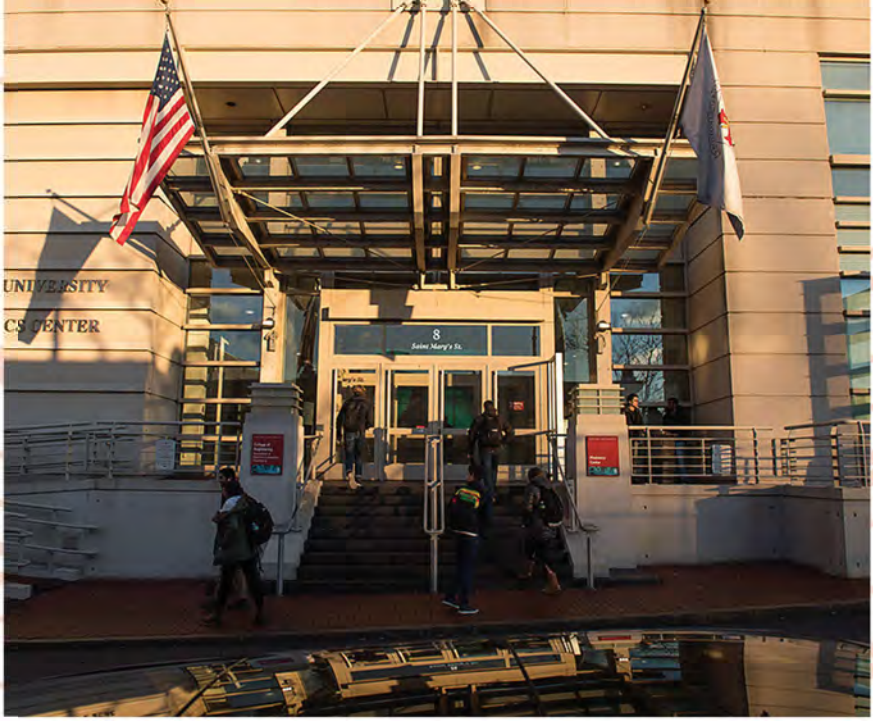
BOSTON UNIVERSITY

ECE DAY

2021



DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

The Boston University Department of Electrical & Computer Engineering (ECE) prepares students to be Societal Engineers for the 21st century.

The ECE academic experience is guided by respected facuity members, cutting-edge facilities, a diverse student body and an emphasis on university-wide interdisciplinary research. After establishing a strong engineering theory foundation, students enhance their understanding by developing technical skills. Seniors graduate with experience in mobile/cloud computing with security, intelligent computation and data science, image and optical science, nanotechnology and bioengineering.

This combination of practical and theoretical education ensures a breadth of experience in innovative problem solving and exploration that will prepare students for careers in industry, academia, and government.

SENIOR DESIGN

The ECE Senior Design Capstone course serves as an opportunity for students to execute the education they gained in the classroom to produce prototypes for real-world clients. Student teams serve volunteer customers drawn from industry, government, small businesses, non-profits, schools, artists, faculty, and staff. The course offers:

Technical, communication, personal, and team skills needed for successful design in electrical and computer engineering.

Knowledge of specifications and standards, information collection, design strategies, modeling, computer-aided design, optimization, system design, failure, reliability, and human factors.

Proficiency in oral and written communication of technical information.

Understanding of team dynamics and ethical issues in design.

Experience in completing a design project for a small-scale electrical or computer system.

ECE DAY AWARDS

Best ECE Senior Design Project Award

Design Excellence Award

Michael F. Ruane Award for Excellence in Senior Capstone Design

Entrepreneurial Award

Team 1 - Fillinda

Angela Vellante

Syed Ghazanfar Yezdan

Kathleen Wong

Nicole Elbeery

Client: Student Defined Project

Modern-day translation services are overpriced, outdated, ineffective, inaccurate, and the list goes on. In the United States specifically, much of our population is made up of non-native language speakers that are learning English as they go on with their hectic 21st century lives. The form-filling process is difficult enough as a fluent English speaker, let alone for those that are still learning the language. Whether it's W2 forms, job applications, visas, medical documents, etc., the accuracy of the information imputed is crucial. How can accurate information be translated into the forms when the language itself is not understood? These forms are vital to the success and well-being of our citizens and we want to help make this process as easy as possible by alleviating some of these pain-points. Our goal for this project is to create a platform that allows users to translate forms into their own language, fill in their information, and then translate them back into the original language. At its core, our project is a language translation platform; the bigger picture, though, is to create an accessibility platform tailored to those disadvantaged in the form-completion process. We plan on beating the top translation accuracy rates by achieving 87% or higher accuracy level. To do so, we will focus strictly on English to Spanish translations and eventually work up to many more. The need for our project is not going away any time soon. The language barrier between people in our country and around the world is a serious problem that needs to be recognized. We are certain that our project, Fillinda, is an ideal starting point for us to chip away at this and help as many people as we can to acclimate into the United States.

Team 2 - BLINKAH

Ritam Das

Raghurama Bukkaraysamudram

Will Pine

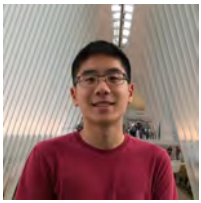
Ayush Upneja

Parker Van Roy

Client: Student Defined Project

WE ARE BLINKAH: Revolutionizing the Road
BLINKAH is a leader in lateral thinking with our disruptive behavior-based-insurance-as-a-service (BBI-AAS) platform that engineers solutions to urgent pain points in our society. We enhance road safety and eliminate statistically proven policing biases. Leveraging proprietary edge computing machine learning algorithms in an IoT system with 4G LTE telecommunications, BLINKAH Dashcam Head Units are able to identify erratic drivers in real time, aggregate contextual information, and send reports to the BLINKAH Cloud. Using these key performance indicators, the BLINKAH Cloud conducts deep behavioral analysis on drivers in a robust big data computing environment and distributes these findings to insurance companies, emergency services, and other relevant entities through a REST API and data visualization tool known as the BLINKAH Computational Frontend (BCF). BLINKAH makes a social impact by incentivizing safe driving and solving non-emergency concerns through appropriate organizations, thus, reducing the risk of racial profiling that results in rampant police brutality and reinforcing road safety. "USE YAH BLINKAH!"

Team 3 - ConnectBU



Benjamin Chan

Damani Philip

Hussain Albayat

Nadim El Helou

Yousuf Baker

Client: Student Defined Project

BU students lack personalized academic/professional/extra-curricular advising resources—it's difficult to meet other students to ask for advice. Support is often decentralized and up to the student to parse from distributed resources (clubs, faculty, events, etc). Connect BU is a platform that seeks to democratize access to personalized advising by allowing students to search and connect with each other based on school/major, clubs, classes, research, and interests. The final deliverable will be the minimum viable product (MVP) of a web app that delivers this experience by allowing students to search by these criteria, and to connect through a built-in messaging functionality, all while maintaining security and privacy of student information. This webapp is built (different) modularly by integrating a variety of cloud microservices to create a robust, responsive, resistance-free, and REACTive user experience. The main innovative feature is the search functionality, which allows for a granularity in search criteria not often found in general use platforms, the profile information fields, and overall architecture, UX, and UI.

Team 4 - Ariel - Autonomous Coral Reef Monitor

Anirudh Watturkar

Constantinos Gerontis

Mrinal Ghosh

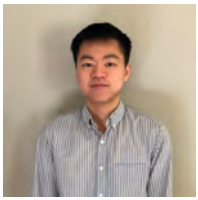
Prudence Denise Aquiatan

Sean Nemtzow

Client: Student Defined Project

Due to the effects of global warming and pollution, coral reefs are rapidly dying, which is destroying the habitats of many aquatic animals. Current methods to monitor the health of coral reefs are laborious and unscalable due to their reliance on divers. To assist marine biologists and conservationists in their efforts to monitor and restore the coral reefs, we propose an autonomous aquatic vehicle, Ariel, which can routinely measure the water quality around and image a specified area of the reef. Ariel will be able to provide color-corrected images of the coral reef as well as metrics such as pH, temperature, and turbidity each minute. Ariel is intended to increase the efficiency of conservation teams by reducing surveying time and cost.

Team 5 - RE3 (Reproducibility, Reusability, Readability

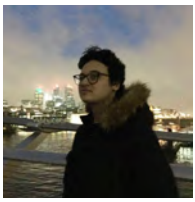


Ethan Hung

Andreas Francisco De Melo Oliveira

Jyotsna Penumaka

Layan Bahaidarah



Lukas Rosario

Client: Ana Trisovic, Harvard Dataverse

An essential part of research and scientific communication is the researchers' ability to reproduce results found in other publications. While there have been increasing standards for authors to make data and code available, many of these files are hard to re-execute in practice, leading to a lack of research reproducibility. This poses a major problem for enthusiastic students and researchers in the same field who cannot leverage the previously published findings. We propose an open-source platform that helps improve the reproducibility and readability of research projects involving R code. Our service involves assessing code readability through a machine learning model that was trained on a code readability survey deployed on the platform, and an automatic containerization service that executes the code files uploaded by the user and warns them of any reproducibility errors. By doing this, researchers would ensure the reproducibility and readability of their projects and therefore fast track the process of leveraging research results.

Team 6 - Selfie Drone and Sports Drone

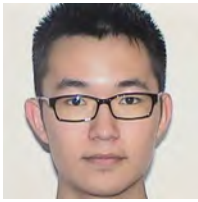
Yuxuan Chen

Shihao Xing

Zhijun Xiang

Yaopu Wang

Yibo Hu



Junyu Zhou

Client: Student Defined Project

The nature of the problem is to provide 2 different drones to solve the user's selfie problem and record the movement moment. We expect that our major project deliverables will include the following: Selfie drone will include: foldable physical design, portable size, and light material, sign language recognition, high-power flashlight for selfie-taking, optical flow sensor for position adjustment, controller-free, fast charging. Sports drones will include: foldable physical design, portable size, and high-resolution camera follow the user by face recognition, fast flight capability, controller-free, fast charging. Our suggestion is to use an optical flow sensor and gesture recognition to control the selfie drone to achieve the goal and use hand recognition to complete the function of the sports drone. What makes us different and innovative from the other drones is that they don't require remote control and can be rolled up and carried in a pocket.

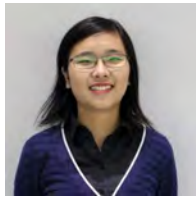
Team 7 – EMPHY

Hussain Valiuddin

Rahul Rajaram

Soumya Nag Suman

Saahil Sood



Yuqi Zhu

Client: Professor Eshed Ohn-Bar

People with visual impairments are often dependent on others for obtaining surrounding information, travel, and performing everyday tasks. Those individuals who are blind or otherwise have impaired ability to navigate often use guide dogs to get around, however, this is not always a practical solution and in the new world of social distancing, a sighted guide may not be suitable either. Assistive technologies can therefore significantly improve the quality-of-life of such individuals by augmenting their navigation ability and providing real-time situational awareness. Despite the promise and immense societal impact of such devices, their existing use is narrow, and their development cost prohibitive, ranging in the thousands of dollars. EMPHY is a fully student-imagined project that has successfully created an autonomous self-driving robot with scalable, cost-effective indoor navigation technology for businesses/public buildings interested in increasing accessibility and for impaired peoples that need a guide at home. Activation is easy, as the robot can understand voice commands to go to key locations in the mapped area and tracks its journey to successfully self-localize at any point in time. EMPHY senses and moves around obstacles, providing vibration feedback to the user through a "leash" that allows them to be more situationally aware than simply using a cane. Most importantly, the total cost of EMPHY is only $150, about the cost of a wheelchair. The future possibilities for EMPHY go beyond a navigation aid for humans, as this autonomous building navigation technology can be implemented for indoor delivery robots, telepresence bots, robot waiters and much more.

Team 8 - MicroGrid

Anthony Biondo

Angela Rodriguez Hernandez

Brian Macomber

Panagiotis Siozios

Michael Kremer

Client: Student Defined Project

The usage of energy has become more and more prevalent in our daily lives. Team 8 has acknowledged that here is a huge need for clean energy but there is not an easy means to mitigating this issue. MicroGrid Energy wants to give these owners a way to provide tenants with an alternative to electrical energy while also creating a re-turn on their investment. Our goal is to construct a solution that can benefit the masses while also having a niche approach and application. Upon completion of our design, we seek to create a product that targets property owners who want to battle climate change.

Team 9 - Language Bear

Ece Ari

Ece Sureyya Birol

Gabriel Ramos

Norman A. Toro Vega

Raymond Oscar Lim

Mouzhes Yoweni

Client: Student Defined Project

Language Bear is an interactive language-learning toy for children between the ages of 3 and 7. It caters to young kids who want to learn a new language through the use of repetition and special RFID sensor-enabled card packs to encourage the child's participation and interaction. Language Bear is composed of a programmable plush bear with RFID sensors that identifies flash cards, translates them, and speaks them out loud in order to provide an interactive experience. The translations and text-to-speech functionalities are handled entirely off-device by the Google Cloud API. Raspberry Pi modules inside the toy control the speakers, the E-Ink Display, and RFID technologies while being connected through a client/server platform on the Pi's. A Flutter-based iOS and Android app allows parents to set up the toy,configure desired languages, and keep track of educational learning analytics.

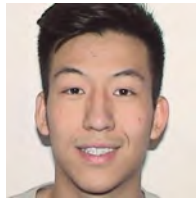
Team 10 - Perry - Walk With Confidence

Chasity Chavez

Elisabeth Garfield

Nnenna Eze

Patricia Ganchozo



Terry Zhen

Client: Student Defined Project

Perry utilizes a variety of API's and integrated hardware to cultivate the final product. The hardware consists of a base - the industry-standard white cane – with LiDAR sensors for object detection, vibration motors for haptic feedback, connected via bluetooth modules to the Perry iOS application. The iOS application utilizes OAuth2 authentication, which leads the user to three functionalities - voice command, powered by Apple's Siri developer tools, image-text-speech recognition, powered by Firebase ML vision, and GPS, powered by Apple's Mapkit Library.

Perry differs from other smart walking sticks out there due to its efficiently integrated design. While other products have separate devices for different purposes in helping the visually impaired, we aim to have Perry be a simple, easy to use, all in one device which will be able to make the basic act of walking be done with more confidence by those within the visually impaired community.

Team 11 - Stöd

Alexander Trinh

Camden Kronhaus

Quinn Meurer

Sharith Godamanna

Client: Student Defined Project

As team Stöd we are aiming to build a virtual platform where users of all backgrounds are empowered to engage in meaningful conversation. We envision Stöd to be an online forum where people come to converse with others about sensitive, uncomfortable, and even embarrassing topics without fear of judgement or scrutiny. On Stöd's forum interface users will be able to anonymously share their motivational stories, ask taboo questions, and make follow up comments and questions to other users' posts. Users will be able to keep conversations going by privately messaging individual posters and commenters. We will build out Stöd as a cloud-based web application with a React/Django/PostgreSQL stack and we will make use of AWS services to host our server(s) and database.

Team 12 - cpVision: A Novel Approach to AI-assisted Endoscopies

Zhengjiang Chen

Karim Khalil

Kevin Delgado

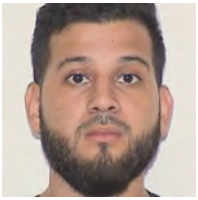
Ryan Schneider

Grayson Wiggins

Client: Eladio Rodriguez-Diaz and Ousama M. A'Amar

With all the great developments in A.I. technologies, it is imperative that we find ways to apply them to real-world scenarios. Currently, there is an industry-wide need for advanced tools that can aid colonoscopists with detecting polyps. The cpVision project aims to conquer this task by developing a clinical support device that can assist colonoscopists with the bowel-preparation assessments portion of their procedure. cpVision seeks to remove the inter-observer variability in bowel cleanliness scoring by utilizing state-of-the-art deep learning methods to accurately score a patient's gastro-intestinal tract. The final deliverable of the project will be a clinically-deployable device that interfaces with a colonoscopy video feed and generates real-time predictions of bowel preparation.

Team 13 - AR Remote



Ivan Barcenes

Myles Cork

Nikolas Smith

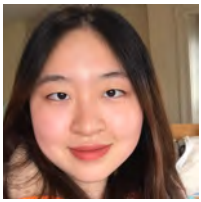
Salem Bugshan

Shazor Shahid

Client: rtangent (Tom Little, Emily Lam)

Consider staying at a hotel equipped with modern appliances such as smart lights, speakers, and climate control systems. It is likely guests may be unfamiliar with these devices and their methods of control. Our aim is to provide a solution which allows for the seamless control of several IoT devices available to a user through a phone app. We are developing a phone case and device tags that communicate with each other through a combination of IR and Bluetooth Low Energy in order to allow the user to easily locate and connect to these IoT devices. The control of the devices will take place in a mobile application which we are developing. The application will show the user's camera view and augment the controls of the IoT devices on the screen when detected. Our device will be able to work with a minimum of six IoT devices, three of which must be unique and their duplicates.

Team 14 - Smart Home IoT-Air Quality Detection for Clean Air



Yuting Chen

Roger Ramesh

Telma Zelaya

Youssef Atti

Muhammad Hazim Bin Ab Halim

Client: Pablo Ferreyra from BOSCH

The Smart Home IoT-Air Quality Detection for Clean Air is an Internet of Things based project which aims to provide air quality analysis inside the home. The IoT device will consist of a device with sensors to evaluate the air quality in a room. The data will be transmitted wirelessly to Amazon Web Services (AWS) and visualized on a mobile application. The device will connect to the AWS IoT Core and send data obtained from sensors via MQTT protocol. The data, which is then received on an MQTT broker, will be forwarded to AWS Kinesis as throughput to be stored in buckets on Simple Storage Service (S3). The data will then be retrieved from the AWS S3 bucket through AWS API Gateway to be visualized on the mobile application. The air quality will be determined by utilizing the Air Quality Index (AQI), ranging from 1 to 300. This project's hardware component will consist of a commercially available IoT board, the Arduino MKR1000, along with various Gas, Dust, Temperature & Humidity sensors to acquire the necessary data to calculate the AQI.

Team 15 – PCLD (Portable Carbon Dioxide Logging Device)

Alexander Rosenthal

August Bernhard

Jarek Bartel

Thachachanok Menasuta

Paul Adan

Client: Greg Blonder

In the wake of COVID-19, it is wise to avoid areas where many people have been breathing and raising aerosol levels. Knowledge of the CO2 levels in a classroom, office, or room can help people to make informed decisions about their potential risk of exposure to an airborne virus. The Personal Carbon Dioxide Logging Device (PCLD) allows users to determine the safety level of the room they are in as it relates to CO2 levels, as well view real-time and historical data of CO2 levels on a website. The PCLD uses an CCS811 CO2 sensor to accurately measure CO2 levels, and an ESP32 microcontroller to connect to WIFI and upload the data to a website. The PCLD also has an LED interface so the user can have an idea of the safety levels of CO2 in a room. Our device is unique compared to other CO2 measurement devices because it is battery powered and easily portable. This allows users to see data from all the different locations they took the device throughout their working day. Unlike commercially available carbon dioxide sensors which are wall-mounted or require a liquid and time to give measurements, our device is highly portable and gives instant measurements. Additionally, the device is easily reproducible, which makes it easy for people with some knowledge in engineering to produce one and add to the measurement network. The PCLD helps users to make better informed decisions about where to go, when to turn on some form of ventilation, or when to simply open a window.

Team 16 - ExploreSafe

Hongcheng Mao

Carlos Eduardo Lousan Padilha

Mohammed Alsoughayer

Neha Rai

Steven Tong

Client: Marissa Petersile

While nature is beautiful to explore and a great place for adventure, it also has a multitude of threats that an inexperienced hiker may be ill-prepared for. Having the knowledge to stay safe in the wilderness is thus very important for any potential hikers, but it can be hard to know what to know. The ExploreSafe team is determined to develop an interactive, user friendly and helpful application for hikers and nature lovers. The goal is to connect users to nature trails using automated data-fetching features, such that even with no prior knowledge of a desired region, users can go hiking without compromise. ExploreSafe will provide a mobile application capable of identifying paths, threats and helpful information with minimal effort from the user. Behind the scenes, a database and smart APIs will gather and analyze information to be displayed, tailored to the user in both iOS and Android applications with support for some embedded devices. ExploreSafe is intended to bring together hiking and accessible technology so that even those with no significant time or experience can learn to interact with, and love nature.

Team 17 - The Future of Heat

Andrew Chen

Benjamin Gross

Fatima Dantsoho

Muayad Al Riyami

Seunghak Shin

Client: Marissa Petersile, National Grid

As global warming is becoming more severe, non-renewable energy such as natural gas and oil is falling out of favor. Using natural gas and oil to heat homes and businesses only continues to accelerate the warming of our planet. One of the promising alternatives is using electricity for heating. So we were tasked by National Grid to create an educational model that will teach the public about the benefits of electric heating and how it will affect grid systems in the future. The final deliverable is a 3 feet by 3 feet diorama with built-in electronics which will be accompanied by an interactive web application. We decided to focus on heating simulations that would behave accordingly to the user inputs and programmed into the microcontroller. The outputs will be displayed using LEDs on the diorama as well as through the web application on the user's screen. A major innovative feature of this project is that it accommodates for the safety protocols regarding the pandemic by creating a contactless but interactive learning experience. Users can simply scan the QR code with a mobile device and use the web application to interact with the diorama to learn about the future of heat!

Team 18 - Greener Living

Ali Areiqat

Yang Hang Liu

Jason Hu

Jovany Vazquez

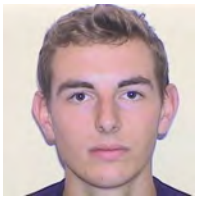
Brian Lin

Client: Professor Anna Swan

With the rise of many environmental issues in the 21st century, it is more important than ever to reduce our individual carbon footprint. By having access to one's utility usage at all times, it becomes easier to make energy-efficient decisions without relying solely on the monthly bill. The final deliverable for the project consists of sensors that log relevant data about the client's household, a database that stores the information collected, and a web application that visualizes the data using graphs and charts. Our approach is to install a monitor and sensors to measure the home's energy at a constant rate throughout the day. Then, using the home's local network, they will write the data to our database, which our web application and other tools will be able to access to provide an end-to-end product. The main feature of this project is the system's ability to update at a constant rate, providing accurate information whenever the client uses the web application. As a result, the client can see a more detailed analysis of their energy usage than they would get from their monthly bill.

Team 19 - Imager

Alexis Gonzalez



Arnaud Harmange

Joshua Bone

Nuwapa Promchotichai

Client: Professor Vivek Goyal and Sheila Seidel

Imager is a mobile application that utilizes cutting-edge algorithms which enable the user to see around corners using their mobile phone. This technology, called non-line-of-sight (NLOS) imaging, has been demonstrated in laboratory settings with controlled lighting environments, but never in real-world environments. This particular variant of NLOS imaging detects the light that bends around corners and forms a pattern on the floor just before the wall ends, called a penumbra. We will perform this detection with nothing more than a mobile phone camera, and implement the reconstruction algorithm on the phone's hardware.

Team 20 - MenuNav

Shreya Banga

Kaito Yamagishi

McKenna Damschroder

Se'Lina Lasher

Vanessa Giron-Berganza

Client: Rtangent

Visually impaired or blind people have a difficult time navigating, selecting, and placing orders at restaurants without the assistance of seeing companions. The purpose of the MenuNav project is to design and build a mobile application that will empower individuals in the visually imparied community to independently order their own food and beverages without the aid of a companion or waiter/ waitress. MenuNav will use machine learning to parse menus provided by menu uploaders and allow its users to navigate through the menu utilizing various accessibility features, including the ability to read out-loud the text displayed on the screen to the visually impaired user, accept the user's audio commands, and store a shortlist of food items a user finds interesting. The application will have a system for menu uploaders to easily import various menus, organize any menu through ontology, and utilize a cloud server to maintain and host these menus. The features implemented are designed to give the users the best experience possible when using the application. These features include but are not limited to, optical character recognition (OCR) that immediately converts images of a menu into machine-encoded text, text-to-speech (TTS) that allows text shown on a mobile device to be read out-loud to the user, and user preferences.

Team 21 - CovidNet on the MOC with Power9

Mario Han

Jonathan Cameron

Hayato Nakamura

Jianyu Ni

Zongxin Cui

Client: Rudolph Pienaar

Hospitals are faced with the reality that they are not appropriately equipped to carry out high-performance computing, which would be hugely beneficial to their operation. Through the implementation of Covid-Net on the MOC (Massachusetts Open Cloud) with Power9, we will give them this computing power. Our final deliverable will be a single workflow that is run on the ChRIS platform, capable of producing a listing of Covid patients in order of severity. This workflow will run on the MOC and will utilize the MOCs x86 64 and Power9 architecture. We deploy the Covid net on Massachusetts Open Cloud to reduce the hardware requirements. We use the ChRIS platform so that the application can be utilized easily by the medical professionals. We use med2image plugins to directly utilize medical scan, and utilize pdf generator plugin to present the result of Covid-net in an easily understandable way.

Team 22 - ContextCheck

Bayard Eton

Ye Chen

Sadie Allen

Sean McDonald

Client: Zachary Lasiuk

The proportion of Americans who read and interact with news in an online format has been rapidly increasing in recent years. Companies who curate online news content such as Facebook, Twitter, and Google use machine learning algorithms to maximize the amount of time that users spend on their platform. These algorithms often push false, misleading, and extreme information that reinforces people's existing views and increases political polarization. The goal of ContextCheck is to defuse the increasing societal tension inflamed by social media algorithms with another algorithm. Our system will provide information to readers about the source and article they have selected and output a "bias measure" based on the linguistic features of the article. We will surface this algorithm through a web application.

Team 23 - OpenStack Manila

Mark Tony

Nicole Chen

Ashley Rodriguez

Client: RedHat, Inc.

OpenStack Manila is an open-source Shared File System service that exists within the OpenStack cloud. It is a collection of microservices and other components that provide self-service management of elastic file system storage infrastructure. Manila allows the user to work with and provision storage via 30+ storage technologies over file system protocols. Manila also makes use of RESTful semantics in consuming shared storage in a reliable and scalable manner. Currently, OpenStack is developing a centralized client and SDK that incorporates multiple software packages exposed on the OpenStack Cloud. The final deliverable of our project is to develop the foundations of Manila support in the OpenStackSDK so the service can be used by the OpenStack community.

Team 24 - FlyJus Tethered Wind Turbine

Jaden Cho

Henry Bojanowski

Christopher Lemus

Not Pictured: Brendan Slabe & Stephanie Pellicane

Client: Brian McCleary

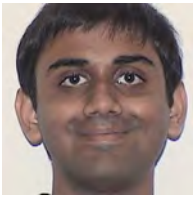
The objective for this project is to create a program that will simulate a drone in a given environment and calculate the amount of power generated by the mechanical energy of a drone pulling on a tether line which is then converted to electrical energy via an electric motor on the ground. This program is designed to calculate the power generated by the drone in real time and help determine what maneuvers provide the largest power generation in a given environment. This program will aid in achieving a new form of renewable energy that has the potential to eradicate the enormous costs associated with building traditional wind turbines. By testing and simulating a various number of flight paths, the program will determine which is the most efficient in generating power via the tethered drone. Having a low-cost alternative green energy source is what will create opportunities for future generations that don't have reliable power, especially because the ideal deployment location for the drone is in environments without a pre-existing grid connection. Areas without this infrastructure tend to be less developed, meaning this project, providing power, has the opportunity to improve economic prosperity. It also can give communities around the clock access to learning that requires light such as reading and writing, which can improve education and quality of life.

Team 25 - Remote Vision Robot

Jayden Tayag

Nicholas Bart

Nikhil Gupta



Purvis Amin

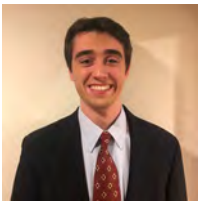
Ryan Verdile

Client: Mindcoord Inc.

In modern times, many work and education related environments have become remote. With this change, there are also difficulties many people have adjusting to these remote environments. Our goal is to create a way in which these remote environments and people could be better connected. We plan to accomplish this goal by creating a remote surrogate robot head. This includes a camera-equipped, motorized robot and a VR headset that a person can use to immersively view a remote location. Existing examples of relevant technology include the Double Robotics telepresence robot and the OhmniLabs telepresence robot. These systems are essentially webcams-on-wheels, allowing the user to navigate and view a physical space, control the robot by clicking, and communicate with others. In contrast, our project focuses on creating a robot head, controllable by using a VR headset, to enable immersive viewing of a remote location. More specifically, the robot head will move along the pitch, yaw, and roll axes to mimic the rotation of the human head. This head can then be mounted to other systems. The goal of our project is to demonstrate a far greater degree of vision and viewing immersion by utilizing virtual reality, with the capability to be mounted to a system that, for example, could navigate a physical space. Our project extracts a VR headset's movement data to drive three stepper motors simultaneously and move the camera around according to the VR headset user's movements. The camera includes a wide lens to mimic human vision with video viewable from the VR headset. The final deliverables will include a camera equipped robot, capable of rotating the camera with three degrees of freedom, controlled by the virtual reality headset, programmed in Unity software. This includes code for the transmission of data and control of the motors, code for the camera projection onto the headset, and a prototype robot structure containing the hardware capable of rotating the camera as needed.

Team 26: The Room Clutter Application

Hanming Wang



Luke Staib

Sara Hamdy

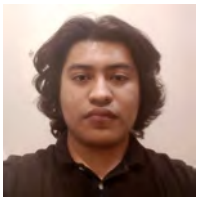
Iker Zamora Algorri

Client: Professor Janusz Konrad, Professor Jordana Muroff

Hoarding and high levels of room clutter are often disregarded symptoms of an underlying mental health condition, and a cluttered living space poses many health and hazard risks. Professor Konrad and Professor Muroff have developed an AI-based algorithm to estimate the Clutter Image Rating (CIR) of a room. This project aims to build a mobile application for image collection to improve this algorithm. The project also aims to make the algorithm widely available through an advanced mobile application for the purpose of building a database for mental health assessment. The project also aims to aid property management and emergency response decision making, as well as provide a platform for healthcare professionals to contact patients who may potentially need treatment.

Team 27 - Smart Agriculture Sensor Network

Benjamin Livney



Emanuel Perez

Maxine Loebs

Noah Spahn

Sergio Pareja

Client: Eugene Kolodenker

Farming is paramount to society. Throughout history, as global populations have increased, farming methods have had to improve to keep up with growing demand. Today, the situation is no different – with more and more mouths to feed, farmers are looking to modernize their practice and adopt technologies that can help them boost crop yields, reduce waste, save money, and stay afloat among industrial-scale agricultural corporations. To address this need, we will be developing a fully-functional agricultural sensor network, which reports data about specific locations on the farm back to the user in the comfort of their farmhouse. We have come up with a detailed plan to realize our design. The backbone of our final product is our sensor nodes. These will contain our selected sensors, a micro-controller equipped with a radio transceiver, and the required hardware to supply power to all of the electronics inside. All of the components will be put into a weatherproof enclosure. All of these nodes will be connected together in a scalable LoRa mesh network. The data from all of the nodes will be pooled into a single gateway node, which will then send compiled data to our web console. Our web console will present this live data in a neat, readable format. There are other agricultural sensor networks on the market, but our product will include a number of innovative features that make it stand out, such as energy harvesting, and the use of a wide variety of sensors to paint a full picture of many conditions out in the field.

Team 28 - SITA Speech Interactive Therapy Application

Alyazyah Almarzooqi

Celia Wilkins

Taqiya Chowdhury

Vivek Cherian

Client: Dr. Andrey Vyshedskiy

Nearly 40% of children with Autism Spectrum Disorder (ASD) have language delays. Early interventions can decrease difficulties with communication and social behavior, which will yield positive results for both the child and caregiver. Speech Interactive Therapy App (SITA) is designed to be used simultaneously by the caregiver and child to help develop the child's communication skills in an engaging manner. Parents or caregivers will have the opportunity to utilize SITA for multiple children and record words or phrases for them to learn. Furthermore, parents will monitor each child's progress through an activity log, which will streamline the child's personalized learning. For every recorded video, there will be a voice matching algorithm that scores the child's attempts, by analyzing the least squares difference between the envelope of the child's recording and that of the original. Because of this feature, SITA extends its accessibility to non-English speakers. The aim of this project is to finalize an Android and iOS compatible application using Unity3D for our client's company, ImagiRation, that will measure the child's pronunciation progress with visual rewards.

Team 29 – Starobike

Brandon Miller

Jonathan Hall

Joshua Taylor

Benjamin Laskaris

William Holden

Client: Professor David Starobinski

In 2020, more commuters in urban areas are using bicycles than ever before. With more cyclists sharing the road with cars, there is a higher risk of accidents that could cause serious injury. Starobike is building a safety device that bikers can carry in their backpacks that will alert nearby vehicles of potential collisions. This system will leverage the nascent C-V2X (Cellular Vehicle to Everything) technology and use software defined radios to allow fast and reliable communication between bicycles and cars. The final product will be two modules, one for a bike and one for a car, that communicate with each other to detect three different common accident scenarios before they happen. This product aims to give those who ride their bikes everyday peace of mind and a new confidence when sharing the road.

THESIS STUDENT

Luisa Watkins

Advisor: Professor Vivek Goyal

Mitigating Current Variation in Particle Beam Microscopy

Particle beam microscopy (PBM) uses a scanning beam of charged particles to create images of samples, but the quality of image reconstruction suffers as this beam current varies over time. Neither conventional reconstruction methods nor time-resolved sensing acknowledges beam current variation, although through sensitivity analysis, my project demonstrates that when the beam current variation is appreciable, time-resolved sensing has significant improvement compared to conventional methods in terms of image reconstruction quality, even for low secondary electron yields. To more actively combat this unknown varying beam current's effects, my project further focuses on designing algorithms that use time-resolved sensing for even better image reconstruction quality in the presence of beam current variation. These algorithms work by simultaneously estimating the unknown beam current variation in addition to the underlying image, offering an alternative to more conventional methods. Using these robust methods, beam current variation can be mitigated, allowing for higher quality image reconstruction and potentially less expensive equipment in the future.

SENIOR DESIGN FACULTY

ALAN PISANO Associate Professor of the Practice

Dr. Alan Pisano received a Ph.D. in electrical engineering from Northeastern University in 1974. He retired from General Electric in January 2010 after a 39 year career there in both Power Systems and most recently Aircraft Engines. There, he was responsible for numerous advanced controls technology programs and held a variety of managerial positions including Manager of Turboshaft/ Turboprop Controls and Manager of Advanced Controls Technology and Planning. After retiring from GE as a Department Staff Engineer, he was appointed to the full-time faculty in the ECE Department at Boston University as Associate Professor of the Practice. He is currently the lead professor and course coordinator of the capstone Senior Design course in ECE and also regularly teaches courses in control systems and electric energy.

OSAMA ALSHAYKH Lecturer & Asst. Research Professor

Dr. Alshaykh is CEO of NxTec. He was CTO of Packetvideo corporation, Scientist at Rockwell and Visiting Researcher at UC, Berkeley. Osama received a Ph.D in Electrical and Computer Engineering from Georgia Institute of Technology in 1996. Osama received Fulbright Scholarship and served as associate editor for IEEE Transactions on Circuits and Systems, Video Technology. He served as a consultant, board member and advisor for several companies and groups.

MICHAEL HIRSCH Research Scientist

Dr. Hirsch is a remote sensing and scientific computing expert. He is an active code contributor to fundamental software packages including CMake, Python, HDF5, cURL, Ninja, LAPACK, Scalapack, Meson, Astropy, Numpy and Scipy. He is co-inventor and contributor to patented, commercialized techniques yielding over $100 M valuation.

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THANK YOU, CLIENTS

Thanks to all who suggested problems, encouraged their student team and challenged the seniors with their real-word engineering needs.

THANK YOU, ALUMNI JUDGES

Special thanks to ECE Alumni, who took time from their schedule to be with us today.

THANK YOU, ECE & ENG STAFF

ECE Staff worked countless hours to support the year-round needs of the senior design projects, and to coordinate the culmination event, ECE day.

THANK YOU, STUDENTS

Finally, thanks to all the seniors-who did the work over the approximately 240 days since they first arrived in EC463.

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