ROARING INTO
our
20TH
ANNIVERSARY

FRED AND HARRIET COX
SPRING
DESIGN
AWARDS

presented by
HOWARD R. HUGHES
COLLEGE OF ENGINEERING

MAY 8TH
2020

UNLV | HOWARD R. HUGHES
COLLEGE OF
ENGINEERING

Fred and Harriet Cox

SENIOR DESIGN EXPERIENCE

Part of every UNLV engineering student's academic experience, the Senior Design project stimulates engineering innovation and entrepreneurship. Each student in their senior year chooses, plans, designs and prototypes a product in this required element of the curriculum. Working in teams, the senior design project encourages students to use everything they learned in their academic program to create a practical, real world solution to an engineering challenge.

BEYOND THE CLASSROOM

Because of the requirement to work in teams, students also build good communication skills, presentation skills, and even business writing skills. They also have to source and purchase the materials for the prototypes themselves, giving them real-world budgeting experience.

REWARD AND RECOGNITION

A team of industry judges choose winners in each category based on innovation, commercial potential, presentation quality and sustainability. A cash first prize and second prize are given in each discipline, as well as a grand prize. Through the generosity of patrons Fred and Harriet Cox as well as award sponsors, the College of Engineering reimburses teams for the costs associated with the creation of their prototype. This ensures that teams are not working under unfair financial constraints, but have the resources they need to excel.

TAKING IT FURTHER

Senior Design teams are offered the opportunity to partner with MBA students from the Lee Business School to create a business plan as part of the MBA curriculum. This collaboration has led to great success at competitions such as: the Governor's Cup, and the subsequent creation of many successful businesses.

Students wanting to take their projects to the next level are offered support from UNLV's Research and Economic Development team to pursue a patent for their prototypes. Additionally, engineering alumnus Chad Miller offers pro bono services to assist students in filing provisional patents on Senior Design projects.

GET INVOLVED

Teams often get project ideas from industry partners or friends of engineering who have an interesting problem or concept they would like to submit. Teams may also be looking for an industry mentor or coach to help them throughout the year as they work on a project.

Industry partners and individuals are also offered the experience of sponsoring an award category. To find out what categories are available, or for other sponsorship information, contact Molly Marks, Director of Special Events, at molly.marks@unlv.edu or (702) 895-3281.

THANK YOU TO OUR GENEROUS SPONSORS!
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GRAND PRIZE

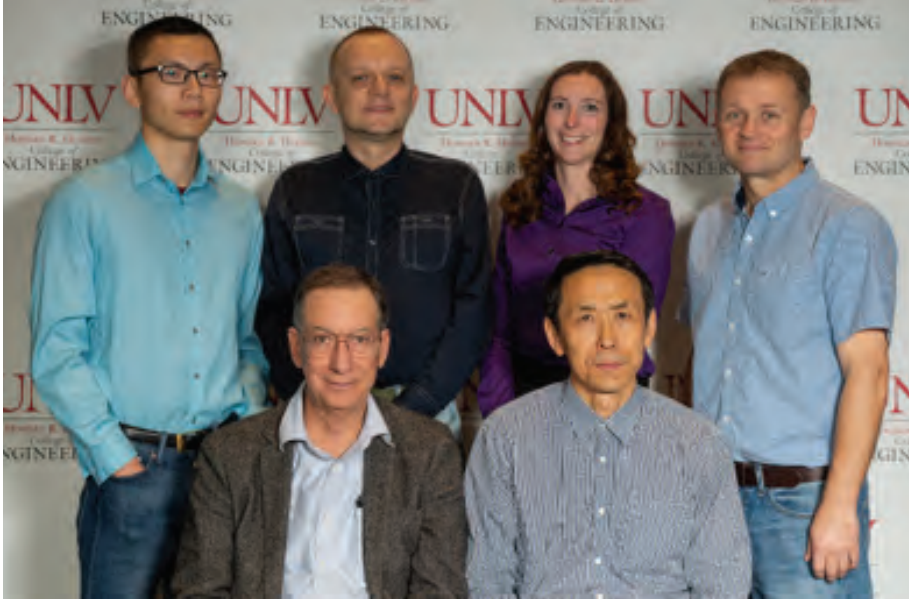## CATEGORY SPONSORS

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Thank you,
Senior Design Instructors!

Civil & Environmental Engineering & Construction
Dr. David James

Computer Science
Dr. Andreas Stefik

Electrical & Computer Engineering
Dr. Grzegorz Chmaj (Spring)
Dr. Ming Zhu (Fall)

Entertainment Engineering & Design
Dr. Grzegorz Chmaj (Spring)
Dr. Ming Zhu (Fall)
Dr. Melissa Morris (Spring)
Dr. Zhiyong Wang (Fall)

Mechanical Engineering
Dr. Melissa Morris (Spring)
Dr. Zhiyong Wang (Fall)

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Spring 2020 Senior Design Judges

WESTON ADAMS
President & CEO of Western States

Weston Adams is President and CEO of Western States Contracting, a vertically integrated civil construction company located in North Las Vegas, NV. As a licensed General Contractor and Developer in multiple states Weston has completed projects in Nevada, Utah, Arizona, Texas, Colorado, Pennsylvania and Wyoming. Mr. Adams was the Chief Construction and Facilities Officer for Core Scientific, a leader in the AI and Blockchain industries, from 2018-2020. He holds a Bachelor of Science in Finance from the University of Nevada Las Vegas and is an active board member of the Young Presidents Organization.

TONY ANTONELLI
Artemis II Mission Director for the Orion Program

Tony Antonelli is the Artemis II Mission Director for the Orion Program within the Civil Space line of business for Lockheed Martin Space. In this leadership role, he is responsible for helping to synergize and expedite the human exploration strategy through the development and integration of both science objectives and human exploration goals. His efforts contribute to shaping a definitive path for sustainable human missions to Mars.

Tony is a retired Navy Captain and former NASA Astronaut who has accumulated over 4,700 flight hours in over 40 different kinds of aircraft and served as the pilot for two Space Shuttle missions: STS-119 and STS-132. While serving at NASA, Tony's leadership roles within the Astronaut Office included the Space Launch System, Commercial Crew, Capsule Communicator (CAPCOM), and Space Shuttle Propulsion.

As the Astronaut Office Lead for Space Shuttle Propulsion, Tony was responsible for all four project elements: the External Tank, Space Shuttle Main Engines, Solid Rocket Motors, and Solid Rocket Boosters. In this capacity, he held signature authority for Certification of Flight Readiness while evaluating impacts of various design changes based on ground and in-flight anomalies, obsolescence, and planned upgrades.

He earned a Bachelor of Science degree in Aeronautical and Astronautical Engineering from the Massachusetts Institute of Technology and a Master of Science degree in Aeronautical and Astronautical Engineering from the University of Washington. He is also a Distinguished Graduate of the USAF Test Pilot School.

Tony has been honored with numerous awards, including a Defense Superior Service Medal, Defense Meritorious Service Medal, two NASA Space Flight medals, a Navy Meritorious Service Medal, NASA Exceptional Service Medal, and the NASA Return-to-Flight Award.

Spring 2020 Senior Design Judges

CARLOS BANCHIK, P.E.

President of Innova Technologies

Mr. Carlos Banchik, P.E., brings 30 years of experience in numerous transportation systems, earth retention, drainage, and building structures. He founded Innova Technologies in 2003. Through his work at Innova, Mr. Banchik has worked on hospitality, commercial, health, residential and education projects.

Mr. Banchik initially represented VSL Corporation, an international post-tensioning materials supplier. After eight years, he joined Carter-Burgess (now Jacobs Engineering) where he in major transportation projects in the southwestern United States.

Mr. Banchik has knowledge of mechanical, electrical, and hydraulic design requirements and operations. He has been responsible for more than $10 million of design fees on projects with more than $800 million of construction costs.

ANTHONY FIRMANI

Anthony Firmani's recent role as Senior Vice president of Operations for Aristocrat, a $5 B revenue global digital and land based gaming organization, he lead a team of approximately 700 employees supporting all field services, supply planning, purchasing, manufacturing and fulfillment. Formerly as Vice President of Global Supply Chain, at Aristocrat he is responsible for the company's demand and supply planning, strategic sourcing, manufacturing and manufacturing quality. Anthony has focused on building high performance teams, making operational improvements in demand planning S&OP, new product introduction and developing a culture of continuous improvement, and quality.

Prior to Aristocrat, Anthony's earlier career included 10 years with BlackBerry where he rose to the position of Senior Director of Strategic Sourcing, managing multiple global initiatives to support the growth of supply chain and fulfillment around the world. Previously, at General Electric, he was a graduate of their Technical Leadership Program (TLP).

Anthony holds an MBA in Strategy from Wilfrid Laurier University, where he graduated first in his class receiving a Medal of Academic Excellence. In 2008, he received the Alumni Award of Distinction from Wilfrid Laurier University. He also holds an Electrical Engineering Degree from Queen's University, located in Southern Ontario, Canada.

In February 2020 Anthony became an American Citizen and chose Henderson Nevada as his home, where he focuses on life with his wife and their children. When not at the office, Anthony enjoys spending time with his family, cooking, exploring every sport, and going to the shore. Anthony is a member of the advisory board of the Howard Hughes School of Engineering where he is engaged in the mentoring and fundraising subcommittees.

Spring 2020 Senior Design Judges

JAMES "JIM" FRENCH

President of Panasonic R&D Company of America

James "Jim" French, is the president of Panasonic R&D Company of America (PRDCA), a Division Company of Panasonic Corporation of North America. He has been employed in various positions at Panasonic since 1995.

Currently, under his responsibility are R&D and innovation laboratories located in Mountain View, California; Hollywood, California, Newark, New Jersey and Boston, Massachusetts. Mr. French has been involved in many collaborative projects with universities, start-up/venture companies and large Fortune 50 companies.

Prior to Panasonic worked at other high technology companies such as Litton Electronic Devices and Teledyne. Mr. French has a Bachelor of Science degree from the University of Massachusetts/Dartmouth.

NORMAN MCCOMBS

Norman McCombs was born in Amherst New York in a home built by his immigrant father. He graduated from Amherst Central High School, where he met his late wife, Grace. Norman went on to earn an AASEE from ECTI, and a BA and an ScD in mechanical engineering from State University New York at Buffalo while serving in the New York Army National Guard.

Norman is a Fellow of the American Society of Mechanical Engineers, which honored him with the EDISON Medal, their highest patent award. He has received numerous other awards for technical achievement, including the National Medal of Technology and Innovation from President Obama for developing the portable oxygen concentrator credited with saving and extending the lives of millions with lung diseases. He has over 200 hundred patents worldwide primarily for air separation technology used for a myriad of oxygen applications around the world.

Norman is also an Officer Commander of the Chaine des Rotisseurs, as well as a sculptor, classical guitarist, and an avid fan of opera and the fine arts in general.

Spring 2020 Senior Design Judges

GLENN NEAL

Founder and President of Locution Systems, Inc.

Glenn Neal, the founder and president of Locution Systems, Inc., is, quite literally, a pioneer in the development of public safety alerting technology. In the early 1980s, he was instrumental in developing an e-911 system for the City of Las Vegas, which was the beginning of a national trend to link addresses with the incoming call. Since then, Mr. Neal has worked for years to develop a new-generation, software-centric dispatching/fire station alerting system which is now the most sophisticated yet cost-effective public safety alerting system available.

As president of Locution Systems, Neal is responsible for overall company management, and for the continuing research-and-development efforts in support of Locution Systems' suite of public safety dispatching and alerting systems. He has developed a series of products designed for use in emergency communications centers and fire stations, as well as systems designed to alert fire/EMS workers located in the field. Prior to founding Locution Systems in its current form in 1993, Neal developed public safety alerting systems under his first company, GCN Electronics, Inc., which was formed in 1985.

After earning his Bachelor of Science in Engineering from the University of Nevada Las Vegas, Neal worked as a digital design engineer for EG&G – where he supervised the development of a digital communication network for a high-profile defense project. Next he as a design engineer for Tektronix/Colorado Data Systems. In this role, he designed automated test equipment and was one of the authors of the VXI bus specification, which ultimately became a communications standard for the instrument testing community.

In his spare time, Neal pursues a love of music through songwriting, playing acoustic guitar, and following the offerings of rock and jazz musicians.

BENOIT NOEL

General Manager, Henderson TIMET plant, PCC group.

Benoit Noel started his career in the aerospace industry 25 year ago. He joined a famous Industrial group in France and became specialist of various metal forming technologies such as stretch forming, elastoforming and superplastic forming and diffusion bonding for aircraft components.

He spent few years and in the US working as expatriate for industrial aerospace companies. In 2007, he became export French counselor for the French government, beside his aerospace career. He mentored several companies willing to export or make business with the US. He was active member of the south east French-American chamber of commerce.

Since 2019, he is managing Timet Henderson plant, unique US producer of titanium sponge for military and civilian aerospace. Benoit has been with Timet for 10 years. He loves the American culture and as a pilot, he is passionate of the aerospace US vintage aircraft. Benoit is part of the French Air Force reserve since 2018. He did relocate to Nevada with his wife and their 3 children.

Spring 2020 Senior Design Judges

GANESH KUMAR RAMACHANDRAN

Senior Manager, Scientific Games

Ganesh has extensive experience in leading all facets of product development and bringing products to market across Gaming, Medical devices, industrial and appliance domains in domestic and international markets. Ganesh has led several complex large scale enterprise software and systems development endeavors managing various functions and geographically dispersed multicultural teams to successfully develop and launch various products in highly regulated and unregulated industries. Ganesh has deep understanding of software design, development, testing and delivery which he leverages to drive bottom line improving initiatives and capitalize on revenue generating opportunities.

Ganesh started his career in a startup developing indigenous Microcontroller & DSP based energy efficient control solutions for various products, and pioneered a low cost solution with potential savings of $1M. More recently at Scientific Games, he played pivotal role in integrating software teams, assimilating software development and test processes across different incoming brands during acquisitions, building high performing capable and productive teams that consistently achieve and excel targets, leading overall software quality initiatives, driving software process improvements and pioneering automation efforts.

Ganesh is an alumni of UNLV's Lee Business School, graduating with an MBA and Master of Science in Management Information Systems to complement his Bachelor's Degree in Electrical Engineering from University of Madras (India). He is passionate about incrementally improving existing products and building new products through data driven approach, nurturing an ecosystem of products and leveraging technology to improve customer outcomes.

ASHISH RAINA

Ashish Raina is a marketing and strategy professional with more than 20 years of experience. His experience includes strategic marketing, brand development, corporate initiatives and alliance management accumulated from his roles at leading technology companies like Capgemini, Kanbay, Mphasis and L&T Infotech. Awarded "Marketing Officer of the Year 2016" by Corporate Vision Magazine. Ashish earned his MBA in marketing (International Business) from SP Jain Institute of Management, Mumbai, India and is a Production Engineering graduate of Osmania University, India. He is also a certified alliance professional.

Spring 2020 Senior Design Judges

KIM SCOTT
General Manager of Intrigue Shows, Inc. Celestia

Kim is the General Manager of Intrigue Shows, Inc. Celestia on the Las Vegas Strip working with the top acts from America's Got Talent. Managing the dynamics of a 30,000 sq. ft immersive tent experience has added to her already diverse operational skills. She also recently launched, KS Consulting; where she leverages her skills in the development and implementation of strategies to enhance performance, operational readiness, and efficiencies for theatre companies and universities world-wide. She is committed to serving as a steward to early career professionals and is a dedicated mentor to young women in the entertainment field.

Kim had a rewarding career with Cirque du Soleil, most recently as the Sr. Manager of Sourcing and Partnerships She created and identified programs to support the technical sourcing needs and collaborated with key organizations to provide insight and growth in the live entertainment industry. Kim also managed the Cirque du Soleil productions KÀ, The Beatles LOVE and CRISS ANGEL BeLIEve. During her tenure with Cirque du Soleil, she served as Director of Show Support for the Resident Shows Division and was responsible for the conception and execution of the Educational Cooperative and the USITT Elite Training Programs.

Kim is the National Treasurer of USITT and has served on the Board for over 10 years. She is also a Director at Large for the Intermountain Desert Region of USITT and serves on the board of several university theatre and entertainment engineering programs, worldwide.

Kim holds a BFA from the University of Nebraska-Lincoln and an MFA from the University of California-Irvine. Prior to joining Cirque, Kim enjoyed a vibrant career in concert dance and musical theatre.

CLIFFORD L. WARNER
Chairman, Mycotoo

From earning his MFA at the Yale School of Drama, Cliff has been a leader in themed entertainment for over 30 years, collaborating with some of the most talented creative people in the entertainment industry. Cliff was one of the founders of Thinkwell Group for which he served as CEO and Chairman for 10+ years. He has been an Executive Strategist and Producer for award-winning projects around the world, including: PortAventura's Templo Del Fuego, Warner Bros. Studio Tour: The Making of Harry Potter, Motiongate and Bollywood Parks in Dubai, Sesame Street Presents: The Body touring exhibit and many more projects for Universal Studios, Tokyo Disney Sea, Walt Disney Entertainment, Harrah's Entertainment, Six Flags and MGM Studios. He has managed the strategic planning process in mixed-use commercial/residential developments, theatre, film, theme parks, museums and location based entertainment.

Department of Civil and Environmental Engineering and Construction Projects

Department Chair
Dr. Sajjad Ahmad

Senior Design Instructor
Dr. David James

Blue Diamond Hwy. & Jones Intersection Analysis

Project Participants
Jonathan Groppenbacher, Shanon Handley & Laura Sida

Instructor	**Faculty & Technical Advisor**
Dr. David James	Dr. Mohamed Kaseko

Problem Identified
In its current configuration, the intersection of Blue Diamond Hwy. and Jones Blvd. is incomplete. The team seeks to reduce congestion on adjacent streets and reduce travel time. The intersection also does not connect with S. Jones Blvd. to the north. Our project seeks to explore three design alternatives that would connect S. Jones Blvd. to Blue Diamond Hwy., while providing the traffic capacity needed for future growth in the area.

Current Solutions
The Clark County Department of Public Works (CCPW) is proposing to connect S. Jones Blvd. via a bridge structure over the existing UPRR facility. These improvements would include grading to match the grade of the existing intersection, construction of MSE walls, and modifications to the signal at Blue Diamond Hwy.

Team's Solution
We are proposing two possible alternatives, in addition to the CCPW's. The first is to take Jones Blvd. off its current alignment and shift it to the west, in order to avoid having to construct a bridge over the UPRR facility. The benefit of this alternative is that it avoids the UPRR facility entirely, as well as the necessity of constructing a bridge. The second is to bring Jones Blvd. up and over Blue Diamond Hwy. as an interchange with eastbound and westbound ramps. The main benefit of this alternative is that it would remove the at-grade intersection entirely, and eliminate delay on Blue Diamond Hwy at this location.

BRANCHING OUT OF THE BORING

Project Participants
Austin Brooks & Acer Melo

Instructor
Dr. David James

Faculty Advisor
Dr. Samaan Ladkany

Problem Identified
The project seeks to solve the issue of non-aesthetically pleasing bridge and overpass columns. Although old concrete columns still work, the project seeks to determine if a column that is more visually appealing will have sufficient capacity to withstand the live and dead loads associated with freeway overpasses, and whether or not they will be sufficient when impacted with wind, rain and seismic activity.

Current Solutions
The current market in Las Vegas shows that columns are made out of reinforced concrete. These columns have been circular, tapered and octagonal to name a few. Tree-like column designs have been implemented in other locations; however, they have not supported loads from a roadway.

Team's Solution
The team's solution is to implement a tree-like column design to support structures. The goal is to provide the same amount of support for the roadway, while improving the aesthetics of the structures. When visitors arrive in Las Vegas, what they see in infrastructure is a lot of concrete. Our solution of more visually appealing columns will add some joy to structures in Las Vegas, which is known as the city of lights and entertainment. Additionally, it will give Las Vegas locals a feeling of excitement about not seeing concrete all the time.
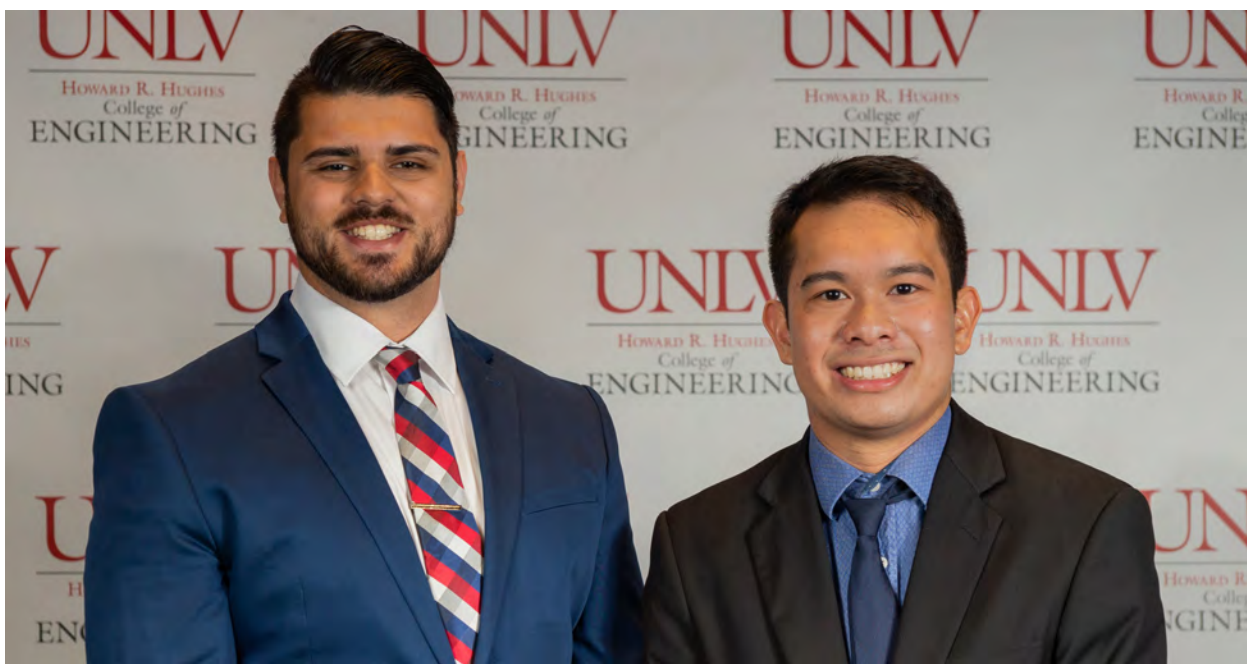
GREY WATER SYSTEM 2.0

Project Participants
Ataklti Abay & Dann Laurence Goze

Instructor
Dr. David James

Technical Advisors
Dr. Kazi Tamaddun & Najia Yasmeen

Faculty Advisors
Dr. Jaci Batista, Dr. Haroon Stephen
& Dr. Erica Marti

Community Advisor
Dr. Kazi Tamaddun

Problem Identified

Based on the SNWA, about 30% of potable water is being consumed through showers and hand sinks. while 24% of the total potable water for indoor use is being consumed through flushing water in toilets. A huge portion of this 54% could be reused in other purposes (irrigation, water display, etc.) to maximize the use of potable water.

Current Solutions

There are water-saving toilets that flush almost half the amount of water as a typical toilet. Additionally, some of the newer buildings/infrastructures in Las Vegas have water-reuse systems that recycle greywater, but they are costly to maintain and operate.

Team's Solution

The prototype (Grey Water System 2.0) will be more efficient, economical, user-friendly, and sustainable compared to the water reuse systems currently on the market. The maintenance and operation of our prototype will be simple and easy to use, as it will not require a trained person to operate it. Our system will require minimal power/energy to operate, use simple and cost effective parts, and be much more budget friendly to build, compared to current items in the market.

GUATEMALA SCHOOLHOUSE

Project Participants
Mary Grace Aldave, Bernardo Espinoza
& Milady Ramirez

Instructor
Dr. David James

Technical Advisor
David Turner

Faculty Advisors
Dr. Nader Ghafoori & Deborah Oakley

Community Advisor
Dr. Erica Marti

Problem Identified
By building a three-classroom school building in the community of El Cebollín, Guatemala, the community will have greater access to elementary education. With the new building, more students will get an education and the community will thrive because of this new building.

Current Solutions
There is currently a one-room school built at the location where the project will take place. The present classroom was built from wood by the community out of necessity. This one-room school currently accommodates six elementary grades.

Team's Solution
The team proposes a new design that will endure the weather and seismic activity of Guatemala. The materials used will be cost efficient, durable, and high strength to endure dead loads, live loads, wind loads, seismic loads, and rainfall. The timber that was used by the community will not hold in the case of an earthquake, making it unsafe; the team will follow Guatemala's building codes to provide a safe and long-lasting structure. This schoolhouse can also be used for community events and may become a meeting spot after earthquake damage to community homes. The design will consist of three rooms, an office, and a playground. The six grades at the school can alternate between the three classrooms, rather than having one classroom shared between the six grades. There is also currently a kitchen that was built by the community; however it is made out of timber and there is no ventilation. Therefore, the team will additionally design a kitchen with the appropriate materials, design, and ventilation.

WETLAND IN-CHANNEL TREATMENT SYSTEM FOR PITTMAN WASH, HENDERSON

Project Participants
Tyler Hill, Meghan Lehto & Yesika Otano-Alonso

Instructor
Dr. David James

Faculty Advisors
Dr. Jaci Batista & Dr. Haroon Stephen

Community Advisor
Suzanne Trabia

Problem Identified
Pittman Wash is an unmaintained, naturally occurring wetlands located in Henderson, NV. Excess vegetation growth poses a potential fire hazard to the surrounding residential community, and creates a habitat for unwanted wildlife, such as mosquitoes and rats. The City of Henderson also lacks easy access to the site in order to maintain utilities in the area. The dry runoff flow of the Wash also introduces contaminants, such as nitrate, phosphate, salts, and heavy metals, to the Las Vegas Wash, located downstream.

Current Solutions
Currently, the City of Henderson has a series of management criteria considerations to provide for public health and safety. These considerations include meeting federal, state, and local regulatory requirements. The Southern Nevada Health District has been conducting mosquito monitoring and surveillance in the Las Vegas Valley since 2004. It is also the responsibility of the community to maintain the wash.

Team's Solution
The team's solution is to implement a constructed wetland at the site. This solution will greatly improve the Wash's dry runoff water quality and prevent invasive flora from growing. This solution will also incorporate recreational trails that will better involve the surrounding community. The design will meet the hydrological demand criteria for the existing drainage facility located in the Wash during flooding events. The design will also facilitate sewer access for maintenance purposes.

Department of Computer Science Projects

Department Chair
Dr. Sidkazem Taghva

Senior Design Instructor
Dr. Andreas Stefik

ALIENATION

Project Participants
Tristan Ayala, Bryan Barajas, Deirdre Chong,
Brandon Coffman, Aaron Gregorio, Sabrina Hollick,
Lerry Logan, Shawn Merritt & Rene Villarreal

Instructor
Dr. Andreas Stefik

Problem Identified
We want to provide accessible entertainment through video games that will give everyone that plays it the same experience. We want the visually impaired, hearing impaired, and any other disabled people to have the same gaming experience as people without disabilities.

Current Solutions
There are many games that already offer built-in accessible features. Solutions for current accessible games are screen readers, audio feedback, and haptic feedback.

Team's Solution
Our implementation of an accessible game will add a new experience, not offered in today's existing accessible games. We are not going to create our video game for a specific group of disabled people, but rather consider all people with respect to their disabilities. Our solution is better because we will directly incorporate our accessibility features as core mechanics of the gameplay, rather than providing them as options. This will create a game that does not allow a player to have a drastically different experience than another player, despite any disabilities they might have.

ALL TERRAIN

Project Participants
Francesca Balgoyen, Paul Barker, Dominique Cardenas,
Austin Downing, Natalie Downing, Kyle Hastings,
Cindy Heng, Brian Herrera, Jason Kreitz,
Christopher Lively, Jason Maurer & Haley Merrill

Instructor
Dr. Andreas Stefik

Problem Identified
The Quorum programming language was originally designed to help blind and visually impaired students learn to program more easily. Its ease-of-use has allowed other students in high schools across the United States to learn programming as well. While Quorum has libraries to help developers to create programs and games, it does not have a terrain generator. Our team will build one for use within the Quorum development environment.

Current Solutions
There are other terrain generators such as World-Machine, Worldpainter, L3DT, and more available in the market. These applications are not, however, accessible to the blind or visually impaired. There are also no other terrain generators that integrate directly with the Quorum Programming Language.

Team's Solution
Our solution is better, as it will integrate directly with the Quorum development environment. Our terrain generator will allow users to create terrain that will also interact with the Physics3D library built into Quorum. This will add another tool in would-be junior-developers pack as they learn to bring their ideas to reality.

CHARI

Project Participants
Michelle Buslon, Om Chaudhari, Hamin Choi,
Aurelio Ceejay Guiking, Luwam Hailu,
Ricardo Martinez & Ou Xi

Instructor
Dr. Andreas Stefik

Problem Identified

Our project seeks to solve the problem of making charity donations accessible, by allowing spare change to be donated to the charity of one's choosing. Our charity search feature will allow people to search for a charity and donate easily, as opposed to visiting multiple websites.

Current Solutions

There is already an app called Acorns that uses the spare change feature to be donated to their portfolio, but it is more of an investment app. There is also a charity searching feature called Charity Navigator, but it only lets people search for charities, and then links them directly to their chosen charity. There is another app called Charity Miles that lets a person donate based on the amount miles they run. All of these apps are only part of a solution, and our design for this project is to combine it into one app.

Team's Solution

The main purpose of our project is to help make charity donations more accessible. There are no current solutions that solely do this. The round-up feature from Acorns, the charity search feature from Charity Navigator, and the application from Charity Miles have their own solutions. A combination of these features will make donating more streamlined, without donors having to worry about numerous links. We will make our UI interface easy to navigate through, and make sure the round-up feature is implemented for donation. Other preexisting charity apps, along with ours, have sharing on social media features and milestone features for users' incentive and psychological rewards. We're taking a further step to reach a larger audience and encourage them by allowing either a points feature or a sweepstakes, so that our app gives users more incentives than other competing charity apps.

CHORD CRISIS

Project Participants
Justin-Chadd Alasco, Joshua Arber, Aeren Dempsey,
Kaleb Johnsonbaugh, Austin Merrick, Nicholas Miller,
Bryant Pochop, Bryan Takemoto & Aaron Winkler

Instructor
Dr. Andreas Stefik

Faculty Advisors
Malou Broder & Tera Eden
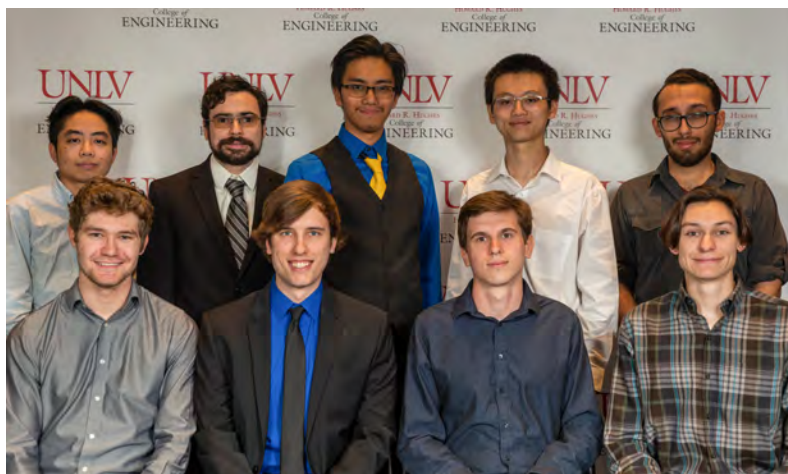
Problem Identified
Chord Crisis looks to expand and improve on current iterations of games in the rhythm genre. Currently, many rhythm games have limited music availability and social sharing capability. Chord Crisis provides a wider selection of musical genres through music streaming, which in turn attracts larger audiences. Additionally, Chord Crisis supports a social networking component to encourage sharing and community participation.

Current Solutions
Today's market contains numerous rhythm games for both desktop and mobile platforms with varying feature sets. osu! is a desktop-exclusive game that features tap and drag-like gestures, which allows for the use of both user-uploaded music and maps. BEAT MP3 for YouTube is a mobile-exclusive game that features tap and swipe gestures that auto-generates maps for songs streamed from YouTube, as well as the user's mobile device. Cytus is a mobile-exclusive game that features a tap, hold, drag, and swipe gestures, but has no support for user-created content.

Team's Solution
Chord Crisis is available cross-platform, using Unity's WebGL module. Music streaming through a third-party API allows for a large spectrum of music to be played on user-created maps. A built-in map editor gives players room for creativity and replay-ability. The supporting website also allows users to share, find, and rate user created content. Chord Crisis appeals to both users new to the genre, and experienced rhythm game players seeking to enjoy music through a unique experience, as well as connect with others.

DiveSports

Project Participants
Janiel Venice Abad, Meisam Ardebiliha, Josiah Canlapan,
Reinhart Fagel, Julie Jeon, Anthony Reed
& Brian Wong

Instructor
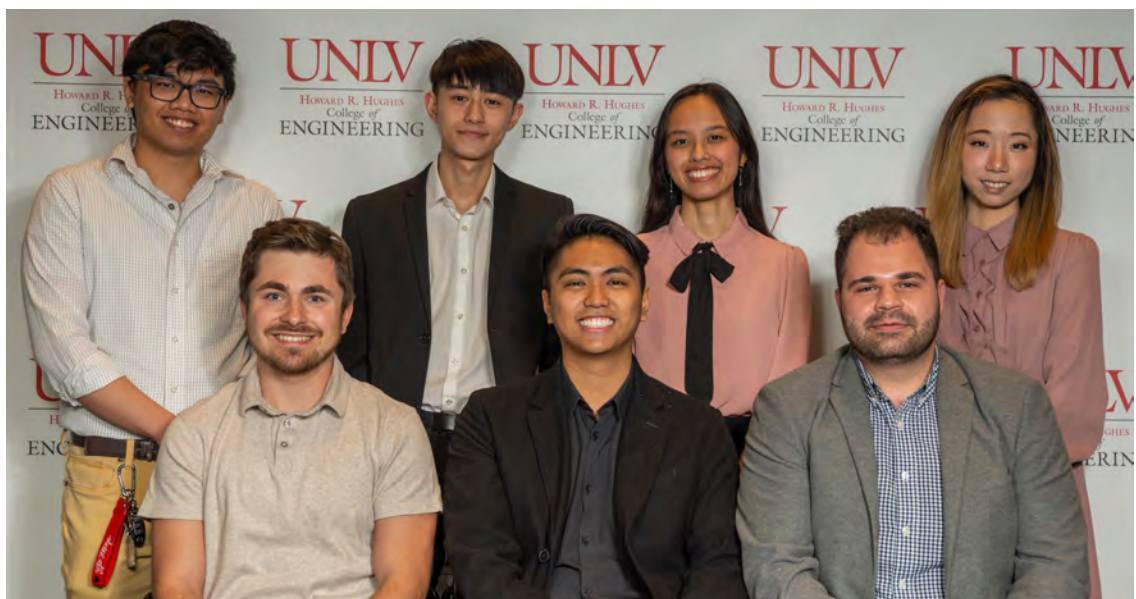Dr. Andreas Stefik

Problem Identified
Our project seeks to serve people who like to casually play sports in their free time. The application will allow users to easily find other people with similar sports interests in their geographical areas. It can also assist beginners in finding other new players who might want to practice together. The user interface will cater to those who seek simplicity.

Current Solutions
In the current market, there are apps like Find A Player, BuddyUp, and OpenPlay. However, much of the competing software have interfaces that date back to 2014, and others lack a steady user bases. Additionally, the sports meet-up software that we came across in our research did not have map functions to help the users visualize where events take place, which poses a difficulty when they want to join a nearby game.

Team's Solution
Many of the applications we have inspected did not include maps which helps users visualize upcoming sports events in the area. Our application will benefit those who prefer visualization, which is a straightforward way to display information. It will be convenient for users to either find a quick partner to practice and improve with, or to find a friend with the same hobby. Our solutions is also accessible on every platform; since it is a web application, any device with a web browser and access to the internet can use it. Schools can also easily use the web application for sports team and intramural practices.

EZTHERAPY

Project Participants
Michael Calderon, Christopher Lewis, Francis Palispis,
V Perumal, Vinh Pham, Joanna Saguid
& Julian Shermis

Instructor
Dr. Andreas Stefik

Problem Identified

We look to address three areas associated with physical therapy: cost, location, and expense. Patients find challenges associated with maintaining enough insurance coverage to see a physical therapist and receive guided help on exercises regularly. Additionally, patients with mobility issues may have difficulty getting to their physical therapist's office regularly to conduct exercises. Our project wants to make it easier for patients to maintain exercises while at home. Patient non-compliance with physical therapy is a major barrier to rehabilitation. Adding a gameplay incentive will motivate patients to increase the time spent in therapy and increase the likelihood of starting a therapy session.

Current Solutions

Neuro Rehab VR, KineQuantum SAS, and Gonio VR are three virtual reality products for physical therapy. These three products have been developed through the collaboration of medical professionals and computer scientists. These solutions feature the gamification of VR exercises, making therapy sessions more enjoyable, providing therapeutic benefits to the client, and meeting therapists' expectations.

Team's Solution

The current products on the market make therapeutic exercises more fun and interesting for patients. However, one factor that can be improved upon is making our product more easily available for individual patients by partnering with providers to give options for the rental and/or purchase of software and hardware to clients. This will make physical therapy more fun and easy to access while at home. Our team can fill the niche of making physical therapy more accessible to individual patients by focusing on in-home training through the use of virtual coaches, and mini games, along with virtual training instruction and exercises that can be done safely without the supervision of a therapist. Unlike other similar products, ours will have lower body exercises available, and a virtual coach to make assistance with training more user friendly.

MATHEMATIC ONLINE CHATTING WEBSITE (MCW)

Project Participants
Yu Chen, Julie Colgan, Even Eberhardt,
Jiaxin Sheng, Il Stickell, Chen Tong,
Xinyu Wang & Junyan Zhu

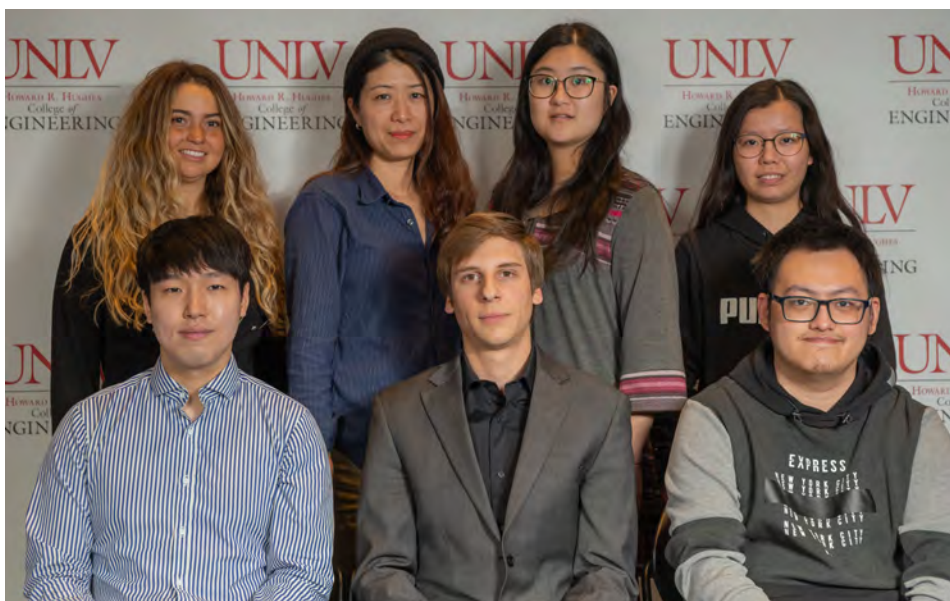**Instructor**
Dr. Andreas Stefik

Problem Identified
There is currently a lack of math chatting websites with math symbols that users can easily type to chat with others. There are few public chat rooms for different math topics or subjects, where people can communicate without knowing each other. This leads to difficulty creating connections between students and their math teachers/tutors.

Current Solutions
There are websites where people can create private chat rooms to communicate on different topics; however, they do not allow participants to use specific math symbols. Some of the websites allows users to input math symbols, but they cannot use those symbols throughout their chatting sessions.

Team's Solution
Our team is creating a math chatting website that can provide a math symbol keyboard and math formulas for participants to use while chatting about math problems. It provides public chat rooms for users to find their related math subjects or their schools. Additionally, the users can create private chat rooms to chat about math with their friends or their teachers. Moreover, they can search for a particular tutor who can help them with their math problems. The people who will benefit from this are students, math teachers, math tutors, and mathematicians.

PARKINN

Project Participants
Kyle Aquino, Leonardo Batista, Lichelle Mae Gaerlan,
John Hanifzai, Marian Hristov, Daee Kang,
Stanko Knezevic, William Lu & Alexis Olaes

Instructor
Dr. Andreas Stefik

Problem Identified
ParkInn seeks to automate common services that most self-service parking offers. We plan to create virtual representations of parking lots that show real time parking availability. Other services, such as reserving parking or permit parking, will also be included.

Current Solutions
We have found three companies that implement parking reservation system: AirGarage, Parkalot, and SpotHero. These companies allow users to either purchase or reserve parking spaces. One provides a map of areas where parking is available, while the other two do not.

Team's Solution
ParkInn plans to focus on designing a system that will allow businesses to create virtual representation of their parking lots. These parking lot maps will reflect real-time parking availability. Users will be able to see the lots, and the task of reserving a parking space will be done automatically, either through a web browser or mobile app. Businesses will be able to automate other features commonly found in parking lots such as parking enforcement hours, pricing for reservations/permits, or even changes in parking availability. The other available solutions either do not provide graphical representations of their lots or limit the representation to a general location, rather than showing individual parking spots. Further, the other parking services available are not completely automated, with options such as reserving parking spaces. Businesses using ParkInn will not need to manually approve reservations, as that will be done when a user requests a reservation.

Department of Electrical and Computer Engineering Projects

Department Chair
Dr. Biswajit Das

Senior Design Instructor
Dr. Grzegorz Chmaj

AI Food Quality Control

Project Participants
Darryl Derico, Morgan Kiger
& Brian West

Instructor
Dr. Grzegorz Chmaj

Faculty Advisor
Dr. Venkatesan Muthukumar

Problem Identified

Currently restaurants do not have the means to test meat in a timely manner to see if it is still sellable and healthy for consumption. Our project is trying to test the validity of using multispectral sensors and machine learning to improve the accuracy of determining if food is edible or not.

Current Solutions

MyFoodSniffer is a handheld device that is inserted into meat packaging and determines if the meat is good or bad using gas sensors.

Team's Solution

Our project aims to be better than current market solutions by not requiring constant user attention, being able to expand into more food types, and by providing readings quicker. We aim to accomplish these goals by using a stand rather than having a handheld device, not using gas sensors which is specific to meat, and by using more power computing solutions. We hope that this project will benefit commercial and home kitchens.

BusBot

Project Participants
Pouya Eslami, Cody McDonald,
Jacob Patrick Reed & Biniam Zerai

Instructor
Dr. Grzegorz Chmaj

Faculty Advisor
Dr. Venkatesan Muthukumar

Problem Identified

The BusBot is a novel solution for the restaurant industry to assist in dealing high guest traffic. As a restaurant experiences an increased number of guests, the quality of guest service may diminish. BusBot can alleviate this issue by assisting restaurant servers in completing their duties, by running food to tables and taking used dishes to the dish pit. When a restaurant is at a high capacity, BusBot will help decrease workload for employees, and increases table turnover.

Current Solutions

The most similar solution found in the current market is a robot named Penny by Bear Robotics. This robot can run food and drinks to tables, as well as bus the tables. Other solutions are small-track robots that move from the kitchen to tables along the tops of short walls, but this type of robot can only run food.

Team's Solution

Our solution is better than current solutions because it will not only run food and bus tables, but also feature guest call-button capability. BusBot is better than the track robots because it can do more, due to its ability to bus tables. BusBot's true competitor is Penny because they are similar in function. However, our solution will be able to carry a bigger load, as well as have more versatility in the types of dishes it can carry. We envision our solution to be a cheaper alternative, which will be able to accomplish just as much as its more expensive competitors.

Combat Swimmer Data Recorder

Project Participants
Bradley Bace, Guillermo Galvez
& Ivan Soto

| **Instructor**	**Technical Advisor**
Dr. Grzegorz Chmaj	Dr. Venkatesan Muthukumar

Problem Identified
Military combat swimmers train in an environment of significant physiological stress. Very little useful data that indicates how swimmers perform is collected during operator training. The United States Special Operations Forces (USSOF) is becoming an AI/data-driven organization, and is interested in learning about sensors that can be used to collect information about soldiers.

Current Solutions
Current market solutions vary in features, which makes it difficult to use one device, and are expensive as well. One solution is the Ariadna Diver Positioning System (DIPS), which is priced similarly to high-tier dive computers, costing around one thousand dollars. Other devices on the market only allow for the recording of a few desired parameters.

Team's Solution
The Combat Swimmer Data Recorder integrates the USSOF's most desired parameters into a single unit for use by a pair of soldiers. The device will log the time of a dive, as well as the desired positional data. The unit will use a GPS, gyroscope, and an accelerometer in conjunction for positional data, and an Android application to log the data from a dive, which can be received through Bluetooth.
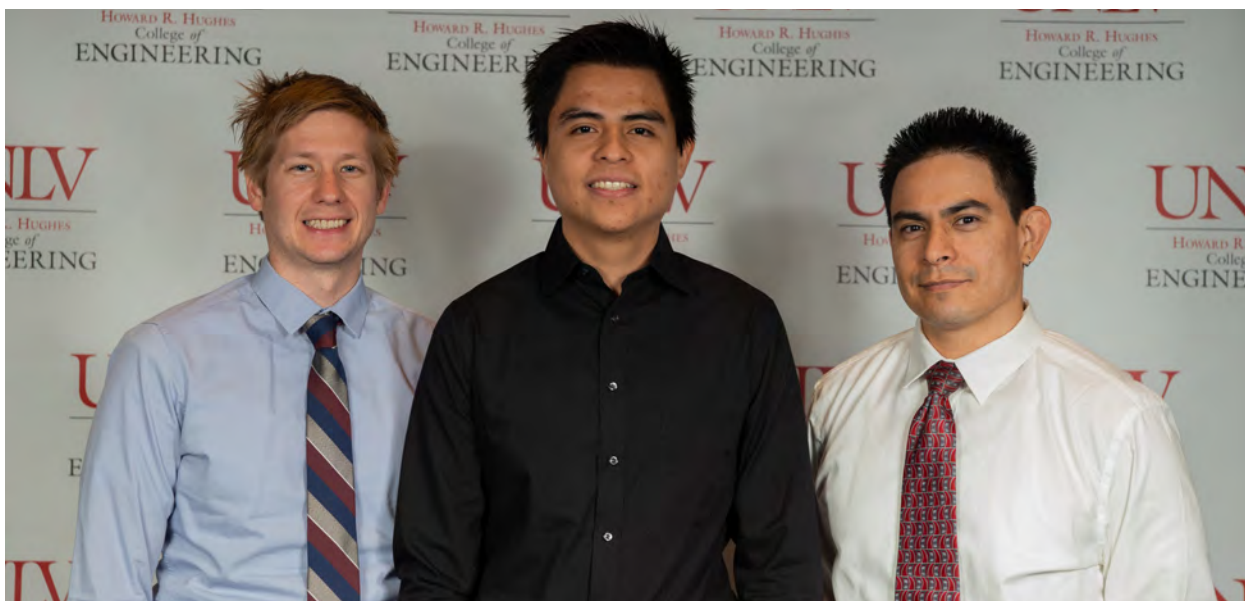
INTERACTIVE VEST

Project Participants
Victor Martinez, Saul Mendoza
& Ricky Perez

Instructor
Dr. Grzegorz Chmaj

Faculty Advisor
Dr. Emma Regentova

Problem Identified
The Interactive Vest is designed as a quality of life improvement device that, which when used in conjunction with a walking stick, allows those with visibility issues to have more independence. The target for this device is for individuals that live alone or want to have the freedom of being alone in their homes.

Current Solutions
There are a couple of different option available in the market, which include walking sticks and ultra-sonic walking sticks.

Team's Solution
The product includes sensors that are laid across the vest, and when the user is approaching an obstacle, they provide haptic feedback depending the proximity of that obstacle. This feedback will give the user enough time to either change direction, or determine if they will only com into partial contact with the obstacle.

Keyless Entry Door (KED)

Project Participants
Adrian Ruiz & Bryan Takemoto

Instructor
Dr. Grzegorz Chmaj

Faculty Advisor
Dr. Brendan Morris

Problem Identified
Our project aims to increase the security of a user's home by allowing the user to unlock the front door. If the door is broken down, Keyless Entry Door (KED) will notify the user. We wish to implement our project with courier services like Amazon to allow the courier to drop the package inside the user's house.

Current Solutions
Currently there are a number of smart doorbells on the market. Many of these products allow for two-way communication and streaming.

Team's Solution
Our project unlocks the user's door which adds convenience for the user. This could allow the user with their hands full or a disabled to person open the door. This project also allows other people, such as friends and family, to enter the user's home if the user is not there. This is done using the included keypad, which allows people to enter in passcodes.

Motor-Driven Laser Alignment Station

Project Participants
Francisco Mata Carlos
& James Skelly

Instructor	**Faculty Advisor**
Dr. Grzegorz Chmaj	Dr. R. Jacob Baker

Community Advisor
Dr. Todd Meyrath

Problem Identified
Lasers are used in an ever-expanding range of applications, from range-finding systems to laser surgery equipment, and from classroom laser pointers to a soldier's rifle-mount aim assist. All laser beams are created using two main components: a laser diode and a lens. Standing alone, a laser diode emits light in all directions, and the lens is used to focus the light emitted by the diode onto a certain point. For the perfect beam to be produced, precise alignment of the lens is required.

Current Solutions
Laser lens alignment is performed manually by technicians every day at laser manufacturing facilities, but manual alignment is a tedious process. The alignment of a single lens can take up to a minute or more, and the technician who performs the alignment only has control over one axis of motion. It is also relatively unsafe to align laser lenses manually. Stray light from a laser (or even more dangerous, stray light from an infrared or invisible laser) can be very powerful, and thus, very harmful to the human eye.

Team's Solution
The 3D Laser Lens Alignment Station is a software-operated machine which will automatically align a lens with a laser diode to produce a laser that is product-ready. The station will consist of three stepper motors, which will align the lens per feedback from an image processing unit. This unit will be driven by an algorithm which will monitor the current shape, position, and intensity of the beam, and command the motors to adjust the position of the lens accordingly. Compared to current market solutions, the 3D Laser Lens Alignment Station offers much higher efficiency, sufficient range of motion in X, Y, and Z directions, and can be enclosed for safety purposes.

SeeBlik (Underwater Optical Communication System)

Project Participants
Shadden Abdalla, Bryan Kerstetter
& David Santiago

Instructor
Dr. Grzegorz Chmaj

Faculty Advisor
Dr. R. Jacob Baker

Technical Advisors
Dr. R. Jacob Baker & Angusman Roy

Problem Identified

We live in a world of information and expect wireless high-speed communication everywhere. Even today, there are areas where such high-speed wireless communication is completely absent. One such area is under water. Our project, SeeBlik, seeks to provide high-speed wireless communication under water.

Current Solutions

Today, two main solutions exist: VLF (Very Low Frequency) RF communication and communication by wire. The problem with VLF RF communication is the data transfer rate is extremely slow. VLF can only provide data transfer rates up to about 300 bits per second. The second solution is to have a wire that provides a communication link from a boat to a submarine. Wired connection provides much greater data transfer speeds, but at the cost of mobility.

Team's Solution

SeeBlik seeks to solve the issue of wireless high-speed underwater communication by creating a high-speed underwater optical communication system. The hardware we have designed can be implemented to create such a system. Our hardware consists of two essential components: a laser transmitter and an optical receiver. The transmitter contains a microcontroller that encodes data onto a modulated blue (450nm) laser beam. A photodetector on the receiver will then receive the optical signal, and the received signal will then be decoded by a microcontroller. SeeBlik will provide data transfer rates into the tens of thousands of bits per second. Our product will provide a service that government agencies, the military, and marine companies need: a product that gives them the ability to communicate under water at high speeds.

Smart Parking Lot System based on LoRaWAN

Project Participants
Yuan Dao & Lihao Qiu

Instructor
Dr. Grzegorz Chmaj

Faculty Advisor
Dr. Mei Yang

Technical Advisor
Binayak Tiwari

Problem Identified

We observed that sometimes it is hard for people to park their cars in a large parking area. This motivated us to develop a smart parking lot to help users find an available parking lot easily. The system will help people quickly park their cars and improve their efficiency on daily basis.

Current Solutions

In the current market, there are several smart parking lot systems. Existing products use Wi-Fi to transmit data, requiring the use of Wi-Fi access points, and consuming a lot of power. Another problem of the existing sensor nodes is the large size, which makes them inconvenient to install and increases power consumption.

Team's Solution

The major objective of the proposed system is to lower the power consumption and miniaturize the size of the sensor node by designing a customized PCB board to host all function modules. As the smart parking lot system does not require high data bandwidth, LoRaWAN is perfect for our system, with low power consumption and a long communication range. The LoRa node can run on a battery for year, and the cost of a LoRa enabled sensor node is low, so our system can help the manager save a lot of money.

Smart Shower System

Project Participants
Chris Barr, David Flores
& Jett Guerrero

Instructor	**Faculty Advisor**
Dr. Grzegorz Chmaj	Dr. Venkatesan Muthukumar

Problem Identified
The project seeks to solve water shortages by creating a solution to reduce water waste. The Smart Shower System's goal is to reduce the amount of water consumption during the showering process.

Current Solutions
There are two companies with similar devices in the current market, Moen and Kohler. The products made by these two companies focus on luxury and convenience for the user, not on water conservation. These devices can output specific water temperature as requested by the users, as well as pause the water's flow.

Team's Solution
The Smart Shower System can also output water's temperature as requested by the user, as well as pause the water's flow. However, there are additional functionalities in our project, such as: a display that shows the amount of water used in gallons during the shower; a timer that times how long a user has been showering; touch screen display as opposed to buttons with the other two products; and the ability to stream music using Bluetooth. The Smart Shower System will benefit new to future homes, hotels, and apartments, as well as homeowners that would like to have this technology in their current homes.

DEPARTMENT OF ENTERTAINMENT ENGINEERING & DESIGN PROJECTS

SENIOR DESIGN INSTRUCTORS
DR. GRZEGORZ CHMAJ
&
DR. MELISSA MORRIS

Fall Arrest Victim Rescue System (FAVRS)

Project Participants
Tristan Galario & Jeremy Klein

Instructor
Dr. Melissa Morris

Faculty & Technical Advisor
Mike Genova

Problem Identified

Fall arrest is the form of fall protection that involves safely stopping a person who is already falling through the use of safety lanyards, harnesses, and anchor points. After falling, the lanyard stops the victim from hitting the ground, but leaves the victim in the air and in need of rescue. The longer a victim is suspended in their harness, the more likely suspension trauma will set in, which can be fatal in as little as 10 minutes. FAVRS aims to reduce the time of rescue in a fall arrest rescue situation, while simultaneously simplifying the rescue procedure.

Current Solutions

There are currently no solutions in today's market that aim to reduce rescue time. While there are devices to aid in fall arrest rescues, there are none like our project for this type of situation. A device that works similarly to the FAVRS is the Petzl Croll; however, this device is limited to rope and cannot be used on safety lanyards.

Team's Solution

This team's solution to this problem is a device that clamps onto the lanyard of the person who has fallen. The device will bite into the lanyard and allow the rescuer to release the victim from their anchor. Through a pulley system, the fall victim will be lowered to the floor. This is better than current solutions because many rescues that this device will be used for require the rescuer to rappel. This device will reduce the time necessary for a rescue, since a person who has fallen will not typically survive longer than 10 minutes. Anyone who is in a situation where fall arrest is required will benefit from this design. A few examples where fall arrest is required include construction, window washing, and live entertainment. This device will save lives.

SPROUT SCOUT

Project Participant
Nicole Furushiro

Instructor
Dr. Melissa Morris

Faculty Advisor
Michael Genova

Problem Identified
Plant care can be challenging for the average, unexperienced plant owner. Maintaining a regular watering schedule, properly measuring the amount of water provided, and ensuring the plant gets enough sunlight are the most common obstacles a plant owner must overcome. Sprout Scout aims to reduce the confusion and make owning a plant fun. It turns the average house plant into a virtual plant with a straightforward care routine.

Current Solutions
Most solutions on the market simply use sensors to detect moisture and light, thus providing feedback when the plant is over or under-watered, or exposed to light. Another solution is a pot that integrates these sensors and provides feedback on a digital screen. This feedback is displayed as an 8-bit face where its emotions show what the plant needs.

Team's Solution
Current systems simply tell the owner when to add water or light, and fail to make it entertaining. Sprout Scout makes owning a plant more like owning a pet, in that it is interactive. The closest system on the market to Sprout Scout limits the user to one size pot, which only comes in two different colors. Sprout Scout works with any pot, thus allowing the owner to choose his/her/their own pot and to repot the plant as it grows.

Department of Mechanical Engineering Projects

Department Chair
Dr. Brendan O'Toole

Senior Design Instructor
Dr. Melissa Morris

3D Printed Fiber Optic Feedthrough Redesign

Project Participant
Alexander Sudderth

Instructor	**Faculty Advisor**
Dr. Melissa Morris	Dr. Alexander Barzilov

Problem Identified

Gas guns have unique capabilities in the vast array of ways they can create and capture data. With the creation of 3d printers the opportunities are endless, and this is seen in the field of fiber optic diagnostics, which is used for data analysis on different types of experiments from velocimetry to displacement analysis. With highly accurate printed feedthroughs, the user can print, epoxy, and install custom fiber optic feedthroughs for each shot. The goal is to create and develop a fully-pledged, universal fiber optic feedthrough that allows high fiber count and custom capabilities to each customer.

Current Solutions

Current fiber-optic feedthroughs are designed out of a variety of non-ferrite metals, and are usually difficult to use, as they provide reduced bandwidth and pass-through channels. Fiber-optic feedthroughs are very important for gas guns, to allow for the ability to collect data based on projectiles. The problem with making a one-off metal feedthrough is that they are prohibitively expensive and require long lead times. Quite often, they do not meet the needs of customers, in that they were not designed correctly, since they are mostly one-off designs for a specific experiment.

Team's Solution

The new concept allows for up to eight jacket ribbons, or nine three mm jacketed multimode complex cables, based on the experiment. This can provide scientists with up to 96 channels of data. With an overall dimension of this design that is three inches tall by two inches in diameter, it will be a class leader in data transmission. Using a ¾ NPT thread allows the printed piece to resist pressure and have a greater surface area when connecting to the gun. It also has the ability for an optional metal conduit connected to the outside of the feedthrough, which allows the team to protect the fiber from the type of careless damage that is seen every day. Based on the current solutions, this design could save companies hundreds to thousands of dollars depending on their needs.

Artemis SPEAR

Project Participants
Thomas Ackerman, Behzad Feda, Allen Izquierdo,
Jeffrey Prezgay, Benjamin Sanidad & Victor Shamanaev

| **Instructor** | **Technical Advisor** |
| Dr. Melissa Morris | Dr. Yi-Tung Chen |

Problem Identified
This project seeks to solve the water needs during extended space exploration by producing water in-situ. Water is needed for many purposes for long-term explorative missions, but it is not feasible to bring enough water from Earth. Until this problem is solved, we will be limited to short-term space missions.

Current Solutions
Currently, the market has no solution to this problem. Some companies like Honeybee Robotics are designing drill systems that are able to penetrate a regolith of unknown composition and hardness to reach ice. The ice extraction is being tested to understand how this process could be done in space.

Team's Solution
The team's solution is to use a rotary-percussive drill to penetrate a planet's surface. Once ice is encountered, a heating probe will be inserted into the drilled hole to both melt ice and pump water up to the surface at the same time. The water is heated as it is removed, pumped back down into the ice to increase the rate of melting, and then filtered after a sufficient volume of water has been extracted. Future space exploration missions will benefit from such drilling systems because they will produce water in-situ, which is essential for both transportation and survival.

DOLLY SAFETY SYSTEM

Project Participants
Jake Hill, Chase Kessler
& Brandon Ortiz

Instructor	**Faculty Advisor**
Dr. Melissa Morris	Dr. Brendan O'Toole

Problem Identified
Current dolly (hand truck) systems do not have a failsafe in the event of the loss of control on a slope. This project intends to solve that problem by providing a ratchet to prevent rollback on slopes. This will allow someone who is handling heavy loads on a dolly to either regain control or move out of the way, providing a factor of safety to a potentially unsafe device.

Current Solutions
Older patents exist for dolly safety systems, but have expired. Other than those, there are no viable products on the market that fulfill the goal of increasing safety.

Team's Solution
As stated, no dolly systems have a failsafe in the event of rollback. The proposed solution will benefit any individual who handles large loads on dollies, whether it be warehouse workers moving product, students transporting a large project, or anything in between. The completed iteration of our solution (beyond the prototype) is intended to be aftermarket installable and low cost, allowing commercial viability to existing dolly users.

LACUS: Clean Water Initiative

Project Participants
Matthew Moore, Jacob Pittman
& Dorian Valdivia

Instructor
Dr. Melissa Morris

Faculty Advisor
Dr. Yi-Tung Chen

Problem Identified
Many communities across the world lack access to affordable clean water. Water is needed for hydration, food production, hygiene, and energy. Access to clean water is a basic human necessity.

Current Solutions
Current solutions for clean water production include expensive filtration systems, chemical additives, and desalination, as well as the shipment of outside water sources to developing communities.

Team's Solution
The LACUS initiative will utilize solar energy to distill dirty or brackish water into clean purified water. The solar energy will be collected by parabolic solar collectors that will not need any outside power source. This makes the LACUS device well suited for developing countries where access to clean water is often scarce. An individual LACUS device is designed to be simple, rugged, and durable to endure a large variety of conditions including weather and mechanical failures. The device is easy to use and does not require any advanced training.

LARGE SCALE PIPE INSERTION ASSEMBLY

Project Participant
Erik Brown

Instructor
Dr. Melissa Morris

Faculty Advisor
Dr. Georg Mauer

Problem Identified

The large-scale pipe insertion assembly allows for measuring or cleaning devices to be inserted into a large hollow object, such as a cylindrical pipe, using one or fewer operators, with high efficiency and repeatability. In certain applications, the large hollow object and the device cannot be touched in fear of contamination or destruction. This insertion assembly would have minimal surface contact and interference.

Current Solutions

The current solutions for measurement include sliding a bore gauge all the way down the pipe or using a laser scanner that is inserted and steadied by pulling it through and locking it into stands on either side of a pipe. The current solution for cleaning is an operator spraying it down with a hose.

Team's Solution

This pipe assembly solution is superior to the bore gauge or the traditional laser scanner placement because it is repeatable and quicker. Instead of manually pulling a device through a pipe for each measurement, this assembly will be pushed and locked along a track. This allows for an assembly line measurement. This assembly is also superior to cleaning a pipe with a hose because an automated sprayer nozzle can be placed on this assembly.

LONGBOARD BRAKE SYSTEM

Project Participants
Jalec Canlapan, Robin Pedro
& Darshan Shetty

Instructor
Dr. Melissa Morris

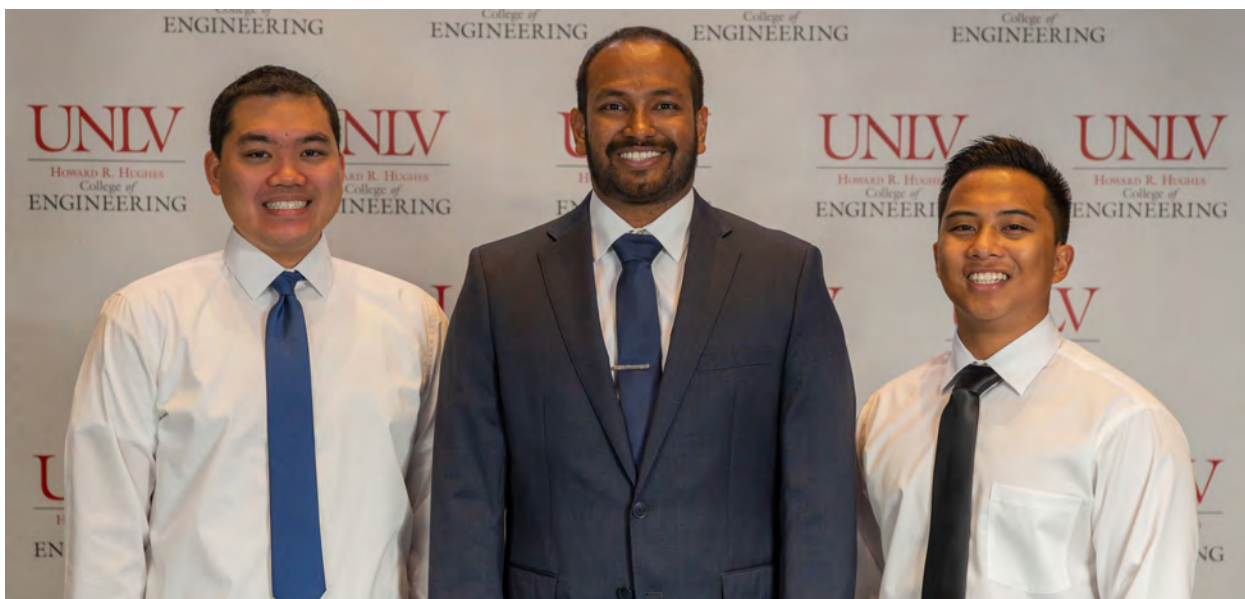**Faculty Advisor**
Dr. Woosoon Yim

Problem Identified
It is difficult for the rider of a longboard to control their speed without having to remove their feet from the board itself. Currently if riders need to make emergency stops, they have to leap off the board, possibly causing harm to themselves or others.

Current Solutions
Currently, there is an option where a rider can push down on a lever, and a bar falls to the ground to create friction and slow the board down. An invention currently in the kick-starter stage requires the rider to re-adjust their lag foot to apply pressure on a pad, which in turn slows the wheels down.

Team's Solution
Our team's solution is to create a brake system that can be controlled via a wireless remote in the rider's hand. Our solution provides riders the freedom of not having to adjust their feet in order to apply pressure on the board, since re-adjustment can cause an imbalance of posture leading to injury. This invention is tailored to anyone and everyone that enjoys riding longboards.

MEDICINE DISPENSER

Project Participants
Gerardo Carbajal, Cody Cronic
& Kylar Sommers

Instructor
Dr. Melissa Morris

Faculty Advisor
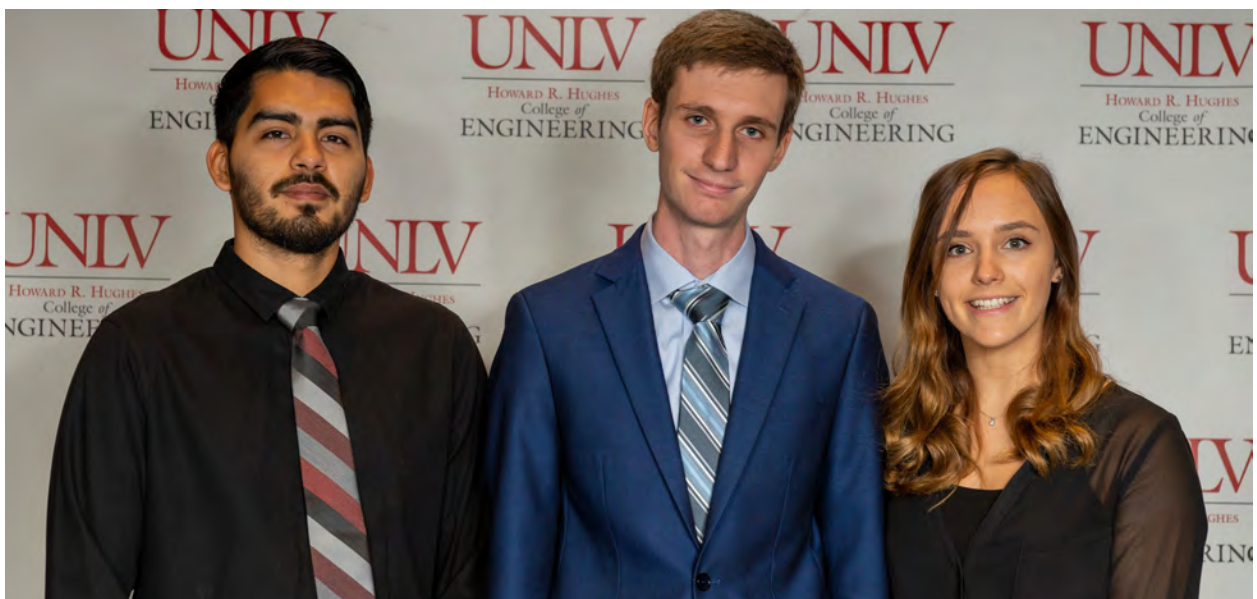Dr. Woosoon Yim

Problem Identified
The medicine dispenser seeks to provide a timely and accurate dose of medicine for those unable to keep track of their medication on their own, due to physical or mental reasons.

Current Solutions
When we began this project, a few solutions were available in the market that focused on the mechanical functions of dispensing pills without automation. The product closest to solving our identified problem is a device that mechanically dispenses medicine, but the consumer has to physically manipulate the device to receive their medication. However, in the past few months we have discovered a device that had many of the capabilities that this team is aiming to achieve in our project.

Team's Solution
The team's solution would be superior to the competition because the goal is to make a more affordable device for the everyday consumer. Customers have to spend close to $700 for the only other direct competitor, as its primary targets are health organizations (hospitals, senior homes, etc.). Since this team seeks to provide a more accessible option, those who cannot afford expensive devices for personal use would benefit the most. Parents of children on medication will benefit from the records kept when medicine dispenses and their child takes their pills, and those taking care of older/handicapped loved ones will also benefit from the aforementioned feature.

MOTORIZED STAIR CLIMBING CART

Project Participants
Nathan Bearden & Teddy Tolentino

Instructor
Dr. Melissa Morris

Faculty Advisor
Dr. Woosoon Yim

Problem Identified
Carrying multiple objects up many flights of stairs can be troublesome and time-consuming. This problem can be compounded when the person is elderly and/or has limited mobility. Many homes and apartments lack elevators or ramps that make this task easier.

Current Solutions
Currently, there are products capable of carrying objects upstairs. However, most of these products are tailored for moving furniture and other large objects. Stair climbing carts that exist for smaller objects require significant effort from the user to function.

Team's Solution
The current market only has real solutions for transporting heavy and large objects upstairs. By incorporating special stair climbing casters and motor driven tank track, our cart becomes easy to operate up a flight of stairs. The combination of casters and tracks makes it as easy as pulling a toy wagon. Our product aims to assist with everyday chores, requiring minimal effort from the user. Enabling people to carry more items with them when they travel up and down stairs will save time and energy. The people who will benefit the most from this product are the elderly and apartment dwellers.

OMNI Security

Project Participants
Koby Okuda, Britton Stankosky & Tyler Topham

Instructor	Faculty Advisor
Instructor	**Faculty Advisor**
Dr. Melissa Morris	Dr. Alexander Barzilov

Technical Advisor
Dr. Venkatesan Muthukumar

Problem Identified
In a world where theft is at an all-time high and thieves run rampant, property owners are increasingly searching for improved security technologies. Homeowners with valuable assets in their yards, or business owners looking to keep an eye on their lots during non-business hours, rely on security systems to keep their properties safe. Many security systems do not provide adequate means to stop intruders from trespassing or damaging property. OMNI Security seeks to provide an updated security platform to not only catch intruders in their tracks, but deter them away from the area.

Current Solutions
Most security systems today utilize a network of cameras to capture video and images of problem areas. Some also utilize motion detectors, motion activated lights, and/or alarm speakers alert owners of an intruder. These systems lack the ability to adequately monitor large areas without the need of additional equipment, and they also lack a proactive aspect to stop an incident from occurring.

Team's Solution
Our solution is to implement video recording and motion sensing onto a drone with the capability of autonomously flying towards and then following an intruder. The drone will also have the addition of a light and speaker to deter the intruder away from the property. Motion sensors will be placed in prime areas of the property, and when tripped, the drone will receive a signal to start flying in the specified area. A machine learning algorithm was created and is used to recognize people, vehicles, and animals from the camera's input. When not in use, the drone will be housed in a weather/tamper proof housing unit that will open and allow safe takeoff and landing when needed. Our solution creates a threat to an intruder that no other security system is capable of. The ability of the drone to fly to the area of concern, identify the intruder, and scare them off with its presence and deterrents puts our solution above the rest. Property owners looking to keep watch of outdoor valuables, and prevent theft and vandalism will benefit greatly from our security drone. This solution can also be utilized by businesses that have large properties and high-value assets.

POWER WALK

Project Participants
Logan Arias, Sabrina Russell
& Ashwin Thomas

Instructor
Dr. Melissa Morris

Faculty Advisor
Dr. Brendan O'Toole

Problem Identified
Mechanical strain, which is the bending or deformation of an object when force is applied to it, is induced any time somebody walks on a surface. This strain can be converted into electricity, but this is frequently not done. Tiles with piezoelectric sensors can convert this strain into power. Piezoelectric sensors are made from materials that produce electricity when pressure is applied to them.

Current Solutions
Some companies have already come out with designs for piezoelectric sensor use in high-traffic urban areas. Pavegen is a UK-based company that created a model that was implemented for the 2012 London Olympics.

Team's Solution
The models existing in the market are prohibitively expensive for personal use. Additionally, they are not practical for smaller buildings and domiciles. Our model is far cheaper to produce, and can be easily installed in rooms. We have several different tile designs that are easy to manufacture. This way, the average homeowner can use piezoelectric materials in their own houses, without having to resort to expensive, impractical alternatives.
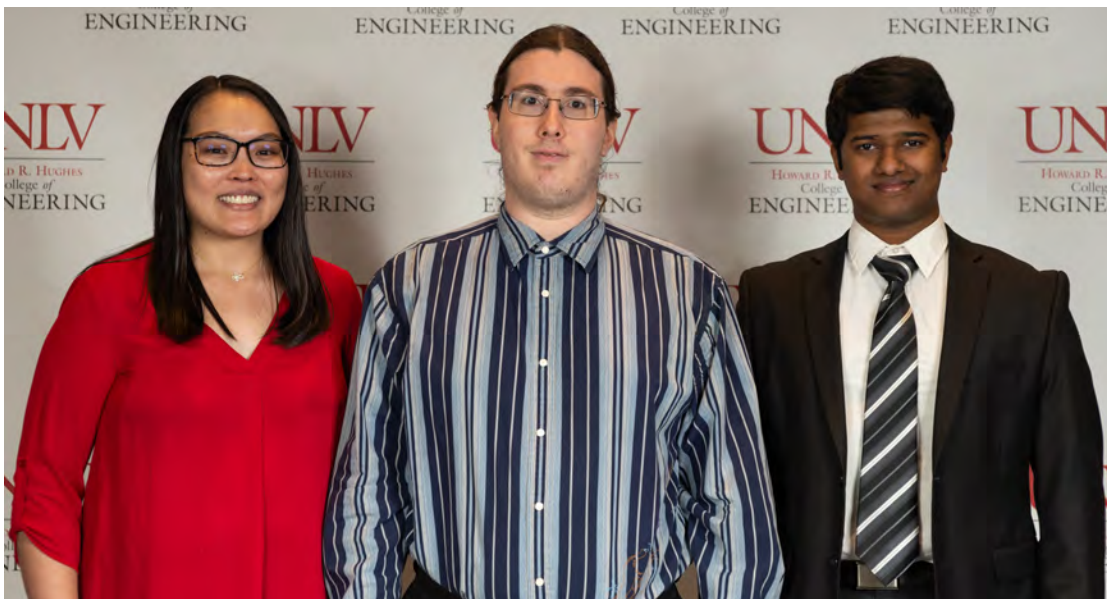
PROJECT DESIGN, BUILD, FLY

Project Participants
Brandon Avendano, Jet Baroudi, Spencer Buyse,
Sophia Leon & Jessalynn O'Brien

Instructor	Faculty Advisor
Dr. Melissa Morris	Dr. William Culbreth

Problem Identified
We seek to create a small-scale aircraft that allows the user to carry a substantial payload at speeds greater than current designs, while maintaining loitering efficiency. This aircraft will also be able to overcome large amounts of drag induced while towing devices, such as a banner for advertisement. Such a device will be stowable during take-off and deployed during flight. The aircraft will also be able to take off in a very short distance to stay competitive with many multi-rotor Vertical TakeOff and Landing (VTOL) systems.

Current Solutions
Much of the focus in the current market is on multi-rotor systems, which are convenient for takeoff and landing operations, but lose efficiency over long distances and with heavy loads. Banner towing is often performed by large scale aircraft, which can be cost-prohibitive and are meant for large scale advertisements. Other forms of aerial advertisements include skywriting, which does garner the public's attention although the advertisement only lasts a few minutes before it is swept away by wind. Otherwise, there are relatively no other forms of local aerial advertisement.

Team's Solution
Any company that needs high efficiency, high performance sub-scale aircraft, or the ability to tow objects would benefit from our design. The design is meant to be a platform for various operational forms that will allow it to outperform other aircraft in many aspects. For aerial advertisement, banner towing methods typically include setting the banner up so that a plane can fly past and hook onto it. Our team's design would reduce the extra set-up and time this requires, as successfully hooking a banner can take multiple attempts. Having an aircraft that has a banner deployment system built in, or the ability to install one, makes it easier and cheaper to tow banners using smaller aircraft. Additionally, the aircraft does not need a pilot aboard the plane. The plane itself can be controlled from the ground and manually or autonomously flown. This is all especially beneficial for smaller companies that may want to utilize aerial advertising, but find the costs of current services offered in the market to be too prohibitive.

Solar UAV

Project Participants
Cameron Marsh, Fredy Santiago
& Michael Sutherland

Instructor	**Faculty Advisor**
Dr. Melissa Morris	Dr. William Culbreth

Problem Identified

Currently the aviation industry heavily relies on fossil fuels, which have a significant impact in our changing climate. Telecommunications are also becoming more important in the current technological age; however, it is currently very expensive and resource intensive to place satellites into orbit. This project seeks to show that there should be more research and resources given to alternative methods for powering flight, in order to limit dependence on environmentally hostile fuels. Additionally, the project seeks to provide an alternative method of communication, as well as potentially extend the flight endurance of current aircraft by incorporating solar power into the power consumption.

Current Solutions

Solar unmanned aerial vehicles (UAVs) are becoming a popular trend in today's market, with a projected worth of 8.4 billion dollars in the past year. To date, major companies (e.g. Boeing, NASA, Google, etc.) have begun developing and testing their own versions of a solar UAV. Although each major company has a different specification and goal with its UAVs, a good number hope to develop a solar UAV capable of providing the United States with modern solutions to current telecommunications issues.

Team's Solution

Our solution will serve as a relatively cheap design example for a solar powered airplane, compared to other solutions already created. Solutions from NASA, Google, Boeing, etc. are multi-million-dollar projects. This project represents a much more accessible approach for the average consumer. A design on this project's scale can be re-designed, scaled up, or scaled down at relatively low cost, depending on the needs of the user. The project's solutions extend the flight endurance of a conventional aircraft during the day, allowing for more time in the air. One example where a longer flight time is beneficial is in surveying remote areas, where ground teams would take significantly longer compared to an aircraft slowly gliding over hours at a time. The autonomous aspect of the aircraft relieves the operator from having to continuously control the aircraft, as they can simply check the status of the aircraft over time. One other aspect of this project's design is the exploration and use of a blended body wing for a solar UAV, which is not something typically done for this type of aerial vehicle.

SolderMatic

Project Participants
Arielle Joven, Austin May
& Luis Mejia Gijon

Instructor
Dr. Melissa Morris

Faculty Advisor
Jeff Markle

Problem Identified
Soldering requires holding many components at once to effectively bond connections. Normally, it is necessary to hold the iron in one hand while manually feeding the solder into the connection with the other hand. This requires additional assistive devices to hold components that are being soldered, such as circuit boards, electrical components, and simple wires.

Current Solutions
Common assistive devices in the market include Helping Hands and manual feeding soldering guns. Helping Hands is a tabletop soldering aid that holds components in place using alligator style clips. Certain soldering guns are built to manually feed solder when the user presses a trigger. These are manually operated, similar to an everyday hot glue gun.

Team's Solution
Our solution is to develop a lightweight housing that attaches to simple, pencil-style soldering irons. The housing directs electronically fed solder into the work piece, allowing for single handed use. This solution could benefit those who work in real-world applications where aid devices are impractical. Our product could benefit beginners, and those who do not have the dexterity to use both hands while soldering. Additionally, as this is an add-on attachment, it will be designed to work with a device that the user is already comfortable using and has in their toolkit.

The CoverBuddy

Project Participants
Ansell Cabrera, Nathan Holt
& Erica San Diego

Instructor	**Faculty Advisor**
Dr. Melissa Morris	Dr. Woosoon Yim

Problem Identified

The CoverBuddy seeks to provide simple, yet effective, protection against damaging environmental hazards such as UV rays, dust, dirt, sap, pollen, and animal droppings. It utilizes a remote-control system to automatically close around a vehicle, protecting it without the need for physical exertion. An alarm serves to secure the vehicle, while the heavy-duty steel base and nylon cover act as theft deterrents.

Current Solutions

Current market solutions include sheet-like covers applied directly over a vehicle, umbrella-like canopies affixed to the top of a vehicle, or permanent structures such as carports. There have been very few advances in car covers since their inception.

Team's Solution

The CoverBuddy is the first and only solution that is completely remotely operated. Current solutions are either labor intensive or fail to protect vehicles from significant environmental hazards. Our product will benefit vehicle owners who need to park outdoors and are seeking an efficient way to protect their vehicle's exterior, as well as car dealerships who leave inventory parked outside overnight in rainy/dusty/snowy environments. The CoverBuddy provides ease of use through automation, along with theft deterrent features such as an alarm, and its modular construction aids in assembly and vehicle fit.

The Millennial Pocketknife

Project Participants
Kenneth Leo, Trenton Motley
& Mark Ryan

Instructor	**Faculty Advisor**
Dr. Melissa Morris	Jeff Markle

Problem Identified
The goal for this project is to create a multi tool that can satisfy "at home" needs for a modern citizen that might find an entire toolbox excessive. Our updated vision of the multi tool will include electronic charging and data storage combined with essential simple tools found in classic designs.

Current Solutions
There are many multi tools on the market serving varying broad or specific niches. Although, there is not one that includes data storage or cellphone charging capabilities. Current multi tools on the market offer plies, screw drivers, knives, etc. The product that we will create will also allow for on-the-go and easy data storage and phone charging capabilities.

Team's Solution
The team's solution is to implement simple electronics capabilities in a multi-tool. This "Millennial Pocketknife" would include USB data storage and charging for various popular micro-USB devices, in addition to containing commonly used tools. This is better than current solutions because for many people in the hands-on mechanical industry, tools are frequently needed, and there is an increasingly frequent needs for data storage and a portable phone chargers. The goal is to combine all of these products in to one easy pocket-sized device, rather than 3 separate tools that can each be forgotten or lost individually.

Weld-Inspecting Vehicle

Project Participant
Miranda Leake

Instructor
Dr. Melissa Morris

Faculty & Technical Advisor
Dr. Mohamed Trabia

Problem Identified
Weld inspection for steel construction and entertainment attractions (namely, roller coasters) is an arduous, time-consuming, and often dangerous process. It can slow progress in meeting construction deadlines and create significant downtimes for entertainment venues. In both industries, inspections can easily spell out danger for technicians performing them, as well as losses of time and money.

Current Solutions
Currently, most weld inspection processes are done by maintenance technicians or iron workers. These people perform inspections manually, and in some cases, they are rigged-up to the structures for hundreds of man-hours. The only product similar to the one that I have developed costs over 1 million dollars.

Team's Solution
My product seeks to make weld-inspection for commercial construction and entertainment attractions (namely, rollercoasters) a safer, more expedient process. The device is designed to travel along steel members and perform visual, ultrasonic, non-destructive weld inspection. This new inspection process can be done remotely by a technician or engineer from the safety of the ground below. Use of the product will shorten inspection time for construction and down-time for entertainment attractions, as well as eliminate a significant amount of risk involved with inspection.

INTERDISCIPLINARY PROJECTS

BCI Telepresence Helmet

Project Participants
Alex Cater, Leonardo Georgescu,
Yu Hang He & Dylan Wallace

Instructor
Dr. Grzegorz Chmaj

Faculty Advisor
Dr. Paul Oh

Technical Advisor
Jadin Tredup

Problem Identified
Predicted by the future of work, automation and artificial intelligence will cause significant disruptions in the workforce. Even more concerning is the fact that the disruption could cause the unemployment rate to increase, especially for people with motor impairments. Moreover, most workplace injuries occurring are due to overexertion caused by lifting, holding, carrying etc., and come at a high cost for both companies and workers.

Current Solutions
Past research has been performed on tele-operating of robots in virtual environments. MIT developed robot control using VR, but the platform they used was not a humanoid robot. Moreover, the projects that have incorporated VR with robotic control have not provided haptic feedback or control through a Brain-Computer Interface (BCI). Tele-operated robots have begun to find success in medical and manufacturing industries, but currently do not integrate BCI and VR technologies to enhance operator control.

Team's Solution
During the transition period to full autonomy, the workforce could consist of tele-operated robotic platforms in which common workplace injuries and costs would be significantly reduced. Typically, a high level of education in engineering and robotics is required before an operator can safely and efficiently tele-operate a robot using traditional control methods. The inclusion of BCI headsets into robot control system would allow average workers without background in engineering to operate these machines. In addition, when augmented with a virtual reality environment, tele-operation of robots will be more intuitive and accessible. This solution benefits both workers and companies. Workers, especially those with motor impairments, will enjoy more opportunities to participate in the workforce safely, and even remotely. Companies can benefit by utilizing the system with multiple controlled robots, reducing hours worked on specific tasks.

Hotel Bed Lifter

Project Participants
Vanesa Esquivel, Jaime Lopez-Cano, Brian Payne,
Cristian Ramirez & Jason Villanueva

Instructor
Dr. Melissa Morris

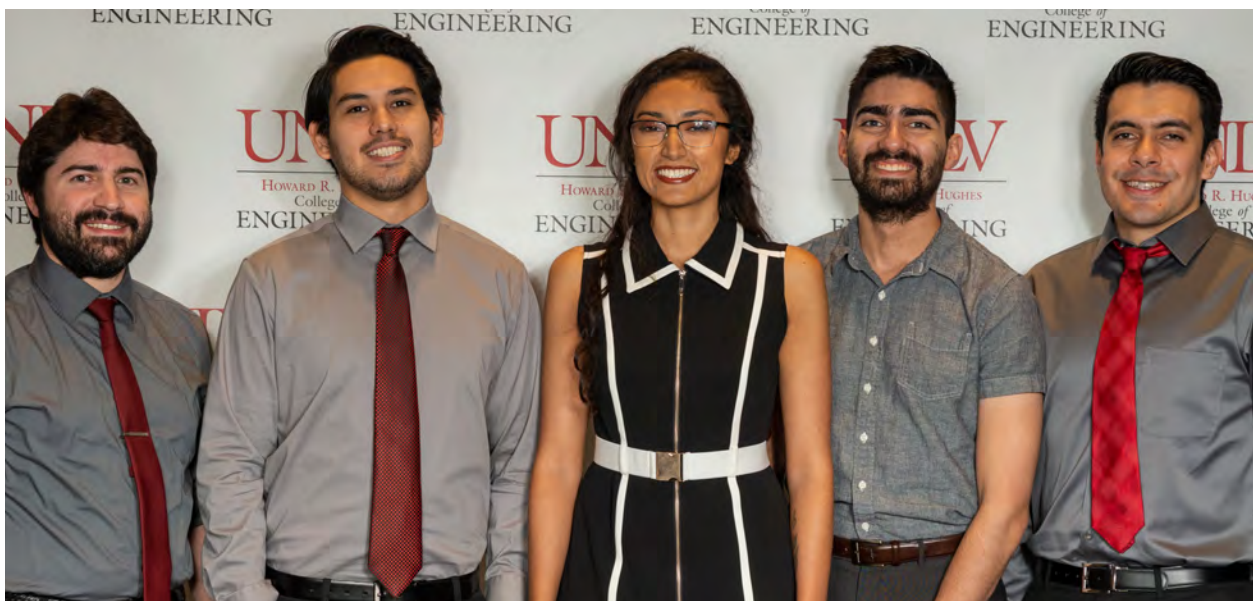**Faculty Advisor**
Dr. Georg Mauer

Problem Identified
Helping hotel staff eliminate the need to bend over during turndown service and reduce their likelihood of developing carpal-tunnel syndrome, due to the repetitive motion required for turndown service.

Current Solutions
A plastic lever is a current solution to lift edges of the mattress to reduce strain on the back and wrists on general room attendants. It is light, cheap, and portable, but isn't commonly used due to the extra seconds it is required to grab and use.

Team's Solution
Due to the time constraints general room attendants must endure, the need of simplicity and time reduction is important. Our team's dual scissor-lift mechanism will be installed under mattresses, ready for general room attendants to use. It will be simple to use and it will require little to no effort from the attendants. In addition to lifting the edges of the mattress, the device will also lift the entire body of the mattress to reduce the time attendants spent on their knees.

SMART MEDICINE CABINET

Project Participants
Yared Abraha, Angelica Clemente,
Biruk Gebremeskel & Daniel Senda

Instructor
Dr. Grzegorz Chmaj

Faculty Advisor
Dr. Pushkin Kachroo

Community Advisor
Anthony Rufo

Problem Identified
The main problem that the Smart Medicine Cabinet (SMC) seeks to solve is the current opioid crisis plaguing the United States. According to the U.S. Department of Health and Human Services, over 130 people die every day due to opioid-related drug overdoses. Additionally, the SMC seeks to solve the lack of consistency and accountability associated with medication management, which both caregivers and patients face every day.

Current Solutions
The closest solution available in the current market is the lockable medicine cabinet. However, the lockable medicine cabinet is not specifically made for medication management.

Team's Solution
The Smart Medicine Cabinet (SMC) is a product designed to help make medication management safe, easy, and secure. Unlike the lockable medicine cabinet, which requires manual locking and unlocking dependent on the user, the SMC will automate this process and make medication management simple and easy. The SMC helps improve the security of medication by remaining locked until it is time for the user to take the medication. It will also alert the user when to take the medication, the correct dosage to take, and keep a log of how the medication is being taken; this information can be shared with a caregiver or doctor. In addition, if the user is not taking the medication correctly, it will let the caregiver know, so assistance can be provided to the user if needed. The Smart Medicine Cabinet mainly targets the elderly and people who take medications on a regular basis, in hopes to make their lives easier, help them become more independent, and prevent them from opioid addiction.

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FROM ALL OF THE FACULTY, STAFF AND STUDENTS AT THE HOWARD R. HUGHES COLLEGE OF ENGINEERING, THANK YOU!

Thank you for your continued emotional, physical and monetary support over the last 20 years. There would be no competition without you.

Thank you to our founders Fred and Harriet Cox. The competition would not be what it is today without the Cox family. It has grown from just a couple student teams with few participants to over 40 student teams with 250 participants each semester. The student teams are so grateful to have the opportunity to show off their knowledge and skills gained as future graduates of the Howard R. Hughes College of Engineering.

Thank you to all of our generous sponsors who have helped us continually grow the competition while awarding over $30,000 in prize monies.

Finally, thank you to all of the families, friends and support networks of our students. Without each of you, their journeys through their academic adventures would have been much more difficult.

We are looking forward to celebrating the next 20 years!