It is my distinct pleasure to welcome you to our annual Fall Engineering Design & Innovation Showcase featuring our students’ capstone design projects.

A big thrust at Speed School is preparing students to be workforce ready for industry. We are continually looking to improve our academic programs by placing a strong emphasis on industry-relevant and industry-sponsored capstone projects. These projects are not simple academic exercises as our students are tackling actual industrial problems and provide solutions that find their way into practice. One of the things that excites me is to hear how some of the project outcomes are adopted by the industry sponsors. This fall, 90 students make up the 26 engineering student teams who, throughout the semester, have collaborated with their project partners to develop prototypes or solutions for real-world projects that involve design constraints, budgets, reviews, and deadlines.

The Engineering Design & Innovation Showcase is made possible by the generous support of our industry partners, project sponsors, faculty, staff, mentors, and judges. As a community, we are developing world-class engineers who are well-prepared to meet the challenges of tomorrow with competitive critical thinking and problem-solving skills.

Our Speed School engineering students have worked hard to prepare for this showcase and welcome the opportunity to demonstrate how their projects developed into real-world products or solutions. Please join me in congratulating them on their achievements.

In Fall 2025, we are set to move into a new 114,000 sq. ft. facility, specifically designed to amplify student success and research endeavors. A dedicated section of this building will support capstone design projects, marking an exciting chapter in the ongoing evolution of Speed School. The future holds great promise for us!

My sincere hope is that you enjoy the Fall 2023 Engineering Design & Innovation Showcase.

Emmanuel G. Collins, Ph.D
Dean, J.B. Speed School of Engineering
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ACKNOWLEDGEMENTS

Senior Design Faculty
Capstone Instructors:
• Bioengineering: Dr. Hermann Frieboes
• Computer Science & Engineering / BACS: Nathan Russell
• Electrical & Computer Engineering: Dr. Andre Faul
• Mechanical Engineering: Dr. Gary Osborne

Administration
Dr. Emmanuel G. Collins, Dean
Dr. Tom Rockaway, Assoc. Dean of Strategic Initiatives
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Dr. Wei Zhang, Computer Science & Engineering
Dr. John Naber, Electrical & Computer Engineering
Dr. Jeffrey Hieb, Engineering Fundamentals
Dr. Pratik J. Parikh, Industrial Engineering
Dr. Kevin D. Murphy, Mechanical Engineering
CAPSTONE INSTRUCTORS

Dr. Hermann Frieboes

Dr. Andre Faul

Dr. Gary Osborne

Nathan Russell
THE LIFECYCLE OF A FALL PROJECT

May - July
- Proposals collected and reviewed by faculty; projects selected; companies notified

August
- Semester begins, project ideas shared with students
- Students placed into project teams
- Project teams have initial meeting with industry partner

September - November
- Students work with industry partner throughout the semester to communicate progress
- Students finalize project work and review completed work with industry partner

December
- Students present at EDIS

PROJECT PARTNERS
- ATech Training, Inc.
- Bluegrass BioDesign
- Bowman Skunk Works
- Donna Franklin
- Kim Noltemeyer, David Noltemeyer, Jr.
- Lindsay Haycraft
- Louisville Metro Department of Public Health and Wellness
- National Security Innovation Network
- Patrick Cummins - Cummins IP Law PLLC
- University of Louisville Center for Positive Leadership
Passive Plasma Extraction

Team 1
Ben Carlsen
Sarah Lee
Olivia Whitehead

PROJECT DESCRIPTION: We are designing a passive plasma separator using SLA 3D printing by designing a model based on the bifurcation law. This model uses the drag force created from using diluted blood forced out of a syringe to go around in a microtube and out a y channel with the plasma in one channel and the remnants in another.

PROJECT BENEFITS: Overall, this device is non-invasive and makes plasma separation more accessible and timelier. By speeding up the processes of diagnoses and treatment, patients would experience fast plasma extraction that could be done as quickly as getting a vaccine. Having a fast way of extracting the plasma means that more patients could have access to this medical device in a given time period. This could save patients considerable time outside of the hospital by supporting more accurate results and efficient treatment plans post diagnostics.

Customize Orthotic Model for Pediatric Spinal Cord Injuries

Team 2
Elayne Shelby
Chris Stegman
Libby Roy

PROJECT DESCRIPTION: The Pencil Pal is a 3D printed pencil grip tailored to children who have suffered spinal cord injuries. Each device is custom 3D printed to fit the patient’s hand perfectly.

PROJECT BENEFITS: This project will assist children who are learning to write again after a spinal cord injury and aid in their rehabilitation journey. The ability to write will allow them to continue their learning in school and provide them with some indepence, which will in turn boost their confidence and aid in their development.
Input of Biological Data to 3D Tumor Model

Team 3
Michael Mills
Liam Hurley
LaMargaret Johnson

PROJECT DESCRIPTION: This project aims to create a clinician-friendly interface to input patient biological data for use in 3D tumor modeling software developed by the Dr. Friebos lab.

PROJECT BENEFITS: This project addresses the challenge of inputting complex modeling parameters into the 3D model by translating common clinician terms into parameters used by the model. This streamlines the input process and makes it more convenient for clinician use.

Web-Based Application for Patient Clinical Evaluation

Team 4
Emma Schmitt
Will Sizer
Emma Pendergraft

PROJECT DESCRIPTION: Our project is a web-based application intended to evaluate patient clinical data by running statistical analysis through machine learning.

PROJECT BENEFITS: Our project offers a faster and easier way to analyze patient clinical data. It reduces the amount of software platforms needed, while also providing clear instructions for the user along the way.
Software for Diagnosis of Age-Related Macular Degeneration

**Team 5**
Julia Bader
Victoria Harris
Alaa Mahmoud

**PROJECT DESCRIPTION:** Software with an integrated graphical user interface system, to diagnose age-related macular degeneration via fundus images of the eye.

**PROJECT BENEFITS:** AMD is usually diagnosed by a retinal specialist, which can be costly to visit depending on insurance status and geographical location. There is no cure for AMD, only preventative measures, so the sooner a patient is diagnosed, the better.

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Photodynamic Therapy Against Multidrug Resistant Microbes in Tissue Abscesses

**Team 6**
Liliana Martinez
Wyatt Quinones
Sara Abdelsalam

**PROJECT DESCRIPTION:** Our device consist of four components which will be used for treatment of deep tissue abscesses. This device will be the only of its kind being equipped with the technology to deliver photodynamic therapy utilizing methylene blue.

**PROJECT BENEFITS:** Our product with reduce the high morbidity and mortality rate related to deep tissue abscesses. In addition, will reduce the number of hospital stays which will alleviate some of the financial burden on the patient. Our product also provides an oppurtunity to combat the clinical over-use of antibiotics as seen by the current treatments for abscesses.
Interventional Device to Locate Vasculature

Team 7
Abby Kuntz
Noureldin Aly
Will Isaacs
Leila Mohamed

**PROJECT DESCRIPTION:** The Hands-Free Ultrasound System is a revolutionary medical device designed to transform the process of inserting peripheral intravenous (PIV) lines, a critical medical procedure used worldwide.

**PROJECT BENEFITS:** This groundbreaking innovation integrates existing ultrasound technology into a meticulously engineered robotic system, enhancing the precision, comfort, and efficiency of PIV line insertions.

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Micro-Ultrasound Needle for Improved Pericardiocentesis

Team 8
Hannah Gibson
Bryce Thompson
Hallie Osborne

**PROJECT DESCRIPTION:** Pericardiocentesis is an emergent procedure done to remove excess fluid from the pericardial sac. The current standard for pericardiocentesis involves the operator inserting a needle until it punctures the pericardium. An external ultrasound is used to aid in the placement of the needle, but the external ultrasound cannot maintain visualization of the needle. This leads to a host of complications, like myocardial perforation and death. To decrease patient mortality and morbidity, we propose a novel solution: direct ultrasound monitoring via a miniaturized ultrasound transducer placed just before the bevel of the needle. This allows the operator to handle the needle and ultrasound imaging at the same time and would prevent puncture of the myocardium or surrounding organs.

**PROJECT BENEFITS:** This device allows for continuous visualization of the needle path to decrease complications and patient mortality. Not only does it allow continuous visualization, but it has an ergonomic design. This device also has a widespread application to other procedures that require continuous visualization of a needle, such as lumbar procedures, thoracentesis, and many more.
Device for More Ergonomic Otolaryngology Surgery

Team 9
Caden Maners
Logan Coovert
Luis Rodriguez

**PROJECT DESCRIPTION:** To alleviate the ergonomic stress faced by surgeons required to stand for lengthy procedures, specifically within the otolaryngology specialty. The shelf life of otolaryngology surgeons is severely hindered by musculoskeletal issues caused by prolonged standing. Neutral standing posture refers to standing with feet shoulder width apart, even hips aligned rib cage, engaged abdominal muscles (core), level chin, and shoulders drawn back. Maintaining this positioning in the operating room can be difficult, especially when multiple surgeons are operating on the same patient concurrently; the operating table can only be adjusted to height requirements of one surgeon, others requiring stackable standing stools to meet the table height. This issue is further compounded when the positioning of display screens for scope, instrument tables, and foot pedals are considered. There currently exists no fully equitable solution for these surgeons; that is our mission.

**PROJECT BENEFITS:** By the end of this term, our team aims to create an improved standing stool to mitigate the negative effects of prolonged standing outside of neutral posture. With features including a wider base to distribute weight and improve lateral movement, a pitched platform to engage core muscles and hold spine in a neutral position, adjustable height to accommodate the vertical requirements of all surgeons more evenly.

Improved Temporary Pediatric Cardiac Pacing

Team 10
Emily Tackett
Camila Lozano Aguirre
Francisco Cortez-Thomas

**PROJECT DESCRIPTION:** Cardiac arrhythmias, or irregular heartbeats, frequently affect infants and children following openheart surgery, posing life-threatening risks. To address this, temporary cardiac pacing is recommended and almost all pediatric patients receive temporary epicardial pacing wires during surgery. However, this procedure often leads to complications such as bleeding, wire fragment migration, and infection, and the installation procedure itself can be traumatic for small children. Our project seeks to mitigate these challenges by designing a medical device that combines a nasogastric (NG) tube with esophageal pacing capabilities.

**PROJECT BENEFITS:** By integrating the NG tube with esophageal pacing into a single device, we foresee an improvement in patient comfort as well as a reduction in complications. Additionally, the device’s simplified installation and removal process would be able to be conducted by a variety of medical staff, not just a cardiology specialist enhancing accessibility and patient care for medically underserved areas.
Improved BiPAP Mask for Greater Patient Compliance

**Team 11**  
Casey Colley  
Kamrin Green  
Christ Moo

**PROJECT DESCRIPTION:** The team’s goal is to design a new cushion that can better contour to user’s unique facial features. The new design has a soft and moldable property that allows for an individualized cushion shape that creates a perfect fit for the user.

**PROJECT BENEFITS:** The team’s goal is to design a new cushion that can better contour to user’s unique facial features. The new design has a soft and moldable property that allows for an individualized cushion shape that creates a perfect fit for the user.

Improved Urinary Catheter

**Team 12**  
Youssef Bekhiet  
Samuel Ibrahim  
Omar Salem

**PROJECT DESCRIPTION:** This is an improved urinary catheter that would be more convenient and less associated with UTIs by creating an innovative way of irrigation.

**PROJECT BENEFITS:** Lower the risk of UTIs, convenient for patients, and doesn’t compromise the catheter closed system.
Developing A Survey Response System for Alcoholic Beverages

Team 1
Dylan Zion
Daniel Bonilla
Ben Ferguson

Joseph Ryan
Satvik Adlakha

PROJECT DESCRIPTION: Develop a website and database. Develop reports to provide information to clients. Building a survey response form for consumers to rate alcoholic beverages.

PROJECT BENEFITS: Allows for beer enthusiast to know which beverage to try based on several different categories of preference.

Solar Lawnmower

Team 2
Noah Joyner
Kris Gardner
Tomas Ferreyra

Sitan Subedi
Sydney Wall

PROJECT DESCRIPTION: Leveraging computer vision image analysis and large language models to control the behavior of a lawnmower in an artificially intelligent way.

PROJECT BENEFITS: Expanding applications and understanding of state-of-the-art AI technologies, exploring new avenues for automation and increased efficiency.
Tobacco Retailer Permits

Team 3  
Lomus Hon  
Alvin Tran  
Hoang Chau  
Jacob Sanders  
Huy Le  

PROJECT DESCRIPTION: We are working with the Louisville Metro Public Health and Wellness Department to identify potential stores around the city that are selling tobacco-related products without a permit.

PROJECT BENEFITS: By monitoring the illegal retail of tobacco products, we prevent a plethora of health issues and addictions that may arise within the populace. The end goal is to stop vendors from providing children and teens these products illegally, stifling early age addiction and protecting against detriments to their health sooner in life than later.

Let’s Go Carquex

Team 4  
David Thompson  
Sabrina Dahl  
Jacob Higdon  
Sarah Chung  
Maria Gonzalez  

PROJECT DESCRIPTION: Finding and visualizing an optimal packing order for a specified list of packages onto pallets to be transported via cargo shipments.

PROJECT BENEFITS: Helps to aid service members in packing a large list of items/containers by finding the easiest and optimal order in which to pack the containers to minimize travel time and maximize ease of organization.
Leadership Amplifier Migration

Team 1
Madison Arnett
Ahmed Abdulahi
Emily Dodd

**PROJECT DESCRIPTION:** The Leadership Amplifier app promotes learning leadership skills through personal reflection and community discussion. It is currently available on Andriod and iOS. We are migrating the app from using the Xamarin framework to using the .NET MAUI framework as well as expanding it to work on macOS and Windows.

**PROJECT BENEFITS:** Expanding the app to run on macOS and Windows is useful for users that prefer desktop applications over mobile apps. Migration from Xamarin to .NET MAUI is important because Xamarin will no longer be supported in 2024.
**MECHANICAL ENGINEERING**

**Assisted Bathroom Device**

**Team 1**
Conner Gilliland  
Micah Wright  
Seth Pugh  
Mustafa Al Ruqayyah  
Amelia Watkins

**PROJECT DESCRIPTION:** An assisted bathroom device to help create and establish good potty training habits, and help kids experience independence when using the restroom. The stand will help younger children be able to independently get on and off the toilet. The dispenser will prevent kids from using too much toilet paper while positively encouraging them and creating good habits.

**PROJECT BENEFITS:** Project benefits include but are not limited to: establishing good potty training habits, safer toilet mounting for kids, reducing toilet paper waste, making potty training easier for parents, and creating a positive environment for kids.

---

**K-9 Kennels for Military Transport**

**Team 2**
Garrett Coates  
Caleb Harris  
Jeffrey Williams  
John Nacario

**PROJECT DESCRIPTION:** The XVIII Airbourne’s Military needs a way to safely transport K-9 over an extended period of time (12+ hours) with the new Joint Light Tactical Vehicle. The K-9 need a kennel that doesn’t impair their alertness and keeps them safe.

**PROJECT BENEFITS:** The benefit of this project is providing a safe transportation device for military use, that will keep the K-9 task force for future runs in the JLTV.
Large Cabinet Redesign

Team 3
Matthew Downs
Edward Basham
Manav Patel

PROJECT DESCRIPTION: Redesign a cabinet containing and supporting automotive training components.

PROJECT BENEFITS: Reduce weight of the entire training assembly. Reduce cost and assembly time compared to prior iterations.

Sand Crab

Team 4
Bryson Haynes
Anthony Griffith
William Mccoy

PROJECT DESCRIPTION: A device for transporting items across different forms of terrain in a nice compact form factor fit for any occasion.

PROJECT BENEFITS: Easily storable, easy to use, and big enough to fit items for the whole family.
**ANS Redesign for ATech Training**

**Team 1**  
David Bell  
James Kearney  
Carson Foy

**Team 2**  
Jacob Jones  
Will Arnold  
Morgan Folden

**PROJECT DESCRIPTION:** Redesigning of communication board known as the ANS board for Atech training simulators.

**PROJECT BENEFITS:** Through University collaboration students gain project experience by revising communication board to enhance and expand Atech’s designs.

---

**Electric Experimental Aircraft**

**Team 2**  
Luke Busch  
Martin Resinger  
Nicholas Rogers

**Team 2**  
Benjamin Christensen  
Isaac Malott  
Jonathan Rideout

**PROJECT DESCRIPTION:** We are tasked to replace a gas-powered engine with an electric motor for a training plane for UPS.

**PROJECT BENEFITS:** Reduce the cost training pilots need to pay for practice flights, reduces the carbon footprint of the plane after so many uses, and simplifies repairs on the plane.
What are Senior Capstone Design Projects?

Senior design courses are required for undergraduate students and are the culminating experience that allows them to put into practice the curriculum that they have been learning. Students in capstone are typically 1-2 semesters from graduating and will have already completed three semesters of an engineering co-op. Students in the capstone course will be divided into teams of 4-5 members and will have 14 weeks to complete the industry project.

The Benefits of Partnering with a Capstone:
- Move forward your innovative idea or back-burner project.
- Interact with potential future employees.
- Gain a fresh set of ideas/designs from talented students.
- Support the J.B. Speed School of Engineering & engineering education.

Intellectual Property (IP) & Non-disclosure Agreements:
The J.B. Speed School of Engineering has worked with UofL legal office to develop an IP agreement that covers all capstone projects. Students can also be asked to sign non-disclosure agreements when working on an industry capstone project.

FINANCIAL SUPPORT
Industry partnered capstone design projects require a donation of $2,000 - $5,000 depending on your classification:
- $5,000 - Corporations
- $3,000 - Start-Up Companies (50 employees or less) / Non-Profits / Government
- $2,000 - Individuals

Please note that 80% of your support is deemed tax deductible.

How is the support used?
Of the money contributed, up to $1,000 will be available for your student team to use toward the completion of the project. Any project needs above that amount will need to be covered by the industry partner. The additional amount of the gift is used by the engineering department to improve facilities, provide training, and cover program costs related to capstone and/or the overall academic mission of the Speed School.

PROPOSAL DEADLINES
FALL 2024
BE, CSE, ECE, ME - JULY 1
SPRING 2025
CSE, ChE, ECE, IE, ME - OCT. 31

FOR MORE INFO PLEASE CONTACT
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PROJECT SUBMISSION - uofl.me/3zVtcjj