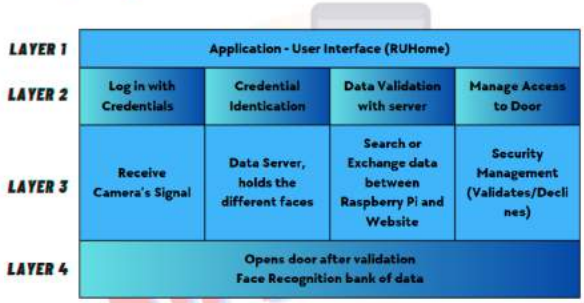
Security is more important now than ever. Physical security and Digital security go hand and hand. Data is one of the most important assets of a company. Companies spend millions on security (show data). In today's digital age, data is a valuable asset that must be protected from threats such as hacking, and other cyber attacks. Our proposed security system, "RU Home" will use a facial recognition authentication system, to secure the facility. Multi-factor authentication is a security process in which a user is prompted for multiple factors, to verify their identity.

In our solution we will have both a mobile/web app as well as a physical device. On the application side users will be able to create an account which will be kept track of using the Firebase service. Once users have logged in, they have the option of viewing the status of the lock and also uploading images of authorized users. Whenever a user logs in a message is emitted to the physical device via Websocket which will finetune the facial recognition model with the images saved under that users account. Additionally, whenever users upload new images the training sequence will be triggered. After the initial training sequence is completed the device will continually look for faces. Users who are not in the system will be labeled as "Unknown". Once the device detects an "authorized" user it will open the lock, wait for 5 seconds and then re-lock once it detects that the door is closed again.

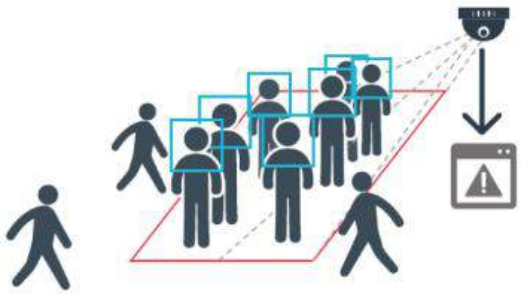
User Workflow Diagram



Software Layer Diagram



SP23-39	***Title***: *Real-Time Overcrowding Detection and Prediction with Aerial Robots* ***Team Members***: *Erik Jagnandan (POC), Tahmeed Chowdhury, Sreeram Mandava, Preston Stecklein* ***Adviser***: *Dr. Dario Pompili*
Keywords	Computer Vision, Drones, Machine Learning, Detection, Coordination
Abstract	We use autonomous drones and onboard computer vision and machine learning techniques to process crowd images, analyze current crowd density, and predict future density to alert officials of danger and possible overcrowding. Many casualties result from overcrowding during mass panic situations, and using drones to measure and predict crowd density provides a unique solution to help officials monitor densely populated areas and make sure overcrowding doesn't occur. Our system uses a network of coordinated drones, each equipped with onboard processors to enable them to use convolutional neural networks in real time to process images taken using their cameras. The drones move fully autonomously to ensure that they do not each need to be monitored or controlled by a human. Our prediction model splits the images taken by the drones into individual segments specified by the user, uses the YOLO (You Only Look Once) object detector to identify the people in each segment, and thus measures the current crowd density in each image segment. It then uses a machine learning-based tracking algorithm to identify how the people in the image are moving and predicts where each person will be in the future based on their current movement. The data on the current and predicted future crowd density for each image segment is then relayed back to the host computer, and warnings are provided if the current or predicted density exceeds a predetermined threshold, alerting law enforcement to respond to an ongoing or predicted incident of potentially dangerous overcrowding.



S23-40

Title: *SmartMed - Automatic Pill Dispenser*

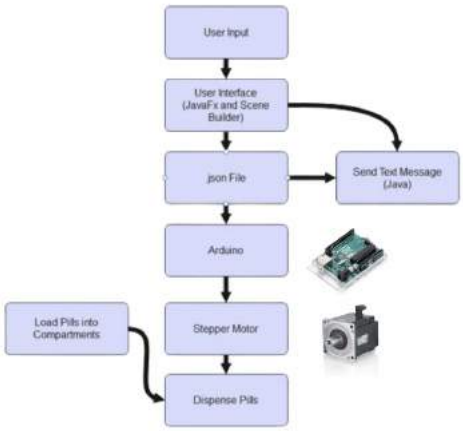
Team Members: *Priyanka Choudhury, Yara Hanafi, Hadi Hameed, Mark Byrnes, Nathan Diller*

Adviser: *Dr. Mehdi Javanmard*

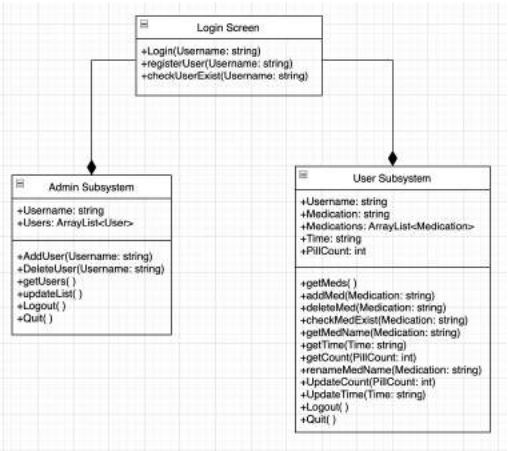
Keywords Usability, Optimization, Signal Activation, Pharmaceutical Compliance, Connectivity

Abstract

This automatic pill dispenser is designed to make remembering to take pills a convenient task. Our device is configured to not only dispense the correct medication but also to notify patients when it's time to take their pills. While the main demographic that stands to benefit from this device is patients suffering from memory loss conditions, this device can also be incredibly useful for individuals who simply want to streamline their medication routine. To ensure maximum effectiveness, our device utilizes a user-friendly interface which allows users to input important information about their medication, including when to take the pills and how many to take. This information can be easily entered by the user, a caretaker, or even the pharmacist responsible for dispensing the medication. Our dispensing mechanism consists of a rotating disk that contains multiple compartments, each of which can hold a certain amount of pills. The pills are then dispensed into a holding area to ensure that they can be easily found. When it's time to take the pills, the software signals the device to turn the disk, dispensing the correct amount of medication at the designated time, while also sending a notification to the appropriate individual. By removing the need to remember to take medication, our device ensures that patients consistently take the proper medication, leading to better outcomes.

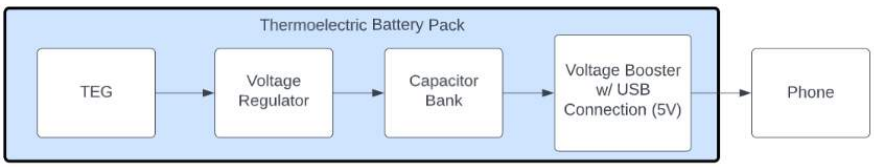


System Design



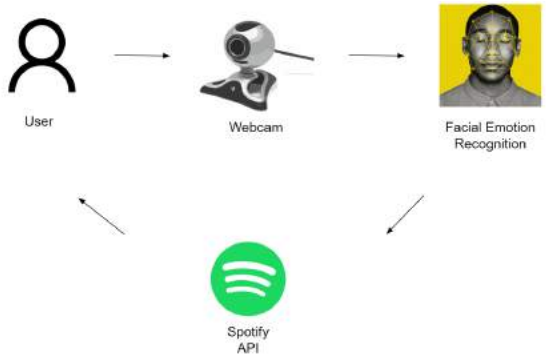
Application Layout

S23-41	***Title***: *Thermoelectric Generator Phone Charger* ***Team Members***: *Harvey Zhang, Daniel Cheng* ***Adviser***: *Michael Caggiano*
Keywords	Thermo-electric, Energy Solution, Sustainable Energy, Electricity Generator, Energy Storage Solution
Abstract	The goal of this project is to create an alternative, semi-portable and environment friendly way to charge your phone using thermo-electric generators that would allow heat energy to power a phone. This design uses heat energy from an external source and captures it inside the Peltier junction generators to convert it to electricity. Approximately seventy percent of all heat is wasted by humanity through any means of heat source. Utilizing this wasted energy ends up with a sustainable and renewable charger for your phone which provides a source of electricity to contribute to an eco-friendlier world. Most thermo-electric generators are currently used for industrial purposes utilizing huge heat flux to power certain appliances. This proves to be an issue regarding transportability alongside price. This solution focuses on creating a more generalized use of thermoelectric generators by providing a cost effective and portable device for the general consumer.



S23-42	***Title****: Mood-Sic* ***Team Members****: Rebecca Kim, Jennifer Penaranda, Anne Lin, Helen Wu, Dibya Dey* ***Adviser****: Professor Shirin Jalali*
Keywords	Facial Recognition, Mood Detection, Convolutional Neural Network, Music Recommendation, Spotify API
Abstract	People listen to music on a daily basis, however it is time consuming for them to manually browse music and create playlists that best match their current mood. Therefore, our project designs a system that captures and detects user emotion and recommends a playlist based on the user's detected mood. Our project consists of three main components: 1. Using a webcam to capture an image of the user's facial expression and saving it locally to Google Drive for future access purposes, as well as implementing haar feature-based cascade classifiers to crop images to only focus on the facial features of the user 2. Preprocessing the FER-2013 Kaggle dataset (a dataset that consists of 30k grayscale images of 7 different emotions) and training a convolutional neural network based on VGG-Face to analyze the geometry of the face, assign the facial expressions to emotional states, and provide mood predictions for different camera captured images 3. Using Spotify API to generate different playlists for the 7 moods (angry, disgust, fear, happy, neutral, sad, surprise) based on the user's personal Spotify account and personal music taste and play the desired playlist based on the mood We expect our project to save countless hours from the user by generating playlists through an algorithm rather than manual generation, introduce the user to new artists and genres that they may not have otherwise explored, as well as help those who may have difficulty expressing their emotions verbally or in writing.

Mood–Sic



SP23-43

Title: *Agrivoltaics : Smart Solar Panels*

Team Members: *Aayushi Kasera, Ahnaf Hasan, Arianna DeMaio, Kamal Paspuleti, Vincenzo DiMatteo*

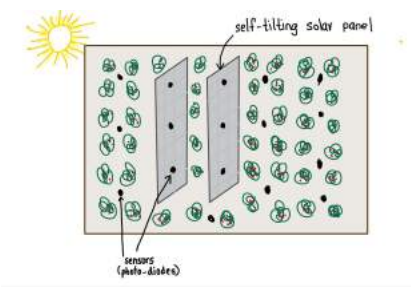
Adviser: *Wade Trappe*

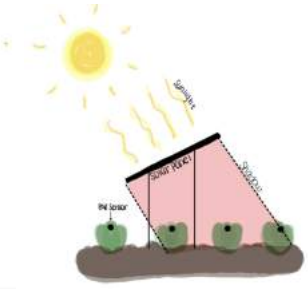
Keywords Agrivoltaics, Self-tilting Panel, Energy Efficiency, Plant Health, Sustainable Energy

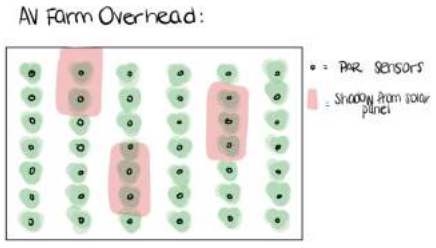
Abstract

The project uses the concept of agrivoltaics, which involves solar panels deployed in farmlands, to provide renewable energy while effectively supporting crop growth. Recognizing that some crops in farmlands do not need a lot of sunlight, and if they receive too much light they consequently require more water to remain healthy creates an engineering opportunity: the extra need for water can be eliminated by providing them shade resulting from deploying solar panels above the plants, thereby allowing for both energy and crop production.

With this engineering opportunity also comes unique engineering challenges and tradeoffs. Large-scale solar deployments do not work well in excessive heat, as panels retain heat from the daytime sun, creating a solar heat island effect similar to that created by urban or industrial area. Further, crops planted under solar panels reduce the surrounding temperature, reducing the heat island effect. As water transpires through the plant's leaves, the panels are cooled by the evaporation. The plants, protected by the solar panels from the worst of the midday sun's rays, act as evaporative coolers on the landscape. This in turn results in better energy efficiency, but only if the tilt of the solar panels is controlled to ensure that the tradeoff between solar energy production, and plant health is suitably maintained. The goal of our project is to design a self-tilting solar panel that accounts for plant health and the amount of radiance received by the panel to find an optimal angle throughout the year. To achieve this, we used light sensors for plants and solar panels. By measuring the sunlight received by the panel and plant and accounting for plant health, we developed a system to adjust the panel orientation to maintain the best possible angle.







S23-44

Title: *Virtual Ping Pong*

Team Members: *Austin Idiarte, Shawn Chang*

Adviser: *Predrag Spasojevic*

Keywords Orientation Tracking, Controller, Arduino, IMU, Unity

Abstract

Our capstone project idea is to create a device that, through orientation tracking technology, can simulate a virtual ping pong game in a cost-effective and scalable way. Our initial design was very ambitious, implementing three dimensional positional tracking to simulate a fully 3D virtual ping pong game; after moving forward with the development, we realized that the hardware we have would not suffice for positional tracking, nor would such accuracy be fun for a user to engage with (too much accuracy results in less leniency for the player regarding their movements). Our current design utilizes an Arduino Nano 33 IoT for the controller: it comes with a built-in IMU (inertial measurement unit) incorporating an accelerometer and gyroscope. Using the Arduino IDE and the Madgwick Orientation Filter technique, we are able to extract the orientation of the IMU. We then are able to send the orientation data into the Unity3D game engine using serial ports, which allows for us to create a scene depicting a ping pong game; the Unity3D engine enables us to accelerate development as we can use their built-in physics engine, incorporating: collisions, forces, and more. After creating some scripts in Unity to utilize and map this orientation data to objects in the virtual scene, we now have created our virtual ping pong simulation. Now, when we move and rotate the physical microcontroller, the object in the virtual scene will rotate, and thus we can play a virtual ping pong game using the physical controller.

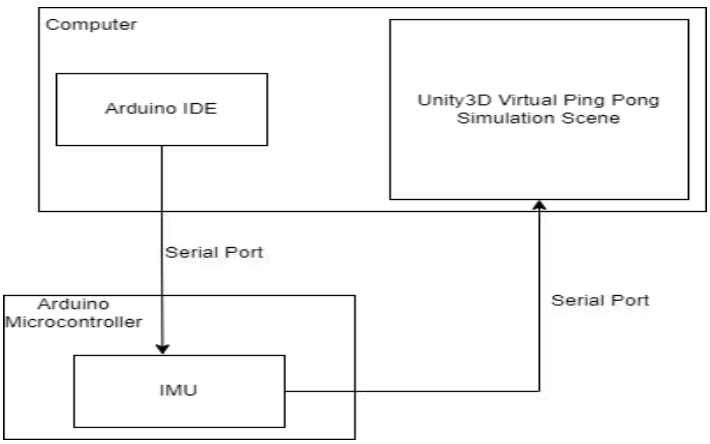
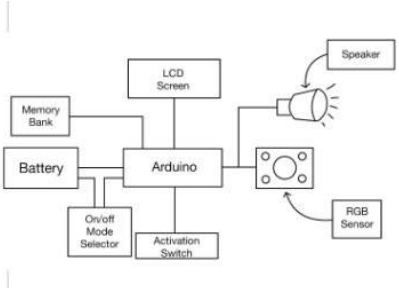
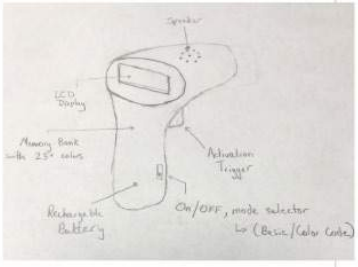


Figure: This high-level diagram illustrates the way data travels between the main components of the device's implementation.

S23-45	***Title***: *ColorSpy* ***Team Members***: *Paul Wolak, Yusuf Alioglu* ***Adviser***: *Hana Godrich*
Keywords	Color identification, color matching, learning tool, disability assistance, paint
Abstract	Our society has many accessible options for measurements. Rulers measure length, cups measure volume, thermometers measure temperature. These measurement tools can be found at any common general store, and if sought online the selection is limitless. What kind of tool would an individual use to measure color? The current polarized colorimeter market leaves an individual with very little options. They can either order a specialized machine for thousands of dollars and be trained on it, or they can order a less expensive substandard product that may not meet their expectations. Using the skills that we learned in Rutgers School of Engineering electrical and computer engineering program, we have an opportunity to design and manufacture a high-quality color detector that will be affordable, ergonomic, and reliable. The goal for our project is to create a product that an individual can simply pick up, press a button while holding against a surface, and have three pieces of information available to them: the color verbally outputted from a speaker, the color code of the scanned object, and the red, green, blue values displayed on the built-in screen. This product can be utilized by individuals with sight impairments, as a learning tool for children, and individuals in the paint industry for cars and homes, as well as people working in the textile industry.





S23-46	**Title**: *3D Mobile Menu* **Team Members**: *Rui Li, Yixuan Deng, David Llivirumbay, Lisifei Yao, Sichao Wang* **Adviser**: *Prof. Yao Liu*
Keywords	Ordering App, 3D modeling, Menu design, Food Product visualization, Interactive interface
Abstract	The food industry has been transformed by technology over the past decade, with food delivery services becoming increasingly popular. However, current food delivery apps lack detailed information about products, leading to potential misunderstandings and poor customer service. To address this problem, this capstone project introduces a 3D menu with detailed models of the products, allowing customers to have a more immersive and interactive experience. By using 3D modeling techniques, this project will provide a complete scope of information and insights about specific products and services. Customers can explore the 3D models of the products, view them from different angles, and understand their size and proportions, making it easier for them to make informed decisions. The benefits of this project are multifaceted. Firstly, it will promote the growth of browsing rate and purchase rate for merchants, leading to more intuitive economic profits and wider brand communication benefits. Secondly, it can prevent scamming and fake advertisements, as the 3D models provide a more accurate representation of the products, avoiding misleading information. Additionally, the 3D models in this project are optimized by Blender to ensure a 1:1 restoration of the products, further enhancing the accuracy of the representation. In conclusion, this capstone project offers a unique solution to the problem of providing customers with a complete customer experience by developing a 3D menu with detailed models of the food products, which is currently lacking in the market.

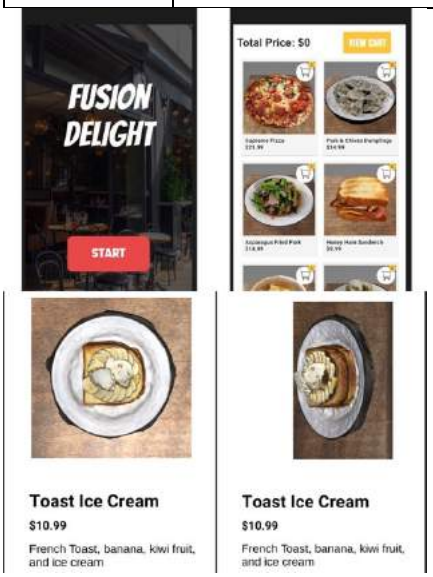
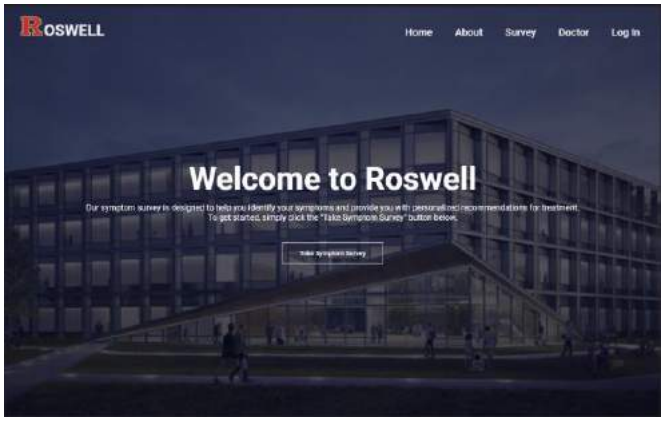
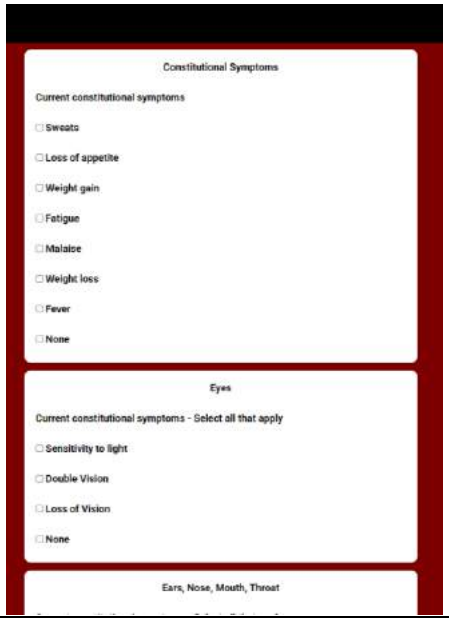
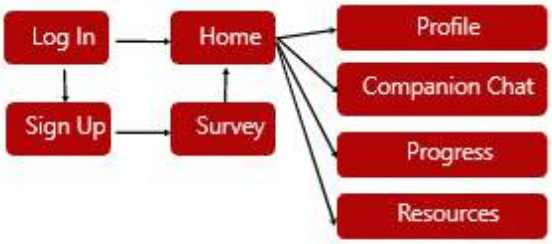


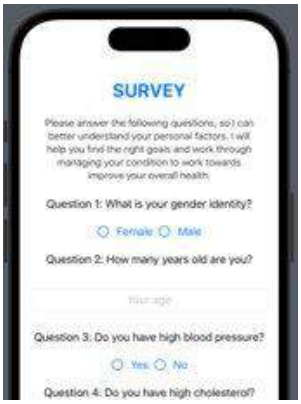
Figure 1. UI of 3D Mobile Menu App

Figure 2. Optimized 3D models display from different angles.

S23-47	***Title:*** **ROSWELL** ***Team Members:*** **Dylan Jenisch, Miguel Acevedo, Christopher Dyson, Michael Schaming, and Faraz Khan** ***Adviser:*** **Prof. Michael Wu and Dr. Anthony Tobia**
Keywords	Data, Diagnosis, Healthcare, Web-based, Review of Systems
Abstract	ROSWELL is a web-based platform that aims to revolutionize the way patient data is collected and recorded by creating a centralized and user-friendly location for healthcare providers and patients. The platform's back-end infrastructure includes an API and database that securely stores patient data, enabling authorized healthcare providers to access comprehensive medical histories and make informed treatment decisions. Beyond streamlining data collection and storage, ROSWELL includes features to help physicians detect potential health risks by analyzing patient data and identifying patterns. By providing early detection and suggesting appropriate courses of action, ROSWELL will improve diagnostic outcomes and reduce healthcare costs. In addition to eliminating the need for patients to repeatedly request their medical records, ROSWELL gives patients peace of mind when struggling with multiple symptoms and no clear diagnosis. With its potential to transform the patient/physician experience, we hope that all healthcare facilities will adopt ROSWELL as their primary method of collecting and storing patient data.  

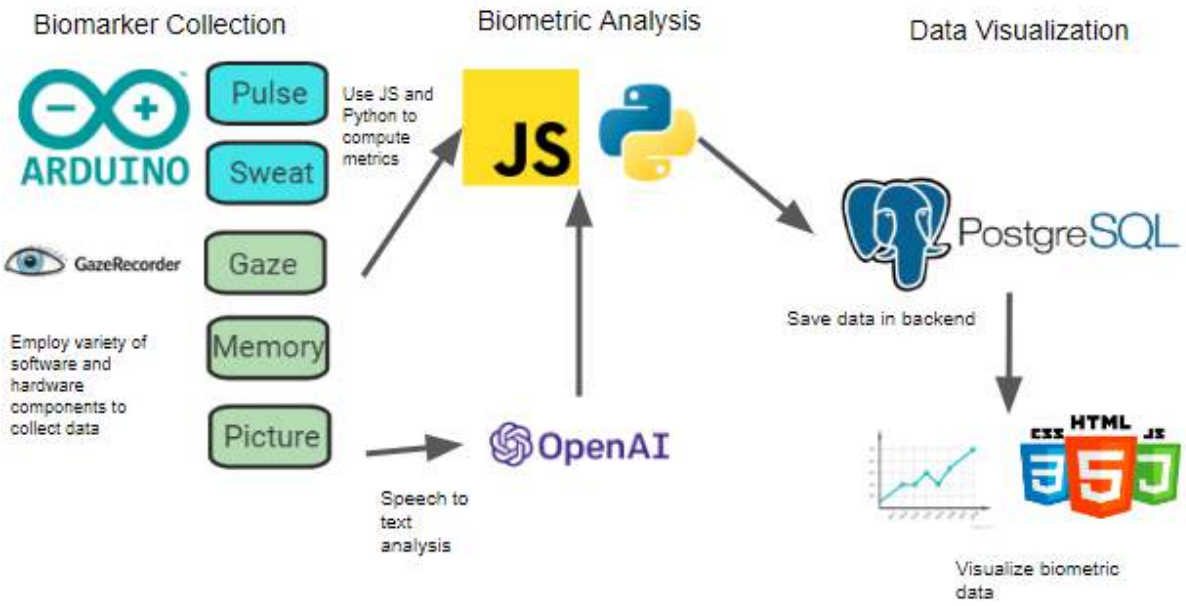
S23-48	***Title***: *Diabetic Digital Companion* ***Team Members***: *Matthew D'Alonzo, Anthony Poppalardo, Daniel Russo, Veronica Vergara* ***Adviser***: *Professor Haghani; Mr. John Canevari*
Keywords	Digital Companion, Mobile Application, Diabetes, Machine Learning
Abstract	Diabetes is a chronic disease that affects millions of people worldwide, and proper management of this disease is critical for maintaining good health, mentally and physically. This Diabetic Digital Companion is an iOS mobile application designed to help improve the overall health and lifestyle of patients with type 1 and type 2 diabetes. This application offers patients a personalized digital assistant that can provide them with personalized counseling, track their health data such as glucose levels, and offer recommendations to improve their lifestyle. The application offers several features such as food and exercise tracking, and personalized habit recommendations and reminders. The app also provides real-time and personalized coaching that helps patients make informed decisions about their health. The app also helps patients to better understand their condition, learn about the latest treatments, and connect with medical professionals. The importance of this Digital Companion lies in its ability to provide personalized care to patients with diabetes. The application uses machine learning models that learn from the patient's behavior and provide them with customized feedback. Ultimately, the companion provides support that helps the user feel less lonely and manage their condition with tailored consideration. In conclusion, this innovative solution aims to provide better support for patients with diabetes. The application offers a personalized digital assistant that can help patients manage their diabetes more effectively, monitor their health data, and offer recommendations to improve their lifestyle. The app's use of machine learning makes it an essential tool in diabetes management, and it has the potential to significantly improve the quality of life of patients with diabetes.





S23-49	***Title***: *Early Alzheimer's Data Collection & Testing Dashboard* ***Team Members***: *Omair Tariq Kham, Ataulhaq Akbar, Calvin Li, Surabhi Panda, Rushabh Patel* ***Adviser***: *Professor Sasan Haghani, Professor Medhi Javanmard, John Canaveri*
Keywords	Alzheimer's, biomarker detection, medical, data pipelining, Arduino
Abstract	Alzheimer's disease is a progressive neurodegenerative disorder that affects memory and cognitive function and is estimated to affect over six million Americans, and many more around the world. We sought to investigate the means of early Alzheimer's detection to allow for early treatment culminating in slowing the disease's progression. Our project consists of two key parts: a set of sensors used to monitor and record data on various biomarkers associated with Alzheimer's disease, and a web application to store and process this data to give insights on the likelihood of Alzheimer's disease. These biomarkers are specifically chosen to be non-invasive and low cost to monitor. They include pulse, sweat, speech, memory, and ocular biomarkers. The pulse and sweat are detected by a non-invasive touch sensor; these are connected to an Arduino that interfaces with the web application. The other tests are designed to be completed without the need for additional hardware, analyzing object tracking, visual short-term memory, and speech patterns. These tests are completed, stored, and analyzed within the web application, and are saved in a user profile, allowing results to be tracked over time intervals. Overall, our project attempts to expedite further research and analysis of early Alzheimer's detection by creating an all-in-one platform to conduct tests and build relevant data sets.

Methodology Figure:



S23-50

***Title**: FireX*

***Team Members**: Aditya Kesari, Harsh Patel, Lucas Cordova III, Dhruv Rana, Melissa Jara*

***Adviser**: Dr. Sasan Haghani*

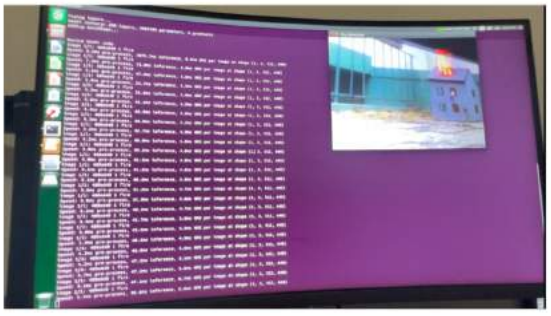
Keywords Computer Vision, Signal Processing, Fire Alarm, Error Reduction, Deep Learning

Abstract

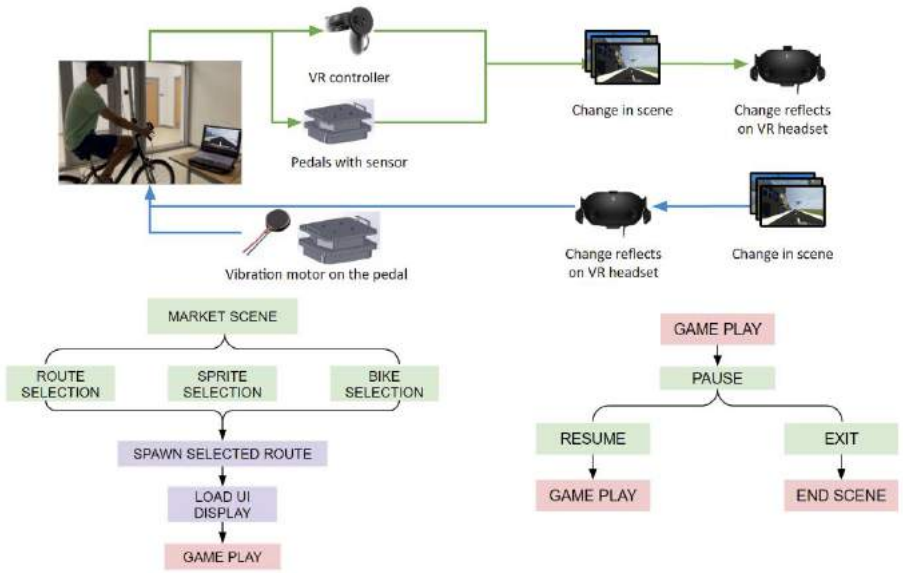
Tech companies have been developing smoke detectors in order to reduce the risks of fire in our communities. However, most of the detectors have several errors and limitations that could cause mis-alarming signals during the fire phase and propagation. This technology will not detect fire spreading, size, nor location, which are all necessary information for the fire department when dealing in incidents. Our solution is to create an AI system that will use advanced computer vision to accurately detect and locate fire in indoor spaces by using a camera connected to a sensor, to eliminate false alarms.

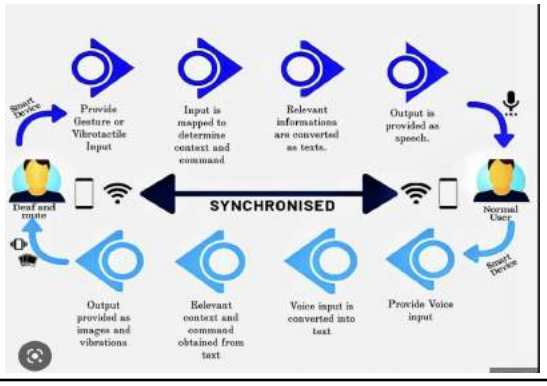
The system was trained on large datasets of fire images (indoor and outdoor) and accurately recognized different types of fire and their locations, after being tested in a variety of environments: bedrooms, kitchens, living rooms, garages, and outdoors to ensure its effectiveness in real-world situations. Overall, the goal of this research is to develop a reliable and accurate AI system for detecting and locating fire in indoor spaces, which will help reduce the risks and consequences of fire in our communities. This project aims to develop a prototype that detects and locates fire activities in indoor spaces, and will require programming algorithms, data analysis, and conducting tests and applications in the environment. The evaluation of the prototype will be placed on bedrooms, kitchens, living rooms, garages, and any indoor spaces that require a fire alarm.

Our Machine Learning model detecting fire and smoke in various images



Our camera detecting fire in a video it has not seen before

S23-51	***Title***: *Virtual Reality Augmented Cycling Kit (VRACK)* ***Team Members***: *Jing Jia, Parth Darji, Julianne D'Avirro Humphrey, Binsheng Zhang* ***Adviser***: *Dr. Yao Liu*
Keywords	Virtual Reality, Rehabilitation, Cycling, Wireless Communication, Sensor
Abstract	Virtual Reality Augmented Cycling Kit (VRACK) was created to improve patient experience and physician efficacy for rehabilitation of a reduction or loss of a sense of balance, specifically for stroke patients. Cycling is an established physical therapy known to improve balance, increase mobility and endurance, and reduce muscle stiffness. Incorporating VR into physical therapy cycling can help to increase and maintain patient morale by providing entertainment and more immediate reward during the long process of rehabilitation. The virtual environments built using Unity 3D will wirelessly communicate with the sensors to take in accelerometer sensor data to move the on-screen avatar. Additionally, there is pressure sensor feedback that will be split between the left side and right side, corresponding to the patient's left and right foot pressure on the pedal sensors, and be displayed to the patient through the VR headset and to the physician displayed on a monitor screen. ESP32 is used for Wi-Fi communication for data transfer from the sensor to the headset with an acceptable latency of less than 1.13 ms. The data from the sensor is rigorously converted to in-game physics and maintains the realistic movement of the avatar. At the conclusion of a session, the Users will be provided with their time in a session, a game score, and a percentage reflecting how laterally balanced they were during the session. 

S23- 52	***Title***: *Voice For All* ***Team Members***: *Aakash Sukhadia, Vaani Menon, Jubin Thomas, Paul Kim* ***Adviser***: *Dr. Philip Brown, Dr. Sasan Haghani*
Keywords	App, Disabilities, Speech, Hearing, Voice recognition
Abstract	For this project, we are proposing an easier medium for individuals with disabilities to communicate with the goal of helping those who are in need. Specifically, our Voice for All application targets those who have impairments relating to speech, hearing, and blindness. The overall objective of the project is to make communication easier for people with verbal, hearing, or speech impairments. The general idea of the application is as follows: The application involves the user selecting what type of disability he/she has from the UI/UX component of the application. From there, an input of either text or speech is fed into a device which may be done by the microphone of the device or through an attached sensor of the device for sign language, in which corresponding output is the message converted into vibrations, text, or speech which is done through the application. The necessary hardware to create a prototype for our project are: vibration motor, raspberry PI, and RF receiver and transmitter. In addition, existing natural language processing tools are needed in our application for it to function as intended. Accessibility of the application to users will be a device or a piece of downloadable software that functions as a translator in which the software will be able to take in multiple different inputs to translate as a corresponding output. The final goal is to produce a workable project within the budget to create an accessible software application where users with hearing or speech impairment can communicate effectively at any given time.  

S23-53

***Title**: Wearable Fox Mask from Sky: Children of the Light with functional eyes*

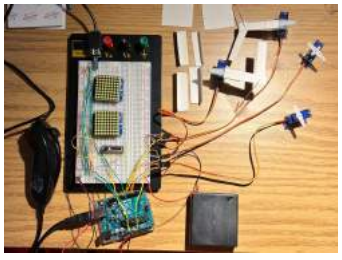
***Team Members**: Rahaf Abdallah*

***Adviser**: Predrag Spasojevic*

Keywords Arduino, LEDs, Servo-motors, 3D Printing, Wii Nunchuk

Abstract

This project is a functional and wearable mask of the Fox Mask from the mobile game, Sky: Children of the Light. Its main feature is a functioning set of eyes. The eyes' section with the pupils is through the use of LED matrices. The eyelids are implemented outside of the LEDs as a physical component. The movements of the eyelids are set through micro-servomotors, with an arm mechanism sliding each eyelid vertically up or down, as intended. All features are controlled through a Wii Nunchuk, with a sliding, linear potentiometer attached. There are two modes: blinking and squinting. For blinking, a blinking animation that is preset for the eyelids will occur with a Z-button press. For squinting, the various levels are aligned with the sliding potentiometer, allowing the mode to be taken as freeform. The modes are toggled through C-button presses. Blinking mode will always be the default when turning the mask back on. The main hardware and coding are with an Arduino UNO REV3 and Arduino IDE, respectively. There is a separate power supply for both the Arduino UNO and servomotors. A dual-strap is attached to support the weight of the mask, as the user is wearing it. Black mesh fabric is placed between the layers of the eyes and eyelids to allow the user to see through the mask through the surrounding area that is not covered by the matrices.



S23-54

Title: Pool Water Monitoring System

Team Members: Andrew Kurtiak, Christine Voynarovskiy, Robert Finke

Adviser: Yingying Chen

Keywords Sensors, Vision Processing, Neural Network, Microcontroller, Data Transfer

Abstract

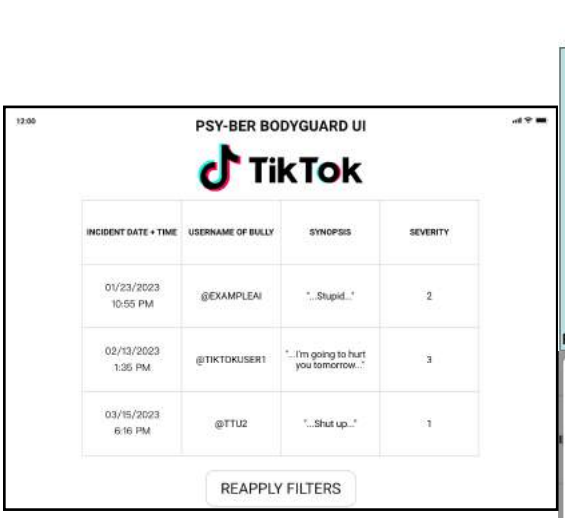
Pools require constant monitoring to maintain a healthy balance of chemicals while avoiding dangerous bacterial growth. Typically, pool maintenance is done using physical test strips, requiring direct intervention from the user. This proposed solution allows for remote testing of pool quality, and gives recommendations based on the current status of the pool. Many of the metrics being tested can use a digital sensor to constantly report a status, such as total dissolved solids, pH, temperature and turbidity.

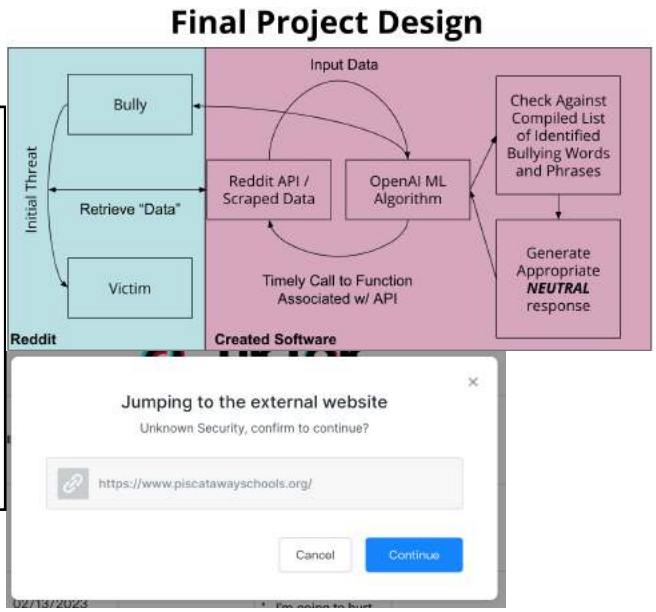
However, the most important chemical to monitor is free chlorine, which cannot be measured accurately on a budget using digital sensors. Instead, this system uses a reagent test to gather information about the chlorine content. Water is pumped into the system, exposing a reagent test, which is then imaged and visually processed. A neural network is utilized to scan information from the image and identify the correct concentration of free chlorine in the sample.

This information is then stored in a dashboard giving the metrics, and historical data about the pool. In addition, the dimensions of the user's pool can be added to get in depth details and recommendations about pool maintenance, including the exact amount of chlorine needed to restore balance to the pool.

The main appeal of this approach is the lost cost of production of this method. Since digital chlorine sensors are not cheap, accurate or accessible, this method leverages the more precise and cost effective technique of using chemical test strips. Our combined approach of electronic sensors as well as chemical tests makes our device uniquely different from others on the market. Ultimately, our automatic and hassle-free design helps pool owners save time and energy while making sure their water is safe to ensure the best pool-going experience possible.

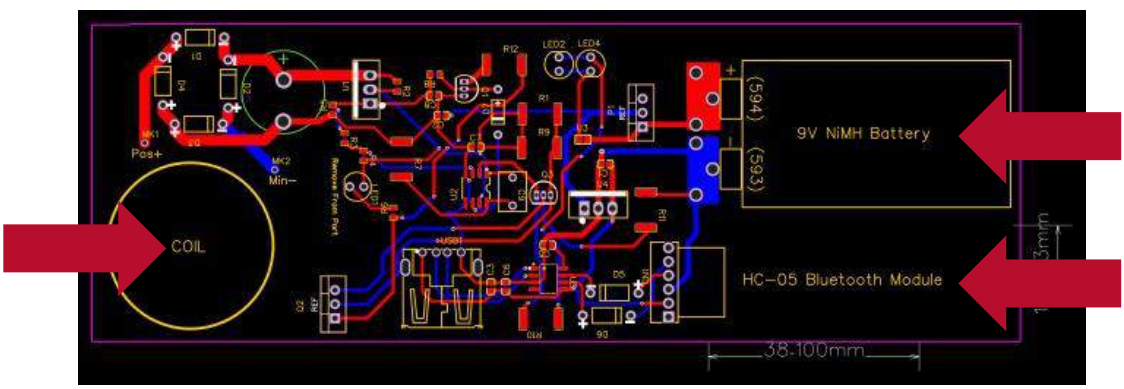
S23-55	***Title**: Psy-ber Bodyguard* ***Team Members**: Srotriyo Sengupta, Sibhithirumeni Ramadoss* ***Adviser:** Dr. Anthony Tobia, Dr. Chung-Tse Michael Wu*
Keywords	Cyber-bullying, social media, mental health, artificial intelligence, machine learning
Abstract	The Psy-ber Bodyguard is a project aimed at targeting cyberbullying amongst younger children by implementing software technology. When an account is signed up for our application it will first scrape comments directed toward the child's social media accounts and identify harmful language. It will then create an appropriate neutral response to the specific comment and send it back to the bully, without escalation, to diffuse the situation. After this AI-generated response is sent back to the bully, the victim's parents and/or school officials will be notified and, dependent on the level of threat, can be taken to higher authorities from the adults involved in the situation. The proposed solution attempts to use existing artificial intelligence, trained on extensive internet-based texts, in order to identify target sources of harmful messages and perform the subsequent actions expressed above. In addition to the up-to-date algorithm we want to implement, we will be using Python, Swift, the OpenAI API, and various other tools in order to create an application that can be used by the parent for this specific technology. The ultimate goal of the overall prototype application, however, is to express ease of use for parents or school officials who may not be technologically adept, while implementing personal solutions to a variety of instances of bullying a child may face. Comprehensively, though, we hope that our product performs in a manner such that young people can continue exploring safely online without significant threats to their mental health.





S23-56	***Title***: *Riptide Drone* ***Team Members***: *Dominic Palazzolla* ***Adviser***: *Sasan Haghani*
Keywords	Drone, Image Processing, Embedded Sensors
Abstract	Even if it is a sunny day at the beach, or a storming night at sea the risk of getting lost at sea is quite a grim fate. The response time of search and rescue operators can vary widely depending on the situation, whether its a lifeguard running from the beach or a helicopter being dispatched from land the main issue is the speed of response. Relevant systems, while super effective are still quite costly with single drones and hardware costing in the thousands of dollars and also do not have always contain life saving equipment for the person. My project aims to fill this gap in response time, with a drone that can be constantly on standby or patrolling waters closer to where people may end up getting lost in the water and also provided the person in trouble with a lifesaving equipment. The problems that arise from traditional search and rescue, can be solved with drones. Drones equipped with thermal imaging cameras can cover much larger areas much faster than crews on the ground or be set on predetermined patrols. Also this system aims to be able to be deployed much quicker, from nearly any location, and at a huge cost reduction than traditional means and to similar systems. This ability to be able to cover larger amounts of space, will reduce the amount of people that might not be noticed by people on the ground, with this the system would be able to alert nearby rescuers of critical information, such as the location of the lost subject. For this system the approach I will be taking is having a multi-sensor array to identify and locate subjects, barring the drone components, the extra needed these sensors would include a thermal imaging camera, a gps sensor, a processing unit, long range signal transmitter, and a regular camera. For life saving equipment I plan to use one time use system to deploy a life preserver, in the form of a compact inflatable similar to systems used in airbags. The plan of identifying people will be done though image processing of the camera data and mainly thermal camera sensors. Then the location detection will be handled through the gps sensor and the long range transmitter. These systems are to be tested as standalone systems, for later implementation. Also deployment of equipment will be later implemented and tested after these systems are finished Overall the techniques discussed will be synthesized into a standalone system, after this combination the steps to full implementation onto a drone will be addressed and tested.

S23-57	***Title***: *Biomarker Sensing and Data Processing App* ***Team Members***: *Tyler Alvarez, Jeremy Francoeur, Humza Mohsin* ***Adviser***: *Dr. Umer Hassan*
Keywords	Medical, Biosensor, Wireless communication, App Development, Automation
Abstract	Spectroscopic analysis is a popular data collection technique used in many biomedical devices. Spectrophotometry utilizes light sources to excite biomarkers from a refined biological sample. Applications for spectrophotometers include measuring levels of proteins, DNA, RNA, growth of bacterial cells, enzymatic reactions, etc. Contemporaneous spectrophotometer markets include devices with expensive and high-level features optimal for hospital and laboratory settings. These functions broaden the device's abilities but are unnecessary for certain applications. Traditional spectrophotometers also leave a large environmental footprint because of their complexity. However, spectrophotometers designed to operate with only essential functions are more affordable and accessible to a broader patient demographic. Given a pre-existing 3D printed absorbance spectroscopy device for therapeutic drug monitoring (TDM) in Tuberculosis (TB) patients, it's possible to simplify the current device into a portable and environmentally friendly model. Achieving this involves the implementation of a rechargeable battery for power and a Bluetooth module for data transfer. The current apparatus features a USB connection responsible for data transfer and power. Furthermore, data analysis will be restructured by an automated smartphone application that works with the newly added circuitry. This eliminates the need for a user to manually organize and graph data. Implementing these improvements will increase portability, automate the user experience, and have a desirable environmental impact.



S23-58

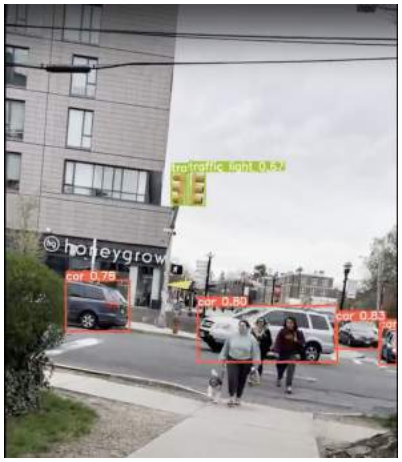
Title: *VisNav: Camera Vision Navigation for the Visually Impaired*

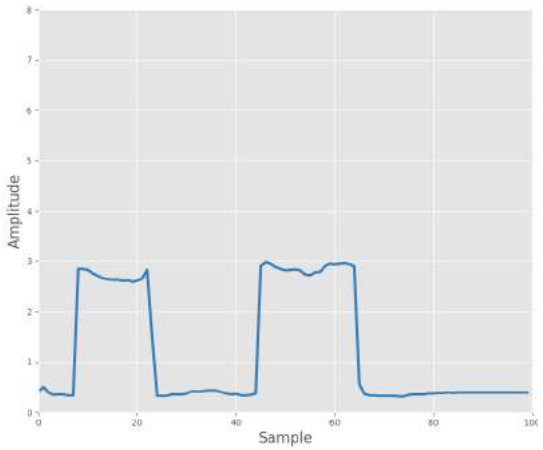
Team Members: *Colin Kanyuk, Mehmet Ali Soner, Steve Yu, Nicholas Palagin, Daniel Mitchinson*

Adviser: *Prof. Yingying (Jennifer) Chen*

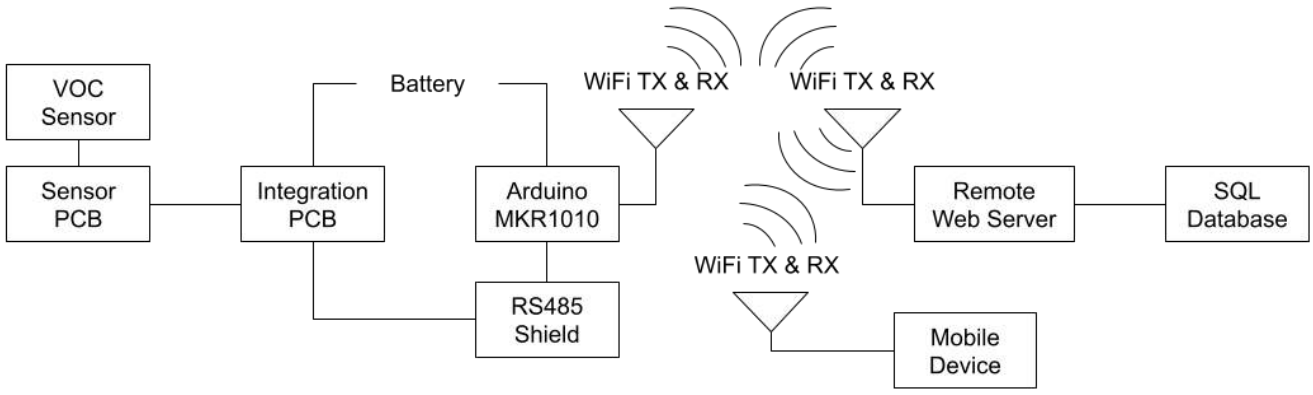
Keywords Camera Vision, Object Detection, LiDar, Wearable, Support Device

Abstract Vision loss significantly increases the likelihood of a visually impaired person being unintentionally injured throughout the day. Many who are visually impaired rely on a few different methods to navigate through their daily lives, including seeing eye animals, guide/white canes, or having an aid to walk along with them. Currently, 2% - 8% of the visually impaired mainly rely on guide canes to help them navigate throughout their daily lives. However, the issue that many brought up about the guide canes is the lack of detection for objects that are above the user, such as low-hanging tree branches, overhangs, or objects outside of the field of the guide cane that could potentially cause head or other bodily injuries. Another strife that some experienced was navigating through crowded areas and limiting contact with other pedestrians as well as finding an open seat in public areas. With the use of LiDar, VisNav will be able to account for the lack of verticality of a white cane by detecting objects above chest height. VisNav is also capable of detecting potential hazards like vehicles through camera vision. With these two systems, our device can work in conjunction with a white cane to provide safety and support for the user.





S23-59	***Title***: *VOC Sensor and Application for Early Alzheimer's Disease Detection* ***Team Members***: *Arpan Gupta, Matthew Irving, Aryan Karakoti* ***Adviser***: *John Canevari (NovoNordisk), Sasan Haghani (Rutgers ECE)*
Keywords	Alzheimer's Disease, VOC Sensor, Biomarker detection, Health monitoring device
Abstract	Alzheimer's disease (AD) is a progressive and degenerative brain disorder that affects memory, thinking, behavior, and cognitive function. There are an estimated 6.5 million Americans aged 65 and older suffering from AD in 2022, with projections indicating that this figure will soar to 14 million people by 2060. Current diagnostic methods rely on behavioral and cognitive assessments, as well as invasive testing such as biomarker testing done using cerebrospinal fluid. Furthermore, they require extensive patient visits leading to later detection of AD and are high cost. Because of this, the pressing demand for a non-invasive, quantitative, cost-efficient tool for AD detection is very prevalent. Early detection and monitoring of AD progression is critical for effective management and intervention. Current research is being done on analyzing different mediums like blood, breath, and bodily fluids, for biomarkers related to AD. Several breath volatile organic compounds (VOCs) have been linked in much higher concentrations for AD patients. Thus, VOC-based sensors have emerged as a promising approach for non-invasive and early detection of the disease. In our research, we present a portable, cost efficient, and highly accurate VOC sensor-based device for AD detection and progression monitoring. The device is designed to be compact, user-friendly, and capable of capturing and analyzing VOCs from exhaled breath. The sensor utilizes state-of-the-art PID technology to selectively detect specific VOC biomarkers associated with AD, offering high sensitivity and specificity for AD detection. We then introduce a mobile-based application for analysis and reporting of the data, with user-friendly screens and features. We test the validity of our device using different concentration samples of specific VOCs and address many current shortcomings in AD diagnosis and monitoring.



S23-60

***Title**: Automation in Hydroponics*

***Team Members**: Dean Ingram, Hoang Phan, Tri Dinh, Jonathan Velez*

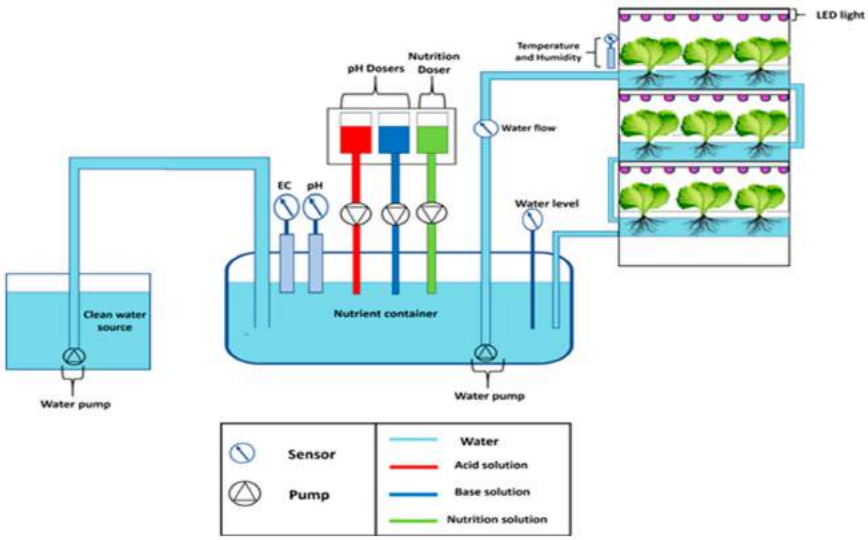
***Adviser**: Professor Takhistov, Professor Haghani*

Keywords

Automation, Indoor Agriculture, Sustainability, Plants, Water

Abstract

The objective of this project is to design and build a hydroponic system which optimizes plant growth and tracks the plant growth via a webcam. Plants thrive when key factors of the environment such as light, nutrition and pH are carefully balanced. Our system automatically measures and adjusts these important variables of the plant's environment. There are two tanks, one mixing tank and one plant tank. Our system uses an Arduino to automatically measure light intensity, water pH and conductivity. Based on the sensor measurements, the Arduino powers the pumps to deliver the appropriate solutions to the mixing tank. The solution in the mixing tank is periodically pumped to the plant tank and then drained after the plants receive nutrients. Additionally, a lighting system hangs above the plants. When the Arduino detects low external light levels, it turns on grow lights to ensure the plants receive enough light. Furthermore, a webcam takes pictures of the plants at regular intervals. The webcam data allows growers to remotely check on their plants. The pictures can be analyzed to gain insight about the plant's photosynthesis progress and offer predictions about when the plants should be harvested. Pictures can also help a grower to determine the optimal growing conditions for a specific plant. The plant chosen for this project is basil due to their fast growth cycle.



S23-61

Title: *Cryptographic Smart Lock*

Team Members: *Aryeh Greenberg, Elly Tsarkova*

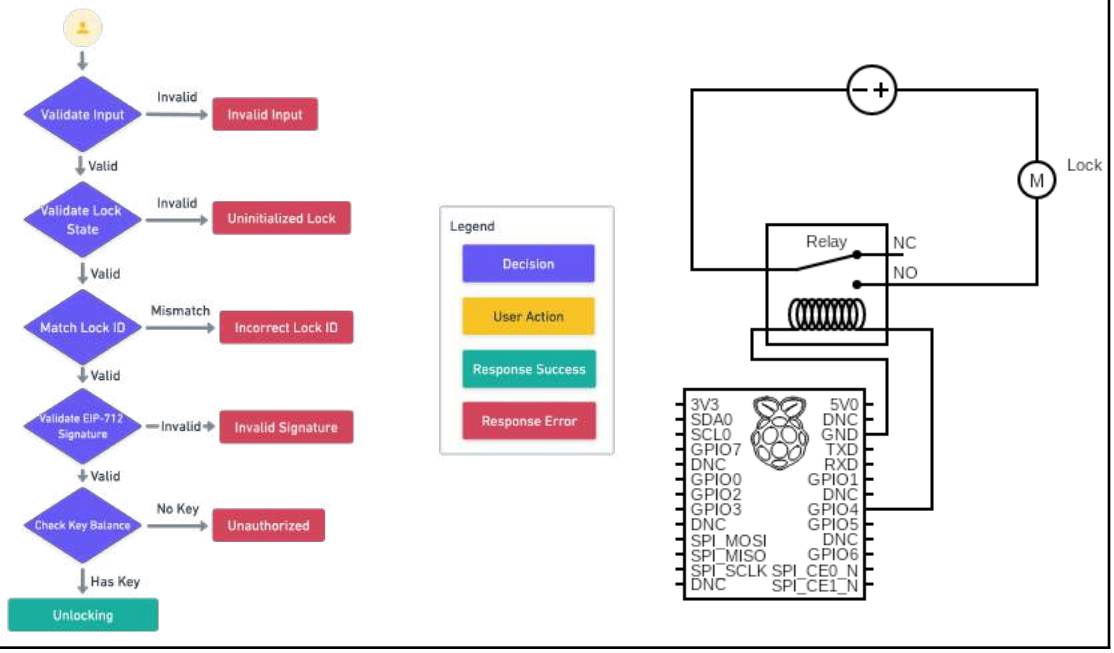
Adviser: *Professor Predrag Spasojevic*

Keywords IoT, Smart-Lock, Cryptography, Security, Decentralization

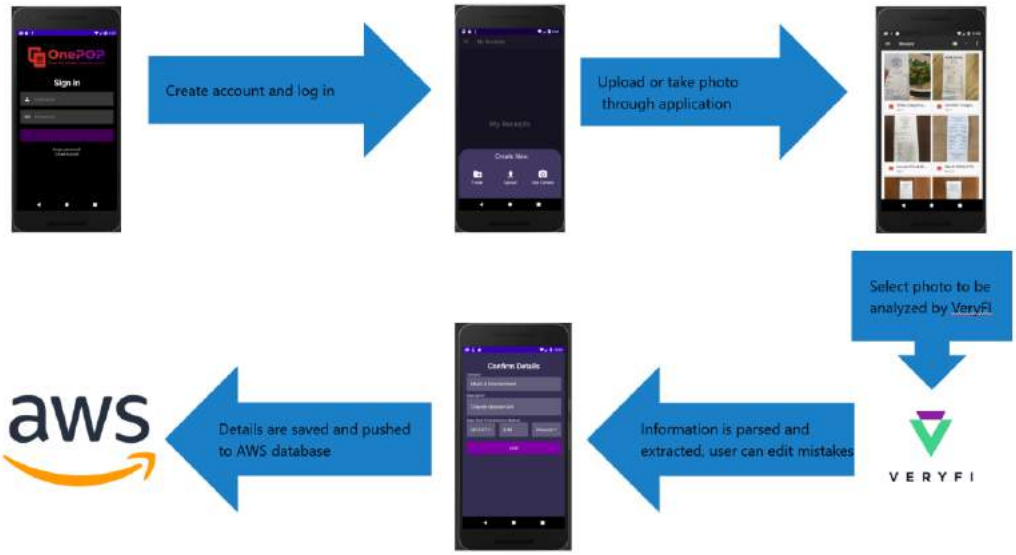
Abstract

Internet of Things, IOT, is the concept of creating a network of devices and sensors to automate processes in one's life for the purpose of efficiency. It is a growing field, with new technologies such as doorbell cameras, personal assistance, and automated home heating controls becoming more prevalent. Smart locks, a lock that can be controlled remotely through an app or using biometrics, is another popular IOT device that seems like a better alternative to the traditional lock, as it cannot be picked, and does not require a physical key that can be lost. However, existing smart locks open up new types of concerns, such as the possibility of it being hacked into, or the loss of access to the lock if the server loses connection or the lock company goes under. Additionally, with company's being unclear about their tech stack, a user does not know who within the company has the ability to unlock the lock, which brings into question exactly how secure the product is.

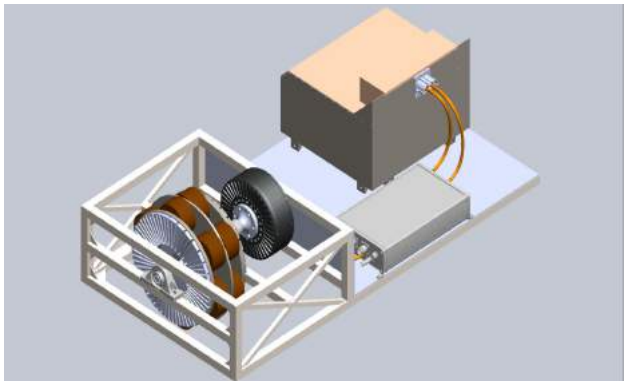
A cryptographic smart lock is an alternative to the traditional smart lock that addresses the mentioned concerns. In this kind of lock, the key is an NFT and key owners are verified through cryptographic signatures. Since the key verification process goes through decentralized networks, the device's uptime is massively improved. Additionally, these networks untether the lock from the manufacturer, ensuring long term functionality. All in all, a smart lock with cryptographic keys has better security, privacy, and uptime than a traditional smart lock.

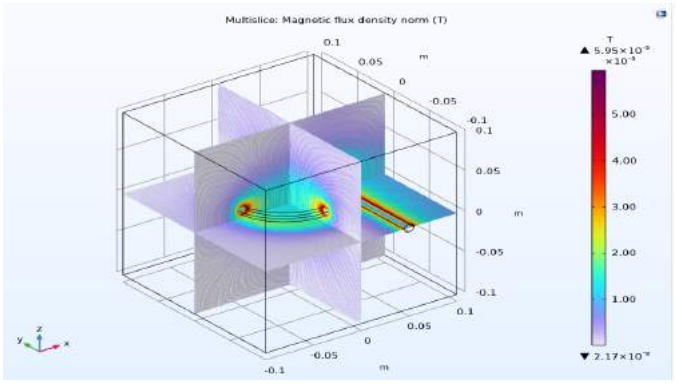


S23-62	***Title***: *OnePOP* ***Team Members***: *Dustin Lee, Ethan Nguyen, Rahul Umrani, Andrew Yip* ***Adviser***: *Antonio Miranda Garcia, Anand Sarwate*
Keywords	Personal finance, organization tool, cloud computing, android application
Abstract	Every day we make purchases which are paid through various methods such as different credit cards or even cash. There is tons of information that comes to the user in a disorganized fashion. Receipts are a huge inconvenience and there are multiple ways for people to handle them. While recycling and keeping receipts in one huge pile are options, they are inconvenient and at some point you may need to claim a warranty or return the product and most times they ask for your proof of purchase and when they do you'll need to find that receipt. Our application eliminates the need to keep a physical receipt and easily find it. Users will be able to take photos of their receipts directly through the app as well as uploading from photos from system files. All receipts are stored in a database using Amazon Web Services(AWS), thus taking up no physical space. Since the database is stored on an AWS server, users are also able to access their files anywhere rather than having it stored on a local device. Our program scans receipts and parses specific data relevant to the user using an OCR. Specifically, we parse the receipts for the purchase total, the store name, the date of purchase, and the form of payment. In addition, it saves a picture of the receipt itself in case of any additional information the user would like to reference to in the future.



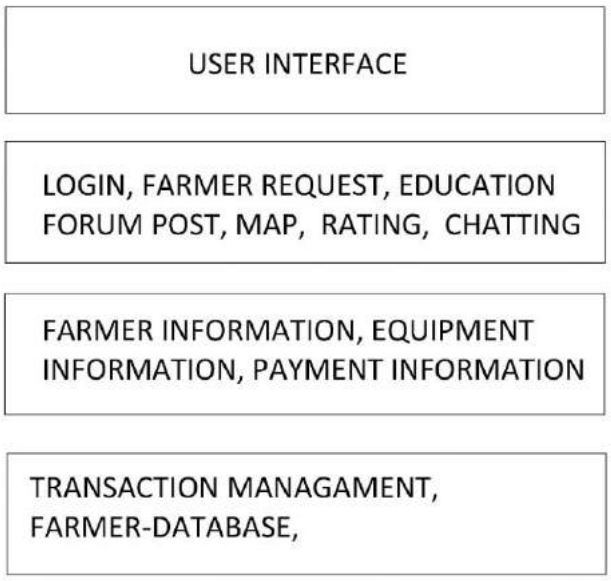
S23-63	***Title**: Rutgers Formula Racing Eddy Current Dynamometer* ***Team Members**: Thomas Bennardo, Paul Bikker, Paul delVechio, Henry Fechhelm, Dmytro Govdan, Erik Robles, Neel Shah, Faiza Sikanar, Karolis Sniras* ***Advisers**: Dr. Pelegri, Dr. Haghani*
Keywords	Dynamometer, Eddy Current Brake, FSAE, EV, Motor
Abstract	Every year, Rutgers Formula Racing designs and manufactures a rules regulated open wheel race car to compete in against other university teams in Formula SAE competitions. Our project is the design and development of a powertrain dynamometer to help the team measure the response between the vehicle's HV battery pack and our motor, the Emrax 208, so that we can improve our powertrain, as the more data we collect from the motor, the better we can refine other aspects of the vehicle whose design is dependent on the derived torque and power curves of the motor. The dynamometer design focuses on using large electromagnets to generate eddy currents that in turn will create a braking force to counter act the torque force of the motor. With this counter torque, a load cell can be attached to a torque arm, and the data can be sent to a data acquisition system to read the torque of the motor. The chassis design for our dynamometer holds not only the dyno itself, but also the data acquisition system, the requisite power regulator, the HV battery pack, and the proper cooling elements to be a self-contained testing apparatus.





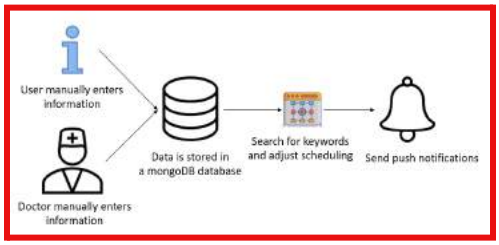
S23-64	***Title***: *NJ Farmer's Commune* ***Team Members***: *Sulaiman Khaliq, Duy Nguyen, Atharva Belsare, Nithin Thannickal* ***Adviser***: *Wade Trappe*
Keywords	Farmers, Equipment, Communication, Application, Service
Abstract	The NJ Farmer's Commune is focused on providing a software application to help struggling small farmers in New Jersey. Currently, modern small farmers face many challenges of survivability and sustainability arising from many environmental, political, and economic factors, whether it be climate change, international affairs, or inflation. New farmers also lack the same level of experience or access to quality tools/gear compared to existing, established farmers. Since the amount of time it takes to cultivate farming experience needed to effectively manage a small farm, combined with the high cost associated with the equipment necessary to run a farm, is a massive barrier to many small farmers, threatening their entry into the profession and making it difficult to earn a living in the long term. The proposed application, titled "The NJ Farmer's Commune," is designed to provide these small farmers a way to connect and communicate with each other, primarily to share advice, equipment, and services with each other with the goal of creating a virtual commune whereby farmers help each other out. This project has involved collaboration with Rutgers' own School of Environmental and Biological Sciences (SEBS), which has helped provide deeper insight into the issues with agriculture faced by modern farmers.

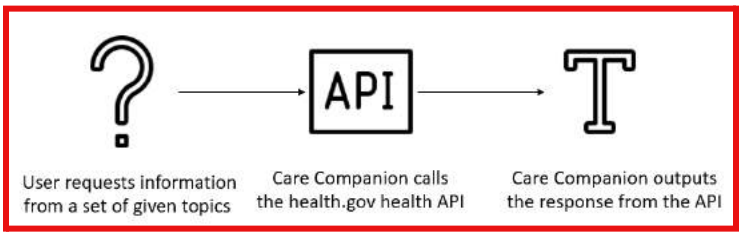
NJ Farmer's Commune Logo



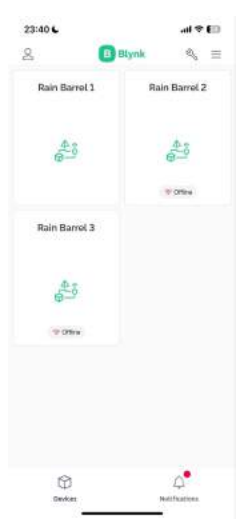
Planning Stage Layered Architecture Diagram

S23-65	***Title**: Care Companion* ***Team Members**: Michael Schleppy, Ritik Patel, Heneil Patel* ***Adviser**: Dr. Maria Striki*
Keywords	Mobile Application, Healthcare, Digital Companion
Abstract	The purpose of this project is to create a digital healthcare companion app that can be used to help people maintain a healthy lifestyle. The main problem that is meant to be addressed with this project is social isolation and lack of available assistance to elderly people. The app may also be developed in a broader sense in order to reach and cater to more people. To accomplish this, the app will be designed to provide general health reminders to the user, such as reminding them to exercise, stay hydrated, and ensure compliance to medical regimens. Through the collection of data entered by the user and their doctors, the application will also assist users with advice to help identify and manage medical regimens, as well as reminders to schedule appointments with doctors. By incorporating helpful health reminders in this app, it will help people by allowing them to live healthier lives and increase their overall well-being. The approach to this project will involve obtaining a broad understanding of how digital assistants work, and how they may be applied to a digital companion mobile app designed for use by people under social isolation. The app will also require an understanding of healthy behaviors, as the application will attempt to provide proactive health reminders to its users, without being prompted beforehand.





S23-66	***Title**: Smart Rain Barrel* ***Team Members**: Erwei He(POC), Zihan Liu, Qihao Liu, Ziqiang Zhou* ***Adviser**: Sasan Haghani*
Keywords	Smart Rain Barrel Network, Remote Monitoring and Control, Scalability, Customization
Abstract	The increasing need for efficient water management and flood prevention has led our team to develop the Smart Rain Barrel Network. The network is an innovative approach to remotely monitor and control rain barrels using mobile devices such as phones and computers. This system allows users to access real-time data of rain barrels connected to the cloud, including water level, turbidity, and view the change of this information over time. Users can decide when to empty the barrels, or adjust the water level to desired percentages (50% and 25%). Two key features of the Smart Rain Barrel Network is its scalability and customization. By allowing users to communicate with multiple rain barrels and access data through a user-friendly interface. We have designed two types of barrels to satisfy different needs. The first type includes four water level sensors and a turbidity sensor for users who require more accurate information. The second type features two water level sensors (50% and 100%) for users who only require basic functionality at a lower cost, making it suitable for commercial use or large-scale production. By establishing a rain barrel network within a region, the local communities can benefit from reduced flooding risks and lower water usage costs. In addition, a unique feature of the Network is each individual barrel contains a self-powering system, utilizing solar energy to power itself. This furtherly lower the maintenance cost on the network, since self-powering reduce the dependency on external power sources The Smart Rain Barrel Network presents a sustainable solution for water management and flood prevention, allowing users to have an advanced control and monitoring approach on their water resources.



S23-67	***Title***: *Analyzing Political Views from Social Media with Machine Learning* ***Team Members***: *Justin Chen, Jerry Huang, Ian Martin* ***Adviser***: *Dr. Shirin Jalali*
Keywords	machine learning; social media; topic analysis; unsupervised learning; BERTopic
Abstract	The proliferation of social media as a medium of political discourse has made huge quantities of information available while that volume simultaneously makes it a challenge for some people to access that information. Twitter has become a prevalent platform for political discourse, but only one in five US adults use Twitter. People who aren't familiar with social media or generally uncomfortable with technology rely on news coverage to learn about what is happening on social media, which may not be reliable. Our goal is to empower individuals, particularly voters, to obtain accurate and unbiased information about politicians' positions free from distortion or misrepresentation that may arise from intermediate sources. Our system analyzes a specified Twitter user's tweets and groups them into topics using a topic analysis machine learning model called BERTopic. Sentiment analysis is then performed on the tweets in each of the most common topics to find the most positive, most negative, and most neutral tweets within the topic. Using the information generated in this analysis, the system provides an overview of the target Twitter account by showing the most common topics, and histograms of the sentiments related to those topics as well as a selection of representative tweets. Those representative tweets are the most positive, most negative, and most neutral tweets that were found in sentiment analysis. The user interacts with the system using a website to input the target Twitter user and view results. Results are presented in the form of graphics including a topic map, timeline, and sentiment histogram. Tweets are also embedded so users can read the original source tweets. The website makes it easier to learn about an individual than manually browsing their Twitter profile and doesn't rely on news articles to exist so it will always provide results where an internet search may not.

S23-68

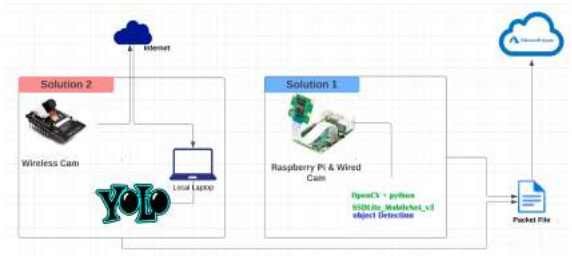
***Title**: Library Occupancy Detection System*

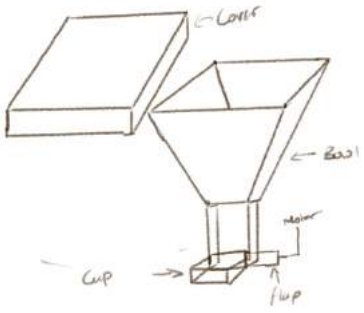
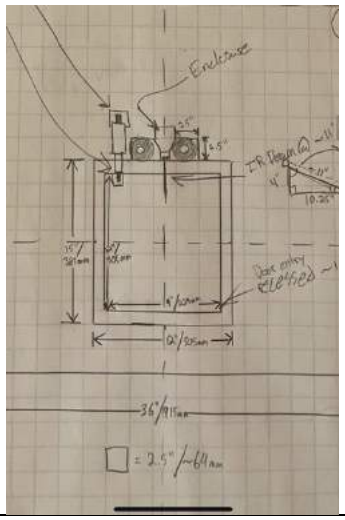
***Team Members**: Hasim Khawaja, Nickolas Chipoco, Arslan Tariq, Muhammad Khan*

***Adviser**: Prof. Athina Petropulu*

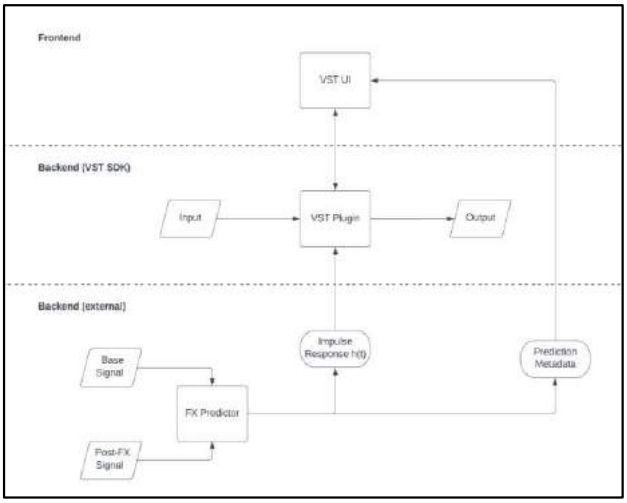
Keywords Facial Recognition, Microsoft Azure, YOLO, Web Development, Machine Learning

Abstract Finding a vacant study spot on campus can be a time-consuming and frustrating task, especially as many campuses face issues with overcrowding and a lack of physical study spaces for students. With more students returning to campus after the COVID-19 pandemic, this problem must be addressed. The Library Occupancy Detection System aims to solve this problem by scanning each room of the library and providing occupancy levels to an application that students can access from their smartphones. The system employs hardware to gather live data, cloud infrastructure to store the data, and an application to display the processed data to end users. Two deep learning models, Mobile Net SSD and Yolov5, process raw video streams, which are hosted on web servers. The models output a dataset at a frequency of three to eight entries per second, which is then filtered using advanced algorithms and uploaded to Azure storage accounts.Compared to alternatives on the market, our approach is low-cost, scalable, secure, and power-conserving. Our system uses inexpensive hardware, scalable data storage, and dynamic webpage templates, making it easy to use and scale in the future. To protect sensitive user data, we employ data distortion techniques that render any transmitted data useless to attackers. Additionally, our device is designed to be power-conserving, using various models that determine when to activate and shut down the hardware. We are confident that our approach, with its many benefits, will successfully address the problem of library occupancy detection. By providing students with real-time information on available study spaces, we aim to enhance their campus experience and increase productivity.



S23-69	***Title***: *AutoDog* ***Team Members***: *Zachary LeMunyon, Loveraj Singh, Jay Patel, Arooba Yusuf, Kareem Fathalla* ***Adviser***: *Mehdi Javanmard*
Keywords	Motion Sensors, Audio Systems, Dispensing Systems, Automated Motors
Abstract	Our project aims to tackle the challenge of enabling dogs to access their own backyards for bathroom breaks when their owners are not present. Leveraging our expertise in circuitry, electronics, and command prompting, we plan to develop a self-sufficient device that caters to both the user and the dog, ultimately resulting in an automated pet door that is safe and functional for unattended use. The proposed pet door will operate using an infrared motion sensor mechanism. It will be programmed to open at a predetermined time and close when the dog successfully enters the house. The system will be adaptable for multiple dogs, allowing owners to customize the settings according to their preferences. To motivate the dog to use the door, we will incorporate a treat dispenser that releases a small portion of treats. This dispenser can be filled at the beginning of the day, ensuring that the dog receives a treat as a reward for using the pet door. To further enhance the functionality of the pet door, we will integrate a voice recognition system with speakers. These speakers will play specific sounds to encourage the dog to enter through the door. The voice recognition system will be designed to effectively persuade the animal to use the pet door with ease. Our project seeks to revolutionize the field of dog ownership by providing a solution that allows dogs to use the bathroom even when their owners are not home. This device makes pet ownership more convenient and ensures that the dogs can comfortably use the bathroom even when unattended.  

S23-70	***Title**: Adaptive Guitar Tone Using ML Impulse Responses* ***Team Members**: Sunny Chen, Jimmy Li, Pranay Musalimadugu, Sterling Shieh* ***Adviser**: Anand Sarwate, Gregory Rossetti*
Keywords	Guitar FX, VST Plugin, DSP, ML, Live Music
Abstract	Virtual Studio Technology (VST) is an audio plug-in software interface that integrates software synthesizers and effects units into digital audio workstations. VST and similar technologies use digital signal processing to simulate traditional recording studio hardware in software. Guitarists often use VST plugins to replace physical effects pedals. In combination with a Digital Audio Workstation (DAW), VST effects can accurately emulate a wide variety of amplifiers, speaker cabinets, and pedals. The objective of this project is to accurately replicate a variety of tone presets from several signal chains. Currently, creating a tone preset involves expensive plugins that simulate one specific element of a guitar signal chain at a time. Identifying a tone preset from a song is a considerable challenge as a guitarist or producer. Researching the exact pedals and amplifiers or using a similar plugin is expensive and time consuming, and signal chains vary in complexity from two components to hundreds. This VST will integrate with the base SDK provided by Steinberg and incorporate a range of effects until several target songs are replicated, from most simple to most complex. Modern AI audio processing technology can isolate instruments from a song and utilize impulse responses to accurately copy the tone exactly. In the music community, there is a large market for custom VST plugins, and an automatic tone matching VST will be a great tool in any guitarist or producer's toolbox.



S23-71

***Title**: GLOVE-CONTROLLED DRONES*

***Team Members**: Andy Lau, Kyle Sia, Chris Caggiano, Zhentao Hu*

***Adviser**: Dr. Dario Pompili, Chuangneng Sun*

Keywords Drone, Glove, Control

Abstract

Nowadays, drone control is a relatively mature technology. People usually use joystick devices to control the movement of individual drones. The joystick device can certainly help people transition from manipulating games to maneuvering drones, but this mode of manipulation is quite limited at the high-level. There are unique benefits to using a glove, not to mention the versatility and intuitive nature of using your hand to give directions. To demonstrate these benefits, we intend to upgrade the drone control technology by replacing the joystick device with the glove device.

In order to demonstrate the real-world benefits of high-level drone control, our project proposes to develop a wireless glove that can control a drone swarm. Possible use cases for this technology would be endeavors like search-and-rescue or any other scenario where the user must scan a large environment.

The glove senses the bending of the user's fingers through five flexible sensors and receives data on the bending of the fingers via the Arduino Nano. The data is then converted into corresponding flight instructions and transmitted to the drone swarm via the wireless transceiver module. Compared with the current mainstream way of using joysticks to control drones, the project can control drones by tracking the user's gestures. Gesture-controlled drones increase the number of transmitted flight commands (up to thirty-one gestures) and enable personalized design. This means that users can modify gestures corresponding to the drone's flight behavior or their own intuition.