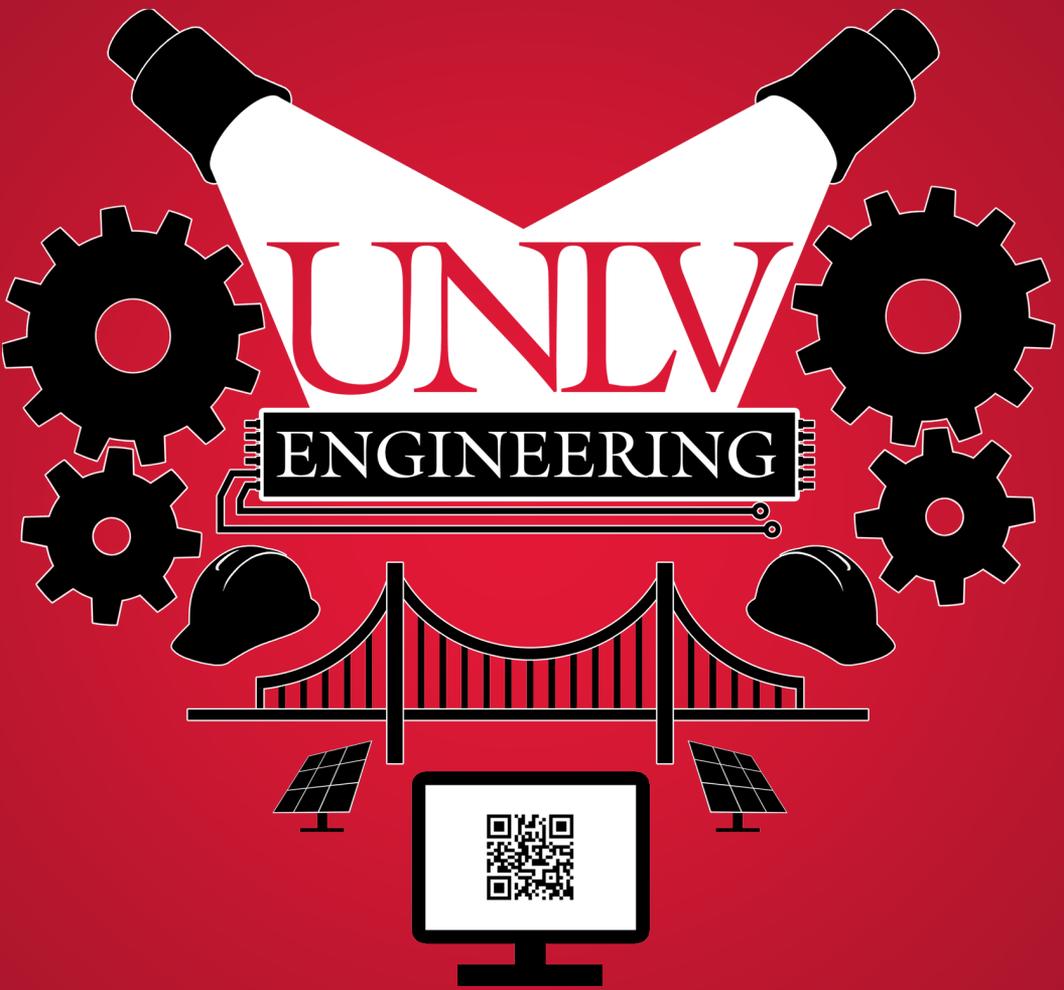


FRED AND HARRIET COX

SENIOR DESIGN COMPETITION



DECEMBER 7, 2016



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 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. Cash prizes for first and second place are given in each discipline, as well as prizes for sustainability, commercial potential, interdisciplinary and the competitions 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 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 the Dominic Marrocco Southern Nevada Business Plan Competition, the Governor's Cup and the subsequent creation of many successful businesses.

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.

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 Jack Aylar at Jack.Aylar@unlv.edu or (702) 895-2913.

Senior Design Clinic

In its second year, the College of Engineering's Senior Design Clinic continues to serve as a unique experience in which companies will be able to partner with the students to work on specific challenges to find business solutions. To find out how to get involved in this exciting new venture, please contact Professor Pushkin Kachroo at pushkin@unlv.edu or (702) 895-4926

Thank you to our Sponsors!



Thank you, Senior Design Instructors!

**Department of Civil & Environmental
Engineering and Construction**

Dr. Douglas Rigby

Department of Computer Science

Grzegorz Chmaj

Department of Entertainment Engineering and Design

Dr. Si Jung “SJ” Kim

Department of Mechanical Engineering

Dr. Zhiyong Wang

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Fall 2016 Senior Design Judges

Dr. Ray Muzyka

CEO

Bioware

Originally trained as a medical doctor, Dr. Ray Muzyka co-founded BioWare, a video game development studio focusing on story and character, in the early 1990s. He practiced Emergency/Family Medicine for two years full time, with medicine transitioning to part-time over the following decade as he focused on his role as BioWare's CEO. BioWare was acquired by Electronic Arts in 2007 and Ray took on the roles of Senior Vice President at Electronic Arts and General Manager of EA's BioWare division, which grew over the next five years to span eight development locations worldwide with ~2000 staff (1400 full time).



He retired from video games in October 2012, with his third 'career chapter' at ThresholdImpact, and focused on sustainable, profitable impact investing - mentoring and angel investing in information technology, new media and medical innovations with social entrepreneurs. He is an active angel investor and entrepreneurial mentor.

He was inducted into the Academy of Interactive Arts and Sciences' Hall of Fame in 2011 and received the International Game Developers' Choice Awards 2013 Lifetime Achievement Award. Dr. Muzyka received the inaugural Alumni Innovation Award in 2015 from the University of Alberta. Other awards include entry into Canada's Top 40 under 40 and Ernst and Young's 2001 Entrepreneur of the Year (IT, Prairies). He obtained his Bachelor of Medical Science from the University of Alberta in 1990, his Doctorate of Medicine from the U of A in 1992, and his Master of Business Administration degree from the University of Western Ontario (Ivey School of Business) in 2001.

Ram Vairavan

Co-Founder

AutoGenomics

Ram Vairavan co-founded AutoGenomics Inc., a biotech company that has developed an automated, microarray based multiplexing diagnostic platform that can be used to assess disease signatures with novel genomic and proteomic markers in pharmacogenomics, genetic disorders, infectious disease and cancer. With the discovery of genes and their link to various disease states, the platform has the versatility to revolutionize the way patients are diagnosed, monitored and managed, leading to the era of precision medicine. He obtained his Master's degree in Biomedical Engineering at Washington University, St. Louis, Missouri, USA, and a Master's Degree in Business Administration.



Richard Rizzo

Vice Chairman

Tutor Perini Building Corp.



Dick Rizzo holds a Bachelor of Science in Business Administration and a Bachelor of Science in Civil Engineering from Lehigh University. In 1986, he graduated from Stanford University's Executive Management Program.

Dick joined Tutor Perini Building Corp. in 1977 and is responsible for new business development and company growth. He works closely with the executive team to develop and maintain the company's vision and is instrumental in project negotiations and client maintenance nationwide.

Additionally, Dick has played a significant role in providing economic opportunities for minority, women and disadvantaged-owned businesses in the construction industry. In 2010, the Minority Business Development Agency (MBDA) honored Dick with the Abe Venable Award for Lifetime Achievement. The award is given to individuals who have played an integral role in the creative, technical or professional progress of the minority business community over the course of their life.

Joe Verrengia

Architect

Arrow



Joe Verrengia is the architect of Arrow's corporate social responsibility program (CSR), combining targeted charitable investing, sustainability and government relations into a strategic initiative to establish Arrow as an innovation catalyst. He also directs the Arrow SAM Car, SmartBike and DigiTruck projects, which demonstrate technology concepts for humanitarian purposes. Arrow is the 2016 Fortune Most Admired Company in its category, including #1 in CSR. In 2016, the SAM car was named the #1 car innovation in the world by Business Insider. He graduated from Columbia University and has held fellowships at MIT, the National Science Foundation, the National Institutes of Health and the Kellogg Foundation.

Howard. R Hughes College of Engineering Leadership

Rama Venkat, Dean

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

Georg Mauer, Associate Dean, Undergraduate Programs

Laxmi Gewali, Chair of Computer Science Department

Donald Hayes, Chair of Civil and Environmental Engineering
and Construction Department

Brendan O'Toole, Chair of Mechanical Engineering Department

Yingtao Jiang, Chair of Electrical and Computer Engineering
Department

Senior Design Competition

Presentation	Time	Project
PRESENTATION 1	8:00 AM	The Pool Auto-Tech
PRESENTATION 2	8:15 AM	"A.U.T.O" -Mobile
PRESENTATION 3	8:30 AM	BEATMASTER
PRESENTATION 4	8:45 AM	Automated Hot Pinning
PRESENTATION 5	9:00 AM	Project V- Rapid Intravenous Analysis
PRESENTATION 6	9:15 AM	3-D Room Scanner
PRESENTATION 7	9:30 AM	NEO Enterprises
9:40 AM - 10:00 AM BREAK		
PRESENTATION 8	10:05 AM	Longboard Speed Wobble Dampener
PRESENTATION 9	10:20 AM	Automated Optoelectronics System
PRESENTATION 10	10:35 AM	An Efficient UNLV Parking Solution
PRESENTATION 11	10:50 AM	Smart Home Speaker System
PRESENTATION 12	11:05 AM	M.A.S.H. Tool
PRESENTATION 13	11:20 AM	CivilVR
PRESENTATION 14	11:35 AM	Weld Inspecting Robot/Drone
PRESENTATION 15	11:50 AM	Smart Microwave

12:05 PM - 1:00 PM LUNCH

Presentation Schedule

Project Title	Department
	Electrical and Computer Engineering
	Mechanical Engineering
	Entertainment Engineering and Design
	Mechanical Engineering
esthesia	Interdisciplinary
	Electrical and Computer Engineering
	Civil and Environmental Engineering and Construction
er	Mechanical Engineering
em	Electrical and Computer Engineering
on	Civil and Environmental Engineering and Construction
	Electrical and Computer Engineering
	Mechanical Engineering
	Civil and Environmental Engineering and Construction
	Entertainment Engineering and Design
	Electrical and Computer Engineering

Senior Design Competition

Presentation	Time	Project
PRESENTATION 16	1:05 PM	Tactical Smart MagZ
PRESENTATION 17	1:20 PM	Maryland Parkway Pedestrian/V
PRESENTATION 18	1:35 PM	Temperature Image Data Logging
PRESENTATION 19	1:50 PM	Super Splint
PRESENTATION 20	2:05 PM	Las Vegas Wash Selenium Rem
PRESENTATION 21	2:20 PM	VR Camera
PRESENTATION 22	2:35 PM	Solar Decathlon
PRESENTATION 23	2:50 PM	Wireless Medical Sensor
PRESENTATION 24	3:05 PM	Advanced Micro-Grid Interconne
PRESENTATION 25	3:20 PM	Wind Tunnel

Presentation Schedule

Project Title	Department
	Interdisciplinary
vehicular Traffic Improvement	Civil and Environmental Engineering and Construction
g System	Electrical and Computer Engineering
	Mechanical Engineering
oval	Civil and Environmental Engineering and Construction
	Electrical and Computer Engineering
	Civil and Environmental Engineering and Construction
	Electrical and Computer Engineering
ection Scheme	Electrical and Computer Engineering
	Mechanical Engineering

**DEPARTMENT OF CIVIL
AND ENVIRONMENTAL
ENGINEERING AND
CONSTRUCTION
PROJECTS**

**Department Chair
Dr. Donald Hayes**

**Senior Design Instructor
Dr. Douglas Rigby**

An Efficient UNLV Parking Solution

Project Participants

Rene Aburto-Garcia, Heather Andrade,
& Stanley Tat

Instructor

Doug Rigby

Faculty Advisors

Donald Hayes, Dave James,
& Alexander Paz-Cruz

Community Advisor

Nathan Goldberg

Problem Identified

The University of Nevada, Las Vegas' increasing student population has led to a higher demand for parking. During daytime students struggle to find parking on campus; some students have resorted to arriving on campus up to an hour before their classes start in order to have time to find a space to park. According to UNLV's website, the student population increased from 27,364 students in 2011 to 28,600 students in 2015. It is imperative that the university find better ways to provide additional parking with the limited resources available on campus.

Current Solutions

One possible solution would be to build a new parking garage on campus. Alternatively, since there is limited space available, the existing parking garages could be redesigned in order to increase the number of parking spaces available. Another solution would be to establish a park and ride system where students could park in hubs around Las Vegas and then take a shuttle bus to campus; this system would be in conjunction with a bike sharing program for students who live closer to campus.

Team's Solution

Out of all of the current solutions, it was decided that the most effective and long-lasting solution would be to establish a shuttle system where students could park in underutilized parking lots around Las Vegas and then ride a shuttle bus to campus. While building a new parking garage and redesigning the existing parking structures are both viable alternatives, they would only temporarily alleviate the current parking situation. Due to the limited amount of space on campus and an ever-growing student population, it would only be a matter of time until the number of parking spaces on campus would again exceed the demand. The proposed shuttle service, combined with a bike sharing program, would provide a solution that improves student parking for the foreseeable future. It would help alleviate the traffic around UNLV, which benefits not only students but also the general population that drives around UNLV during their daily commute. Additionally, by decreasing the number of vehicles that are on the road, the program would provide a positive environmental impact.



CivilVR

Project Participants

Ivan Crisologo, Tori Dickey,
& Nick Zahedi

Instructor

Doug Rigby

Faculty Advisor

Paul Villaluz

Problem Identified

With approximately 93% of University of Nevada, Las Vegas students commuting to school, passenger car volume accessing the campus vicinity causes significant traffic problems. One specific intersection where traffic is constantly congested is at Cottage Grove Avenue and Maryland Parkway. During peak hours (typically 8am-11am and 2pm-5pm) commuters are forced to either wait or seek alternate routes. Furthermore, with the completion of the new Cottage Grove Apartments, there will be an additional 4000+ occupants who will need to use that intersection.

Current Solutions

Currently, there are plans to improve traffic through mass transit and alternate forms of transportation. As for improving the Cottage Grove/Maryland Parkway intersection there have been ideas such as creating the Rochelle/Cottage Grove intersection. This has become one of our options through conversation with the campus planning department. However, at this time, the UNLV Campus Planning Department is not moving forward with any of these presented solutions.

Team's Solution

Our team's goal is to find a solution that optimizes traffic flow in the most economically feasible way. By comparing two alternatives against the existing situation through the best traffic analysis software at our disposal. This project will consider the idea of re-routing Cottage Grove to align with Rochelle Ave to create a new 4-way light intersection. It will also consider the idea of a two-way overhead pass for drivers to move between Maryland Parkway and Cottage Grove without affecting the surrounding traffic. These solutions will ensure better traffic flow for commuters, increase pedestrian safety for the community, and account not only for the present situation but also for the future developments of UNLV and the surrounding community.



Las Vegas Wash Selenium Removal

Project Participants

Natalie Pinon, Matthew Shannon,
& Neil Wacaser

Instructor

Doug Rigby

Faculty Advisor

Daniel Gerrity

Tech. Advisor

John Bettencourt

Community Advisors

LWVCC, COLV, SNWA, & CCRFD

Problem Identified

The Las Vegas Wash is comprised of natural and man-made drainage pathways. There are 10 major tributaries that collect untreated urban runoff that discharges into Lake Mead. This runoff has excess fertilizer, herbicides, pesticides, metals, and sediments that are polluting Lake Mead and will require treatment in the near future due to increased EPA regulations. One major concern is the abundant selenium concentration found in the lower wash. No local government agency is claiming ownership of the problem when it is everyone's business. On the other hand the flood district is responsible for the flow and will need to join with the cities and county to manage the problem.

Current Solutions

Local government entities, such as Clark County and various municipalities are concerned with future treatment requirements and have researched the problem. However no current solution is being implemented.

Team's Solution

Since the surface runoff is currently untreated, any solution that will clean the water going into Lake Mead will benefit everyone in the Vegas Valley. The solution will also clean the environment around the discharge point that is currently being polluted. We will be looking at the design of the unit operations to treat the runoff by means of: coagulation, precipitation of metals, and small technologies. One alternative will be to analyze the cost efficiency of re-routing the runoff to the nearest wastewater treatment facility, provided it is capable of handling the extra flow. Another analysis will be conducted on the building of a new facility that would treat the runoff to an acceptable level. The plant would be designed to handle only normal flow conditions and allow high flow summer storm events to bypass. This allows for the facility to be constructed at a reduced size relative to one that would handle storm events.



Rebel Pass: The Maryland Parkway Pedestrian Bridge

Project Participants

Connor Barlow, Phillip Madriaga,
& Kaelan Tanigawa

Instructor

Doug Rigby

Faculty Advisor

Moses Karakouzian

Problem Identified

The current state of Maryland Parkway between Harmon and Tropicana is crippled with traffic caused by the lack of accommodations to handle the needs of vehicle and pedestrian flow. Vehicular traffic is congested by crosswalks in near-constant use during peak periods and result in standstill driving conditions. Pedestrians are at risk by the current design's lack of barriers and maintenance. The situation will only become more severe as the city of Las Vegas and UNLV's population grows.

Current Solutions

Currently there are crosswalks at the intersections of Maryland and Tropicana, University Road, and Harmon Avenue. Additionally, a supplemental crosswalk was implemented south of Del Mar Street and allows for a continuous right-of-way for pedestrians. This addition is currently the most popular means of crossing Maryland Parkway and is causing the majority of the vehicular backup. With the expected increase in users of both populations, the level of service efficiency is expected to decrease even farther.

Team's Solution

Our design focuses upon creating a continuous and highly efficient flow of traffic for vehicles and pedestrians across Maryland Parkway. The resultant will utilize a pedestrian bridge across Maryland Parkway with renovations to the current crosswalk system. The goal is to provide a constant flow of vehicular traffic by limiting or eliminating the interruptions caused by pedestrians. Furthermore, pedestrians are given a safe and quick means to crossing the busy roadway. The overall design implements expected changes along Maryland Parkway and to the UNLV community, such as: the new parking structure, the Gateway Project, and the light rail system.



NEO Enterprises

Project Participants

Omar Alvarez, Nathan Enos,
& Emily Gonseth

Instructor

Doug Rigby

Faculty Advisor

Haroon Stephen

Problem Identified

Global climate change has the capacity to impact rain events in a dramatic fashion. In the Las Vegas Valley, these changes translate to rain events of increased duration and intensity. In urban environments the runoff created by these events can quickly overwhelm drainage infrastructure leading to flooding. On the campus of UNLV this scenario has manifested itself as flooding of parking lots and common areas.

Current Solutions

The current solution employed by the University of Nevada, Las Vegas is to barricade off the areas known to have flooded people's vehicles. This solution has no present cost associated with it but it does have the opportunity cost for having that space unused. Another solution for this problem would be to expand the current storm sewer infrastructure.

Team's Solution

Our solution is to place a small retention area underneath the Thomas & Mac parking lot. A portion of the parking lot would also be repaved with a porous pavement so the storm waters will seep into the area before standing water collects. This solution is better because it will remove the standing water from the equation unlike the current practice. It will also be more cost efficient than replacing the current storm water infrastructure. This will benefit the university because they will be able to open the barricaded spots allowing for more revenue through parking. It will also benefit the student, faculty and public who come to UNLV because they will not have to worry about a flood event causing damage to their property or their health.



Solar Decathlon – Structural Team

Participants

Christopher Delaney, Ryan Henderson,
Francisco Morga Jr., & Chester Padernal

Instructor

Doug Rigby

Faculty Advisor

David James

Tech. Advisor

Christopher Parker

Community Advisors

Daniel Bartlett & Bob Froehlich

Problem Identified

UNLV's 2017 Solar Decathlon house needs to be taken from a concept to a final design that is ready for construction. The structural team will be tasked with collaborating with the architecture and mechanical engineering teams to design a house that is structurally sound, satisfies multiple buildings codes, and is extremely energy efficient. This is a completely custom design that will require a high degree of collaboration and innovation to be successful.

Current Solutions

There are currently pre-fabricated chassis that require a permanent foundation for modular housing. This type of foundation requires pouring concrete. It also requires driving steel rods into the ground to resist lateral forces. This type of design works well for permanent use, but rules set by the Solar Decathlon do not allow for this type of foundation design.

Team's Solution

The team's solution is to create a custom designed structural system capable of withstanding various seismic, gravity, wind, snow, and transportation loads. The team will also design both a temporary foundation, to be used during the 2017 Solar Decathlon competition, and a permanent foundation for the house when it reaches its final location.

The design will meet Colorado and Nevada state building codes, as well as the International Building Codes. This design will go beyond that of others by maximizing both the energy efficiency and constructability of the house. Stakeholders include the Department of Energy and UNLV.



DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

Department Chair
Dr. Yingtao Jiang

Senior Design Instructor
Dr. Grzegorz Chmaj

3D Indoor Scanner

Project Participants

Clinton Bess, Martin Jaime,
Mario de la Torre, & Jun Wu

Instructor

Grzegorz Chmaj

Faculty Advisor

Venkatesan Muthukumar

Problem Identified

The recent advances in 3D rendering and scanning technology have created many new opportunities for innovation. 3D scanning can be used to develop creative solutions for independent contractors, surveyors, hobbyists, and even cave explorers. While there is an increasing demand for 3D services, a current problem that plagues the industry's growth is the exceedingly high cost for accessible 3D surveying equipment.

Current Solutions

The recent advances in 3D rendering and scanning technology have created many new opportunities for innovation. 3D scanning can be used to develop creative solutions for independent contractors, surveyors, hobbyists, and even cave explorers. While there is an increasing demand for 3D services, a current problem that plagues the industry's growth is the exceedingly high cost for 3D surveying equipment.

Team's Solution

The design of our indoor scanner involves a single distance sensor to measure hundreds of points in its surrounding area. The data is read by a microcontroller and published to the cloud. Afterwards, the data can be rendered in 3D and displayed on any device that runs a modern browser such as a personal computer or smartphone. The main goal of the project is to create a product that is easy to use, open source, and compatible with many devices.



The Pool Auto-Tech

Project Participants

Darius Smith & Andrew Wells

Instructor

Grzegorz Chmaj

Faculty Advisor

Emma Regentova

Problem Identified

Residential pool owners today have to monitor their pool water daily because the sensitive water can easily become unbalanced, and therefore, unhealthy. The maintenance is easy for some people but it can be a very daunting and tedious task for others.

Current Solutions

Balancing a residential pool today consists of daily, manual litmus paper-like tests. These tests depend on the naked eye precision, accurate pouring, proper estimation of amounts of water, accurate temperature of air, knowledge of chemicals and other pool materials and tools.

Team's Solution

The Pool Auto-Tech will benefit any residential pool owner. It will automate the process of balancing pool water by electronically testing the accurate pH level of the water and calculating the exact amount of base or acid needed to keep the water within its desired range. It will also electronically test the amount of chlorine and calculate the amount needed and then add that amount. The device will work on a clock which will be programmed to test as often as the user chooses. The only responsibility of the pool owner is to refill the necessary chemicals as needed.



Automated Optoelectronics Platform

Project Participants
Hector Valencia & Kirk Vrigian

Instructor
Grzegorz Chmaj

Faculty Advisor
Ke-Xun Sun

Tech. Advisors
Robert Buckles & Ke-Xun Sun

Problem Identified

Anyone who has done research is well aware of how problematic data acquisition can be. Any external interference will contaminate any data being processed starting with a simple touch of a fingertip, all the way to a poorly designed schematic. Troubleshooting someone else's work is time consuming, which in turn can cost thousands of dollars to companies, and slow down productivity greatly. Not to mention the thousands of dollars that gets wasted because of human and computational errors.

Current Solutions

After speaking with a scientist within the field, our team has not identified a reasonable solution to this main problem. The only alternative that is in practice today is to buy expensive equipment, which can cost nearly 80 to 90 percent of the researcher's budget. Researchers are faced with a dilemma of cost vs reliability.

Team's Solution

The solution we came up with is to provide the scientific community with a solid product that will enable them to acquire precise data. Our fully automated optoelectronic platform would provide scientists with a product that will perform 6 tests (initially), with a high level of accuracy and repeatability. The most important aspect of our design is that our product will provide this solution automatically and remotely. By limiting human contact with high-sensitive equipment and samples, we will reduce any variations on measurements between experiments. To confirm the level of accuracy, our system will repeat the same test several times and it will deliver the same accurate results. This improvement will increase productivity, speed, and most importantly reduce any unnecessary costs that are wasted on expensive equipment, technicians setting up experiments between runs, and hours troubleshooting experimental setups.



Smart Home Speaker System

Project Participants

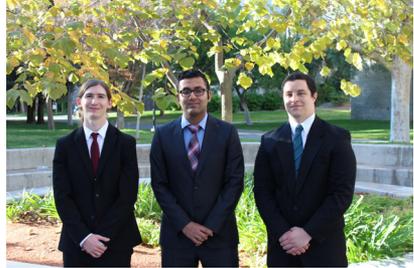
Ulises Diaz Jr., Dane Gentry,
& Brandon Thomas

Instructor

Grzegorz Chmaj

Faculty Advisor

Jake Baker



Problem Identified

Speaker systems in the current consumer market are complex, expensive, and inefficient due to lack of wireless connection between individual speakers within the system as well as due to the unnecessary requirements for manual user control. Modern users also are not able stream music from their audio source (i.e. Smart Phone, Laptop, Tablet etc.) to their speaker system and have their music “follow” them from speaker to speaker. Many existing speaker systems require wires installed in walls with complex interfaces that can be confusing to the user. Bluetooth technology does not offer a simple solution for true wireless connection as well.

Current Solutions

Current solutions include various expensive and complex speaker systems that utilize technology such as Bluetooth or Wifi to wirelessly stream music to a system of speakers connected by wires in the walls.

Team's Solution

Our team is designing a smart home speaker system prototype integrating multiple sensors to track a user such that the music they stream from their device will “follow” them. A speaker will activate and output the streamed audio when the user is within a certain range (optimal hearing range) of it and other speakers will not undesirably play to others (i.e. family members). There will be options for anyone, in addition to the user, to listen in. After researching numerous available sensors, we decided to integrate RFID (Radio Frequency Identification) technology (and potentially thermal sensors for better detection accuracy). The user and any additional guest users will have a RFID tag (i.e. FOB, keychain, beacon, etc.) on them which will activate ONLY speakers within range.

The Google Cast app will be used by the user in order to stream their audio to each individual speaker (which has its own Google Chromecast Wifi Adapter) simultaneously. Only speakers that detect a user's presence will output. The app also allows the user (and any guest user with the pin to each respective speaker's Chromecast) to control the volume of each speaker. This solution is perfect for anyone who wishes to have a continuous stream of their music playing within optimal hearing range as they move throughout their respective area (most likely home) without playing anywhere the audio is not desired.

Smart Microwave

Project Participants

Youssef Abdallah, Michelle Mata,
& Alyson Weber

Instructor

Grzegorz Chmaj

Faculty Advisor

Grzegorz Chmaj

Problem Identified

Smart technology has been incorporated into most aspects of our lives; except microwaves. The smart microwave will resolve this issue by introducing a microwave that knows all the instructions on pre-packaged, microwavable food simply by scanning a QR code on the package.

Current Solutions

There are no microwaves on the market that scan QR codes or are considered smart. During research, the closest we found was a hacked microwave that can scan a barcode that refers to a database to get the information needed to cook the food. The hack has to be accomplished and the database has to be built by the consumer. Currently, there is an intelligent microwave that can scan a QR code and sense the temperature and moisture level of the microwavable food, but it is still in the research process and years away from mass production.

Team's Solution

The smart microwave is a concept that will be easy for any microwave company to include in their microwaves with very little change to their current product. The QR code will have a standard format for ease of use. Getting this product to market would take less than a year. It would bring the common microwave up-to-date with current societal standards of smart electronics. Anyone in the market for a new microwave would be able to get a smart microwave for only a small increase in price over the comparable non-smart microwave. The future of microwaves is here.



Temperature Image Data Logging System

Project Participants
Monty Sourjah & Ryan Ung

Instructor
Grzegorz Chmaj

Faculty Advisor
Muthukumar Venkatsan

Problem Identified

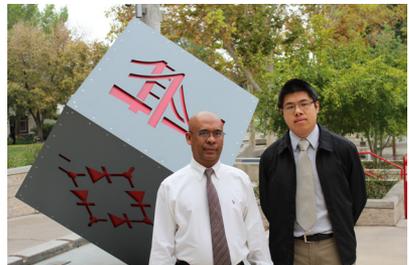
Maintaining a safe temperature in food items is crucial in the food service industries in order to avoid harmful bacteria from spreading and to prevent food poisoning. According to Southern Nevada Health District, the health code for food service establishments requires them to maintain temperature logs for food items every four hours in order prevent food poisoning. Managers in the food service industries need to have easy access to temperature logs recorded by their team members. During the health inspection, the managers need to present proof of maintaining temperature logs with temperature image, date and time.

Current Solutions

Paper, pencil, and analog or digital thermometers are used to record temperatures of food items. Digitally recording temperatures of food items and storing in smart phones.

Team's Solution

Temperature Picture Data Logger records food temperature using NSA certified analog temperature probe (with $\pm 0.25^{\circ}\text{C}$ accuracy) and captures the image of that particular food item using miniature camera on board. The captured data and images are transmitted via Bluetooth module to a computer and stored for later reference. This is the only device to record temperature and image with a time stamp in the food service industry. Our system gives proof of maintaining temperature logs in accordance with health code. Also in the near future, this data will be available in cloud services for anybody to access. There are temperature recording devices that require manual entry of temperature values. Our system does not require manual entry of temperature, instead temperature and image are recorded with a button and the data is time stamped. It is better than current solutions because it is a less time consuming method for food service personnel. Both food service personnel and the health district will benefit from the accuracy of the log.



Advanced Micro-Grid Interconnection Scheme

Project Participants

Octavio L. Gonzalez and Travis L. Taylor

Instructor

Brandon Blackstone

Faculty Advisor

Dr. Yahia Baghzouz



Problem Identified

This senior design engineering capstone project was motivated by the evolving need for reliable and “smart” grid-tied PV inverter-based distributed resources. Over the past decade, electric power generation, by means of PV, has experienced an exponential growth worldwide due to reduced PV infrastructure costs, the adoption of renewable energy standards and government incentive programs. However, as PV penetration levels increase, the stability and reliability of a system becomes compromised due to its susceptibility to system disturbances. To make matters worse, utility interconnection standards, require that grid-tied inverter-based devices disconnect from the grid after sensing “out of tolerance” voltage or frequency conditions, which can cause greater system instability and nuisance tripping.

Current Solutions

In recent years, inverter manufacturers have responded to these issues with “smart” inverters: devices that remain connected to the grid during voltage or frequency fluctuations that last no longer than a few seconds to help mitigate or reduce the severity of instability. Yet, this approach is only effective for short time power system induced disturbances, and fails to address the prolonged disturbances caused by reduced PV output such as the case with scattered clouds.

Teams Solution

The participants herein propose a method of “best source” selection in combination with closed-transition techniques to provide a greater degree of voltage-frequency support during prolonged disturbances. Hence, this senior design engineering capstone project demonstrates the protection and controls for the autonomous functionality of an advanced micro-grid interconnection scheme consisting of a 12kW inverter, PV array, local utility supply, and a 13kW diesel-powered generator set. The system is implemented at the Center for Energy Research (CER) – University of Nevada, Las Vegas (UNLV); and can make real-time decisions on the micro-grid’s optimal configuration, as well as place itself in any particular islanding or parallel operating mode for stability, reliability and economy. The utility company, home/business owners, students, and the university will benefit.

Telepresence Vision

Project Participants

Ja Manipon, Isais Osorio,
& Tone Pondaharn

Instructor

Grzegorz Chmaj

Faculty Advisor

Mei Yang

Problem Identified

Controlling motorized cameras requires a special kind of controllers and can sometimes be unintuitive. The users may have trouble moving the camera in the direction they would like.

Current Solutions

Universities and entrepreneurs have integrated drones with special cameras that utilize VR Headsets to control the camera. The VR Headset makes controlling a camera more intuitive. The drones built are very complex and have a sophisticated gimbal setup to control the camera. In addition, the controllers required with the VR Headset are all custom built to fit their needs. None of these devices are commercially available and are still under development or used for research purposes only, creating the problem of availability.

Team's Solution

With our team's solution, the camera will not be restricted to only being attached to drones. In fact, our camera will be portable enough to be mounted on any device or surface. Not only will it be portable, the device will not require a high end VR Headset. Instead, a smart phone, like the iPhone or Samsung Galaxy, can be used as a VR Headset. The phone and camera will be connected wirelessly. Everyday customers who have an interest in technology can benefit. This device can also benefit people with limited mobility by having a camera placed in an area they do not have access in order to look around intuitively.



Cardiac Wireless Sensor

Project Participants

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& Samuel Villanueva

Instructor

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Faculty Advisor

Jake Baker

Problem Identified

During medical exams, patients are required to run on treadmills with a cardiac sensor. However this process is both uncomfortable and dangerous due to the attached sensor wires.

Current Solutions

Current solutions include tethered straps and wires to hold a current position upon the body of a patient. There are currently no alternatives other than multiple tests that combined results yield the same results. The patient is restricted to one place due to the restrictions of the testing devices.

Team's Solution

Our team's solution is to provide a wireless, transportable device for the patient receiving the cardiac stress test. Our solution consists of radio frequency chips and several micro controllers. This design will benefit multiple agencies, particularly the medical field. It is a unique device that augments the current ability of the already existing test. This wireless test will be used within a medical clinic as well as out in the field. RF chips do not require direct line of sight; our solution allows for the patient to be inside or outside the testing area with multiple obstructions.



DEPARTMENT OF ENTERTAINMENT ENGINEERING & DESIGN PROJECTS

Department Chairs
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Senior Design Instructor
Dr. Si Jung Kim

BEATMASTER™

Project Participants

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Instructor

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Problem Identified

Drumming injuries can occur for many different reasons. These injuries, specifically musculoskeletal, develop in the lower back, lower leg/shin muscle pain, wrist, elbow, neck areas or hand blisters due to long hours of practice and performances. Musicians play through pain because some don't understand the potential risks of long-term repetitive play without concern to specific muscles. Unfortunately, these injuries have terminated many musicians' career.

Current Solutions

With the rise of EDM music comes the rise of midi controllers or drum pad machines. Using drum pad machines in a live performance or recording session could be converted to certain tones and pitches since there are already preset programming which assists the artist to prevent fatigue that could occur since a percussionist performs via hands or sticks. However, one must understand that drum pad machines or midi controllers only remove the human aspect of artistic expression and defeats the purpose of live performance. When it comes down to it, you can spend hours trying to make a digital drum track sound real, but nothing really beats the real sound of drums.

Team's Solution

The BEATMASTER™ is a robotic attachment designed to allow the user to control one or more percussion instruments using a modular button controller. With this product, you can now control entire drum sets, orchestra percussion lines, or just a single instrument all from one location. A single user will have the ability to play percussion instruments from a distance away, either for recreational use or creating samples in a studio setting. This also allows the user to play a complicated array of percussion instruments efficiently, easily, and with minimum energy expenditure (four appendages limits a person compared to ten fingers). Our modular design will allow the user to expand their system to fit the needed requirements; whether they have one or twenty drums, the BEATMASTER™ is easily expanded. With a variety of different adjustable clamps and stands, the BEATMASTER™ can be precisely positioned to strike any percussion instrument. As a broad impact, it is our conjecture that the BEATMASTER™ would be a valuable tool for children or people with disabilities and an everyday user.

Weld-Inspecting Drone for Roller Coasters

Project Participant
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Faculty Advisor
Joe Aldridge

Tech. Advisor
Michael Genova

Problem Identified

Pulse radiation source X-ray machines are one of the security and inspection industry's greatest tools for ensuring that vehicles and imported goods are safe and free from contraband. In an ever-developing industry, coupling X-ray sources, digital detectors and advanced material discrimination software, one challenge remains unsolved; image variations due to physical limitations. X-ray machines that incorporate a linear accelerator to produce photons experience great variances due to heating causing a noticeable decrease in beam intensity over the first few minutes. Imaging through large trucks and containers might suffer from dimming at the end of scans or oversaturation at the beginning of scans due to the settling.

Current Solutions

At the moment, the industrial imaging industry has three options to handle radiation dose droop: (1) allow X-ray producing machines a stability period before taking any image scans (2) create advanced detection software to compensate for the variances in radiation, (3) model the fluctuations mathematically and solve algorithms to predict those fluctuation for future scanning. These solutions create additional challenges, in that they either create delays for end-use customers, or require application on a machine to machine basis.

Team's Solution

The X-ray systems, produced by Varian Medical Systems, can be controlled with an active pulse forming network, or a solid state modulator to produce high-voltage pul



DEPARTMENT OF MECHANICAL ENGINEERING PROJECTS

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Automated Hot Pinning Machine

Project Participants
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Faculty Advisors
Yi-Tung Chen & Stephen Rice

Community Advisor
IMI Precision Engineering

Problem Identified

IMI Precision Engineering's current hot pinning process is manually accomplished and is not precisely reproducible. IMI wants an automated mechanism that will "remove the art" from this process and improve ergonomics for their employees.

Current Solutions

Automated hot pinning processes exist in countries such as Brazil and China, but these are designed for large glass tubes. As far as we know, there are not any mechanisms for the tubes IMI is working with, which are less than 1 inch in diameter.

Team's Solution

At this time, there aren't any automated mechanisms that bevel the ends of glass tubes that are smaller than a few inches in diameter. Our solution is a small mechanism that attempts to combine elements of the chuck of the lathe and the 2-D motion from a CNC machine.



A.U.T.O. - Mobile

Project Participants

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Instructor

Zhiyong Wang

Faculty Advisors

Brendan Morris & Woosoon Yim

Problem Identified

There is a great deal of interest in the advancement of autonomous vehicles. While large corporations are working on developing their own autonomous cars, there is a stark lack of effort towards vehicles that operate on private pathways, e.g. on a university campus. Local Motors has shown interest in developing smaller types of autonomous vehicles with universities across the country.

Current Solutions

While there is a lot of interest in these smaller, private road bound autonomous systems, not much work has been done. University of Michigan begun working on automating the steering control over one of Local Motors vehicles, the Loco, but has not achieved fully autonomous capabilities.

Team's Solution

This project demonstrates the first steps in achieving a marketable and functional autonomous vehicle designed to operate within smaller private pathways, such as university campus roads. To advance from current solutions, additional sensor systems have been implemented to provide necessary information to safely integrate with pedestrians it may encounter. These sensor systems include cameras to detect and track individuals and find the pathway, ultrasonic sensors to detect objects within a certain proximity, and GPS systems for navigation. These sensors are linked to an onboard computer where an appropriate course of action is determined through customized programming. This allows the vehicle to act as a fully autonomous vehicle that can be used for on campus transportation operations. This project is a system dubbed the Autonomous University Transportation Operation (A.U.T.O. – mobile).



Longboard Speed Wobble Damper System

Project Participants

Craig Anderson, Trevor Hunt

Instructor

Zhiyong Wang

Faculty Advisor

Georg Mauer

Problem Identified

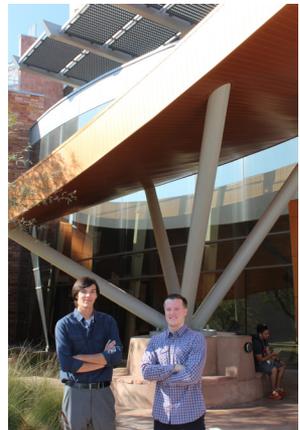
One of the biggest dangers with riding longboards is speed wobble. Speed wobble is a self-exciting oscillation of the longboard's trucks due to axis of rotation and usually occurs at high speeds. In some cases, the board wobbles uncontrollably and ejects the rider from the board resulting in injury.

Current Solutions

The most common solution for avoiding speed wobble is for riders to adjust their technique using their bodies effectively to counteract the truck oscillation. However, this skill takes years to fully develop. Several inventions have been produced that have claimed to solve the speed wobble problem but these solutions are often unappealing to riders or disproven to work.

Team's Solution

We are developing a system that will utilize viscous damping to stabilize the rotational motion of the trucks at high speeds. Due to the linear relationship between velocity and the viscous damping force, stability will be maintained at higher speeds and responsiveness will not be diminished at lower speeds. This system will be most helpful for beginning to intermediate level riders as they begin to travel down hills at higher speeds.



M.A.S.H. Tool

Project Participants

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Instructor

Zhiyong Wang

Faculty Advisor

Nicholas Fiore

Problem Identified

Currently, there are only two ways to break concrete: an externally powered jackhammer or a labor intensive striking rod and hammer.

Current Solutions

Smaller jackhammers are available for the retail price of \$300. This type of jackhammer requires gasoline and oil mixtures as a power source. The weight of the machine is also concerning. There are also electrical jackhammers that retail for \$200. This type of jackhammer requires replacing the battery or charging the battery.

Team's Solution

The MASH tool will offer a middle ground of the two extremes. The tool will be able to break concrete and tamp. No external power source is required. This machine will also be lightweight, allowing easy transportation. The tool will be great for both private (like NV Energy, water reclamation, etc.) and personal use (for small DIY projects around the house).

Super Splint Project

Project Participants

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& Reginald Regala

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Faculty Advisors

Jaeyun Moon & Stephen Rice

Community Advisor

Anis Khair



Problem Identified

Plantar fasciitis is a painful, degenerative inflammatory condition of the plantar fascia, which is a fibrous tissue that supports the arch of the foot. Approximately 32 million people in the United States (10 percent of the population) suffer great pain due to plantar fasciitis. Although there are a wide range of treatments available including surgery and corticosteroid injections, splinting has proven to be an effective and non-invasive treatment for early to early-middle duration plantar fasciitis.

Current Solutions

Several types of splints exist in the market today. However, many of these splints are ineffective in providing the adequate and sustained stretch of the plantar fascia that is necessary for effective treatment. Another common limitation of current splints is the lack of size and volume customization for patients of different foot sizes. For this reason, splints can often be very uncomfortable to wear, and can impede the patient's mobility, resulting in non-compliance and ineffective treatment.

Team's Solution

The Super Splint Project is a safety-enhanced splint which: (1) provides a sustained and adequate stretch of the plantar fascia without skin hyper-aesthesia, (2) is composed of adjustable and durable frame components, and (3) is comfortable and easy to use for the general population. The splint will support the entire length of the plantar fascia, from the calcaneus to the metatarsal bones.

The adjustable angle allows a provision for health care professionals to prescribe specific angles of ankle dorsiflexion, a vital requirement for the treatment of plantar fasciitis. The adjustable base allows for a comfortable fitting of a wide range of foot sizes. It withstands a large variance in loads, both with the patient standing and in mobility. The easily detachable back allows for safe and unimpeded short-distance mobility.

This product is accessible to patients of all ages, including those of ages 55-64, where incidence of plantar fasciitis is prevalent. With mass production, the Super Splint is expected to be affordable for the general population.

Laboratory Wind Tunnel for Testing Miniature UAVs

Project Participants

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& Jose Torres

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William Culbreth

Problem Identified

Currently the Department of Mechanical Engineering at UNLV has no wind tunnel. A wind tunnel is needed for laboratory instruction, research, and for demonstration purposes. Wind tunnels can be used for various mechanical engineering courses, including Advanced Fluid Mechanics II (ME 701) and Gas Dynamics (ME 482/682).

Current Solutions

There are many options, but a conventional wind tunnel with a test section big enough to test actual UAVs is not only expensive, but space consuming.

Team's Solution

The objective is to provide a wind tunnel for testing miniature UAVs in a crosswind and in static air that measures the lift and drag forces on the aircraft. The test section for our wind tunnel measures 4 ft x 4 ft x 4 ft which can be used to test actual UAVs with wingspans of up to 3 ft, as well as the lift force generated by quadrotors in static air.



INTERDISCIPLINARY PROJECTS

Project V – Rapid Intravenous Anesthesia

Project Participants

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Ralph Mago, & Dominic Picardal

Instructors

Grzegorz Chmaj & Zhiyong Wang

Faculty Advisor

Rama Venkat

Problem Identified

The Venefit™ procedure is the name of a minimally invasive treatment for collapsing varicose veins of the leg to prevent the spread of Chronic Venous Insufficiency (CVI), a debilitating medical condition which results in oxygen deficient blood cells to be transported back to the heart. However, prior to the heat ablation, anesthesia must be injected around the vein walls. During the Venefit procedure, the anesthesia takes too long to administer and causes patient discomfort.

Current Solutions

An anesthesia mix of lidocaine and saline is injected externally around the vein walls using a single needle. It is administered by injecting the patient multiple times along the target vein.

Team's Solution

Our proposed solution is to design a unit which will travel within the vein and administer anesthesia. Our concept of an Intravenous Rapid Injector will inject anesthesia rapidly from within the vein. This unit will consist of two 21 gage needles which will puncture through the vein wall to distribute anesthesia to cushion the surrounding tissues from the heat. This will provide the patient with less discomfort since the pain is felt at the skin level as well as cut down on overall procedure time.

This will benefit the patient in terms of comfort and the doctor in terms of time, allowing the doctor to treat more patients.



Tactical Smart Magz

Project Participants

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Instructor

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Faculty Advisors

William Culbreth & Jeff Markle

Problem Identified

In combat, the amount of rounds remaining in a magazine is crucial in a firefight. Currently, the user must count the amount of rounds fired in their head. However, during a firefight, it would be convenient if the user could see the exact number of rounds in the magazine.

Current Solutions

Accelerometers mounted to the gun counts the amount of bullets fired. This sends the data to an LED displaying the amount of rounds remaining. Chronographs use the muzzle velocities to determine how many rounds have been fired.

Team's Solution

Our design is fundamentally better than the current solutions for a few reasons. With the accelerometers, many vibrations occur when firing. These vibrations can make the system believe that a round has been fired when it has not. The current solutions depend on measuring the amount of remaining rounds by the act of firing. Our system directly measures the amount of bullets using an array of magnetic sensors and a magnet. The people who will benefit the most from this are military and law enforcement. This system will only respond to what is going on inside the magazine and the environment will not affect the reading.



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