UCONN | SCHOOL OF ENGINEERING

# SENIOR DESIGN DEMONSTRATION DAY

seniordesignday.engr.uconn.edu

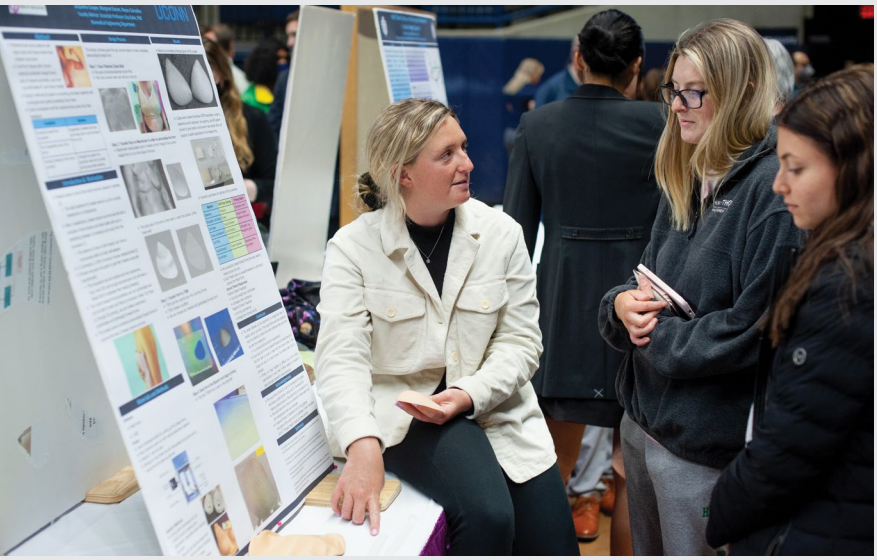
## ECONOMIC IMPACT STARTS HERE.

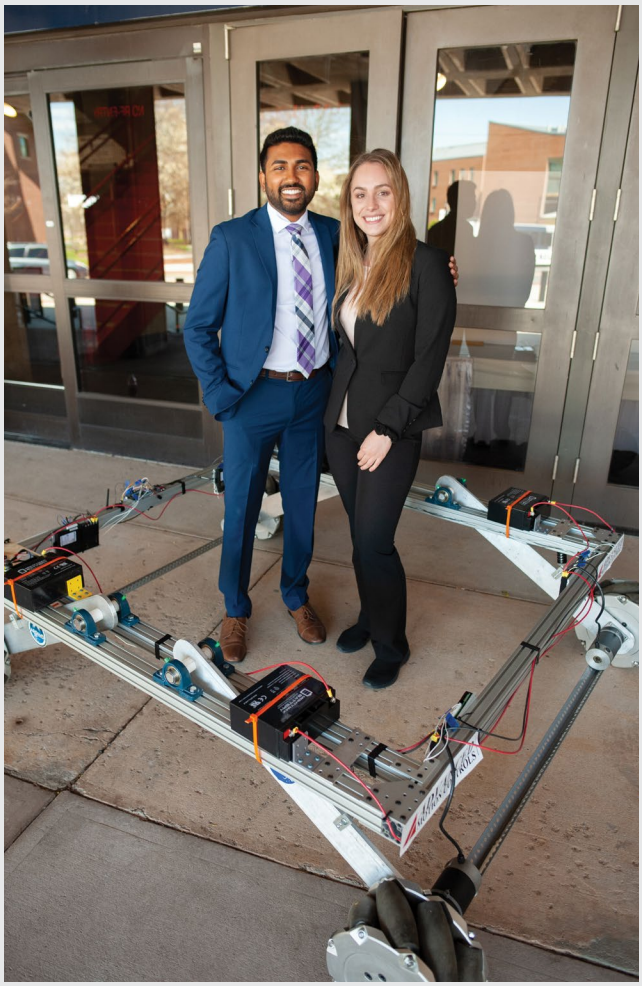
HARRY A. GAMPEL PAVILION STORRS, CONNECTICUT APRIL 28, 2023

2023 CONTENTS

# SENIOR DESIGN DEMONSTRATION DAY







**A MESSAGE FROM THE DEAN**
KAZEM KAZEROUNIAN

# ECONOMIC IMPACT STARTS HERE.

The School of Engineering's Senior Design is the final phase in our students' undergraduate studies, but also the culmination of four years of diligent studies. Senior Design involves two courses spread over a year and provides a hands-on, independent application of the principles and theories students learned at the University of Connecticut. Students learn design procedures while engineering solutions for societal, environmental, economic and ethical issues in our world. By learning the language of business and industry, students create new solutions to big-picture problems and needs like clean energy, 21st century computing, additive manufacturing and more.

This work would not be possible without the support of 75+ organizations that partner with the School of Engineering to fund projects, but also donate valuable time as mentors and advisers. The school and the university have a direct connection to innovative and impactful organizations throughout the state and country. By fostering those relationships, seniors get direct access to high-level engineers in the industry while launching significant economic impacts for the companies and the state of Connecticut at large. In combining industry sponsors, advisers and fellow classmates, students work in a group setting, solidifying collaborative skills that will serve them for years to come.

This next generation of engineers will graduate very soon, stepping off into the next stage of their lives, regardless of their path into industry or graduate school. We applaud our seniors for completing this capstone, for proving to the state of Connecticut, the world, and themselves, their ingenuity as scholars and their persistence as engineers.

**"We applaud our seniors for completing this capstone, for proving to the state of Connecticut, the world, and themselves, their ingenuity as scholars and their persistence as engineers."**

Kazem Kazerounian

BIOMEDICAL ENGINEERING TEAMS 16 & 17

# MULTIMODAL METHODOLOGY TO EVALUATE PATIENT STRESS DURING MAMMOGRAPHY SYSTEM COMPRESSION PROCEDURES


**TEAM 16 MEMBERS** HALEY DONOVAN, ALICIA SLEIGHT, ADITYA PANT, EMILY SCHILLINGER
**TEAM 17 MEMBERS** MANU KOMMA, MARLA FAIS, ANDREA MECHERY
**INDUSTRY SPONSOR** HOLOGIC INC.
**FACULTY MENTOR** KRYSTYNA GIELO-PERCZAK


UConn's Human-User Interaction Lab, created and maintained by Professor Krystyna Gielo-Perczak, brings together industrial partners and senior design students to address real world needs. Currently, two biomedical engineering teams are working with Hologic Inc. to study patient stress during mammography compression using two different paddle designs. For the study, Massachusetts-based Hologic Inc. generously donated a 3Dimensions™ Mammography system with the SmartCurve™ breast stabilization paddle.

Since early detection is imperative to proper treatment and improved prognosis of cancer patients, regular mammograms are recommended for women. However, the stress and discomfort associated with the procedure are known to deter many women from routine screening[1,2,3,4]. The purpose of this research is to quantitatively and qualitatively measure the stress and discomfort experienced by biological females during a mammogram.

Next generation biomedical researchers (UConn students) apply state-of-the-art technologies (to measure ECG, EMG, Galvanic skin responses and body balance) and participant surveys to gather a broad base of data. By investigating data parameters such as age, breast density, anthropometry, physiological and psychological stress, the study will identify those factors which may influence the stresses experienced by certain groups during mammograms.

Results will provide a more holistic understanding of the stresses and discomforts women experience during mammograms so that appropriate improvements can be implemented in the equipment design and screening procedures.

Ultimately, this study intends to advance ongoing research and clinical efforts to make mammograms more comfortable and less stressful for the patient, which could potentially improve early cancer detection outcomes.

**1 in 8**
**WOMEN HAVE A CHANCE OF BEING DIAGNOSED WITH BREAST CANCER**

**264,000**
**BREAST CANCER DIAGNOSES IN THE UNITED STATES EACH YEAR**

**> 40**
**WOMEN OVER 40 ARE RECOMMENDED TO UNDERGO MAMMOGRAPHY SCREENINGS**




1. Andrews, F.J., *Pain during mammography: Implications for breast screening programmes.* Australasian Radiology, 2001. **45**(2): p. 113-117.
2. Brédart, A., et al., *Anxiety and specific distress in women at intermediate and high risk of breast cancer before and after surveillance by magnetic resonance imaging and mammography versus standard mammography.* Psycho-Oncology, 2012. **21**(11): p. 1185-1194.
3. Fayanju OM, Kraenzle S, Drake BF, Oka M, Goodman MS. *Perceived barriers to mammography among underserved women in a Breast Health Center Outreach Program.* Am J Surg. 2014 Sep; **208**(3):425-34.
4. Fochler, S., et al., *Reasons for Non-Attendance in the German National Mammography Screening Program: Which Barriers Can Be Overcome Using Telephone Counseling?—A Randomized Controlled Trial.* Healthcare, 2022. **11**(1): p. 17.


**Click on the QR code for more Biomedical Engineering Senior Design Projects!**

CHEMICAL AND BIOMOLECULAR ENGINEERING TEAM 04

# ENGINEERING FOR EFFICIENCY: A REDESIGN OF BYK USA'S RAW MATERIAL PUMPING SYSTEMS


**TEAM MEMBERS** MARK CAIAFA, TREY MASTRIANI, JONATHAN SYNOTT, NICK BENVENUTO
**INDUSTRY SPONSOR** BYK USA, INC.
**FACULTY MENTOR** BURCU BEYKAL


BYK is a leading global supplier of specialty chemicals that produces 150 different additives at their regional headquarters in Wallingford, Connecticut. Starting from over 350 different raw materials, the plant provides products used across a wide variety of industrial applications including paints, plastics, pharmaceuticals, food, and lumber. In recent years, BYK USA has experienced a massive soar in demand and is running 133 percent above their present process throughput specifications. While they are undergoing a plant expansion, their current operating pumps and piping systems are not optimized for their latest recipes which has created production bottlenecks. The company was looking for solutions to ease the flow of product throughout their factories safely.

The team redesigned the raw material transfer pumps to realize process throughput gain opportunities. By applying chemical engineering fundamentals, the students analyzed the design basis of the existing pumps and upsized accordingly to optimize material transfer times from the outdoor storage tanks to unit operations in the plant. Additionally, they calculated the net present value of the newly designed pumps to prove their economic viability and determine their total added value. Factored in the design are important environmental and safety considerations limiting pump size such as maximizing energy efficiency and preventing runaway reactions. The team's final design has increased BYK's capacity to produce high-quality chemicals as they expand to meet growing industry demand.

**5**
**BYK LOCATIONS IN THE UNITED STATES**

**>350**
**RAW MATERIALS USED IN BYK ADDITIVES**

**160**
**MILLION CHEMICALS ARE KNOWN TO HUMANS**

## Q&A

**WHAT DREW YOU TO THIS SPECIFIC PROJECT?**
Additives are an underrated and often overlooked part of consumer products around the United States. We were interested in learning more about those manufacturing processes during the course of this project.

**WHAT WAS THE MOST REWARDING PART OF THE PROJECT?**
Visiting the Wallingford plant and seeing the BYK staff work together to face new challenges in their rapidly growing facility.

**HOW IS THIS PROJECT PREPARING YOU FOR THE REAL WORLD?**
Our project focused on improving production lines to keep up with increasing demand. As consumer needs continue to grow, we expect the skills we learned can be easily replicated for future manufacturers.

**WHAT WOULD YOU WANT FUTURE SENIOR DESIGN STUDENTS TO KNOW?**
If you are working with an industry partner, take advantage of all they have to offer you. We leaned heavily on the experienced engineers at BYK and gained a deeper understanding of chemical engineering during that process.



**Click on the QR code for more Chemical and Biomolecular Engineering Senior Design Projects!**

CIVIL ENGINEERING TEAMS 14 & 15

# AUTOMATED VEHICLE RESEARCH AND DEVELOPMENT FACILITY BUILDING DESIGN

**TEAM 14 MEMBERS** DANIEL PARILLO, JACK FITZPATRICK, MEER KAREEM, ARYANNA FONTANEZ (Missing from photo)
**TEAM 15 MEMBERS** MAXWELL AUGUST, OWEN SPANGLER, JOHN DONNELLY III, MAX ST. AMAND
**ACADEMIC SPONSOR** CONNECTICUT TRANSPORTATION INSTITUTE
**FACULTY MENTOR** MANISH ROY

The University of Connecticut is exploring the design and construction of a training and testing facility for automated vehicles at the Depot Campus. This state-of-the-art facility will be focused on transportation safety, smart and connected cities, and automated and autonomous vehicles. This facility's design needs to be functional and help enhance research and training. This project has to allow for regional training, private and public partnerships that include but are not limited to automated and connected vehicles, traffic incident management (TIM), intelligent transportation system (ITS), and commercial vehicle safety technologies. It also includes smart and connected cities, infrastructure resiliency, bridge design, construction, maintenance and inspection, unmanned aerial vehicles (UAV) and drones for public protection and data collection, and testing and calibration of data collection vehicles.

The teams worked closely with their sponsor, the Connecticut Transportation Institute (CTI), which performs transportation-related research at the university and training throughout the state. As autonomous and automated vehicles continue to become more and more popular, thorough research and testing is needed to ensure safety for passengers and pedestrians. The Depot Campus serves as an excellent site to perform these safety tests and training sessions. Each team worked with CTI to design a research and development (R&D) building facility using CAD concept drawings. The students were tasked to imagine a site that would not only be able to test current transportation technology, but also the future of transportation technology that is currently unknown. By laying this framework, the students are opening a potential discussion for further private and public partnerships or sponsorships.

**30**
**MILLION DRIVERLESS CARS ON THE ROAD IN THE WORLD**

**2014**
**THE YEAR AUTOPILOT TECHNOLOGY BEGAN**

**>10K**
**SQUARE FEET PLANNED FOR THE NEW FACILITY**

## Q&A

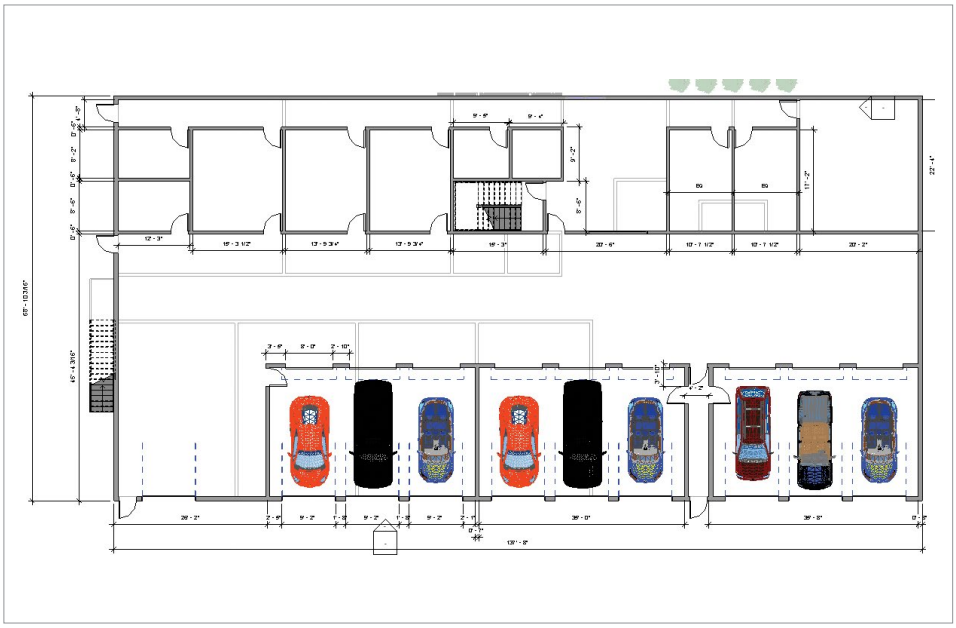
**WHAT DREW YOU TO THIS SPECIFIC PROJECT?**
Autonomous vehicles are an understudied and often contentious transportation issue. We were interested in working together to design a research and training center for the vehicles, making the facility one of the first of its kind.

**WHAT WAS THE MOST REWARDING PART OF THE PROJECT?**
Working with the talented CTI staff to determine the highest needs and priorities of the planned facility. The staff there are skilled engineers and transportation/public works experts.

**HOW IS THIS PROJECT PREPARING YOU FOR THE REAL WORLD?**
As civil engineers, we need to be on the forefront of trends and practices for consumers. Working through the details of this project allowed us to wear many hats and connect the public and private needs.

**WHAT WAS THE BIGGEST CHALLENGE DURING THIS PROJECT?**
To predict the needs of an R&D facility for future automated/autonomous vehicles. We planned a flexible facility that can accommodate future changes and advancements in this field.


Connecticut Transportation Safety
Quantum Park
Autonomous Vehicle Test Track




Click on the QR code for more Civil Engineering Senior Design Projects!

COMPUTER SCIENCE AND ENGINEERING TEAM 05

# UCONN NUTRITION AND EXERCISE MANAGEMENT APP


**TEAM MEMBERS** MADISON SARGEANT, MORPHY KUFFOUR, BRIDGET SMITH EPAUL, ERIC JARA, NOAH RAMDIAL, ARIANNAH BLACK

**ACADEMIC SPONSOR** COMPUTER SCIENCE AND ENGINEERING DEPARTMENT

**FACULTY MENTOR** CAIWEN DING


Being a college student can be overwhelming and take a toll on a pupil's mental and physical health. The University of Connecticut offers resources to students in order to maintain their wellbeing, but some students may feel these resources are spread thin and not motivating enough. To encourage healthy habits for UConn students, the *HuskyFit: Nutrition and Fitness Mobile App* provides a platform for users to track their nutrition and exercise choices on the Storrs campus. The HuskyFit application shows food options at all eight dining halls on campus and provides a user-friendly interface for logging daily meals. Users can track caloric intake on a daily basis and view all nutritional information for dining hall options to ensure they are eating well-balanced meals. The application also allows users to track their daily workouts at the UConn Recreation Center. Having an application that incorporates both the nutrition and fitness resources specific to UConn motivates students to monitor their wellbeing and make healthier choices. The university currently provides separate sources of information for the dining hall and the recreation center. HuskyFit is an application that combines these resources into one with additional functionalities via a user-friendly interface, benefiting the UConn community as a whole.


The team came up with the concept for the application and custom-coded it themselves. Within the application, users can easily add foods from the dining hall menus to their daily food log and add completed exercises to their daily workout log for an overview of their nutrition and fitness. HuskyFit will be able to give food recommendations that align with the user's allergens, dietary restrictions and personal preferences. Further campus expansion and integration of the HuskyFit application could include QR codes posted in the dining halls and the UConn Recreation Center. These scannable codes could allow users to view and log food ingredients and serving sizes automatically, and easily log a completed workout from a certain machine or fitness class in the recreation center.

# Q&A

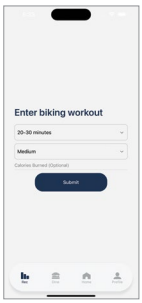
**WHAT DREW YOU TO THIS SPECIFIC PROJECT?**
We knew we wanted to custom design an app, but we deliberated on a topic that would be most relevant to fellow Huskies. No one on the team is a health and wellness expert, but we thought it would be useful to have an app that combines dining hall information with both food logging and workout logging capabilities all specific to UConn.

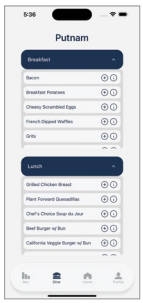
**WHAT WAS THE MOST REWARDING PART OF THE PROJECT?**
Working together toward a common goal. We all brought something different to the table, but our skills meshed well and we were able to effectively problem solve when creating the app. It has been really rewarding to work on an application that we know will bring benefits to the wellbeing of the UConn community.

**HOW IS THIS PROJECT PREPARING YOU FOR THE REAL WORLD?**
Technology and software companies are looking for engineers that can create visually striking applications that are most relevant to their customers. In less than a year, we've launched an app specialized for thousands of people on the Storrs campus. In doing so, we all have learned extremely valuable skills that will translate into our careers in the real world.

**WHAT WAS THE BIGGEST CHALLENGE DURING THIS PROJECT?**
Our CSE professors taught us the attention-to-detail that is necessary when coding software. It hasn't been easy working out the bugs, but it's a process we're familiar with.

**8**
**DINING HALLS ON UCONN STORRS CAMPUS**


**14,915**
**SIGN-UPS FOR RECREATION CENTER PROGRAMS**


**Click on the QR code for more Computer Science and Engineering Senior Design Projects!**

ELECTRICAL AND COMPUTER ENGINEERING TEAM 04

# CREATING AN ELECTRIC-POWERED BOAT FOR ASNE

**TEAM MEMBERS** SERGIO PIRES, TYLER SHOBAN, BLAKE PEMBER
**INDUSTRY SPONSOR** AMERICAN SOCIETY OF NAVAL ENGINEERS
**FACULTY MENTOR** ABHISHEK DUTTA

The American Society of Naval Engineers through funding supplied by the Office of Naval Research (ONR) sponsors an annual competition "Promoting Electric Propulsion (PEP)." Promoting Electric Propulsion for small craft is an educational and competitive program to foster the development of electric boats in the United States. Electric-powered boats are an alternative to traditional gas-powered boats which use nonrenewable energy. The fourth annual PEP competition will be held Spring 2023. The race is open to students, academia, businesses, and individuals. Participants in the competition must complete five laps of a short course of less than one-mile in length. The competition is open to both manned and unmanned boats which compete in separate races. The team set off to design and fabricate an electric-powered boat to participate in the 2023 competition.

The team is fabricating a boat following a traditional model, by creating a mold and forming a fiberglass hull with a smooth gel coat finish. By using a kayak body, the team was able to create a prototype, to test the electronics as well as determine particular hull characteristics. The team achieved electric propulsion by using twin electric jet drives. While the boat is in use, power is drawn through the electrical system utilizing power from eight 4s Lipo batteries. Through a wireless receiver and transmitter the boat is controlled and propelled forward. The team will compete and test their final product on June 27.

**4th**
**ANNUAL ELECTRIC PROPULSION COMPETITION**

**200**
**NAUTICAL MILES CAN BE SAILED WITH THE MOST ADVANCED ELECTRIC BOATS**

**4**
**THE AVERAGE MPG RATIO ON A 25MPH BOAT RIDE**

## Q&A

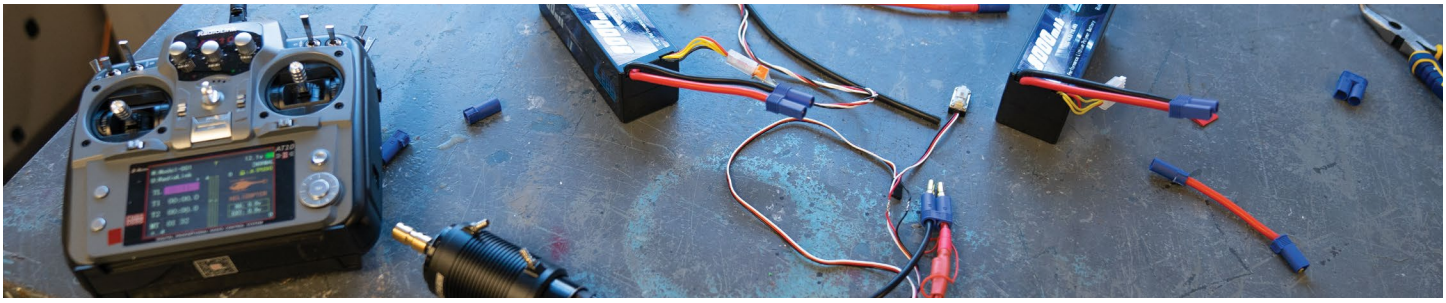
**WHAT DREW YOU TO THIS SPECIFIC PROJECT?**
We've seen and experienced hybrid and electric-powered vehicles in the last several years, but we thought it'd be interesting to focus on a different type of vehicle: boats.

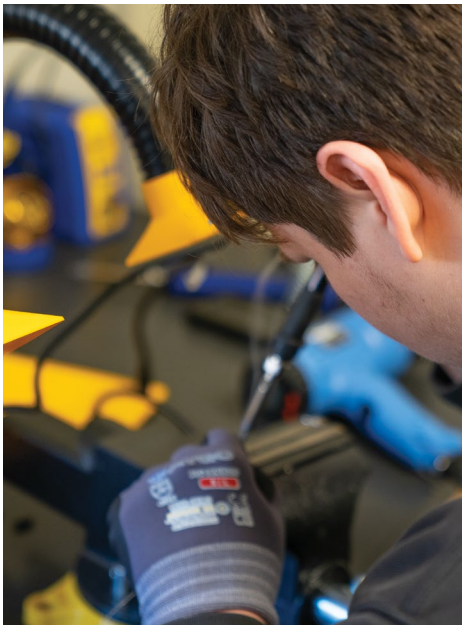
**WHAT WAS THE MOST REWARDING PART OF THE PROJECT?**
Experiencing the support of the American Society of Naval Engineers and the Office of Naval Research. These two organizations allow student engineers to learn from real-world experience and test their skills.

**HOW IS THIS PROJECT PREPARING YOU FOR THE REAL WORLD?**
Electric vehicles will continue to offer new opportunities for engineers. We're also excited at the prospect of taking advantage of our location on the coasts of New England and working with boats or submarines in the future.

**WHAT WAS THE BIGGEST CHALLENGE DURING THIS PROJECT?**
Ensuring the boat gathered enough power to be able to complete a full course. It was also challenging to test without regular access to a body of water.

**Click on the QR code for more Electrical and Computer Engineering Senior Design Projects!**





ENVIRONMENTAL ENGINEERING TEAM 03

# SOIL VAPOR EXTRACTION SYSTEM DESIGN AND CLOSURE


**TEAM MEMBERS** GRACE PERRY, MATTHEW BOEHMER, BROOKE FANCY, ETHAN WEED
**INDUSTRY SPONSOR** LOUREIRO ENGINEERING ASSOCIATES, INC.
**INDUSTRY ADVISORS** DENNIS KEANE, MIKE MARLEY
**FACULTY MENTORS** AMVROSSIOS BAGTZOGLOU, GUILING WANG


The team was asked to develop a soil remediation plan for a contaminated site in Sauget, Illinois. By implementing a Soil Vapor Extraction (SVE) design, the team plans to address any drinking and surface water concerns from this problematic soil. The site is an operating chemical manufacturing facility across the Mississippi River from St. Louis. The area of concern held a two-million-gallon benzene tank that leaked over decades and released more than 100,000 pounds of benzene into the underlying silty-sandy soils, with clay layering. Numerous investigations of the impacts to the underlying soils and groundwater at the site have been performed; a substantial amount of data is available as a result of these investigations.

Due to the volatility of benzene and the permeable nature of the majority of the soils above the groundwater table, the team determined that SVE is the appropriate remedial technology for the site. SVE is a minimally invasive method of treating soils for contaminants. This extraction operates in the vadose or unsaturated zone. The function is to remove volatile contaminants by creating a pressure gradient, and contaminated air/water is treated before release back into the environment. Soil vapor extraction involves inducing air flow in the underlying soils to cause volatilization of the benzene and removal of the vapors to an above-ground treatment system. During the course of this project, the team worked on a site analysis, literature review, project proposal, pilot test design, and finally the full-scale site remediation plan, including the SVE shutdown.

**2,350**
**MILES IN THE MISSISSIPPI RIVER**

**450K**
**BROWNFIELDS IN THE UNITED STATES**

**100K+**
**POUNDS OF BENZENE LEAKED**

## Q&A

**WHAT DREW YOU TO THIS SPECIFIC PROJECT?**
We were interested in the opportunity to have a real-world impact and address a site in need of remediation. We were interested in learning about this specific site and its characteristics and problems over the years.

**WHAT WAS THE MOST REWARDING PART OF THE PROJECT?**
Eliminating a public health hazard. Benzene is carcinogenic and volatilizes easily, so local residents could be at high risk through dermal and inhalation exposure. It could also make its way into surface waters which would harm aquatic wildlife.

**HOW IS THIS PROJECT PREPARING YOU FOR THE REAL WORLD?**
Across the country, there are thousands of similar brownfields and other contaminated sites that will need remediation and clean-up. This process gave us insight about how we can help even more in the future.

**HOW DID YOUR UNDERGRADUATE COURSES PREPARE YOU FOR THIS CAPSTONE PROJECT?**
This project has been a culmination of everything we've learned in our undergraduate courses to this point. We've tackled literature reviews, a project proposal, soil analyses, remediation steps and more.



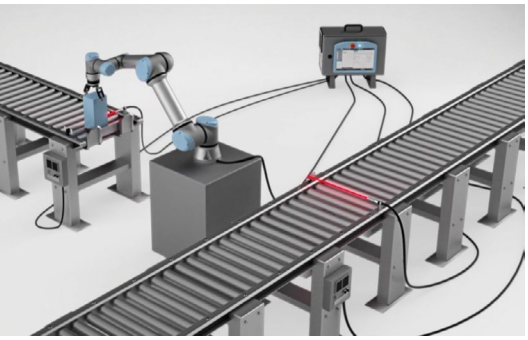
**Click on the QR code for more Environmental Engineering Senior Design Projects!**

MANAGEMENT AND ENGINEERING FOR MANUFACTURING TEAM 04

# RESEARCH AND IMPLEMENTATION OF A COBOT FOR SHORT-RUN AUTOMATION


**TEAM MEMBERS** PATRICK SWEENEY, ERIC LIEBERMAN, DOGA SELEN TAKUNYACI, JIAMING GU
**INDUSTRY SPONSOR** HORST ENGINEERING
**FACULTY MENTORS** CRAIG CALVERT, FRANCISCO CUNHA


Horst Engineering is located in East Hartford, Connecticut, and is an advanced manufacturer of precision parts in the aerospace industry as well as other high-technology and mission-critical industries. Horst is currently looking to increase their manufacturing capabilities by implementing a collaborative robot (cobot) into their facility. A cobot is intended to work directly with humans in a shared space, unlike traditional manufacturing robots which are kept separate from human workspaces. To accomplish this, Horst tasked the team with recommending cobot implementation within the manufacturing company. In addition to this, the team must prove that the implementation of a cobot will generate a return on investment (ROI) within two years for Horst. This ROI will show that by implementing a cobot, there will be an increase in the availability of high-skilled labor for more technical work. The students' report provided a technical review of the project, explaining the scope of the project, as well as the business justification.



Horst suggested a five-phase plan to ensure project success. Within this five-phase plan are milestones that were critical to achieve and finish the project successfully. To launch the project, the students created a list of 15-20 potential future opportunities for cobot implementation. The team narrowed those opportunities to the top two, then created a business case, cost analysis, and engineering plan to support the final option. Finally, the team provided an in-depth review of how a cobot can accomplish its assigned task with CAD models, simulations, and technical drawings.

**75+**
**YEARS SINCE HORST BEGAN OPERATING AS A FAMILY-OWNED BUSINESS**

**34,987**
**INDUSTRIAL ROBOTS INSTALLED IN THE UNITED STATES IN 2021**

**17%**
**AVERAGE PERCENTAGE OF SAVINGS AFTER IMPLEMENTING ROBOTS**

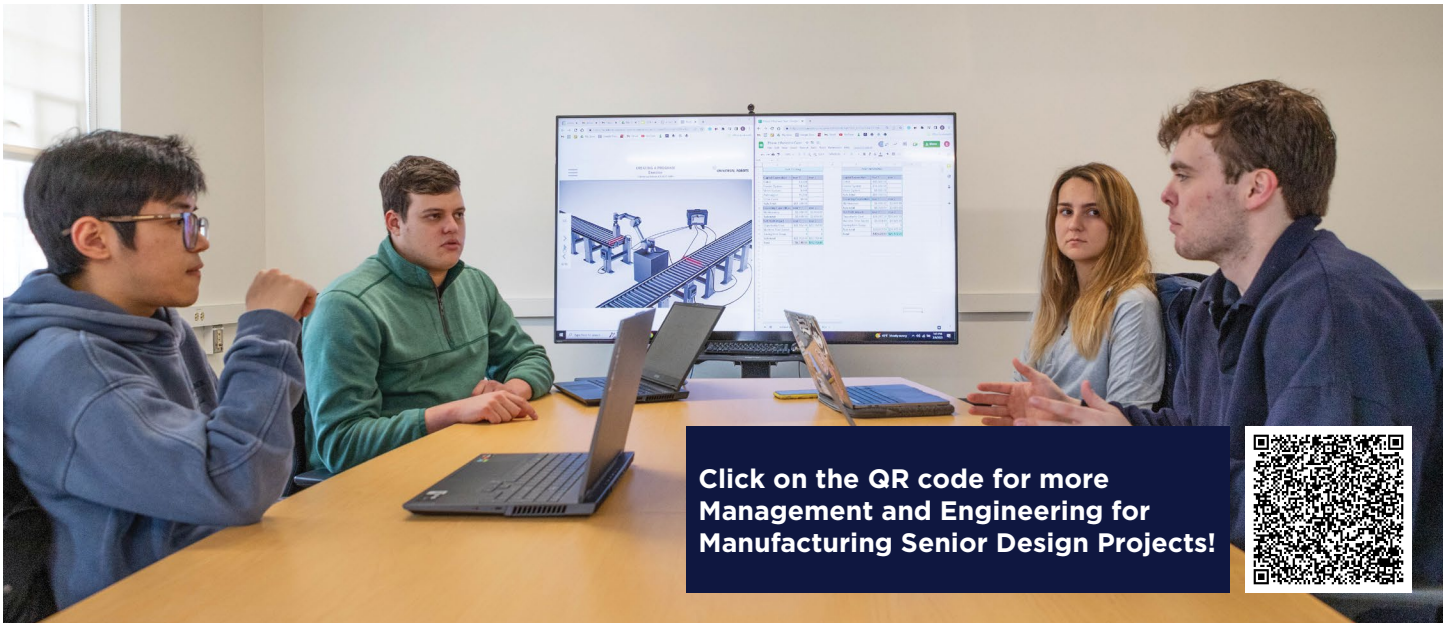
## Q&A

**WHAT DREW YOU TO THIS SPECIFIC PROJECT?**
Cobots are an important addition to manufacturing in recent years. We were interested in building on that momentum and exploring additional opportunities for cobots for a local manufacturer.

**HOW IS THIS PROJECT PREPARING YOU FOR THE REAL WORLD?**
The use of robots will only continue to increase over the years. We feel our implementation plan could be relevant in various industries and companies.

**WHAT WAS THE MOST REWARDING PART OF THE PROJECT?**
Helping a local company transition towards the future of manufacturing and working with the technology that will dominate the industry over the next 15 years.

**WHAT WOULD YOU WANT FUTURE SENIOR DESIGN STUDENTS TO KNOW?**
Working collaboratively with fellow group members is a very important part of the process. By working in a team, we were able to learn from one another and accomplish more together.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UCONN
SCHOOL OF ENGINEERING

MATERIALS SCIENCE AND ENGINEERING TEAM 02

# HIGH SECURITY CYLINDER DRILL RESISTANT LOCK REDESIGN

**TEAM MEMBERS** JONATHAN BANE, CHARLES SCHWARZ, MATTHEW CARRAGHER
**INDUSTRY SPONSOR** MEDECO
**INDUSTRY ADVISORS** CLYDE ROBERSON, DOUG TRENT
**FACULTY MENTOR** LESLEY FRAME

Medeco produces high-security locks for doors all over the world. Medeco wanted to investigate new ways to make their locks more resistant to physical attacks, like drilling or sawing. Medeco was also interested in improving manufacturing efficiency. The project goal was to implement a drill-resistant material into Medeco's high-security lock cylinders. This material must be easy to manufacture and provide equal or greater resistance to drilling and sawing than the current material and design. The demand for stronger, cheaper, and more functional materials is inherent in all types of industries. Through the Materials Science and Engineering laboratories in the new Science 1 Building the student team was able to investigate and recommend three different drill-resistant materials to use in Medeco's locks.

The company requested different materials that had high drill resistance according to ANSI drill test standards, high hardness, corrosion resistance, and acceptable toughness. The team processed each material option differently, either through heat treatment and decarburization or through sintering. 52100 steel is a high hardness steel, but is very difficult to machine so the team investigated decarburizing the outer layers to make machining and manufacturing more efficient. WC and a T15-WC metal matrix composites were produced through sintering and have the benefit of extreme hardness and drill resistance. Through a multitude of test methods, the team was able to provide a recommendation and the data necessary to make a decision on new materials used in Medeco locks based on the pros and cons of each material or process.

**100,000**
**BURGLARIES IN THE UNITED STATES EACH YEAR**

**1848**
**THE YEAR IN WHICH THE LOCK AND KEY WERE INVENTED**

**3**
**COMMON METALS FOUND IN A LOCK AND KEY**

## Q&A

**WHAT DREW YOU TO THIS SPECIFIC PROJECT?**
Locks are not a new invention, but if we've learned one thing in the MSE department, it's that existing products can always be improved. We were interested in working with a company to improve their existing product and manufacturing processes.

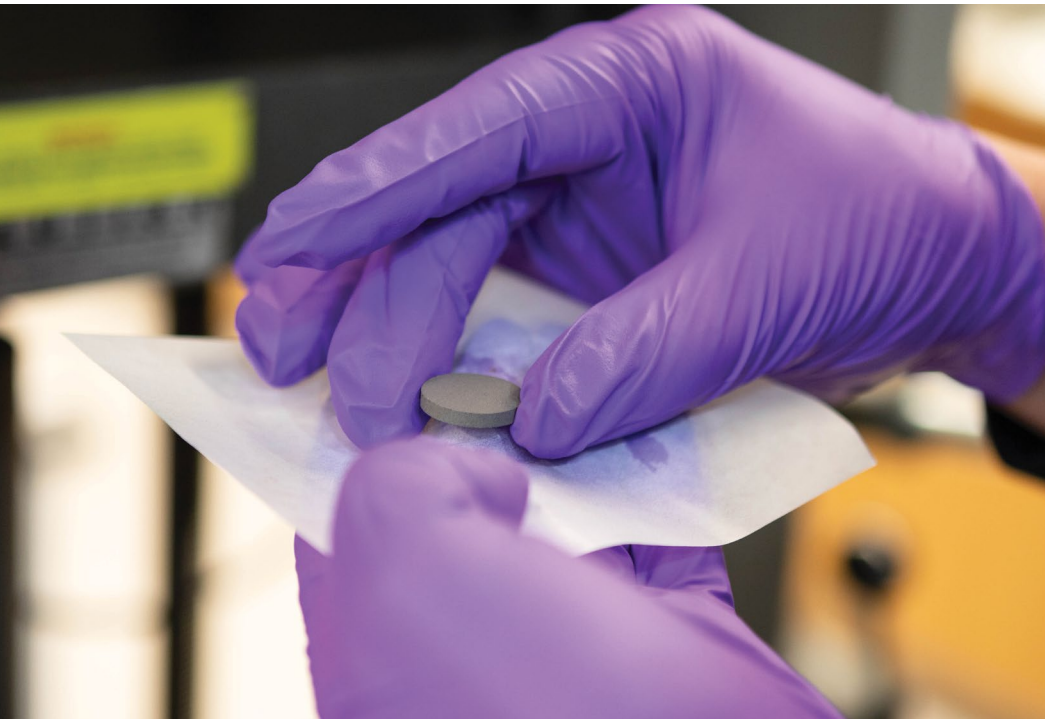
**WHAT WAS THE MOST REWARDING PART OF THE PROJECT?**
Knowing that we might have a hand in the safety and security of millions of people around the world.

**HOW IS THIS PROJECT PREPARING YOU FOR THE REAL WORLD?**
We worked closely with Medeco's engineering, production and quality teams to determine the best way to proceed. That kind of collaboration is beneficial in any type of organization and cannot be overstated.

**WHAT WAS THE BIGGEST CHALLENGE DURING THIS PROJECT?**
The trial and error of testing and combining materials in the Science 1 Building laboratories. There are many unknown variables in Materials Science, but it was a rewarding challenge to run those experiments.




**Click on the QR code for more Materials Science and Engineering Senior Design Projects!**



MECHANICAL ENGINEERING TEAM 61

# DEVELOPMENT OF AN AFFORDABLE WHEELCHAIR RAMP WITH EMPHASIS ON RECYCLED MATERIALS


**TEAM MEMBERS** PATRICK MICONI, LEILA AWAD, EDWARD RAMOS, KALEY LUK
**ACADEMIC SPONSOR** UCONN COLLEGE OF LIBERAL ARTS AND SCIENCE
**FACULTY MENTOR** JORGE PARICIO GARCIA


Accessibility ramps are a necessity for those with physical disabilities unable to safely use stairs or get up a non-sloped elevated surface. Wheelchair ramps are designed to meet local codes and Americans with Disabilities Act regulations to ensure the safety and well-being of those using them. Common accessibility ramps range in prices from $1,000 to upwards of $4,000. The goal of this project is to design and fabricate an affordable prototype wheelchair ramp that is modular to allow for customizability and greater freedom during assembly. By creating a modular design, the revised ramp gives caregivers and loved ones the ability to lift and move the ramp with their own strength. The team also set out to have at least 80 percent of the ramp assembly be made from recycled materials. Using recycled materials is a sustainable and eco-friendly option to create sturdy ramps without adding more materials to landfills once the ramp reaches the end of its useable life. Finally, the team worked to determine how the wheelchair ramp could attach to various house structures, allowing a disabled person to stay in their existing home to increase comfort and reduce cost.

The team worked in the Innovation Zone Makerspace within the Peter J. Werth Residence Tower. The space is the first official Makerspace at UConn, and allows UConn students to bring their ideas from conception to reality in an innovative and entrepreneurial environment. The team used new and old technologies within the Makerspace, like CAD drawings, circular and band saws to design and build their wheelchair ramp.

**2.7M**
**WHEELCHAIR USERS IN THE UNITED STATES**

**$1,000**
**THE STARTING COST FOR A WHEELCHAIR RAMP**

**36”**
**WHEELCHAIR RAMPS SHOULD BE AT LEAST 36” WIDE**

## Q&A

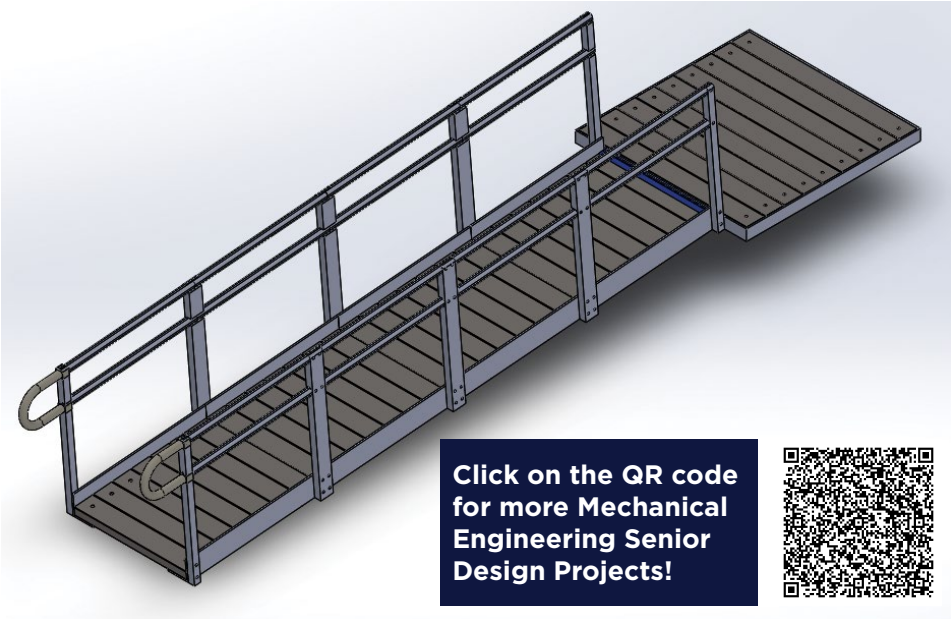
**WHAT DREW YOU TO THIS SPECIFIC PROJECT?**
We wanted a project that would allow us to improve upon an existing product or design. Building an affordable, modular wheelchair ramp seemed to be a good challenge.

**WHAT WAS THE MOST REWARDING PART OF THE PROJECT?**
Working in the Innovation Zone Makerspace. The infrastructure there is set up for creativity and success, and offered us the equipment we needed to work through the project.

**HOW IS THIS PROJECT PREPARING YOU FOR THE REAL WORLD?**
Mechanical engineers are tasked with designing builds that are safe and affordable. We believe every project in the future will have sustainability concerns, which is something we incorporated in this project.

**HOW DID YOUR UNDERGRADUATE COURSES PREPARE YOU FOR THIS CAPSTONE PROJECT?**
Our mechanical engineering courses allowed us to think creatively about solving society’s common problems. In order to do that, we leaned on the faculty that taught us how we can help the people that need it most.



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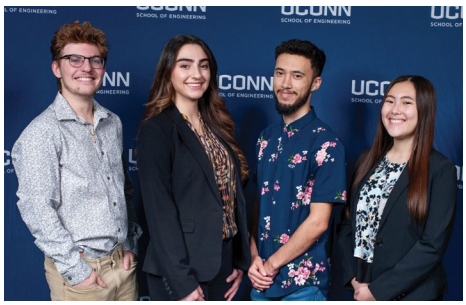

SYSTEMS ENGINEERING TEAM 08

# DEVELOPING A DIGITAL TWIN OF THE UCONN INNOVATION PARTNERSHIP BUILDING


**TEAM MEMBERS** JADEN MCDONNELL, JASON CHEN, WILLIAM CRYAN, NICHOLAS JANUS
**INDUSTRY SPONSOR** EVERSOURCE, JASON STRANO
**INDUSTRY ADVISOR** BRENDAN FILBURN
**FACULTY MENTOR** RAVI GORTHALA (ME), LIANG ZHANG (ECE), AMY THOMPSON (SE)


Advanced laboratory and research buildings are energy intensive and consume more energy than typical commercial/office buildings. However, these types of buildings can be improved with energy efficiency measures such as controlling ventilation based on occupancy and automated raising and lowering of blinds/shades in response to solar radiation. At the Storrs campus, various energy intensive and modern buildings can benefit from increased energy-efficient processes. The Innovation Partnership Building within the UConn Tech Park that opened in 2018 is one such example.

The development of a digital twin of the Innovation Partnership Building (IPB) offered two engineering teams in different departments the hands-on experience of applying modern digital engineering methods and practices to achieve higher performing buildings. The digital twin of the IPB will incorporate real-time data from the existing HVAC equipment, lighting, building management software, and sensors. This technology enables an effective simulation of energy use, indoor air quality and comfort, space, security, and environmental impact. The digital twin can be used as a model project to demonstrate the best practices for operating and maintaining energy-efficient, high-performing buildings, and can be replicated by others as the UConn Storrs campus continues to grow and modernize.

**119,180**
SQUARE FEET IN THE INNOVATION PARTNERSHIP BUILDING

**15**
RESEARCH CENTERS WITHIN THE IPB

**$225M**
IN APPLIED RESEARCH AND DEVELOPMENT IN 2022

## Q&A

**WHAT DREW YOU TO THIS SPECIFIC PROJECT?**
Digital twins are a rapidly expanding area in many fields including aerospace, manufacturing, healthcare and smart buildings, and our model could ultimately help UConn reduce spending and/or use the space more effectively.

**HOW DOES IT FEEL TO BE MAKING A DIFFERENCE TO UCONN'S RESEARCH COMMUNITY?**
University researchers are working on projects and products with far-reaching impacts. We hope our model will provide valuable data which will yield both economic and environmental benefits, and that those savings can be redirected to university researchers.

**WHAT WAS THE BIGGEST CHALLENGE DURING THIS PROJECT?**
We would say the most challenging part has been having to quickly learn how to use advanced software such as EnergyPlus with minimal previous experience.

**HOW IS THIS PROJECT PREPARING YOU FOR THE REAL WORLD?**
In Electrical and Computer Engineering and Mechanical Engineering, there are a lot of opportunities to support companies' infrastructure. Digital twins allow for individuals and organizations to save time and resources by allowing them to test and optimize solutions in a virtual environment before implementing them in the physical world.


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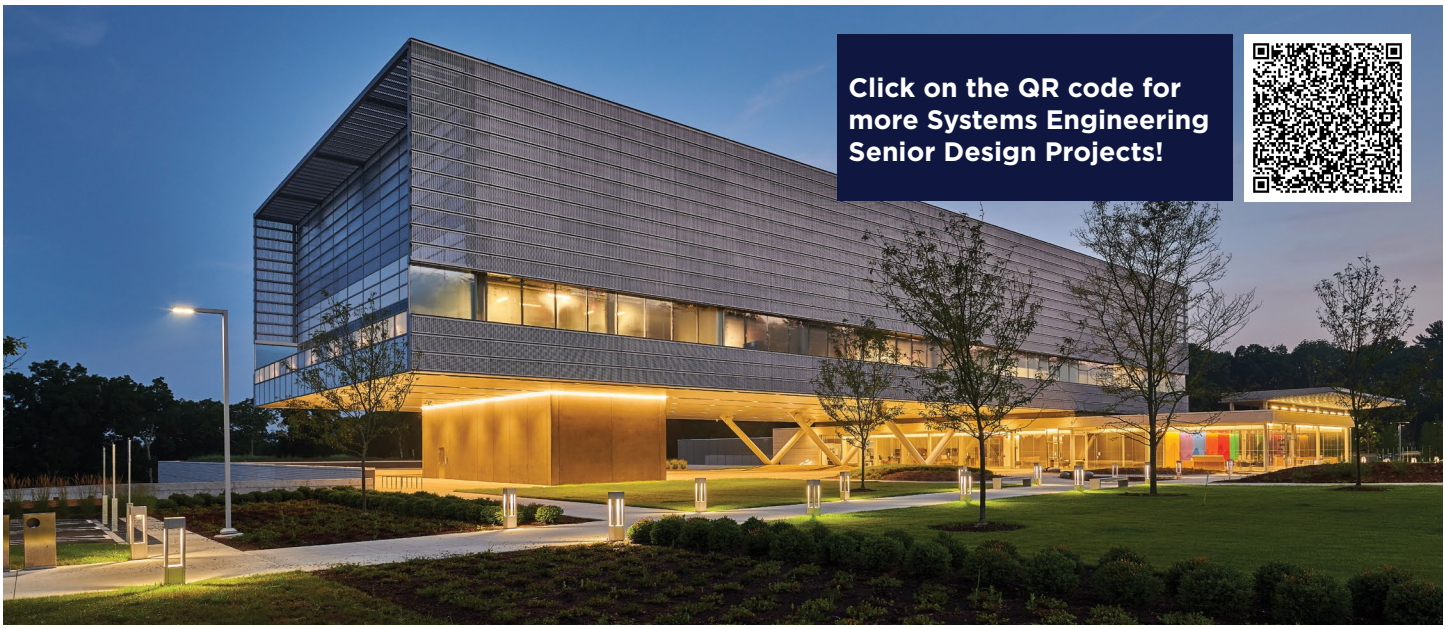
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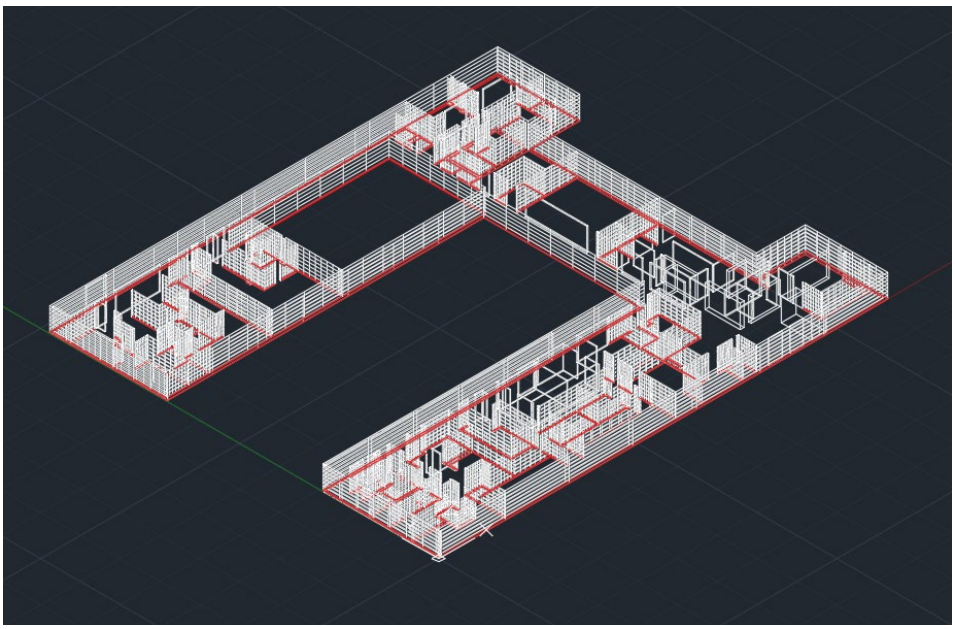
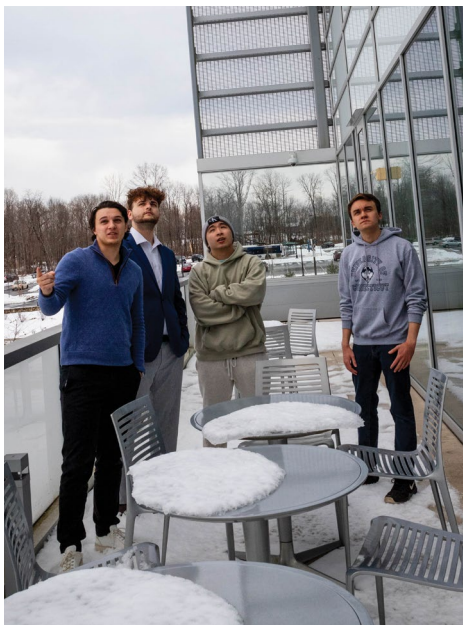





SUPPORTING STUDENTS AND FACULTY

# ENGINEERING ELECTRICAL AND MACHINE SHOPS

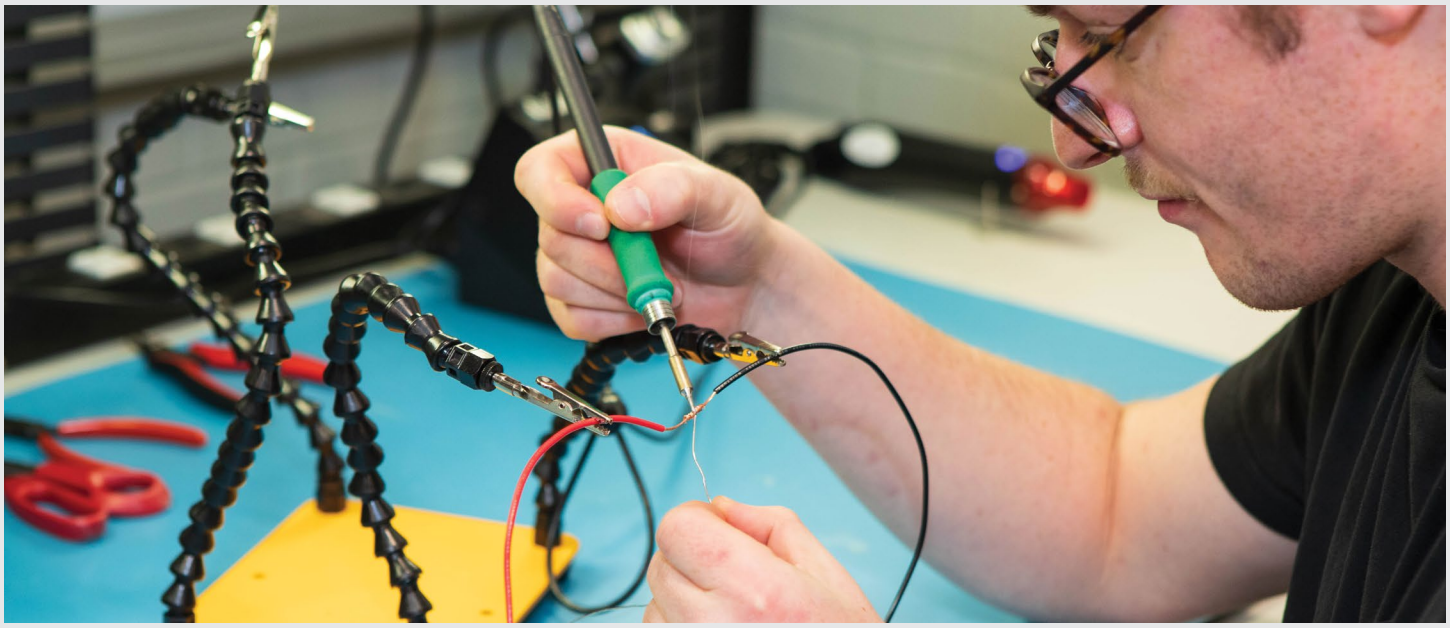
**SHOP STAFF** PETER GLAUDE, KEN PREMO, ANTHONY BEATTY

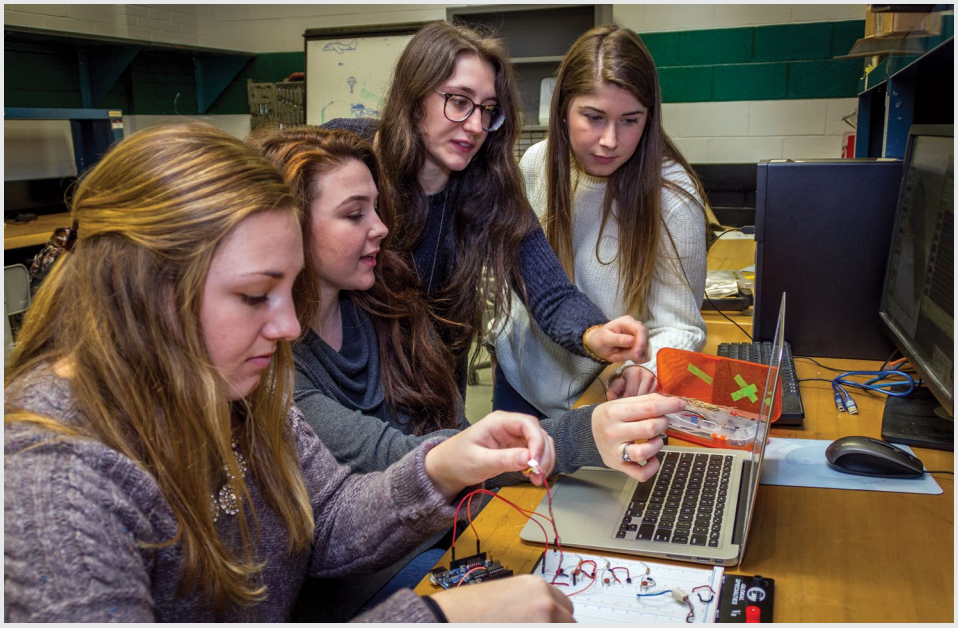
## ELECTRONICS SHOP

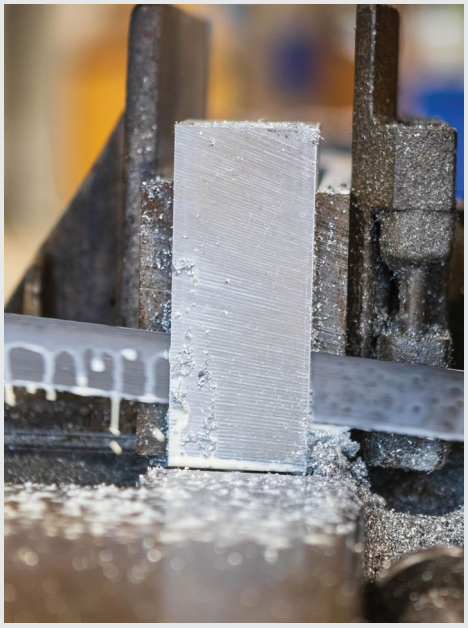
The shop staff work with students and researchers to design and build custom electronic equipment. The services and mentoring provided are unique for each situation and are dependent on the student's needs. A sampling of the services provided are circuit board design, wiring, soldering, programming, and all types of data acquisition. They also provide advice, mentoring, and design assistance on automation and control, robotics, custom cabling, and troubleshooting all types of equipment and instrumentation. The shop has workbenches outfitted with power supplies, meters, o-scopes, and professional soldering equipment which the students can utilize for their research. The School of Engineering Electronics Shop aids in the senior design process, but also manages day-to-day requests from departments such as Electrical and Computer Engineering.

## MACHINE SHOP

The School of Engineering Machine Shop offers academic and research support to all school departments. Senior Design is a major part of the yearly activity in the shop. The shop has a staff of two full-time employees and four student helpers. They work with senior design students in the fall to learn about the manufacturing equipment available and to develop their skills. During the spring they guide teams through any manufacturing restrictions and then continue with the fabrication of their final product. The machine shop has three and four-axis CNC mills, CNC lathe, conversational CNC knee mills, manual lathes, drill presses, CNC router, panel saw, sheet metal area, MIG/TIG Welding, surface grinder, and many other hand tools. Additionally, there is a state-of-the-art production-level 3D printer. Shop staff design, fabricate, modify, and repair research lab equipment for all SoE faculty throughout the entire year.







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*External Sponsor list complete as of April 4, 2023 - any omissions or errors are unintentional.*


UCONN ENGINEERING

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