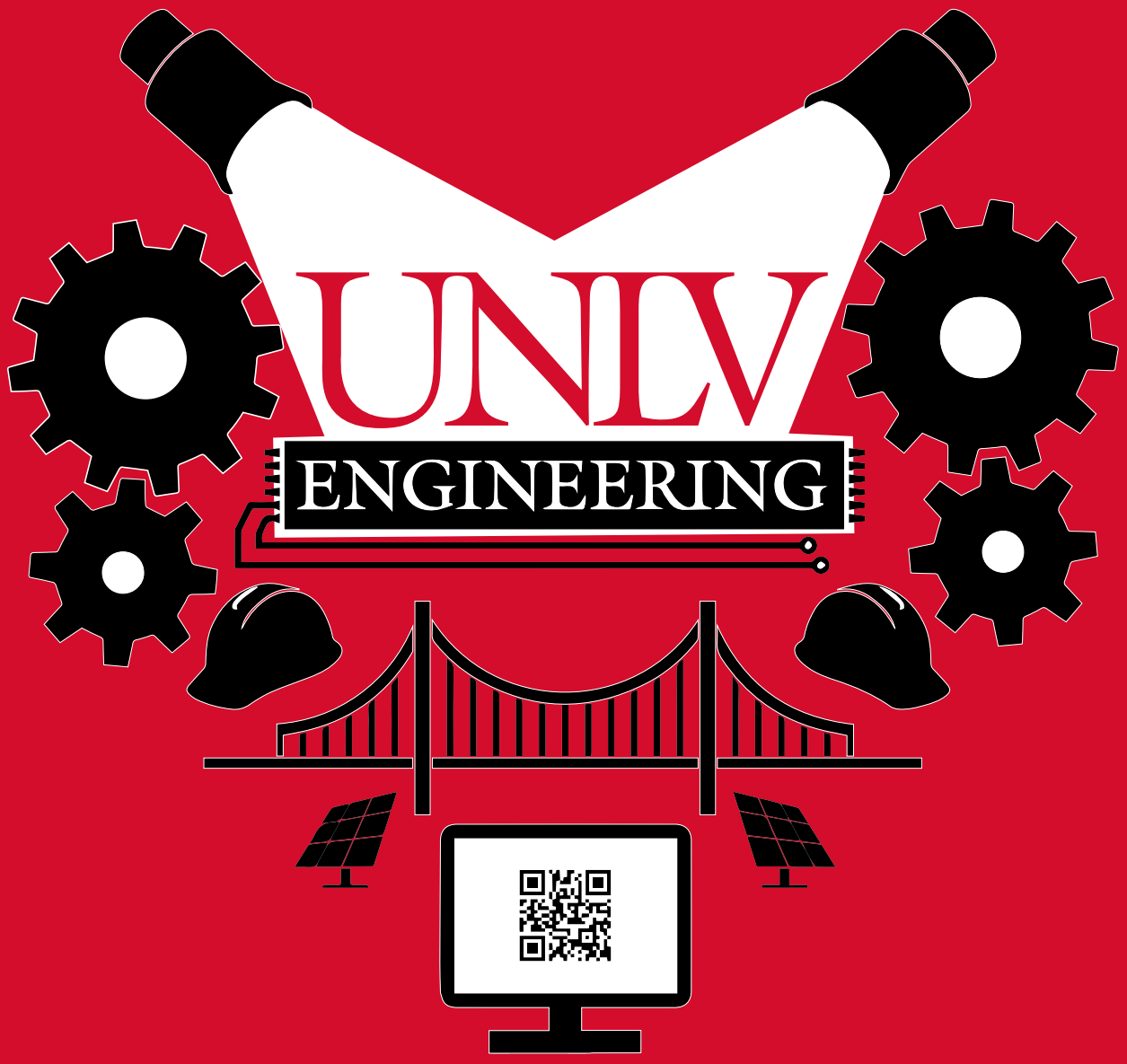
FRED AND HARRIET COX

SENIOR DESIGN COMPETITION



May 9, 2019

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

2019

Fred & Harriet Cox

Senior Design

Sponsors!

Thank you,
Senior Design Instructors!

Civil & Environmental Engineering & Construction
Dr. David James

Computer Science
Dr. Andreas Stefik

Electrical & Computer Engineering
Dr. Grzegorz Chmaj

Entertainment Engineering & Design
Dr. Grzegorz Chmaj

Mechanical Engineering
Dr. Zhiyong Wang

Table of Contents

Spring 2019 Senior Design Judges

Christopher Gandy

Chief Technology Officer, Unified Command

Chris is a retired police officer with the Las Vegas Metropolitan Police Department, 16 of his 21 years with the department was spent in the Technical Detail. He spent his time since 2001 specializing in design, integration, and deployment of IP-based camera systems. Over the last decade Chris has designed, built, and deployed Crime Camera systems for public safety, Rapid Mobile Camera systems for emergency management, Tactical Thermal Camera systems for tactical response, and Festival Security Camera systems for both public and private safety and security interests. Chris' design and deployment experience covers an end-to-end understanding of IP video and wireless networking in relation to delivering a video solution to Command Operation Centers. Chris joined Unified Command in 2013, bringing his vast experience to their Video Command solution.

Kim Grange

VP of Engineering, The Venetian and Palazzo Hotel and Casino

Kim Grange is the Vice President of Engineering at The Venetian|The Palazzo Hotel Casino. His early career path began as an Electrician/HVAC Tech and, in 1983, began working in the hotel industry when he was hired at The Golden Nugget. Kim worked his way up to Director of Facilities at the Golden Nugget, assisted with the opening of The Mirage in 1989, then accepted a job as a Project Manager during construction of The Venetian, which eventually rolled into the Director of Facilities once it opened. During his tenure at The Venetian, he has opened every property, including The Venezia, The Palazzo, Sands Macau, Venetian Macau, Singapore, and Bethworks. His involvement with the operational designs, MEP, and the creation of their Facilities management teams helped to guide each property in their operations after opening.

Mark E. Johnson, P.E.

Director of Engineering and Chief Engineer, Jacob's Federal Operataions

Mark is the Director of Engineering & Chief Engineer for Jacobs's Federal Operations in Oak Ridge, Tennessee. Mark is responsible for the technical execution of nuclear engineering and environmental projects for the federal government, as well as commercial clients. His areas of expertise include pharmaceutical, semi-conductor cleanroom, and nuclear confinement zone designs. He has been with Jacobs for 29 years. Mark holds P.E. licenses in Tennessee, South Carolina, and Washington State. He has professional affiliations with The Society of American Military Engineers and the American Society of Heating, Refrigerating and Air-Conditioning Engineers. Mark holds a B.S. in Mechanical Engineering from the University of Akron and continued studies with the Air Force Institute of Technology.

Brandon Main

CEO, Xtreme Manufacturing

Brandon joined Xtreme Manufacturing in 2008 as Vice President of the Xtreme Cube division. He was promoted in 2015 to President for Xtreme's manufacturing operations in Nevada and California, and in 2018 was promoted to CEO of the Xtreme Cubes Corporation. Brandon has a strong background in Mechanical Engineering, and is a licensed Professional Engineer (Mechanical) in the State of Nevada. Prior to Xtreme, Brandon operated his own engineering consultancy.

Eric Olsen

Principal, Olsen Consulting

With over 30 years of gaming experience, Eric has significant achievements in product development and deployment of gaming equipment of all types. As a founder and leader of a multi-million dollar gaming equipment provider, Eric has unique insights that are highly valuable to startups and other entities involved in corporate formation and high-tech product development. Today, Eric is a senior member of the gaming community and continues to provide advice to top tier gaming organizations, executives and prospective licensees. Living in Las Vegas for over 50 years, Eric is committed to supporting our gaming industry, and is always happy to help strengthen and maintain the high ethical standards and values the industry has achieved.

Benjamin C. Taylor, P.E.

Project and Office Quality Manager, Jacobs Engineering Group

Benjamin Taylor is a Project Manager and Office Quality Manager for the Las Vegas office of Jacobs Engineering Group. He has more than 15 years of civil engineering experience in design, planning, and construction support of various civil works projects including; rural and urban freeways, bridges, interchanges, arterial streets, multi-use trails, utility corridors, drainage channel and storm drain facilities, and both greenfield and brownfield site development.

Raj C. Shrotriya, MD

Physician and Director of Avant Diagnostics

Dr. Shrotriya has been a Director of the Company since September 2014. From 2000 – 2017, Dr. Shrotriya was President and Chief Operating Officer and Chief Executive Officer of Spectrum Pharmaceuticals. In this capacity he spearheaded major changes in business strategy and coordinated structural reorganization culminating in the formation of Spectrum Pharmaceuticals, Inc. Prior to joining Spectrum, Dr. Shrotriya was Executive Vice President and Chief Scientific Officer for SuperGen, Inc. and Vice President, Medical Affairs and Vice President, Chief Medical Officer at MGI Pharma, Inc. For 18 years he held various positions at Bristol-Myers Squibb Company, the most recent being Executive Director Worldwide CNS Clinical Research.

Steven Winfree

Engineer, Stantec Consulting Services

Mr. Steven D. Winfree is an Environmental Engineer with Stantec Consulting Services, Inc. based in the Las Vegas Nevada office. He currently serves as the Southwest Region Process Lead for all of Arizona, New Mexico, Nevada, Utah and Idaho. He received a BS degree in Civil and Environmental Engineering from the University of Nevada Las Vegas in 2012. He has over seven years of experience in the design and construction of treatment processes and site layouts for greenfield construction as well as the rehabilitation of existing treatment processes and pumping stations. Key experiences include UV disinfection for water and wastewater facilities, UV advanced oxidation, and chemical disinfection, as well as, solids handling processes including anaerobic digestion, co-digestion systems, thickening and dewatering processes and sludge pumping stations. Mr. Winfree has fulfilled multiple roles on design projects throughout his career, including Process Engineer, Project Engineer, and Design Coordinator. He has extensive experience in interdisciplinary design coordination including working with remote team members across multiple geographies around the globe.

William M. Shepherd

Retired Captain United States Navy

William Shepherd has served as a Navy SEAL, NASA Astronaut, Program Manager, and Senior Government Official with the Department of Defense (DOD). He started his career in 1971 as an Underwater Demolition “Frogman”, and Navy SEAL by 1984, he was one of 17 Astronaut Candidates in NASA’s Astronaut Group 10. Captain Shepherd flew as a NASA Mission Specialist and Flight Engineer on 3 Space Shuttle flights carrying DOD and scientific payloads to space, performing materials and life science experiments in microgravity and launching the interpalanetary probe “Ulysses” into the first polar orbit of the Sun. In 1993, Capt. Shepherd was selected to serve as Program Manager for the new International Space Station (ISS) leading a 16 nation partnership to design and build this new orbital “gateway” to space. In 1996 Capt. Shepherd was named by Vice President Gore and Russian Premier Chernomyrdin to command the “First Expedition” to the new space station. In 2000, Capt. Shepherd’s crew, with Russian Cosmonauts Yuri Gidzenko and Sergei Krikalev, launched from Kazakhstan aboard a Soyuz rocket, flew into Earth orbit, and docked with the Space Station. From October 2000 to March 2001, The Expedition One crew brought the station to life, establishing the operational and research capabilities of the new outpost. Their 4 ½ month mission covered 58,000,000 miles—equal to two-thirds the distance between Earth and Mars. By 2009 the ISS was the recipient of the Collier Trophy for its great achievements in aviation and astronautics.

Capt. Shepherd received a Bachelors Degree in Aerospace Engineering from the U.S Naval Academy, and Master’s and Engineer’s degrees in Mechanical and Ocean Engineering from MIT. Throughout his career Capt. Shepherd has been awarded: NASA’s Steve Thorne Aviation award, “Honorary Naval Aviator Number 30”, Defense Distinguished Service Medal, National Intelligence Medal, Spirit of St. Louis Medal, Gagarin Gold Medal, Robert H. Goddard Trophy and the Congressional Space Medal of Honor.

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING AND CONSTRUCTION PROJECTS

Department Chair
Dr. Sajjad Ahmad

Senior Design Instructor
Dr. David James

Hempcrete Insulating Walls

Project Participants
Jonathan Cole, Daniel Drake
& Jessica Skarupski

Instructor
Dr. David James

Problem Identified
The current materials used in construction, such as drywall and insulation, produce excessive amounts of carbon dioxide during the manufacturing process. In addition to generating a carbon footprint, the efficiency of the insulating materials is not sufficient.

Current Solutions
The current market solution is the use of additional insulation in the walls and ceiling.

Team's Solution
The use of hemp in construction has many benefits. Hemp is a sustainable, fast-growing material that takes very little energy to produce. Not only does the production of hemp not emit much carbon dioxide, but it also absorbs it from the surrounding environment, making hempcrete, a carbon negative material. Additionally, because of its low level of thermal conductivity, it is an efficient insulator. Other beneficial characteristics include water, mold, and fire resistance. Moreover, the reduction of carbon dioxide emissions will benefit the environment. However, a more easily observable benefit will be reduced energy bills for the owners of houses made with hemp concrete.

Rebuilding Paradise Part 1

Project Participants
Sean Caviola, Carson Kerbrat
& Rafael Montoya

Instructor
Dr. David James

Faculty Advisors
Dr. Jin Ouk Choi & Ryan Sherman

Technical Advisor
Tom Wilzcek

Problem Identified
The town of Paradise, California was recently devastated by the fast moving November 2018 Camp Fire. Most of the town was destroyed, leaving hundreds of families homeless. Rebuilding the town's neighborhoods using traditional methods will take a long time. Another, non-traditional, method can be used to shorten that time.

Current Solutions
The current market solution is to rebuild the town's neighborhoods the traditional way, using wood frame houses.

Team's Solution
With the help of Xtreme Manufacturing, temporary living spaces can be built onsite while homes are being rebuilt. The temporary living spaces will utilize Xtreme Manufacturing's Xtreme Cube technology. An Xtreme Cube is a modular structure. Once the homes are finished, the Xtreme Cubes can be repurposed as safety shelters.

Re-Sourcing Waste

Project Participants
Farah Al-Karawi, Niel Christian Tugadi
& Joell Waldron

Instructor
Dr. David James

Faculty Advisor
Dr. Erica Marti

Community Advisor
Calvin Starman

Problem Identified
Remote and developing communities are facing illnesses caused by contaminated water, due to unreliable water sources and inadequate sanitation systems. The lack of resources, materials, and funds make it difficult for these communities to overcome the effects caused by deficient systems.

Current Solutions
The most common solutions currently in the market are a combination of unsustainable pit latrines and the practice of open defecation. Some communities use composting latrines, but these produce minimal beneficial products.

Team's Solution
A sanitation and water treatment system will be implemented to control the outbreak of illnesses caused by waste contamination. The sanitation system will be set in place to maximize the recovery and reuse of useful products from both solid and liquid wastes. Simple, local, cost-effective materials and resources will be used to ensure the community's prosperity, without the need for advanced maintenance of the system. The proposed solution will be implemented in a local setting in the Las Vegas Valley to showcase its effectiveness and adaptability for different environments.

Stormwater Solutions for the Paradise Parking Lot

Project Participants
Nicholas Diana & Gregory Hansen

Instructor
Dr. David James

Faculty Advisor
Dr. Sajjad Ahmad

Technical Advisor
Rick Read

Community Advisor
Joshua Carpenter

Problem Identified

Previous studies and data reveal that the current infrastructure of the UNLV Paradise Campus (UNLVPC) is incapable of handling the runoff flows generated from a 2-year 1-hour storm event. Thus, the parking area located at the UNLVPC is subject to inundation of rainwater during a 2-year 1-hour rain event. This conundrum inconveniences the patrons (mostly the elderly), and staff. There has been one injury per month recorded at this facility. Even though the injuries encountered by the patrons are mostly due to the serious grading issues associated with the faulty asphalt concrete, this project will focus on the flooding issues. Therefore, the design that our team proposes will attempt to alleviate the flooding problems by holding paramount the health, safety, and welfare of the public.

Current Solutions

Since this project is an expansion/improvement of previous Senior Design projects conducted for this site, then the current market solutions will inevitably consist of the tried and true construction techniques provided by the Senior Design teams of previous semesters. 1. Large above ground detention basin. 2. Large above ground open channel. 3. Large subsurface RCB (reinforced concrete box). 4. Large subsurface detention basin with RCB. 5. Regrade and repave the parking lot.

Team's Solution

We will use porous concrete to great effect in diverting pooling and flowing water through and/or around the parking area of the UNLV Paradise campus. This will decrease the volume of flood water flowing through the parking lot, decrease or halt interruptions of power outages, decrease or halt flooding of vehicles, and most importantly increase the safety for the patrons using the UNLVPC. Concurrently, incidents of injury should diminish. Our solutions will strive to have reasonable cost estimates regarding money spent in rehabilitating the site. This will aid in the acquisition of funds and make our solution viable. Additionally, we aim to keep our proposed solutions simple to enact. This will help to facilitate minimal disruption to the workings of the UNLV Paradise campus. If at all viable, then our scope will attempt to include ponding and flooding of water on Bock Street, as we don't want to shift the parking lot problem to Bock Street.

Wastewater Treatment Plant

Project Participants
Taylor Musarra, Nicholas Portugal & Bany Umanzor

Instructor
Dr. David James

Faculty Advisor
Dr. Sajjad Ahmad

Technical Advisor
Chris Krizmanic, P.E.

Community Advisor
Dr. Jacimaria Batista

Problem Identified
The CCWRD Laughlin Water Resource Center is a biological water treatment center that has served Laughlin since 1985. The facility was designed to treat eight million gallons per day (MGD) of water although this capacity is becoming difficult to maintain as the city's population increases. At the same time, the chemical composition of the effluent water from the facility contains high levels of trace organics and PPCPs (pharmaceuticals and personal care products), which cannot be discharged into the Colorado River to recharge Laughlin's current allotment of water. There are several challenges impacting the current plant's ability to support future land development in the city, including high temperatures, complex geology and soils, long travel times from supply/treatment locations, and steep terrain.

Current Solutions
The current layout of the Laughlin facility has a maximum water treatment capacity of eight MGD. Recently, two clarifiers, dissolved air flotation thickeners, and other mechanical systems have had their existing carbon steel parts rehabilitated in order to improve the efficiency and life of technology within the plant. However, the solids removed during water treatment are dried and dumped into a landfill, which leaves the resulting effluent water replete with trace organics and PPCPs.

Team's Solution
The team has proposed expanding the current treatment plant to increase the capacity so that the growing population of Laughlin can be served without difficulty. In addition to the expansion, the team proposes that solar powered cells be added near the plant to provide energy. As wastewater treatment plants use a significant amount of energy to operate, using solar power is a more environmentally friendly way for the power plant to receive its electricity. The team will use the best equipment currently available for the water treatment facility in order to provide cleaner influent without having to worry about meeting EPA standards. Along with using the newest equipment, the team will ensure that the equipment makes it simpler for operators to control and repair it, if needed. With top of the line equipment and renewable resources, the Laughlin plant can run efficiently and can continue to eliminate hazardous effluent from entering the Colorado River.

DEPARTMENT OF COMPUTER SCIENCE PROJECTS

Department Chair
Dr. Sidkazem Taghva

Senior Design Instructor
Dr. Andreas Stefik

BioKey Security

Project Participants
Anthony Cruz, Kevin Moreno,
Mnemeth Piros & Kahliah Plaster

Instructor
Dr. Andreas Stefik

Problem Identified
Currently, there are smart security systems available on the market, but they all require human supervision. We aim to automate the smart security system by removing the need for someone to watch, and only report issues when the system deems necessary. We plan to create a security and notification system based around facial recognition. The system will allow for interaction with other security devices.

Current Solutions
There are currently solutions on the market that are very similar to what we are doing. However, the problem with these systems is that they have not been integrated into a single unit. For example, Ring has live feed; Samsung has some facial recognition; Schlage has smart locks; and Alexa can send messages. Our solution is to bring the key pieces of each service together into one package.

Team's Solution
Our smart security system will integrate the features of some diverse products that are currently on the market into a single unit. This is beneficial for both home security and business security. Security issues are seldom common to all users, yet many of the on-market products require constant monitoring or are tailored to only protect one aspect of security (eg. smart door lock, live video doorbell, 24/7 video surveillance onto hard storage). We plan to barebones the system into notifying and asking the user what actions to take when absolutely necessary, creating a security/ automation plus solution.

Blogly.io

Project Participants
Alex Amphone, Luis Castaneda, Amit Etiel,
Javier Llerenas, Nicholas Lower & Gierael Ortega

Instructor
Dr. Andreas Stefik

Technical Advisor
Patrick Eaton

Problem Identified
Not all media content is accessible to those with vision disabilities. Moreover, some people are too busy to sit down and read a blog post. Our survey of over 60 people showed that over 80% of people want to read/use blogs and would be interested in an application that reads blogs and articles aloud.

Current Solutions
There are several similar products in the current market, but all have deficiencies. Pocket and Motoread are blog-reading applications that have robotic-sounding outputs. VoiceOver is a built-in Mac tool that is redundant and robotic-sounding, and too complex for blog-use. NV Access is a downloadable Windows program that sounds robotic and has many controls that make it difficult to use.

Team's Solution
Blogly.io will focus heavily on centralizing blog articles, while converting them into an audio format that is pleasant to listen to. The app will provide a state-of-the-art voice user interface, which will give users the ability to navigate through it solely with voice commands. Other attempts in this area have lacked in providing output that is clear and easy to follow. On the contrary, Blogly.io will emphasize usability and simplicity, with a focus on providing users with human-like audio. As a Progressive Web Application, Blogly.io will be accessible through any device.

Game of Life: Code to Survive

Project Participants
Adam Hoffman, Jun Yan Liang,
Dale Milburn & Tyler Syme

Instructor
Dr. Andreas Stefik

Problem Identified
Our project seeks to teach the fundamentals and building blocks of programming to the next generation, so as to ensure computer and programming literacy.

Current Solutions
Current solutions on the market include MIT's Scratch and Codable Crafts, among others.

Team's Solution
To accomplish the task, our solution will take the format of a video game, in which the player will code the behavior of a cellular life form called a "bit-creature" using interlocking coding blocks. Our solution differentiates itself from the competition by creating a fun and engaging game of survival, in which the player will create a personal attachment to their "bit-creature," engendering a sense of pride and accomplishment as they progress through each lesson. This will allow users to experience and learn coding in an exciting and fun new way, benefitting people of all ages.

GymSpace

Project Participants
Andie Escala, Rolly Lacap, Marc Sevilleja,
Paul Stanik III & Kevin Tungcab

Instructor
Dr. Andreas Stefik

Problem Identified
Establishing or maintaining a healthy lifestyle is a challenge many people face. The overlying issues in this area include lacking knowledge about what to do, not having motivation, or needing a partner for support. Those striving for a healthy lifestyle should be able to easily connect and share with others who are like-minded.

Current Solutions
There are currently apps on the market that focus mainly on either fitness or diet. There are few applications that can do both, while including a social feature to connect with others.

Team's Solution
Current fitness apps allow users to focus on themselves, but there is no open platform to share or collaborate on workouts. GymSpace proposes a system in which users can join groups and/or events based on their common interests. Unlike other fitness apps, this application links diet and fitness with a social network. GymSpace users can create and share custom workout routines. Additionally, there is an award system for completing various challenges.

Jour

Project Participants
Adrian Alberto, Kyler Earhart, Peter Hernandez,
Shawn Norris, Kassie Wong & Natthinee Wongsavit

Instructor
Dr. Andreas Stefik

Problem Identified
Our project will allow an individual to engage in methods of reducing stress by means of organizing daily goals, thoughts, and emotions.

Current Solutions
There are currently organizational apps in the market, such as To-Do-Lists and other note-taking options, which allow users to organize their tasks. There are also many journaling apps, in which people can write about their day, life, etc.

Team's Solution
The purpose of our project is to create a goal-oriented, journaling application. It has been shown that organizing daily goals is a key factor in reducing stress. It has also been argued that journaling reduces stress, while providing mental clarity. Combining these two aspects into our project will allow for a more streamlined tool for people interested in benefiting their mental health.

Math with Friends

Project Participants
Jaren Braza, Leslie Tran, Thien Truong,
Zachary Waddington & Sabrina Wallace

Instructor
Dr. Andreas Stefik

Problem Identified
Mathematics is a core subject in standard education. Our project aims to make math more widely enjoyable, and more than just a class that students have to take. There is an increasing demand for workers in STEM fields, so we want to help promote problem-solving skills, especially to younger generations.

Current Solutions
Some solutions in the current market include math workbooks, board games, flash cards, and online games.

Team's Solution
Our solution is to create a mobile app that allows users to play math games against each other. This solution offers more convenience than current market solutions because people are more likely to be carrying their phones than board games, computers, flash cards, or books. Also, people will be able to play against their friends. Incorporating this competitive element reinforces learning and makes the experience more fun. Parents and teachers can use our app to help their children or students benefit by practicing math and problem-solving. However, our app is appropriate for all ages, for fun mental stimulation.

Pick Up Game

Project Participants
Erik Chow, Dayton Flores,
Frank Frisbee & Joseph Sharphalpin

Instructor
Dr. Andreas Stefik

Problem Identified
Are you tired of going to the park and not having anyone to play sports with? Do none of your friends want to play sports with you? Do you want to meet new people to play sports with? Our project seeks to solve these problems.

Current Solutions
The current market contains ineffective apps in this area.

Team's Solution
Our app will let users search the area around them to find others to play sports with. Users can meet and communicate with other users. They can also choose a place to meet to play sports. The app also allows users to customize their profiles.

The Void

Project Participants
Ace Don Adriatico, Rafael Pineda, William Rogers,
Jean-Luc Sandqvist, Alex St. Aubin & DeAndre Stallworth

Instructor
Dr. Andreas Stefik

Problem Identified
Introducing a new and captivating Amazon Skill that engages users in a dense “dungeon-like” adventure. The Void pushes the boundaries of open-world adventure skills in the Amazon market by allowing users to have complete control of their own surroundings. Learn how to explore, persuade, and battle your way through The Void.

Current Solutions
The available solutions in the Amazon Alexa skills market mainly consists of “trivial like question” engagements between the user and the Amazon Echo. Escape the Room by Stoked Skills, LLC is a solution in the current market that allows users to engage in different invocations, in aims to escape the room or setting that they are in.

Team’s Solution
The Void is a Dungeons and Dragons type spin-off for the Amazon Echo. Our game takes players on a journey through various lands and creatures. The Void allows users to engage with the Amazon Echo in a way that has never been done before, as currently the market tends to be saturated with linear games that limit users to repetitive and claustrophobic engagements between themselves and the Amazon Alexa. The Void allows users to imagine themselves adventuring through their own utopias, benefitting those with fruitful imaginations and who choose not be bounded by limitations, as well as those who may suffer from conditions like blindness or impaired vision, and all who want to engage in adventure from the comfort of their own homes.

UNLV One Stop

Project Participants
Belete Engidawork, Sang Huynh, Ty Kurata,
Matthew Lazeroff, Jose Llamas & Jinger Siu

Instructor
Dr. Andreas Stefik

Problem Identified
UNLV lacks a central hub that displays useful information about the campus for students to see. Currently, the UNLV website is overflowing with information, links, and webpages. Users need to dig through several web pages to find information that is sometimes outdated. The purpose of UNLV One Stop is to develop a web solution for students to find information and data easily, whether for academic needs or fun activities.

Current Solutions
Currently, UNLV's website, www.unlv.edu, is the first place most students go when looking for information. For new students, it is difficult to find needed information using the UNLV website.

Team's Solution
Our team's solution is to compile relevant information from various sources into a single website that will display the information in a clear, easy to read manner. The website will list business hours for popular places around campus, show when areas of campus are busy and when they are not, provide a campus directory for building names and locations, and display announcements for events on campus, as well as other things like library room availability and parking enforcement hours. The idea behind this is to create a one stop shop for students to find information without the hassle of navigating through multiple webpages to find what they are looking for. While all UNLV students can benefit from our website, we feel that freshmen/transfer students will benefit the most as they learn the ins and outs of campus life.

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING PROJECTS

Department Chair
Dr. Biswajit Das

Senior Design Instructor
Dr. Grzegorz Chmaj

Auto-Box

Project Participants
Kyle Butler, Jose Munguia
& Robert Sander

Instructor
Dr. Grzegorz Chmaj

Faculty Advisor
Dr. Brendan Morris

Problem Identified
Auto-Box allows users of any skill level to grow plants. The aim is to utilize machine learning to optimize the growing process and produce higher yields, while remaining water and power efficient.

Current Solutions
The current market solutions have products that are too large, and do not fully incorporate a system that can identify the state of a plant, or assist in controlling a plant's environment. The majority are still in the process of development, and have yet to ship out working devices. Moreover, the current products do not have the same capabilities as the Auto-Box.

Team's Solution
Our product makes use of Google's Tensorflow, which is a machine-learning tool built into the functionality of the device, and through the use of a wireless sensor network, helps achieve autonomous environment control. All sensors are wireless and communicate with our cloud, where an image classifier and an autoregressive (AR) model are used to classify the state of the plant and predict the required future conditions of the environment. The image processor and AR model has been trained with machine and deep learning. The Auto-Box control system will adjust pre-established parameters to reduce the amount of affliction. Additionally, our product will continue to learn and optimize growth with each use, ensuring the best possible yield for each grow cycle. The system has the potential to be adaptable to large-scale operations with easy retrofitting for clients' current assets. The target markets for the product are at home plant enthusiasts, people in urbanized areas that might not have other access to grow plants, and commercial horticulturists.

Biometric & RFID Lock Systems

Project Participant
Prachi Patel

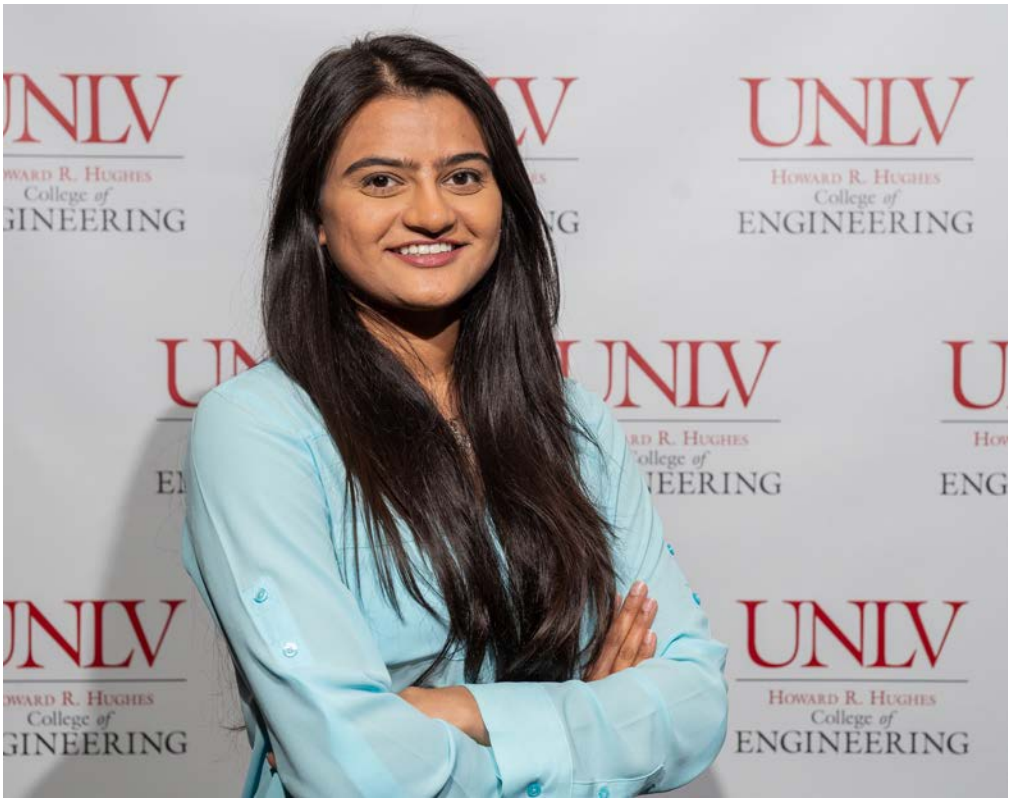
Instructor
Dr. Grzegorz Chmaj

Faculty Advisor
Dr. Venkatesan Muthukumar

Problem Identified
The aim of the project is to design a Biometric & RFID Lock system that will increase efficiency in biometric entry as well as to utilize an Active RFID concept for a faster and keyless entry.

Current Solutions
There are many biometric security devices in the market today, but a majority of them allow a number pad unlock, which compromises their security. There are also systems that use passive RFID, which requires a key card to be used at a mm distance.

Team's Solution
Our design will allow a faster biometric entry, with a capacitive fingerprint module that will fit on a door's handle. The system will use a wireless transceiver, with a small microcontroller as a key that stays with the customers (for example in their pocket), but opens the door when attempted, if the key is within the assigned range. If the wireless transceiver receives a signal from another transceiver, the lock will override the biometric system and allow keyless entry.



Conduit Crawler

Project Participants
Clayton Higbee & Cody Hudson

Instructor
Dr. Grzegorz Chmaj

Faculty Advisor
Dr. Brendan Morris

Community Advisor
David Tress, LVVWD

Problem Identified
Our project's goal is to create a cheaper and more efficient method of conduit inspection.

Current Solutions
Current market solutions are known as Pipe Crawlers, or Pipe Snakes. They typically consist of small rovers with cameras and lights attached to a main video display hub by the use of a tether. They typically range in price anywhere from $11,000 to $35,000.

Team's Solution
The project goal is to create a cheaper and more efficient conduit inspection device. The Conduit Crawler will use LIDAR (Light Detection and Ranging) technology to allow for precise measurements of a conduit's interior. The device will not rely on a visual feed, as current devices do, but instead provide a 3D map of the entire conduit length. This product will rely less on the skill of the technician and more on the capabilities of the device. Therefore, the device will benefit both device operators and companies that contract out for inspections. Inspections can be completed faster and 3D models that show accurate representations of complication points can be saved. Though the majority of the chassis and exterior elements will be similar, we will attempt to engineer the device to be less expensive. With these advantages, required repairs to broken sections can be more precisely reported to construction crews, so they know exactly where to work. This will remove the guesswork from underground conduit repairs.

Emotion Detection Device (E.D.D.)

Project Participants
Junho Bae, Jeeno Don Doria & Joseph Kim

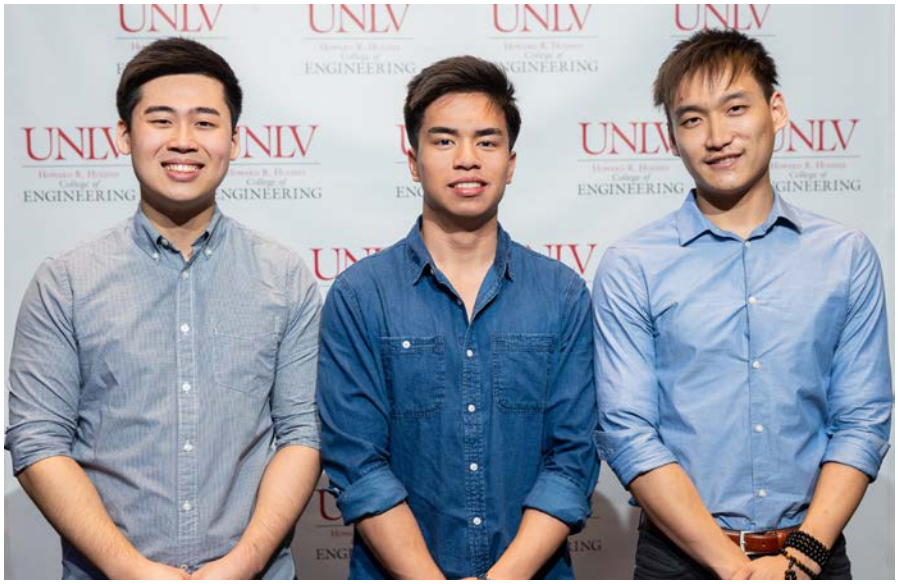
Instructor
Dr. Grzegorz Chmaj

Faculty Advisor
Dr. Brendan Morris

Problem Identified
In recent years, many businesses have learned how to improve the quality of their products and services by gathering consumer feedback through social media and surveys. Unfortunately, collecting information in this way leads to the loss of true qualitative data regarding consumers' experiences. Collecting data related to consumers' feelings about products and services is restricted by the factors of time, money, and human resources. Technological applications of emotion recognition can greatly reduce the amount of people necessary and time spent on this task, but currently, there are no easy-to-use and cost-effective market solutions.

Current Solutions
Current market solutions are limited to only Affectiva and Eyeris. Affectiva caters its emotion recognition services to advertisement/marketing companies, charging up to $25,000 for the use of its services. Eyeris, on the other hand, must be contacted for pricing, and its product is used mainly by manufacturers of smart cars or social robotic companies. As the market for facial emotion recognition systems is in its early stages, no systems are easily available from any vendor.

Team's Solution
Our product seeks to provide clients with an easy, out-of-the-box solution for integrating emotion-recognition artificial intelligence (A.I.) with their own products and services. The physical components the Emotional Detection Device (E.D.D.) consists of are: a camera to capture video or images; a small computer for image processing and emotion classification; and a microcontroller programmed to deliver the output as emotional data. This emotional data offers clients a more distinct quality of consumer feedback. Our compact, self-contained product is designed to give businesses a simple way to track and gather customers' emotional responses, without the need of human facilitators. Clients that may benefit from the use of our product include business market researchers, online education learning platform developers, as well as any others who wish to integrate the ability to learn how an end-user feels into a product or service.



Falcon DPF Control System

Project Participant
Joseph Bellow

Instructor
Dr. Grzegorz Chmaj

Faculty Advisor
Dr. Ke-Xun Sun

Community Advisor
Dr. Brady Gall

Problem Identified
Design and fabricate a custom printed circuit board which will minimize the required space and maximize reliability to the control system of a mobile pulsed power neutron generator.

Current Solutions
Similar devices to the one we are designing would be something like the Thermo Scientific MP 320 Neutron Generator and the Adelphi DT-110 Neutron Generator.

Team's Solution
The primary difference (concerning the PCB) would be the custom requirements such as safety interlocks, timing controls, and power monitoring, which will be needed by my group at MSTS for our controls system.

Non-Invasive Glucose Monitor

Project Participants
Eliat Avidan, Ryan Choy
& Carlos Daniel Zuniga

Instructor
Dr. Grzegorz Chmaj

Faculty Advisor
Dr. Robert Schill

Problem Identified
The project seeks to solve the problem of diabetics having to go through the constant hassle of testing blood glucose levels by taking blood samples. It aims to accurately obtain the glucose level in the body in the simplest way possible.

Current Solutions
There are some non-FDA approved products on the market, which use similar methods to our product. However, they use different technology than this project will use. In addition, there are many products that test blood glucose by pricking the skin and drawing blood samples.

Team's Solution
The Non-Invasive Glucose Monitor is a device that is designed to replace the conventional method of blood sugar testing for the human body. The objective is to eliminate the need to draw a blood samples in order to determine such levels. By developing and incorporating a mathematical model, blood glucose levels can be correlated to a dielectric constant through the variance in capacitance levels in the body. A painless reading can be taken by placing a finger on top of the fingerprint capacitive touch sensor, through which thousands of samples are taken after a few seconds for accuracy and clarity. The major components of the device are a capacitive sensor, microcontroller, digital-to-analog converter, and an LCD. The main market for the monitor is the typical diabetic person, who has to constantly monitor blood sugar levels.

Pool Activity Monitor

Project Participants
Damian Cisneros & Enrique Saldana

Instructor
Dr. Grzegorz Chmaj

Faculty Advisor
Dr. Venkatesan Muthukumar

Problem Identified
Our project will help prevent unintentional deaths by drowning. According to CDC.gov drowning is ranked fifth among the leading causes of unintentional injury, mainly affecting children under the age of 14. This project aims to improve security in a pool, which can help reduce drowning deaths.

Current Solutions
The solutions found in the current market have similar functions to our project. One is the SafetyTech Pool Alarm with Remote Receiver; this device automatically sounds an alarm when children or pets fall into an unsupervised pool. The other, and most used solution, is simply to put a fence around the pool area to prevent access to it.

Team's Solution
Current market solutions have negative reviews and only one basic function, which is to sound an alarm if they detect movement within the pool. Then a person has to turn the alarm off manually with a built-in switch. In this day and age, many security devices are connected to users' phones, allowing the users to view information and control the systems to an extent. Our solution aims to improve pool security and allow users connect with it through their phones, including receiving messages when the alarm is triggered. Our system will have a camera to show the user the pool area when the alarm goes off, as well as other functions.

Self-Sorting Disposal Unit

Project Participants
Brian Medrano-Kiaer & Phillip Sortomme

Instructor
Dr. Grzegorz Chmaj

Faculty Advisor
Dr. Shahram Latifi

Problem Identified
The Self-Sorting Disposal Unit seeks to solve the common human error of incorrectly sorting recyclable materials. Although there are methods to assist in recycling, such as separate bins for specific materials, objects often get misplaced. The Self-Sorting Disposal Unit will be responsible for reducing the percentage of incorrectly placed objects.

Current Solutions
Currently, the most popular method of recyclable organization is a three-bin set within a container, labeled for compost, recycle, or trash. This solution is the most cost-effective solution for many organizations and businesses due to the lack of technology needed for operation. In addition, there is a higher cost model called Oscar the A.I., which is designed for offices, with a price tag of about $1,000.

Team's Solution
The proposed solution has the advantage of not relying on human decision for the sorting of materials. Common errors applied in recycling materials are the lack of understanding of what can be recycled, and the lack of motivation as to why an item should be recycled. With the Self-Sorting Disposal Unit, these errors are factored out using machine learning with image recognition and inductive sensing to categorize and separate recyclable materials, without any extra effort from the user. The unit consists of storage bins for designated material types and an automated sorting system. The sorting system contains an infrared light to detect new items, a short-term holding area for high volume that feeds into a conveyor transport operated by a DC motor, and two material sensors that determine item placement. The product will be marketed to companies, due to the large number of objects being disposed of and the size of the unit.

Vaultlet Smart Wallet

Project Participants
Michael Loreto & Angelica Perez

Instructor
Dr. Grzegorz Chmaj

Faculty Advisor
Dr. Henry Selvaraj

Technical Advisor
Dr. Sarah Harris

Community Advisor
Dr. Emma Regentova

Problem Identified
As security is heightening in areas from smart homes to fingerprint authentication locks, smart wallets are becoming more prevalent. Protecting items of value is in every consumer's interest. Vaultlet is a smart wallet designed to establish peace of mind in guarding against skimming and theft, as well as offering the convenience of added commodities.

Current Solutions
Several examples of current smart wallets in the market include: Ekster, Woolet, and Nomad Slim Wallet, to name a few. These products contain limited security measures and are specialized in one area—notably their focus on a power bank, GPS system or tracking device. There are a select few smart wallets that incorporate more than one feature; however, these wallets have high price tags and/or their designs are inconveniently large.

Team's Solution
Vaultlet will reduce the number of skimming incidents with a simple solution of aluminum casing, as aluminum is a poor conductor of electromagnetism, thus blocking radio-frequency identification (RFID) waves. For additional security, a biometric sensor and repurposed obstacle avoidance sensors (IR) will be integrated. To unlock the wallet, the user places their finger on the touch sensitive pad found on the surface of the wallet, where the biometric authentication system will determine accessibility. Further, IR sensors are found in each card slot, which serve to determine whether or not the card is in place. If the card is absent after a given amount of time, the user will be notified via short message service (SMS). Should Vaultlet be misplaced or stolen, the user may access its location in real time by means of the embedded GPS system. Additionally, the power bank within Vaultlet offers convenience for smart phone owners, as battery life becomes an issue when traveling. The target market of the product is the tech enthusiast looking for a smarter way to keep their belongings safe.

Wireless Bone Conduction Stethoscope

Project Participants
Stephen Bausch & Armon Latifi

Instructor
Dr. Grzegorz Chmaj

Faculty Advisor
Dr. R. Jacob Baker

Problem Identified
An invaluable diagnostic tool in modern medicine is auscultation: the act of listening to sounds from the heart, lungs, or other organs, typically with a stethoscope. In order to improve the facets of an ordinary stethoscope, we propose a cost-effective, wireless version that utilizes bone conduction technology. A traditional stethoscope tethers the health practitioners to the patients, occupying all of their attention and faculties (particularly hearing). Having a wireless, non-intrusive stethoscope would alleviate some of these issues for doctors, nurses, and EMTs, particularly those of immobility and full attention.

Current Solutions
Currently, there are no bone-conduction stethoscopes in the EMS market. There are examples of wireless digital stethoscopes, although these products range upwards of $500. Currently, the only implementation of audio bone-conduction technology is through wired headphones and hearing aids; however, none have become as integrated within the medical field as our product could be.

Team's Solution
Our solution, a Wireless Bone-Conduction (WBC) stethoscope, would untether the healthcare practitioner from the patient. This added mobility could allow a surgeon, for example, to actively listen to a patient's heart, in terms of tempo and pitch, during surgery. A traditional stethoscope puts quite a bit of emphasis upon the ear of the practitioner and has no way of separating body sounds; the WBC stethoscope has integrated settings for heart sounds and lung sounds, as well as a volume setting in order to be able to differentiate between bodily sounds. Additionally, the integrated bone-conduction technology would allow opportunities for hearing-impaired healthcare practitioners. This would be an invaluable asset to any individual who is denied this type of work because of a hearing disability. Furthermore, bone-conduction transducers are never inserted into the ear, allowing a practitioner's ears to be unoccupied, leaving for open communication between a doctor and various nurses assisting in an operation. Lastly, the WBC stethoscope would be more accessible and affordable than the majority of its electronic counterparts that are available today.

Wireless Charging Menu

Project Participants
Jesus Frias & Miguel Morga

Instructor
Dr. Grzegorz Chmaj

Problem Identified
Today's wireless chargers only operate within a few millimeters between the device being charged and the charger. Our project aims at increasing the distance between the charger and the device being charged by a few inches.

Current Solutions
In today's market, we could not find any wireless charger that is able to charge from any more than a few millimeters away. Although there are many wireless chargers for phones and other devices, the problem is that if the device is being charged needs to be resting on the charger or you will not be able to transfer any power.

Team's Solution
My team's solution is to use resonance frequency charging. The Wireless Menu Charging Station is designed as a menu, lit with appealing LEDs, which will be wirelessly charged from under a table, while being offered as a charging station for other devices that can be directly connected to it. It will incorporate electromagnetism for wireless charging at a medium range distance with components that allow the electromagnetic field to be made into usable energy. The electronic components consist of a transmitter to send an electric field over a few inches, a receiver to rectify and regulate the power, and a micro-controller programmed to display the menu with LEDs. This concept will allow us to have maximum power transfer up to a few inches in our desired frequency. We believe our solution is better than current solutions because there is no other device currently in the market that can charge another device from a few inches away. This wireless charger could benefit restaurant owners because they could add this device to their tables to allow their customers to charge their devices conveniently. Our device could also create a clean working environment allowing the charging cables to any device to be hidden underneath the table while they work.

DEPARTMENT OF ENTERTAINMENT ENGINEERING & DESIGN PROJECTS

Senior Design Instructor

Dr. Grzegorz Chmaj

Haptic Vibes Vest

Project Participants
Nicole Moore & Kevin Sheeler

Instructor
Dr. Grzegorz Chmaj

Faculty Advisor
Michael Genova

Problem Identified
The Haptic Vibes Vest is a wearable device that will be used to enhance entertainment experiences for the hearing impaired. It is an innovative product that allows its user to “feel” the music of a concert, performance, or live entertainment event. The purpose of this vest is to make audio-centric entertainment accessible to the hearing impaired by creating a tactile experience, comparable to the auditory sensations that drive these events.

Current Solutions
Current market solutions work by converting nearby audio into vibrations. One of the main issues with these types of products is that they pick up unwanted sounds, such as room ambience and nearby conversations. This issue gets exponentially worse during large concerts, where the crowd is yelling and there is a lot of extra noise. This leads to indistinguishable and unpleasant vibrations, which do not correlate to the intended source of sound - the music.

Team’s Solution
The Haptic Vibes Vest is fully programmable, so an audio engineer or technician will be able to create a fully controlled experience for the user. The vest consists of 30 motors, each of which is programmed to vibrate in specific patterns to create a clear and pleasant sensory experience for the wearer of the vest. While the vest is designed with the intention of being used in concert experiences, its applications can be expanded to include any event that involves time-based programming. Whether it’s a fun night watching the best bands perform live, a trip to the movie theatre with loved ones, or watching one of the many spectacular shows on the Strip, the enhanced clarity and careful vibration patterns provided by the Haptic Vibes Vest can be used to help the hearing-impaired experience an audio world.

L3D Display

Project Participants
Dannielle Doplayna, Tre Shannon
& Manuel Tapia

Instructor
Dr. Grzegorz Chmaj

Faculty & Technical Advisor
Michael Genova

Community Advisor
Dr. Si Jung Kim

Problem Identified
Our L3D Display seeks to innovate from standard LED displays. Each individual pixel module has the ability to be controlled in terms of movement along the Z-axis: color and speed. Currently, there is no similar product on the market that does this in a portable and cost-effective way.

Current Solutions
The closest solution to our product was created by a company named Radius Displays. This company produced the world's first 3D robotic billboard in Times Square. Radius Displays developed moving cube modules to create the immersive 3D effect.

Team's Solution
Our L3D Display will allow for the control of each individual pixel module. Our solution is better than current solutions because it is more affordable and empowers creators to have absolute control of movement, speed, and color over each individual pixel. Artists, programmers, and companies advertising a product or service will benefit from the L3D Display because it creates a more immersive experience, compared to standard LED displays.

INTERDISCIPLINARY PROJECTS

Recycling Drone

Project Participants
Teague Bostic, Gabriela Cuicas
& Ethan Tash

Instructor
Dr. Grzegorz Chmaj

Faculty Advisor
Dr. Woosoon Yim

Problem Identified
The Recycling Drone is an unmanned aerial manipulator that incorporates soft robotics and machine learning for a wide array of remote retrieval applications. The target market will include individual consumers who want a way to reach inaccessible trash, or to perform regular maintenance around their property. The commercial applications include telecommunication and power companies that need retrieval in hazardous areas, such as power lines and transformers.

Current Solutions
The drone itself is a commercially available model with wide availability and an affordable price point. However, there is not a product available in the current market that incorporates both the drone and the manipulator.

Team's Solution
The Recycling Drone is an unmanned aerial manipulator (representing the initial prototype of single-system drone augment) that incorporates soft robotics and machine learning for a wide array of remote retrieval applications. The scope of the product includes modification to the physical design of the drone, including mounting a soft robotic gripper controlled by the Arduino module that operates a pneumatic pump to operate the flexure of the gripper. The augment also includes a microcontroller that integrates a mounted camera with the machine-learning portion of the design, which makes use of computer vision and other machine-learning based concepts. The capabilities of the Recycling Drone allow for many applications, both consumer and industrial.

SCABY

Project Participants
Cohl Hatala, Yannick Kengne Tatcha, Brandon Lange,
Abenezer Namaga & Stephen Weninger

Instructor
Dr. Zhiyong Wang

Faculty & Technical Advisor
Rick Hurt

Problem Identified
The issue with all current autonomous lawn mowers is that they are unguided, which leads to an unappealing outcome. Our project attempts to fix this problem by using GPS to control the path of the mower.

Current Solutions
Current solutions on the market are Husqvarna, RoboMow, Worx, and Roomba. They all work in a similar fashion, except for Roomba. There is a perimeter wire laid in the grass, and the mower will move until it receives a signal from the wire. Then the mower will stop, turn, and continue.

Team's Solution
Our product is better than current solutions because it will have the ability to provide an effortless, appealing lawn. Our product will also eliminate the need to dig up portions of the lawn to install a perimeter line to keep the mower contained. Those who will benefit most from our product are homeowners who wish to spend more time doing things they enjoy or those who pay for lawn care.

Tennis Butler

Project Participants
Jesstin Estauillo, Ivan Luk,
Leslie Rose & Joseph Riesen

Instructor
Dr. Grzegorz Chmaj

Faculty Advisor
Dr. Venkatesan Muthukumar

Technical Advisor
Jeff Markle

Community Advisor
Neil Rose

Problem Identified
The Tennis Butler will automatically collect tennis balls from a tennis court during and after a practice session with a tennis coach or ball machine. This allows coaches and players to spend more time practicing instead of picking up tennis balls.

Current Solutions
Tennis ball hoppers are cumbersome to use, while tennis ball mowers are bulky and heavy, and must be pushed all over the tennis court. There is only one autonomous robotic solution on the market for tennis ball collection: the Tennibot, an Aurora University student project, which recently completed a Kickstarter for around 200 units.

Team's Solution
The Tennis Butler is a self-powered, autonomous robot that automatically navigates the tennis court and collects over 100 tennis balls in a removable bin. It is controlled with an easy-to-use mobile phone application, and once, it collects tennis balls without human intervention. It intelligently orients itself within the tennis court, locating and collecting tennis balls, while avoiding people and obstacles. A built-in rechargeable battery offers 5+ hours of use. The platform is more cost-effective than the Tennibot, and does not require manual operation like ball hoppers or ball mowers. The simplicity and flexibility of the Tennis Butler will save players' and coaches' time and effort better spent on playing and practicing tennis.

DEPARTMENT OF MECHANICAL ENGINEERING PROJECTS

Department Chair
Dr. Brendan O'Toole

Senior Design Instructor
Dr. Zhiyong Wang

Banana Ripening Box

Project Participants
Prince Carlos, Armando Cuellar
& Reu Paulino

Instructor
Dr. Zhiyong Wang

Faculty Advisors
Dr. Rama Venkat & Dr. Pushkin Kachroo

Technical Advisor
Dr. Georg Mauer

Problem Identified
Our project seeks to solve the problem of the spoilage of climacteric fruit, in both households and the restaurant industry.

Current Solutions
Currently, there are products on the market that absorb ethylene, like bags and absorption packets. These, however, do not allow for regulation of the ripening time of fruit. They simply extend the shelf life.

Team's Solution
Our project allows us to control the ripening time of fruit by using an ethylene gas and ethephon mixture. This will not only ensure that the shelf life of the fruit will be extended, but also that the fruit will be at peak ripeness when desired. The device can be scaled to a restaurant level or household level to help reduce the spoilage of fruit.

Metal Framing Spacer Tool

Project Participants
Luis Cuevas, Abel Garcia Morales
& William Roseberry

Instructor
Dr. Zhiyong Wang

Faculty Advisor
Dr. Yi-Tung Chen

Problem Identified
Metal framing is a labor intensive and time-consuming phase during construction of large commercial buildings. Currently, the most common method of metal framing involves several steps, each taking a significant amount of time. A construction worker must measure and mark the placement for each stud, place and secure the stud to the metal track using vice clamps, and then fasten the stud to the track.

Current Solutions
Current solutions only lessen the time it takes to measure the stud spacing. These solutions use a long piece of angle iron with notches cut at the applicable lengths. Construction workers still need to secure the studs to the track before they can fasten them together.

Team's Solution
Our solution functions by combining the measuring, placing, and securing of metal framing. Effectively, this turns a four-step process into a two-step process. With our product, a construction worker would only need to place the spacer tool into the track while sliding the stud into place and then fasten the stud to the track. This can also be done on the top track due to magnets on the bottom of the tool that allow the spacer tool to sit inside of the upper track without falling. The tool can be made modular so that workers can work with any size track or spacing.

Modified 3D Printing Process for Biomedical Applications

Project Participants
Adam Allocco & Vicente Lagunas

Instructor
Dr. Zhiyong Wang

Problem Identified
Our project seeks to effectively 3D print biomedical implants that meet industry standards. A previous senior design project successfully printed a meniscus implant using ChronoFlex biomaterial; however, the team experienced issues regarding the product's quality and consistency as of result of inefficiencies during the 3D printing process. As a result of the defects, the final product failed to meet industry standards.

Current Solutions
3D printers found on the market are not optimized with ChronoFlex or similar materials required to create a meniscus implant. There are no commercially available 3D printing solutions specifically designed to create similar products using FDA-approved biomaterials.

Team's Solution
The project aimed to modify the existing 3D printing process and equipment used by the previous senior design team. Several key components of the equipment were redesigned to optimize the printing of ChronoFlex biomaterial, as well as to improve the quality of the printed meniscus implant. The team incorporated changes in the filament extrusion system and the 3D printer's direct drive extruder. By improving the consistency and quality of the 3D printing using ChronoFlex, the process will able to produce meniscus implants and similar biomedical implants more effectively.

Simple Hardware Counter

Project Participants
Patrick Messimer & Junghoon Nam

Instructor
Dr. Zhiyong Wang

Faculty Advisor
Dr. Brendan O'Toole

Community Advisor
Pololu Robotics and Electronics

Problem Identified
Counting out parts for packaging is mundane, time-consuming, and costly when providing products that include small amounts of hardware like nuts and screws. This is especially detrimental for batch-level manufacturing companies that sell hardware components at small profit margins only to support other flagship products. For example, at Pololu Robotics and Electronics, a Las Vegas engineering, manufacturing, and online retail company, counting generic hardware obtained in bulk to be resold in small amounts distracts workers' attention from producing unique, internally designed electronics and robotics equipment.

Current Solutions
Although counting is usually automated in mass production facilities using large and expensive machinery, practical options for lower volume manufacturers are limited. Automatic hardware counting devices that are affordable for small and medium size companies are poorly supported, but more reliable devices cost thousands of dollars.

Team's Solution
The Simple Hardware Counter (SHC) is an automatic counting device that is ideal for batch level production needs. Parts are deposited in bulk onto a rotating disk that pushes the parts through a fixed channel directly above the disc. The channel guides the parts from near the center towards the outside of the disc, causing separation between the parts, so that a sensor can detect the passing parts. The channel frame is interchangeable in order to quickly allow the machine to count different sized parts. After passing the counting sensor, parts are dropped off the edge of the disc into a holding receptacle. A load cell measures the weight of the collected parts to ensure counting accuracy. Because the custom mechanical components of the SHC are entirely laser-cuttable or 3D-printable, it is an inexpensive and quickly producible solution for small companies. Its small size and its adaptability make it especially useful for busy table-top manufacturing lines.

Solar Stirling Engine

Project Participants
Emma Chao, Rozzele Cruz & Lucas Gallup

Instructor
Dr. Zhiyong Wang

Faculty Advisor
Dr. Yi-Tung Chen

Technical Advisor
Terry Kell

Problem Identified
Existing Stirling engines lack the efficiency to sustain a significant power supply on a residential or commercial scale. The efficiency of Stirling devices is inhibited by factors such as leakage of the working fluid, and the thermal limitations of common working conditions. As a result, engines that use fossil fuels remain the prevailing technology in the market, thus contributing to global warming and the depletion of nonrenewable resources.

Current Solutions
Stirling engines are not currently sold for residential and commercial power generation. Alternatively, rooftop solar panels are the most common method of providing clean energy to homes and commercial buildings. The implementation of this technology is expensive and scarce due to the high costs of manufacturing, installation, and maintenance.

Team's Solution
Operating strictly on a temperature gradient, Stirling engines are emissionless sources of energy that can combat the high costs and negative environmental impacts of modern electricity consumption. Designing the engine to optimize efficiency and power output included: 1) implementing a Scotch Yoke mechanism to reduce the number of moving parts in the engine, as well as improving reliability and reparability; 2) increasing the temperature difference to maximize the Carnot and, therefore, the actual efficiency; 3) utilizing Helium as the working fluid to minimize the friction between gas molecules in the Stirling cycle, as well as increase thermal cycle efficiency; 4) pressurizing and sealing the piston-cylinder system to minimize leakage of the working fluid, which will increase the overall efficiency and power output of the engine.

The Solar Stirling Engine is designed to generate 1000 Watts (1kW) of power and will offset the cost of electricity for Nevada residents who use a monthly average of 1.3kW. Homeowners can install the Solar Stirling Engine to reduce expenses and greenhouse gas emissions. This engine will increase the implementation of renewable energy technology in both residential and commercial applications.

Stirling HVAC

Project Participants
Justina Johnson & Grant Runion

Instructor
Dr. Zhiyong Wang

Faculty Advisor
Dr. Yi-Tung Chen

Technical Advisor
Terry Kell

Problem Identified

Modern air-conditioning systems require large amounts of power to run compressors, as part of the refrigeration cycle. As a result, people in many parts of the world are unable to utilize air-conditioning systems due to high electricity rates or unstable power grids. Additionally, research in recent years has determined that certain refrigerants have negative impacts on the Earth's atmosphere. The refrigerant R-22 (used in commercial and residential central air conditioning systems) has been determined to cause damage to the ozone layers and will be phased out and replaced with R-410a by 2020.

Current Solutions

In the air-conditioning market, no products utilize a beta-type Stirling engine. Stirling engines have been used for large-scale refrigeration needs, but no products have successfully replaced traditional residential/commercial air-conditioning systems. The current solutions in the market that reduce operational costs include: VAV boxes (dampers placed in air ducts that regulate the flow of air into rooms), occupancy sensors (sensors that adjust air-conditioning controls dependent upon levels of occupant activity), and floor ventilation (cooling/heating rooms more effectively by dispersing air through the floors). To combat the negative impact of R-22 on the atmosphere, R-410a has been selected as a safer alternative refrigerant.

Team's Solution

Our solution uses a DC motor to run a beta-type Stirling engine in reverse, creating a Stirling refrigeration cycle. The DC motor drives the compression and expansion of the working fluid within the cylinder of the Stirling engine to create a temperature difference across the surface of the cylinder. The cylinder is inserted into an air-duct, where air flows across the cylinder removing heat from the air by convection and conduction, thus decreasing the temperature of warm air to a comfortable level. The use of a DC motor eliminates the need for a "power-hungry" compressor, which is typically a part of a traditional air-conditioner system. The DC motor can be sized according to the needs of the consumer, providing the comfort of air-conditioning to those who do not have access to large amounts of electricity those who cannot afford it. The Stirling engine by nature is emissionless, but the use of natural fluids prevents any impact to the environment (should the fluid leak).

Tire Pressure Cap

Project Participants
Ruben Alberts & Brett Willis

Instructor
Dr. Zhiyong Wang

Technical Advisor
Terry Kell

Problem Identified
Our project seeks to make a theft-resistant tire pressure cap. A problem observed in our community is the theft of tire pressure caps, which causes an aesthetic issue, as well as increased pressure loss in tires. A common tire pressure cap is quick to remove by a simple twisting motion and is easy to hide. This allows a thief to operate in an unobserved and efficient way.

Current Solutions
Similar ideas found include a product that can only be removed with a custom designed key. Another product incorporates an intricate internally threaded body inside the tire pressure cap that screws onto the valve. None of the products found are common in the market.

Team's Solution
Our theft-resistant tire pressure cap will allow for regular people to secure their caps, with an easy way of placing and removing the caps, while preventing the average thief from taking them. The design is to use one solid cylindrical piece, cut a counter sink hole into the top, and bore a hole in from the bottom. The counter sink will be for a Phillips-head screw, and the bottom bore will be for the rubber interior, where the stem will be inserted. After the threading and bore have been placed, the casing will be cut into halves. The outer casing will be retained by a steel ring and secured by soldering/welding the ring to the outer casing. The idea is for the screw to displace the top part of the casing outward, while the steel ring acts as a lever point; thus, resulting in the casing displacing inwards towards the bottom, causing the rubber to squeeze the stem. The hope is that this will be enough force to prevent thieves from removing the tire pressure cap with their hands by requiring a Phillips-head screwdriver to remove it.

Vegas-Style Pachinko

Project Participants
Thomas Arambula, Annita Martinelli Becker
& Lukas Mittelman

Instructor
Dr. Zhiyong Wang

Faculty Advisor
Robert Rippee

Technical Advisor
Dr. Brendan O'Toole

Problem Identified
Our project seeks to create a fusion of mechanical and electrical design to develop a unique slot machine. The game intends to entice new and old players/gamblers alike, and create a new source of revenue within the gaming industry.

Current Solutions
Mechanical designs for slot machines are few and far between in this day and age. There are next to no popular solutions in this regard. However, there is an extant version of this product in Japan, where Pachinko originated, but the market has yet to develop in America.

Team's Solution
In a market comprised of purely digital gaming machines, such as slot machines, Vegas-Style Pachinko meshes together the mechanical aspects of the traditional Japanese game "Pachinko" with the electronic aspects of the current gaming era. Vegas-Style Pachinko equips a series of metal balls that descend a board that contains pins, which deflect the balls into sporadic patterns. At the bottom of the board, there are illuminated values of playing cards, which are triggered as the balls fall past them. After each ball passes, a random card swaps with the current card. Finally, after five balls pass, a poker hand is formed, and payouts are allotted. This could potentially serve as a revolutionary design in modern gambling, drawing in a whole new source of revenue for the gaming industry and spurring similar models and games down the road.

VersaBox

Project Participants
Sebastian Mijaica & Tommy Perkins

Instructor
Dr. Zhiyong Wang

Faculty Advisor
Miles Boulton

Technical Advisor
Dr. Brendan O'Toole

Problem Identified
Our project seeks to provide solutions to the common issues of space and versatility in athletics and calisthenics. Many plyometric boxes take up large amounts of space, and do not allow for intermediate ranges of exercises to be reached. Many set ups have too many parts, are complicated to use, or lack range.

Current Solutions
One common solution on the market is the Soft Plyobox, in which parts stack onto one another. Titan Fitness has an adjustable plyometric box. Another comparison is the Gold's Gym Xtreme plyometric box.

Team's Solution
Our project, the VersaBox, utilizes linear height adjustment for ease. The use of aluminum allows for good transportability, while the use of shapes with high inertia allow for its ability to support higher weights. Moreover, our plyometric box only requires a total of two-and-a-half square feet of floor space. Overall, the VersaBox allows for greater versatility for use, while maintaining feasibility and ease.

Howard R. Hughes College of Engineering Leadership

Rama Venkat, Dean

Mohamed Trabia, Associate Dean of Research, Graduate Programs and Computing

Yingtao Jiang, Interm Associate Dean, Undergraduate Programs

Sajjad Ahmad, Department Chair, Civil and Environmental Engineering and Construction

Sidkazem Taghva, Department Chair, Computer Science

Brendan O'Toole, Department Chair, Mechanical Engineering

Biswajit Das, Department Chair, Electrical and Computer Engineering

UNLV President's Cabinet

President
Marta Meana

Executive Vice President and Provost
Diane Z. Chase

Vice President for Research and Economic Development
Mary Croughan

Vice President of Student Affairs
Juanita Fain

Associate Vice President for Economic Development
Zachary Miles

Chief Diversity Office
Barbee Oakes

Director of Athletics
Desiree Reed-Francois

VP for Philanthropy and Alumni Engagement, UNLV Foundation
Scott Roberts

General Counsel
Elda Luna Sidhu

Chief of Staff
Fred Tredup

Vice President for Government Affairs
Luis Valera

Vice President for Finance and Business
Jean Vock

Chief Marketing Office & Vice President of Brand Integration
Vince Alberta

Howard R. Hughes College of Engineering Advisory Board

Anthony Baerlocher
James Barbee
Jody Belsick
John Benner
Jack Braman
Ray Chavez
Jay Chmelauskas
Shawn Danoski
Ralph Decker
Harshal Desai
Judi Dohn
Anthony Firmani
John Fountain
Tristan Hayes
Adam Godorov
Bruce Graff
Jonathan Grantham
Christopher Grenz
Ken Haertling
Tony Hills
Randy Innis
Greg Korte
Michael Maier
Clark McCarrell
David McElwain
Doa Meade
Jason Mendenhall
Mark Newburn
Mike Plinski
Carrie Porterfield
Joan Rueben
Charles Scott
Manjit Gombra Singh
Paolo Tiramani
Gerry Tuffy
Brian Walsh
Victor Wei
Heather Wilde

UNLV appreciates the leadership and support of our Nevada System of Higher Education Board of Regents.

Mr. Kevin J. Page, Chairman
Dr. Jason Geddes
Vice Chairman
Dr. Patrick Carter
Ms. Amy J. Carvalho
Mrs. Carol Del Carlo
Dr. Mark W. Doubrava
Mr. Trevor Hayes
Mr. Sam Lieberman
Mrs. Cathy McAdoo
Mr. Donald Sylvantee McMichael Sr.
Mr. John T. Moran
Ms. Laura E. Perkins
Mr. Rick Trachok

For further information on Senior Design and College of Engineering Activities

Molly Marks
Director of Special Events
molly.marks@unlv.edu

Cheryl Bella
Director of Communications
cheryl.bella@unlv.edu

Jack Aylor
Director of Development
jack.aylor@unlv.edu

Daniel Mendoza
Director of Undergraduate Recruitment
daniel.mendoza@unlv.edu

Marian Mason
Engineering Career Services Coordinator
marian.mason@unlv.edu

Jaekeun Cho
Director of Engineering International Programs
jaekeun.cho@unlv.edu

Follow us:

@unlvengineering

UNLV | HOWARD R. HUGHES COLLEGE OF ENGINEERING