FRED AND HARRIET COX
SENIOR DESIGN
COMPETITION

UNLV ENGINEERING

May 5, 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 Molly Marks at molly.marks@unlv.edu or (702) 895-3281.

Senior Design Clinic

In its second year, the College of Engineering's Senior Design Clinic continues to serve as a 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

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Thank you,
Senior Design Instructors!

Department of Civil & Environmental
Engineering and Construction
Dr. Douglas Rigby

Department of Computer Science
Dr. Evangelos Yfantis
Dr. Ju-Yeon Jo
Dr. Andreas Stefik
Dr. Matt Pedersen

Department of Electrical and Computer Engineering
Brandon Blackstone

Department of Mechanical Engineering
Dr. Zhiyong Wang

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Spring 2016 Senior Design Judges

Manjit Gombra-Singh
Chief Techonology Officer
Aristocrat

Manjit Gombra-Singh was appointed Chief Technology Officer of Aristocrat in December 2012 after previously holding the role of Senior Vice President for Aristocrat responsible for research and development of enabling technologies. Manjit has a broad background in technology, having worked at Juniper Networks on virtualization and management technologies as well as cloud initiatives, leadership roles on Internet and Mobile product lines at IGT, and engineering management roles at Sun Microsystems. Manjit is a published author on cloud computing and mobile gaming technologies and holds a Master of Technology (Computer Science) degree from University of Hyderabad.

Subbarao Govindaraju
President
SVG Consulting Inc.

Govindaraju earned his MSEE from UNLV in 1992 and has built a career in the electric utility industry. He conducted research in Control of Power Systems while at UNLV and published several research papers in international conferences and journals.

Prior to joining UNLV, he worked as a Senior Engineer at a Thermal Power Plant in India in construction and maintenance groups. Upon graduation from UNLV, he joined the then Nevada Power Company (now NV Energy) and was a team leader in new construction development in Las Vegas. In 1998, Govindaraju the consulting firm Arthur Andersen as a senior manager and developed the Operational Consulting area for the firm.

In 2004, he founded SVG Consulting Inc, and currently serves as its founding President. SVG Consulting is focused on providing management strategy consulting to large electric utilities in North America. He built the firm on the sound foundations of providing exceptional advisory to clients. SVG Consulting holds the reputation in the industry as a pragmatic consulting group offering the most innovative and cost effective solutions to the most complex of problems. SVG Consulting has several major clients on the west coast including Southern California Edison, NV Energy, Puget Sound Energy. Govindaraju enjoys playing golf and international travel for business and pleasure.

Anthony A. Marnell II
Founder, CEO, and Chairman
Marnell Companies

Marnell is the founder, CEO, and Chairman of the Board of Marnell Companies which is acclaimed internationally for its design and construction of the world's most recognizable resort hotel and gaming properties. Through his efforts, he has propelled Marnell Companies to be acknowledged as the largest and preeminent design-build firm specializing in the hotel and resort industry in the world.

Under his leadership, Marnell Companies has served as the designer and general contractor for some of the largest resorts in Las Vegas, building more than 90,000 hotel rooms at casinos and resorts around the world, totaling more than $11 billion.

Calum Pearson
Vice President of Resident Shows Division
Cirque du Soleil

Calum is currently the Vice President of the Resident Show Division of Cirque du Soleil, where he is responsible for the operations of 9 multi-million dollar permanent theatre shows across the US. This is the second Vice Presidency Calum has undertaken at Cirque du Soleil. Previously Pearson was at the helm for their Technical Show Support division.

Pearson served as Company Manager for KÀ, (fourth permanent show in Las Vegas) and was responsible for managing the day to day operations of Cirque du Soleil. With more than 300 cast and crew members from 18 different countries and a production cost of $200 million. Pearson had his hands full. He joined KÀ in November 2004 just as the first public performances started and the creation process was still in an intense period. With over 25 years of operations and management experience in the entertainment industry, Pearson brings a wealth of knowledge and leadership skills to Cirque du Soleil.

Prior to Cirque du Soleil, Pearson spent 16 years touring with well known music productions including Bon Jovi and Van Halen, and family acts such as Disney on Ice. He progressed his responsibilities over the years from Lead Rigger, to Technical Director and Company Manager.

Pearson, a native of England, and his wife Cory, have two young sons and live in Las Vegas.

Charles Martin
Director, Nuclear Operations Directorate
National Security Technologies, LLC

Dr. Martin is currently the Director of Nuclear Operations for National Security Technologies. He is responsible for the safe, compliant and efficient operation of all nuclear operations and activities at the National Nuclear Security Site in Nevada. He will lead four divisions: Compliance & Surety, Nuclear Services, Nuclear Safety, and High Hazard & Nuclear Facilities.

Prior to joining NSTec, Dr. Martin was a Senior Engineer with the Defense Nuclear Facilities Safety Board where he reviewed the safety bases for nuclear explosive operations at the Pantex Plant and Stockpile Stewardship activities at Los Alamos National Laboratory, Lawrence Livermore National Laboratory, and the Sandia National Laboratories. Dr. Martin was a recipient of the John W. Crawford, Jr. Award, presented for the most valuable individual contribution to the work of the Board.

Before joining the Board, Dr. Martin worked in the Air Force Secretariat as a Nuclear Weapon Development Officer and as a Nuclear Research Officer. Prior to that, he held the following positions: Program Manager for the Joint Department of Defense/Department of Energy Thermionic Space Reactor Program, Technical Director for several underground nuclear weapon tests, and Assistant Professor of Mathematics at the U.S. Air Force Academy.

He is active in the American Nuclear Society, ASME, and IEEE. He serves on the Main Committee of the ASME Nuclear Quality Assurance Committee and is a Fellow of the Washington Academy of Science.

He received his Ph.D. in Nuclear Engineering from the Air Force Institute of Technology in 1983.

Senior Design Competition

Presentation	Time	Project Title
PRESENTATION 1	8:00AM	IMPACT SOLUTIONS
PRESENTATION 2	8:15AM	APOLLO: AUTOMATED HELION
PRESENTATION 3	8:30AM	HSIS16
PRESENTATION 4	8:45AM	WIRELESS WAITER
PRESENTATION 5	9:00AM	PLAN- IT
PRESENTATION 6	9:15AM	PLASTIC MICROPARTICLE FIL
PRESENTATION 7	9:30AM	HI-GROWPONICS
PRESENTATION 8	9:45AM	AUTOMATED SOLAR STILL
PRESENTATION 9	10:00AM	AIR PARTICULATE P.O.D V2
MORNING BREAK 10:15-10:30 AM		
PRESENTATION 10	10:35AM	DUAL ALTERNATOR LOAD BA
PRESENTATION 11	10:50AM	PEG- TUBE
PRESENTATION 12	11:05AM	SUSTAINABLE LIVING
PRESENTATION 13	11:20AM	PROCESS J. COMPILER
PRESENTATION 14	11:35AM	MOBILE AUTONOMOUS SURV
PRESENTATION 15	11:50AM	ROW CYCLE
PRESENTATION 16	12:05PM	STEREO SOUND EXTRACTOR
PRESENTATION 17	12:20PM	SAFTEY SENSOR SYSTEM
PRESENTATION 18	12:35PM	VISUAL CLASS TREE
LUNCH 12:50- 1:30PM		

Presentation Schedule

	Department
	Electrical and Computer Engineering
DON	Mechanical Engineering
	Civil Engineering
	Computer Science
	Electrical and Computer Engineering
LTRATION SYSTEM	Mechanical Engineering
	Civil Engineering
	Mechanical Engineering
	Interdisciplinary
LANCER	Electrical and Computer Engineering
	Mechanical Engineering
	Civil Engineering
	Computer Science
VEILLANCE SYSTEM (M.A.S.S.)	Electrical and Computer Engineering
	Mechanical Engineering
R	Electrical and Computer Engineering
	Mechanical Engineering
	Computer Science

Senior Design Competition

Presentation	Time	Project Title
PRESENTATION 19	1:35PM	THE ASSIST
PRESENTATION 20	1:50PM	FREQUENT-Z'S
PRESENTATION 21	2:05PM	SMART BOOT
PRESENTATION 22	2:20PM	PH LEVEL AND TEMPERATUR
PRESENTATION 23	2:35PM	HAILEY'S HAND V. 2.0
PRESENTATION 24	2:50PM	DSM SENSING
PRESENTATION 25	3:05PM	H2 DRONE
PRESENTATION 26	3:20PM	GOWAN SOUTH DETENTION E CORRECTION
PRESENTATION 27	3:35PM	THERAPEUTIC INCLINING BED
AFTERNOON BREAK 3:50-4:05PM		
PRESENTATION 28	4:10PM	SPACE FLIGHT – THE APP
PRESENTATION 29	4:25PM	DROPLET ACTUATION VIA DIG EDUCATIONAL DEVELOPMEN
PRESENTATION 30	4:40PM	BIKE MAINTENANCE LIFT
PRESENTATION 31	4:55PM	SIGNAL QA TOOL
PRESENTATION 32	5:10PM	TASKR
PRESENTATION 33	5:25PM	LOW COST WATER JET CUTTI
PRESENTATION 34	5:40PM	PULSED RADIATION MEASURE SYSTEM
PRESENTATION 35	5:55PM	FIT

Presentation Schedule

	Department
	Mechanical Engineering
	Entertainment Engineering & Design
	Electrical and Computer Engineering
E MONITOR DEVICE FOR POOLS	Electrical and Computer Engineering
	Mechanical Engineering
	Electrical and Computer Engineering
	Interdisciplinary
BASIN- DEPTH MEASUREMENT ERROR	Civil Engineering
D	Mechanical Engineering
	Computer Science
GITAL MICROFLUIDIC SYSTEM AS AN T TOOL	Electrical and Computer Engineering
	Mechanical Engineering
	Electrical and Computer Engineering
	Computer Science
ER	Mechanical Engineering
EMENT AND FEEDBACK CONTROL	Electrical and Computer Engineering
	Computer Science

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING AND CONSTRUCTION PROJECTS

Department Chair
Dr. Donald Hayes

Senior Design Instructor
Dr. Douglas Rigby

Gowan South Detention Basin–Depth Measurement Error Correction

Project Participants
Dillon Hines, Marc Moore, James Reynolds & Henry Schlierkamp

Instructor
Douglas Rigby

Faculty Advisor
David James & Haroon Stephen

Tech. Advisor
Todd Meyers, P.E.

Community Advisor
Timothy Sutko

Problem Identified

Detention basins are integral components of the flood control system in the Las Vegas Valley. During significant rainfall events, basins can quickly fill with large volumes of storm water. Stormwater is then slowly released into channels and pipes to mitigate flash flooding risk to people and property downstream. Additionally, given the large surface area required, land use considerations, and infrequent precipitation in Southern Nevada, detention basins may sometimes double as public park space. The ability to quickly and accurately measure storm water depths in detention basins during rainfall events is critical to ensuring public safety.

Current Solutions

Gowan South Detention Basins existing depth measurement systems at the Clark County Regional Flood Control District (CCRFCD) is comprised of a stilling well and pressurized bubbler, both of which measure depth near the outlet structure of the basin. Data from these systems are automatically transmitted to CCRFCD's office by radio. It is believed that significant drawdown at the outlet structure, i.e., a reduction in water surface elevation, yields inaccurate measurements. When compared to high-water marks, depth is under-reported by as much as 6 feet and 3 feet by the stilling well and bubbler, respectively.

Teams Solution

An enclosed concrete structure designed to house new inlets for the existing stilling well and bubbler system is to be constructed on the basin floor away from the outlet structure, where no drawdown occurs. The structure will feature a lockable grate on top to provide protection against vandalism as well as accessibility for maintenance.

Utilizing the existing measurement systems, both of which are functioning, is a simple, cost-effective solution. Redundancy is also achieved by utilizing both systems. Having accurate depth measurement allows CCRFCD, and numerous other public agencies that rely on the data, such as emergency personnel and public works, to make informed decisions regarding public safety during significant rainfall events.
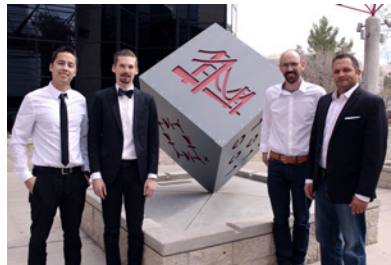
HI-Growponics, Inc.

Project Participants
Caitlyn Alcantara, Turhan Bae, Trisha Nakakura & Jacob Sakaguchi

Instructor
Douglas Rigby

Faculty Advisor
Daniel Gerrity

Problem Identified

As the population on Earth rapidly increases and the freshwater crisis intensifies, communities will soon require a more efficient use of available resources. The food-water-energy nexus demonstrates that an improvement in any of these three branches will affect all three disciplines of living a more sustainable and therefore greener lifestyle. One remarkable alternative that can act as a supplement to conventional agriculture is hydroponics, and as a relatively new concept that is trending rather than established, unexpected facets arise to fit conventional needs. Specifically, the use of wastewater raises the large issues related to water treatment such as salinity, residual pharmaceuticals, etc.

Current Solutions

There is one concept that is currently being implemented in California and Arizona to preserve water. It is to use treated effluent from a wastewater treatment plant (WWTP) for agricultural purposes – a concept known as water recycling. Similar to California and Arizona, the treated effluents from WWTPs within the Las Vegas Valley are currently being used by local golf courses for irrigation purposes. Other hydroponic systems also exist but do not consider wastewater components.

Teams Solution

Although current solutions do work, there are several issues with using treated effluent for commercial agricultural purposes. One issue, the cost of transporting treated effluent to agricultural sites. This includes basic economic costs in addition to direct and indirect water costs, specifically water loss due to evaporation or unintentional spillage and embodied water related to the energy consumed in transportation. One alternative that offers a more sustainable solution to this conventional approach is to bring the farm to the WWTP rather than the WWTP to the farm. Our engineering design will include a hydroponic system that can be used to supply food for a community or commercial business, but can also be used to conduct research into wastewater-based hydroponics. By incorporating a hydroponic system at a WWTP, the need to transport the treated effluent to agricultural facilities would be reduced. This serves both time and money. Ultimately, this project aims to target all aspects of the food-water-energy nexus. From energy use via fuel cost and water demand without water waste, all to create a more sustainable food source. Locally, this approach will provide a more sustainable lifestyle within the Clark County area.

HSIS16

Project Participants
Nelson Baggs, Hailemichael Debela, Kenneth Greenhalgh,
Joe Podegracz & Bryan Sarmiento

Instructor
Doug Rigby

Faculty Advisor
Alexander Paz

Problem Identified

The intersection of Swenson Street and Harmon Avenue has seen increased traffic stemming from the McCarran International Airport expansion and University of Nevada, Las Vegas (UNLV) rising student population. To best serve the community, redesigning the intersection must be considered. There are two alternatives to increase multimodal (autos, pedestrian, bus and bicycles) level of service and the corresponding impact of suggested changes on the existing drainage system.

Current Solutions

There are no immediate plans for redesigning the intersection of Swenson Street and Harmon Avenue. The intersection's level of service (LoS) has been rated a F during peak periods. In both traffic and stormwater this intersection is inadequate. Stormwater drainage ditches on Harmon resulting in its incapability of handling an event such as the 100 year event.

Teams Solution

Currently there are no plans by Clark County to address this situation. This proposal will positively impact resort corridor traffic, UNLV access, and egress from the McCarran International Airport. This project will benefit Las Vegas residents, UNLV students, and tourists as well as businesses in the area. The project team hypothesizes that this traffic redesign of the intersection will best meet Clark County's needs. This project will include reviewing and recalibrating traffic lights to optimize flow with the surrounding intersections. Extra lanes will be added on the Harmon corridor between Swenson and Paradise to handle greater storage. Another option is to make Harmon (between Swenson and Paradise) one way to accommodate a larger storage capacity; eastbound traffic routed through Naples. Moreover incorporate the current stormwater drainage system into the Flamingo wash and enhancing the capacity to handle larger flows.

Sustainable Living

Project Participants
Gavin Balajadia, Jared Baughman, Ashley Brown,
Rommel Pamintuan & Danielle Stevenson

Instructor
Douglas Rigby

Problem Identified

The desert environment of the Las Vegas Valley has a limited supply of water, which is further limited by ongoing drought. Overuse of natural water resources can have important negative effects on the environment and the human built environment. Existing conservation efforts often focus on unpopular restrictions on water use. Expanding water conservation efforts to include water reuse could further improve the sustainability of communities in arid environments.

Current Solutions

Traditional wastewater treatment discharges effluent to Lake Mead. This is effective for prevention of disease, which creates an environmentally-buffered loop of water reuse. However, this loop is intensive both in energy (required to pump water to and from Lake Mead) and water treatment technologies (treat all tap-water to standards required to make it safe to drink). Much of water use in the average Las Vegas household is used for applications such as landscaping and operation of toilets. Such a high level of water treatment is unnecessary and wasteful.

Teams Solution

A community designed for sustainability could further conserve water and resources needed to supply water by implementing water reuse. Greywater reuse accomplishes this by reusing water used in appliances such as sinks, showers, and washing machines in applications such as toilets and landscaping which do not require high levels of treatment. Most existing greywater systems are for single households. These solutions are effective, but can require substantial investment, both in initial cost and maintenance and repairs. A community-scale greywater reuse system could lessen the burden on individual owners and take advantage of economies of scale also. A community greywater solution can make a community more sustainable by increasing water conservation through more effective use of existing resources.

DEPARTMENT OF COMPUTER SCIENCE

Department Chair
Dr. Laxmi Gewali

Senior Design Instructors
Dr. Evangelos Yfantis
Dr. Ju-Yeon Jo
Dr. Andreas Stefik
Dr. Matt Pedersen

Fit

Project Participants
Evan Pierzina

Instructor
Evangelos Yfantis

Problem Identified
Many US citizens today are classified as having a chronic disease related to poor activity and diet. The estimated cost to Americans for healthcare-related expenses dealing with obesity and diabetes is roughly 300 billion dollars every year.

Current Solutions
Recently, there have been more initiatives to encourage healthy lifestyles, but they are often flawed for many reasons, such as: someone is more interested in profiting from them, solutions focus on one aspect of a healthy lifestyle only, and/or a lack of community and support between members. Most people who want to become more active end up either paying for someone to teach them, or have to sift through false claims about miracle diets in order to find something that will work for them.

Teams Solution
This project is to ease the transition to a healthier lifestyle and motivate people to to keep their goals. A mobile application will be created to assist users and keeping them motivated to stick with their own customized programs. Through evidence-based information, helpful guidance, and by providing a community platform for like-minded individuals, it is meant to be an all-in-one resource for people who are just becoming or trying to stay active; all the user has to do is go out and make their goals a reality. Unlike some other programs meant to promote activity, the ideals of this project are not focused on making money, but rather on making a difference. When we, as a nation, become more responsible about our health, more funding can be spent in other areas, such as cancer research and prevention, and everyone will benefit to some degree.

ProcessJ Compiler

Participants
Omar Navarro-Leija & Austin Ross

Instructor
Jan Pedersen

Problem Identified

The number of cores per computer has increased dramatically over the past years. Unfortunately, software has lagged behind adapting to this rapid change. Few programs and languages take full advantage of parallelism that the extra cores provide and provide only low-level support for parallelism and concurrency. These mechanisms are complex and prone to error: difficult to replicate bugs like race conditions and dead-locking are common in threaded code while verifying correctness is often impossible or impractical.

Current Solutions

Languages like Go and Rust seek to improve the state of concurrency by using channels and asynchronous communications. Industry languages like Java provide support through concurrency libraries, threads, and monitors. Languages like C leave is completely up to the programmer to ensure the code won't be afflicted by race conditions and deadlocks.

Team Solution

ProcessJ is a process-oriented programming language based on the communicating sequential process (CSP) style concurrency. In this project, we worked on developing the code generator for the ProcessJ compiler. Kroc is a multicore compiler with a C runtime and an accompanying C API to interact with the standalone runtime. Thus our code generator compiles down to native C code to take full advantage of the Kroc runtime. Additionally, by compiling to C we are able to produce highly optimized and portable code by taking full advantage of the ubiquitous GCC compiler. This approach allows us to run millions of processes in parallel with context switches between threads in the nanoseconds. ProcessJ has the advantage of familiar Java syntax allowing smooth transition for programmers. We hope projects like these will increase the use of process-oriented languages in this area of multicores.

Space Flight – The App

Project Participants
David Truax & Daniel Truax

Instructor
Evangelos Yfantis

Problem Identified

The problem with creating a mobile game app, is that everything is subjective to the user. We designed the app and program in a way to appeal to everyone, but everyone has a different opinion on what is considered "good". We have gone through multiple iterations on the design to make the user feel immersed in our game.

Current Solutions

There are many mobile game apps on the market today; some are noticed some are not. The highest grossing mobile app games on the iTunes store are free to play games. It uses in-game purchases and advertising to generate revenue. Some games are complex and some are simple, but complexity doesn't necessarily translate to the games performance.

Teams Solution

We decided to create a mobile game app that has a simplistic and fun. We plan to use the current marketing strategy that most mobile gaming apps use, free to play with in-game purchases and advertising. Our mobile game has a story mode; where the user is able to complete levels that progressively become more difficult. It will have a time trial mode where the user is able to play different modes with a time limit, trying to beat their high scores. For the more casual gamer or for those who want to practice, we have a practice mode to hone ones skills. Regardless of your skill level, age, or experience. We feel that this game will be appealing and fun for everyone.

Taskr

Project Participants
Trevor Scheer & Raul Collazo

Instructor
Evangelos Yfantis

Problem Identified
Currently there is a gap that exists between people who are looking for supplementary income and people who are willing to pay for their services. The purpose of this mobile app is to provide a service to bring these two groups of people together.

Current Solutions
Similar to Angie's List, TaskRabbit, Thumbtack, and Fiverr. These platforms generally cater to customers who need professional services (i.e. landscaping, plumbing, electricians, etc.).

Teams Solution
Our solution solves various types of services that are left out of the previously mentioned solutions. For example, TaskRabbit only hires within a specific set of verified professionals. With our platform, anyone will be able to make their services available in a wide range of categories. These categories include professional and trade services like the current solutions, but will also include nonprofessional services. For example, services may range from menial tasks such as grocery shopping, to specialized services such as building custom furniture. This mobile app provides a platform where anyone who is willing to pay for a specific task to be completed will be connected to those who can.

Wireless Waiter

Project Participants
Adrian Gee, Aleksander Samandzija, Jessica Cotton, Ron Pai,
Jordan Mulcahey, Gayle Roces & Thomas Marten

Instructor
Ju-Yeon Jo

Problem Identified
Today's food establishment customers are more impatient than ever. Long lines could mean lost customers. Ordering from a single cashier/waiter is inefficient and time consuming. Studies have shown that lines at food establishments are getting longer and slower. They need a faster, more efficient ordering system.

Current Solutions
Traditional restaurants are moving toward advanced technology, including tablets on tables, to automate parts of the order taking process. Fast food establishments and cafes offer ordering from online websites, apps, and provided tablets. However, these solutions are neither fully frictionless nor integrated. Provided tablets are costly and confusing to use, online websites use customer data and are not mobile friendly, and apps take memory and time to download; therefore, these solutions are not ideal.

Teams Solution
Our solution, Wireless Waiter, is an innovation in interface design for seamless order taking. Customers can use their own mobile device to connect to a businesses' ordering system. Customers will simply connect to the businesses' Wi-Fi and will be directed automatically to the ordering screen after they accept the terms and conditions. This will provide seamless integration of the ordering system to the customer's mobile device. No new app install is needed which means time to order is reduced. Also, the order does not need to access an external website, which means it is not routed from a central server, vastly improving speed, reliability and accuracy. As soon as the customer is in range of the Wi-Fi, he/she will be able to connect and place his or her order. Wireless Waiter will serve as a personal cashier / waitperson for every customer at a very low cost to the business.
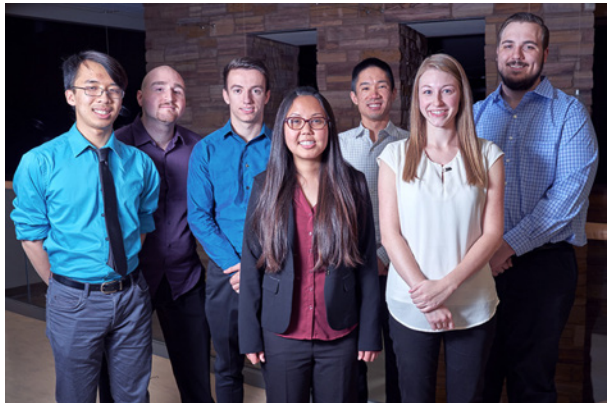
Visual Class Tree

Project Participants
Sanju Varghese & Brian Cummings
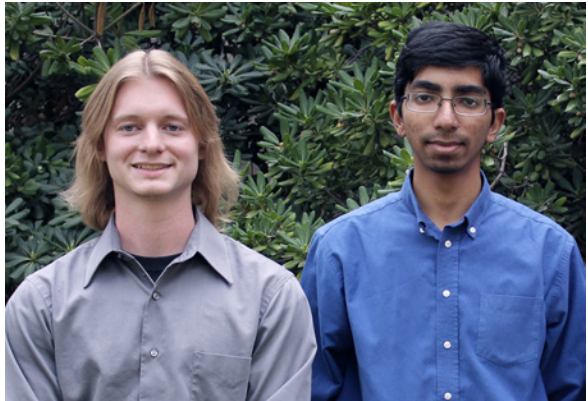
Instructor
Andreas Stefik

Problem Identified

Every college student has to take certain classes in their major for graduation but it is difficult to determine the order in which to take these classes. Often students are unable to take the class they need because they were not aware of prerequisites resulting in another delayed semester, wasting time and money. The issue boils down to a lack of intuitive representation that shows all the classes they need to take with the prerequisites listed for each.

Current Solutions

The current method for determining the classes necessary for a major is a degree sheet or a huge list of dropdowns in MyUNLV. But neither of those list the prerequisites of each class. This information can only be retrieved by searching each class individually on MyUNLV or by asking the advisors and an appointment with an advisor can take anywhere from 1 - 2 months.

Teams Solution

Our solution to this problem is to visually represent the relationship between each class for a major in a tree format that makes it intuitive to understand the prerequisites for each class. By selecting a class as taken, the tree will automatically update to show any new classes that are now unlocked. This allows for students to plan out their next semester ahead of time or even their entire graduation roadmap. This is better than the current solutions since it not only shows all the required classes for a major but also the prerequisites for each class. This will mostly benefit the students by helping them plan out their semester by knowing about classes they have to take ahead of time. This could also help out advisors as they could visually show each student their own individual graduation roadmap as opposed to doing it on a paper checklist.

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

Department Chair
Dr. Yingtao Jiang

Senior Design Instructor
Brandon Blackstone

Droplet Actuation via Digital Microfluidic System as an Educational Development Tool

Project Participants
Mason Hill & Hongzhong Li

Instructor
Brandon Blackstone

Faculty Advisor
Jacob Baker

Technical Advisor
Yiyan Li

Problem Identified

Currently, educational tools for mixing, splitting, and moving liquids are done through primitive measuring devices through the use of a human medium to control said devices. This method will allow for automation of it and higher precision of said tools compared to the standard method of extracting chemicals (humans with measuring devices). For biomedical/chemical analysis, sample preparation is a complex, labor intensive and multi-step process. By designing an integration system on a microscale level that is able to precisely prepare the sample on an automatic process will result in a reduction of laboratory size, analysis time, and sample needed.

Current Solutions

Currently, there are very few products commercially available that can achieve the automatic process of microscale lab analysis. The already existing microfluidic devices are very costly to manufacture (ranging from $2000 to $6000). Moreover, it is not commercially available so only professionals have access to it.

Teams Solution

The need for this is that currently it is potentially dangerous when dealing with harmful liquid substances and currently measurements are also imprecise due to the control of human error. Both of these matter when bringing chemistry and biology as an experimental science for lower grades such as students in the elementary to middle school range who cannot be responsible for injuring themselves through mishandling of chemicals. This will allow students to be able to experiment with chemicals at an earlier age and also save school resources as the process of extracting said chemicals will be significantly more efficient than the human operator. Furthermore, using the Droplet Actuation via Digital Microfluidic System is significantly cheaper than any other comparable device, allowing for it to be better produced at a more reasonable cost.

DSM Sensing Circuit

Project Participants
Stephen Berta, Cesar Macias & Koby Sugihara

Instructor
Brandon Blackstone

Faculty Advisor
Jacob Baker

Tech. Advisors
Jacob Baker & Kris Campbell
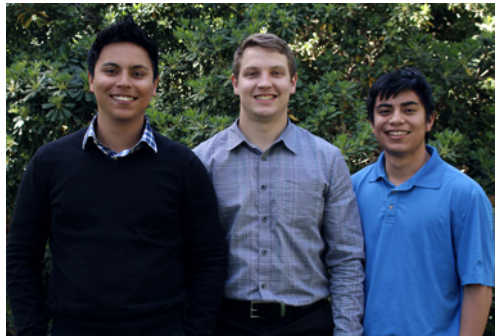
Problem Identified

In the modern information age nothing is as valuable as memory storage. Advances within computing are making it necessary to both reduce the footprint of storage and increase its efficiency. As current NAND Flash memory is reaching its physical limits, it is important to look to a new form of non-volatile storage. With this new storage comes the need for a new sensing circuit designed for this type of memory.

Current Solutions

There are several new forms of memory that are being experimented with, one of these is resistive memory AKA memristors. Memristors are currently being experimented with by several large companies but no commercial offerings are available and all sensing technology is proprietary.

Teams Solution

Our theory for sensing memristors is simple, resistant to noise and is implemented using CMOS logic. The benefit of CMOS logic would be that memristors can be placed on top of a CMOS chip and thus the two technologies can be integrated with minimal changes to current industry fabrication techniques. It can also be implemented in several different test structures depending on the level of sensitivity needed. These benefits could one day make resistive memory available for any device that requires non-volatile storage of information.

Dual Alternator Load Balancer

Project Participants
Matthew Meza & Joey Yurgelon

Instructor
Brandon Blackstone

Faculty Advisor
Jacob Baker

Problem Identified

Off-road vehicles suited for endurance and short course racing through extreme conditions require a large assortment of accessories. These accessories, which require stable and efficient power, load down a vehicle's electrical system limiting sustained peak performance. To supply the needed power, two alternators are used in tandem. These alternators, however, tend to fight each-other for their share of the load causing degradation in the lifespan of either or both alternators along with reduced efficiency for driving the needed accessories.

Current Solutions

Currently, there is no known plug and play solution for running two vehicle alternators with their respective voltage regulators. The need for such a system came directly from the project's sponsor whose clients consistently place at the top within various racing organizations. The constant need to ever improve their clients' vehicles persists and any engineering solutions, which may give an advantage, are heavily sought after.

Teams Solution

The solution presented offers users, manning a dual alternator set-up, the unique ability to distribute the load evenly amongst the two alternators. Doing so improves the life span of the electrical system as a whole by preventing wear on any one individual alternator whilst allowing the ability to drive additional vehicle accessories. In addition, diagnostic information of the system's performance is provided in real-time as a means to effectively inform the user of any possible issues via the Vehicle's CAN network. The Dual Alternator Load Balancer is the only plug-and-play currently available, and gives even the most novice user the ability to improve their dual alternator system's efficiency.

Impact Solutions

Project Participants
Dwayne Thomas & Iain Drews

Instructor
Brandon Blackstone

Faculty Advisor
Evangelos Yfantis

Community Advisor
Russell Meurer

Problem Identified

A professional football player will receive an estimated 900 to 1500 blows to the head during a season. In most situations the player is used as the only gauge for the magnitude of impact. This means many potentially life threatening concussions go unreported each year.

Current Solutions

Head Impact Telemetry System (HITS) was developed in 2002 and can measure an impact and stores the data so the individual may download it later. A HITS helmet can be bought online today for 1030.99.

Teams Solution

Impact Solutions aims to improve upon the hits system in two ways. First it is substantially more economical. While anything can happen in production it is unlikely that Impact Solutions will be even one fourth as expensive as HITS. Second it creates an immediate response to a hit in the form of an LED. This LED will flash when the impact magnitude is greater than a preset threshold. Each player can set this threshold prior to the game based on what he or she is comfortable with. This way players and teams have an immediate and objective way to assess the magnitude of a hit.

Mobile Autonomous Surveillance System

Project Participants
Nicholas Moya & Justin Le

Instructor
Brandon Blackstone

Faculty Advisors
Pushkin Kachroo & Emma Regentova

Problem Identified

Current surveillance systems consist mainly of an array of cameras placed strategically throughout a facility. An increase in the coverage of the system requires a proportional increase in the number of sensors, and as a result, this approach is limited by the cost of manufacturing, installing, and maintaining multiple devices. The cost also increases proportionally with robustness, as it requires the use of additional sensors (FLIR, audio, etc.) with each device.

Current Solutions

The most popular solutions for mobile, autonomous surveillance with support for real-time communication between devices include systems that are either too costly (Turtlebot, Knightscope), stationary (Nest), requires construction and maintenance (Turtlebot, Raspberry Pi-based projects), or does not include high-level detection and tracking of objects (Appbot). The Turtlebot and Raspberry Pi-based projects are not pre-built, making them difficult to use and maintain. The Nest camera is stationary and requires multiple instances to achieve wide surveillance coverage. The Appbot is not autonomous, making it inconvenient to use, and the Knightscope machine, although autonomous, has a monthly cost of $4500, making it not sustainable on smaller budgets.

Teams Solution

To achieve the same coverage and robustness as an array of surveillance devices, we propose an autonomous device that travels by land and performs high-level recognition of objects, signaling a detection to a network that can be accessed by an Internet-connected device, such as a mobile phone or laptop. Our system has the advantage of achieving wide coverage with a single cost-efficient system, as well as ease-of-use and durability. Surveillance teams that currently employ multiple cameras in a facility such as an office building will benefit from using our system.

Surveillance is accomplished by operating the device in one of the three modes: scan, patrol, and follow. In Scan Mode, the system is stationary and pans the sensors in search of anomalies in the environment. When a match is found in the environment, it enters Follow Mode and transmits a warning signal to the network. In Follow Mode, the device adjusts its position and location to center the detected object in its viewing window and records optical footage, while a proximity sensor and optical camera paired with object detection software allow the device to avoid collision. In Patrol Mode, the device follows a path that is either specified or automatically determined by mapping the environment, changing path at regular intervals, and stopping periodically to scan for anomalies.

PH Level and Temperature Monitoring Device for Pools

Project Participants
Gerardo Gomez Martinez & Emmanuel Sanchez

Instructor
Brandon Blackstone

Faculty Advisor
Jacob Baker

Problem Identified

Optimal levels of pH in swimming pools are desired in order to prevent eye and skin irritation, water cloudiness, poor chlorine disinfection, damage to the pool liner, and lime precipitation. In cities with hot climate, such as Las Vegas, pools are very common and a product like this may appeal to many because of its convenience.

Current Solutions

Currently, pH tests need to be done manually by having someone go over to the pool and performing the measurements themselves. Measuring the pH level of the pool is useful for estimating the effectiveness of chlorine, but doing it manually requires additional interpretation of data, which makes the testing process slightly more complicated and inaccurate.

Teams Solution

Our project will consist of a floating device that will measure the pH levels in a pool to ensure good chlorine disinfection. This device will offer the convenience of performing those tests automatically and alerting the pool owner when the pH level is in a bad state. This way, no action is required from the user unless the levels are not within range. If the pH levels appear to be out of the recommended range, the device will send a text message to the user, informing them that pool maintenance is required. Furthermore, the device will eliminate the need for battery replacement by making use of a solar panel to charge an internal battery.

PLAN-iT

Project Participants
Alfred Dichitang, Kaitlin Hoffman & Leanna Guevara

Instructor
Brandon Blackstone

Faculty Advisor
Brendan Morris

Problem Identified
With much of the West Coast in a drought, it is become of great importance to be conscious of our water usage. The government approaches the issue by focusing on the big areas of water consumption such as agriculture. For many people, the only time they see how much water they use is at the end of the month when they open their water bill. During everyday tasks such as washing our hands or taking a shower we let the water run even when it's not needed.

Current Solutions
Today, there are multiple products that are designed to measure and display water usage as well as promote conservation such as the Driblet, Amphiro A1, FLUID, Waterpebble, and MyWater. However, most of these devices are still in development and are not currently available for consumers to purchase. Some of these products do not quantitatively measure the amount of water used or are expensive ranging in price from $100 to $300.

Teams Solution
Our product will benefit those who want to be conscious about their water usage going forward. While most solutions provide a single connection that updates an app, our product will network multiple devices together. Our project includes two different options on how we will track water consumption. The first will be a battery powered device that can be screwed to a faucet while the other is connected to the water pipes under the sink. Consumers will be able to monitor their water usage from however many sources, such as the kitchen sink, and the guest bathroom shower, in real-time and in an easy to read display. By

having the viewing device it makes everyone constantly aware of how individual usage affects the overall household. The device allows the owners to constantly compete with themselves and everyone around them to encourage water conservation. Through continuous water monitoring, consumers will not only be able to conserve water, but save money in the process.

Pulsed Radiation Measurement and Feedback Control System

Project Participant
Nathan Hanson

Instructor
Brandon Blackstone

Faculty Advisor
Yingtao Jiang

Community Advisors
Ignacio Aguilar, John Turner,
Lawrence Miller & John Stammetti

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.

Teams 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 pulses to an RF system. The feedback control project measures X-ray radiation on a pulse-to-pulse basis and controls a variety of input parameters to compensate, in real time, for fluctuations of dose due to heating. The heart of this system is an FPGA controller, which allows for production and control of gating the pulses as well as the duration and duty cycle of them. This servoing of the X-ray system will allow universal, stable, flat radiation over time scanning without costly warm-up delays custom software.

Signal QA Tool

Project Participants
Tim Larsen

Instructor
Brandon Blackstone

Faculty Advisor
Robert Schill

Community Advisor
Jon Daniels

Problem Identified
One of the biggest issues with automating UASs (Unmanned Aircraft Systems) is control link failures, which could cause the UAS to become unresponsive to controller communications, and another is incorrect commands being sent to the UAS from the automated controller. Either of these issues could cause the UAS to damage itself, other property, or be harmful to human workers in the area, so when either of these issues occur, the UAS and its corresponding controller need to be located and taken offline for maintenance until the issue is resolved to keep the workers safe and out of harm's way.

Current Solutions
Similar solution: Airbus has made a similar system that is used to locate drones by utilizing active radars, infrared cameras, and direction finders, but is very costly. (Atherton, Kelsey, Popular Science 2016)

Teams Solution
The objective of this project is to create a fleet management system that can passively detect Unmanned Aircraft Systems (UASs) and their corresponding transceiver(s) to be able to verify the use of flights/locations for warehouse management and delivery and the primary purpose is to enable UAS traffic management within a local area distribution center. The key performance quality of this system is that it does not rely on any external equipment or modifications for the UAS beyond the existing controller system. This could allow for a warehouse technician to detect/measure/track the correct UAS/controller and determine if there are any unwanted or unnecessary signals in the warehouse or distribution center.

Smart Boot

Project Participants
Steven Leung, Saied Samara & Shada Sharif

Instructor
Brandon Blackstone

Faculty Advisor
Jacob Baker

Technical Advisor
Paolo Ginobbi

Problem Identified
A majority of patients who injure their ankle and use orthopedic boots experience difficulty in adjusting the pressure of the boot. Having an incorrect pressure on the ankle can lead to problems for the patient such as compartment syndrome, blood clots, etc. Additionally, when a patient finds a comfortable pressure level, it may be difficult to adjust the boot to the same level when wearing it the next time, especially for elderly or young patients.

Current Solutions
The different types of orthopedic boots in the market consist of boots with no air bladders or those with adjustable or fixed bladders. When using an adjustable bladder boot there is no set pressure level that the doctor advises for the patient, patients are advised to inflate or deflate the air bladder to a pressure level that they find comfortable. Overall, there is not current solution to allow for patients to see exactly what pressure the boot is inflated to and keep a record of this.

Teams Solution
We have developed a device that is capable of keeping track of the pressure of the bladders inside the boot and while using a friendly user interface to relay this information to the user. This device is also capable of keeping track of the number of steps a patient takes per day with and without crutches. Everything that the boot is capable of keeping track of will be logged and stored in memory such that it can be monitored by the patient or their doctor. Some of the benefits of this device includes allowing for the patient to know the pressure level that they found to be comfortable to allow for the bladders to be inflated to the same exact level the next time and allow for the patient to keep track of the exact number of steps they have taken throughout the day to meet the physical activity level as prescribed by their doctor. In addition, this device will allow for caretakers to assist the elderly and children in putting on the boot and ensuring that the boot is inflated to a comfortable and safe level. This device will help patients avoid the dangerous side effects that come from accidentally over-inflating the bladders and optimize the recovery process.

Stereo Sound Extractor

Project Participants
Jimmy Manone

Instructor
Brandon Blackstone

Faculty Advisor
Venkatesan Muthukumar

Problem Identified

Imagine a crowded room with many conversations being carried on at once and being able to focus in and listen to any one of those conversations all by itself with a simple turn of a dial. Now imagine being able to do this with music recordings (to hear musical instruments in isolation) or fine-tuning a pair of stereo microphones in real time for surveillance or live sound reinforcement. That is essentially what Stereo Sound Extractor is designed to do. The Stereo Sound Extractor is capable of all these tasks and more, is fully portable, and operates in real time.

Current Solutions

Current solutions are complicated, requiring knowledge of various computing platforms and audio signal processing and lack the flexibility found in the Stereo Sound Extractor. For example, a company called Audionamix offers a commercial service where the user can send them sound files, a team of technicians perform audio separation tasks, and the company sends back the isolated tracks to the user. Solutions such as these are costly, inefficient and do not guarantee the types of isolation the user desires. Other solutions are based on computing platforms such as MATLAB, Python, etc., and require a computer, an extensive knowledge of programming, dealing with complex libraries, and costly licensing fees (e.g. in the case of MATLAB), and do not operate in real time.

Team Solution

The solution is simple: Plug in a phone's headphone jack, computer, CD player, or a set of microphones and turn the dials to pick which portion of the sound you want to hear - all with a small device that can be taken anywhere. Unlike currently offered methods, the format of the signal is not important (e.g. whether it be in wav or mp3 formats), nor does it matter whether the signal consists of speech, music, noise, ambient sounds, or any combination thereof. A computer is also not required, nor is there a need for any complex setup of libraries. Furthermore, unlike applications that can only process audio offline, this solution offers real time processing and real time control so the user can choose the sound to be isolated, and fine tune the output for the highest quality – all using two simple controls (position and width) while they are listening. Many industries rely on sound processing, yet dedicated solutions designed to isolate portions of an audio signal are out of reach for the average user. This is due to current solutions being inefficient, complex, expensive, and of varying audio quality at best. DJs, law enforcement, scientists, researchers, musicians, designers of robotic devices, military personnel, and others will benefit from this simple audio solution which will enable them to use isolated portions of audio signals in ways never dreamed of before.

DEPARTMENT OF ENTERTAINMENT ENGINEERING & DESIGN PROJECTS

Department Chair
Dr. Rama Venkat
Dr. Joe Aldridge

Senior Design Instructor
Dr. Si Jung Kim

Frequent-Z's

Project Participants
Michelle Albert, Katlyn Cunningham, Terazia Frierson
Jadin Tredup & Jerra Strong

Instructor
Si Jung Kim

Faculty Advisor
Joe Aldridge

Problem Identified
People suffer from insomnia due to a myriad of reasons. In particular, those diagnosed with Autism Spectrum Disorders (ASD) can experience trouble sleeping and feelings of restlessness. There are few mobile, non-medical resources available to help with these issues. These devices are often expensive and cumbersome for the average consumer.

Current Solutions
Currently, solutions for insomnia and restlessness vary between expensive daily/nightly medication to expensive non-portable mattresses and pillows. Devices that are used to create vibrations which have been found to help with this are usually very bulky and have very few settings to customize towards the client's desires. Sound machines that sometimes are used to help with insomnia can disturb partners and others sleeping in the same room.

Teams Solution
Frequent-Z's is a vibroacoustic mattress pad that can vibrate at low frequencies. Sound is used to create vibrations that can have a calming effect for the user. Consumers are able to select music or a pre-programmed pattern and customize the frequency and intensity to suit their unique needs. The design is made to be affordable, compact, and mobile when compared to current products. With the help of Frequent-Z's, those suffering from insomnia and anxiety will potentially be able to achieve a full night's rest at home or abroad.

DEPARTMENT OF MECHANICAL ENGINEERING PROJECTS

Department Chair
Dr. Brendan O'Toole

Senior Design Instructor
Dr. Zhiyong Wang

Apollo: Automated Heliodon

Project Participants
David Johnson, Valerie Lawdensky & Allan Tan

Instructor
Zhiyong Wang

Faculty Advisor
David James

Technical Advisor
Terry Kell

Problem Identified

With the resurgence of passive solar design for buildings and other applications comes the need for an efficient and intuitive way to model the sun's effects on the shadows of scale models. Traditional manually-operated solar modelers, or heliodons, are often unwieldy and offer low resolution; while computer software is often difficult to operate or slow to implement. Only by combining the best aspects of these alternatives can a superior heliodon be designed.

Current Solutions

Dozens of heliodons are currently in use around the world, but most of these are one-off constructions built for universities and architectural design studios. A few are available as commercial products, and of these, only a handful are automated in any way. Commercial heliodons are priced in the tens of thousands and typically take up large footprints, meaning purchasers need to make a significant investment in order to acquire one.

Teams Solution

Apollo is a fixed-model, mobile light-source heliodon that can be adjusted to emulate the apparent position of the sun as seen from anywhere on earth. The user inputs a time of day, a time of year, and a latitude and Apollo uses a series of stepper motors to precisely position an LED light source that shines down upon a fixed scale model. By automating the heliodon, many parts needed for manual adjustment were able to be eliminated, thus reducing the size, weight, and complexity of the structure. Apollo was built using low-cost electronics and structural materials and is projected to cost less than a third of popular commercial heliodons. The Apollo is more portable, lightweight, accurate and more affordable than competing products while offering the potential for data-logging and programming. It is our hope that Apollo can serve as an affordable, powerful learning tool and design aid for use by organizations that may otherwise not be able to invest in competing alternatives.

Automated Solar Still

Project Participants
Ibrahim Abdullah, Tristan Dmitrijev, Daniel Henry,
Lawrence Martinez & Francisco Reynoso

Instructor
Zhiyong Wang

Faculty & Technical Advisor
David James

Problem Identified

Availability of fresh consumable water is the most important aspect of people's lives and makes or breaks the development of an economy of a household, village, or even country. A lack of fresh water mainly leads to difficulty in managing public health and maintaining agricultural quality, which severely impedes the growth of many developing countries. Coupled with poorly maintained or nonexistent infrastructure, many fresh water sources around the world have been contaminated by human pollution (i.e. Garbage, chemical waste, etc.) to the point of which the water is unsafe to use. In developed countries, a lack of clean fresh water translates into higher water prices and in severe cases, water shortages and shutoffs.

Current Solutions

Many rural areas, farms, and even outdoorsmen have resorted to locally treating water. One of the most common and simplistic ways to get fresh water is through distillation using the power of the sun. Modern solar box stills contain contaminated water which evaporates and flows down into a collection trough. Current stills require heavy maintenance and suffer from inefficiency that renders them useless.

Teams Solution

The automated solar still relieves users of complicated assembly, heavy maintenance, low efficiency and tedious upkeep by delivering a still with attachable legs and a system of electronically controlled valves that fill and clean the still. Made out of a fiberglass shell with foam insulation, the still is lighter than a traditional wood still. The resin used in the fiberglass is food grade, removing the need to routinely coat the still in food grade paint or Teflon. To have the still fill, drain, and cleaning valves open and close at desired times, a Raspberry Pi board controls the valves in synchronization with values given by water level sensors and time libraries. Important information that can be used for both research and maintenance purposes will be streamed to a remote location so that a user does not have to go to the still, which at often times is in an inconvenient place to access (the roof of TBE-B in the case of the prototype).The market of users this product would attract are those who do not have access to clean water, and would benefit them by reducing the time it takes to maintain a still from multiple hours per week to 10-20 minutes.

Bike Maintenance Lift

Project Participants
Ian Horak & Berhane Haile

Instructor
Zhiyong Wang

Faculty Advisor
Brendan O'Toole

Technical Advisor
Terry Kell

Problem Identified

The bike maintenance lift has the ability to provide a secure and stable mount to hold a bike for the purpose of repair and maintenance for those who have limited workspace (such as a small garage or bike shop) by eliminating the need for a workbench or stand with a large footprint. It will also provide the ability to store a bike near the ceiling to allow for improved floor space.

Current Solutions

Currently, many models of repair stands exist. On a professional repair shop level, large and very costly models exist with limited or no vertical freedom. Small, inexpensive repair stands lack stability and thus put users at an increased risk. Many storage options exist; however, none are designed to support a bike for maintenance and repair. Many storage options require mounting a device to the ceiling, which is both dangerous and challenging for those without experience.

Teams Solution

We are developing a bike maintenance lift that will integrate the need of providing a safe and secure device that will allow bike maintenance as well as storage which will be ideal for those with limited workspace. The bike maintenance lift will provide the safety and stability of high priced professional stands and reduce large space and cost requirements. The stand will also allow storage of a bike in unused ceiling space. The functionality of our product will benefit anyone from the average cycling enthusiast that enjoys the satisfaction of performing their own repair and maintenance to the experienced and professional bike repair shops.

Hailey's Hand v2.0

Project Participants
Michelle Lopez, Jacob Mauro & Cameron Rollins

Instructor
Zhiyong Wang

Faculty Advisor
Brendan O'Toole

Problem Identified

Prosthetic hands vary greatly in price depending on functionality. For example, a purely cosmetic prosthesis can cost less than $5,000, while a fully functional myoelectric arm can cost anywhere from $20,000-$100,000. It can become very expensive to replace prosthetics as the patient grows.

Current Solutions

Since 3D printing technology became main stream, the printing of prosthetics has created a huge relief to families who cannot afford high-end medical devices. One of the open-source designs available for 3D printing is the Flexy-Hand 2. It uses wrist flexion to tighten fishing wire threaded through plastic fingers to create a closed grip. This can cause pain and cramping, especially if the user is a child.

Teams Solution

We are taking the open source Flexy Hand and making modifications to increase functionality and user comfort. Currently, 3-D printed prosthetic hands are not usually motorized and have limited usability. Using two servo motors, an Arduino board, and a button actuator, the improved hand will allow the user to create a closed (power) grip and a three-finger pinch grip without losing functionality of their other hand. By using a 3D printer, we are greatly cutting costs and increasing accessibility to those who would greatly benefit from cheaper alternatives. Because 3D printing is so cost effective, users will be able to upgrade to a larger sized prosthetic without having to worry about cost.

Low Cost Water Jet Cutter

Project Participants
Matthew Boswell & Brian Kist

Instructor
Zhiyong Wang

Faculty Advisor
Darrell Pepper

Problem Identified

Currently, there are no reasonable solutions for low cost water jet cutters. "Affordable" machines in the market currently cost upwards of $60,000. In addition, these machines take up significant floorspace, and are inaccessible to the average consumer.

Current Solutions

One solution could be to pay by the hour to use a waterjet that was purchased by a larger company. Another solution is to use a similar machining tool, however the benefits of water jet cutting such as cold cutting, omni-directional cutting, and having no need for post processing in many cases is lost. Similar machining tools are also similar in price, and can be very expensive as well, which would still create a barrier of entry.

Teams Solution

Our solution is to reduce the size and cost of the waterjet by having the first stage be a pressure washer that would be purchased at a home improvement store. The pressure washer will be connected to the second stage, which will increase the pressure at a 10 to 1 ratio. With this setup, we aim to be able to cut decently thick materials, but without the cost of an expensive machine. In future iterations, CNC could be added quite easily, which would further increase the machines utility. This project would benefit home users, small commercial shops, and starting businesses that want the benefits of a waterjet, but cannot afford an industrial grade machine.

PEG-Tube

Project Participants
Amy Shigeta, Michael Goodwin,
Joseph Baggs & Benjamin Hensel

Instructor
Zhiyong Wang

**Technical Advisor**
Samir Moujaes

Problem Identified
The percutaneous endoscopic gastronomy tube is the first tube placed into patients who have difficulty swallowing food. After being surgically placed into a patient the only method of removal is to physically pull the tube out. The head of the tube is roughly 17 millimeters in diameter and the tract the head has to be pulled through is 6 millimeters. The removal of the tube causes extreme discomfort, our group is designing a removal device to alleviate the pain.

Current Solutions
Physically pulling the tube out is currently the only removal method. There are other PEG-tubes that can be put into a patient but that is only after the original tube is removed. Those tubes feature heads that can be filled with a saline solution to expand making insertion and removal less painful.

Teams Solution
The team has two designs: wire ribs and plate ribs. The wire ribs will be inserted into the patient and collapse the tube on the inside allowing for a smaller area when removed. The plate ribs also function in a similar manner. The current solution for removing this type of PEG-tube is simply pulling it out of the patient and our designs will allow doctors to reduce the area of the tube before having to remove. The main benefactor of this product will be all percutaneous endoscopic gastrostomy patients and doctors.
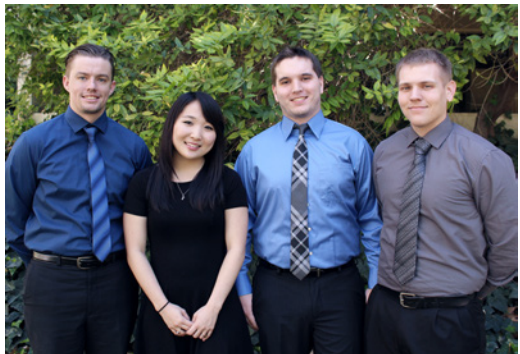
Plastic Microparticle Filtration System

Project Participants
Erika Adams, Richard Howard
Cameron Slade & Prince Oroke

Instructor
Zhiyong Wang

Faculty Advisor
David James

Problem Identified

Currently, no known commercially available mechanical solution exists that efficiently filters plastic microbeads from treated wastewater. These beads enter our natural waterways, pollute the environment, and harm wildlife. There exists the potential for a hazard to humans if plants or animals from contaminated waterways are consumed, as powerful toxins and other harmful substances can accumulate on the surface of the beads.

Current Solutions

The most effective possible solution is the outright ban of the production and usage of plastic microbeads in consumer products. Legislation does exist, but has limitations. The most common engineering solution is gravity bed filtration, which is inefficient and requires a large footprint at wastewater treatment facilities.

Teams Solution

Our solution is a smaller, more efficient way of filtering out plastic microparticles from treated wastewater. Existing systems are far too large and inefficient to adequately filter out these contaminants from all wastewater, resulting in most wastewater facilities simply ignoring the problem. Known deployed gravity filtration systems only filter a small fraction of total wastewater. Our system requires a much smaller footprint and will not require the use of extra pumping facilities to filter the water, ensuring clean water for future use while minimizing cost to wastewater treatment facilities. The system is also flexible and can be applied as a "pre filter" for water purification purposes, such as desalination plants, to remove existing plastic microparticles from untreated water. The fauna and flora of local waterways, and by extension humans, will benefit from the elimination of these particles from the environment.

Row Cycle

Project Participants
David Hale, Trevor Mangelson & Jonathan Ruvalcaba

Instructor
Zhiyong Wang

Faculty Advisor
Mohamed Trabia

Problem Identified
Upper extremity cycling isn't new; however, the current solutions are expensive, not ergonomic, and do not maximize performance.

Current Solutions
The current solutions are hand cycles or other forms of upper extremity cycling, such as rowing bikes, and do not allow for paraplegic riders to use the cycle by themselves. Hand cycles take a typical bicycle crank and place it in front of the rider allowing the rider to use arm power to propel the cycle forward and steer.

Teams Solution
The Row Cycle removes the bulky mechanism in front of the rider and moves it behind the rider, while still allowing for upper extremity input. The rider must be able to lean in order to steer, but the design allows for greater accessibility to the rider. The Row Cycle extends two levers on either side of the rider, which act as inputs and increase torque, and thus, increases ergonomics and overall efficiency of the rider's efforts. The rider uses a "bench press" motion to propel the cycle forward.
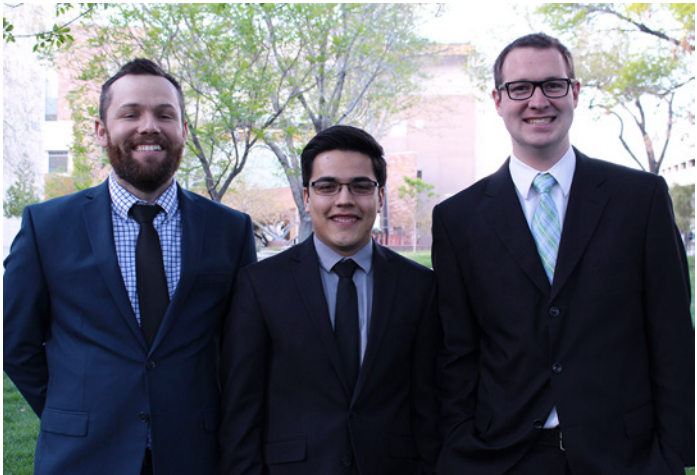
Safety Sensor System

Project Participants
Fania Mendez, Danielle Flowers & Linda Ndenga

Instructor
Zhiyong Wang

Faculty Advisor
Alexander Barzilov

Problem Identified
On a day when the outside temperature is 72 degrees Fahrenheit, the temperature inside a car can increase by 40 degrees in an hour. The temperature increases by 70% within the first 30 minutes! Infants, young children and pets have the highest risk of being forgotten inside of a vehicle. This is a preventable tragedy that kills on average 38 children and hundreds of pets a year according to the National Safety Council.

Current Solutions
Currently, several safety sensor systems exist in the market. Unfortunately, most have a history of failure and are very expensive. Examples include; the Evenflo car seat which uses a battery operated receiver embedded in the chest strap clip, the Starfish car seat weight- activated sensor and the TOMY international car seat that uses several sensors that send alerts to a smartphone.

Teams Solution
The Safety Sensor System is made up of two sensors that work in conjunction in order to prevent failures. A motion sensor will detect motion inside a vehicle and a CO_2 sensor will verify the presence of a live subject. The sensors will communicate wirelessly using Xbee radios and alert the driver that a child or pet has been forgotten in the vehicle. The driver will be alerted by a small buzzer attached to the car keys which receives a wireless signal from the sensors through Xbee radio. The Safety Sensor System has the advantage of not being localized to a particular section of the car and therefore preventing most common failures found in currently available systems. The system will benefit parents and guardians of children as well as animal lovers all over the world.

The Assist

Project Participants
Conner McCubbin & Kyle Hemenway

Instructor
Zhiyong Wang

Faculty Advisor
Georg Mauer

Technical Advisors
Jeff Markle & Terry Kell

Problem Identified
There has always been a need to make shooting a basketball easier to practice. Simply shooting from different places on the court and rebounding the ball wherever it may bounce is just inefficient for basketball players of all levels. The point of practice is to simulate game-like situations repeatedly in order to best prepare for the moments that count during actual basketball games. Spinning the ball back to yourself to simulate a pass or dribbling into every jump shot fails to adequately prepare basketball players.

Current Solutions
Basketball passing and rebounding machines are currently in use at every professional basketball organization, most collegiate universities and a handful of fortunate secondary schools. The machines on the market are expensive and tailored to top flights athletes. A catapult fires the passes from the machine to the player. The current design maximizes repetition for the shooter and rebounds the ball as well. While the rebounding function is what makes the machine great, the pass subsequently only ever comes from under the hoop.

Team Solution
The Assist is built to pass from every spot that the current model cannot, moving easily around the half court. The new machine will be able to hold three balls for efficient practice, staggering the passes by a few seconds. The new design will feature a battery-powered motor, eliminating cords and maximizing the amount of different passing points. The launching mechanism will look new to the basketball market, but stems from similar designs used in baseball and tennis guns. The two rotating wheels will allow the new machine to fire harder passes to the shooter, simulating a more game-like scenario. The new design will also be more affordable than the current market product, enabling families, recreation centers and junior high schools to make practice a little easier.

Therapeutic Inclining Bed

Project Participants
Jordan Bullock, Andy Madrid & Carlos Ulloa

Instructor
Zhiyong Wang

Faculty Advisor
Samir Moujaes

Problem Identified

Twenty percent of the population suffers from acid reflux disease. Most have a hard time sleeping at night because the symptoms worsen when the patients lie down in a regular bed. This is because the acid can more easily enter, irritate and burn the person's esophagus. Doctors recommend that patients lift the head of the bed approximately seven inches in order to alleviate the symptoms.

Current Solutions

The current solutions available are either low-cost or high-cost. The low-cost solutions are flimsy, require heavy lifting, and are not adjustable, so the bed has to be inclined all the time. The high-cost solutions are expensive, heavy, and often elevate only the upper part of the mattress, forcing the patient to sleep on their back to the exclusion of other sleeping positions.

Teams Solution

Our solution is mid-priced, but offers the advantages of both the low-cost and high-cost solutions. Unlike the high cost options, ours is light and can be fitted to existing bedframes. It elevates the whole box-spring and mattress, placing the head of the bed seven inches higher than the foot. The main feature that differentiates our design from competitors is that the user can sleep in any position they choose, including their side or face-down. Our design can easily be adjusted to three different heights by remote control, so it can be raised and lowered at will. It can look like a normal bed during the day and be elevated at night. It is much lighter and about half the cost of the cheapest high-cost units. Our market research shows that over 2.3 million people a year can benefit from our solution to this ongoing problem.

INTERDISCIPLINARY PROJECTS

Air Particulate P.O.D. v2

Project Participants
Eduardo Hoyuela-Alcaraz & Jason Sikorski

Instructors
Zhiyong Wang & Brandon Blackstone

Faculty Advisor
David James

Community Advisor
Dronesmith Technologies

Problem Identified

There are several agencies in the United States that monitor air quality to prevent deterioration and contamination of our nation's air. To accomplish this, constant sampling and evaluation are conducted to maintain an accurate database and monitor pollutants. These pollutants can cause health problems, harm the environment and cause property damage. In addition to air pollutants, in certain confined spaces there is a high risk of exposure to deathly gases.

Current Solutions

Currently, monitoring of air pollutants is mainly done by an established network of air monitoring stations. The infrastructure of such stations is costly, non-mobile and permanent. Monitoring of gases is usually performed by using a handheld device.

Teams Solution

We are proposing the development of a mobile aerial platform for air quality monitoring using a small unmanned aerial vehicle (UAV) paired with a low cost air particulate sensor and gas sensors. This will be a low cost robotics solution that can eliminate multiple high cost monitoring stations. It can be used even in extremely hazardous environments where a human cannot enter or access. The sensor module is designed to be a Plug and Operate Device (P.O.D.).

H2DrOne

Project Participants
Corwin C. Grigg, Jonathan DeBoy,
Jeremy Letkiewicz & Jeremy Nelson

Instructors
Zhiyong Wang & Brandon Blackstone

Faculty & Technical Advisors
Darryl Pepper & Venkatesan Muthukumar

Community Advisor
Richard Williams

Problem Identified
Currently, there is no drone development platform commercially available that is capable of transitioning between aerial and underwater travel while retaining the ability to takeoff again after reemergence from underwater travel.

Current Solutions
Boeing currently has an active patent detailing a drone that lands on water and ejects wings used for flight before submerging so as to reduce underwater drag, effectively removing its flight capabilities. It is also possible to waterproof motors before submerging a drone to achieve a state of 'underwater flight' with minimal control and high power requirements.

Teams Solution
Our design outperforms existing drone development platforms by granting the user with the ability to traverse both air and water using wireless control with a constant video feed. Our ballast system allows for better depth control while underwater compared to water-tight-only drones. Unlike other existing solutions, our drone can take-off again after reemerging from the water. This is accomplished at nearly a third of the cost of some current developmental drone platforms on the market.

Competition Notes

Competition Notes

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