



URCAD
UNIVERSITY RESEARCH AND
CREATIVE ACHIEVEMENT DAY

Undergraduate Demonstrations – AIH 107

Location: AIH 107

Time: 9:00 AM – 11:00 AM

Unitree Go2 Robot Dog Safety Monitor

Gray Solovyev

Computer Science-Honors

Advisor: Dr. Stan Kurkovsky

This project focuses on developing a vision-based safety and situational awareness system using the Unitree Go2 EDU robotic dog. The robot dog is equipped with onboard cameras and an NVIDIA Jetson computer, providing a powerful system for monitoring safety through computer vision. This project aims to create a system that automatically detects potential safety hazards within AIH 107. The system utilizes the Unitree SDK to control and communicate with the robot, YOLO AI models for real-time object detection via PyTorch, and OpenCV to define virtual safety zones. The Go2 robot will be positioned in a fixed location at the front of the lab, where its camera will monitor key safety areas such as the doorway and emergency shutoff button. OpenCV is used to establish these predefined safety zones thanks to its association with Go2. At regular intervals, the system will capture images and apply an object detection model trained on lab-specific images to identify objects such as chairs, bags, carts, or tables obstructing safety zones. Any object overlapping the safety zones for a preset duration is flagged as a safety issue. When this occurs, the system logs the event to a terminal and triggers the robot to “bark,” sending out an alert if the obstruction persists. The expected outcome is a safety monitoring system that detects obstructions in critical safety areas in real-time, improving overall lab safety and response to hazards.



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High Channel Data Acquisition for CCSU Robotics Lab

Daniel Polgun

Computer Science

Advisor: Dr. Stan Kurkovsky

This project is focused on creating a standalone Windows desktop application to acquire and visualize state and signal data provided by an ABB IRB 1200 robot arm. The idea is for a user to connect to a robot, select which channels to monitor, and initiate real time data acquisition. The main objective is to get around the ABB Robot Studio application's 12 channel limit and set up a system for possible future AI analysis. We developed a new project using the ABB PC SDK for connection to the robot as well as desktop app technologies .NET, WPF, C#, and XAML all in Visual Studio. Using these tools, we've created a similar, but simpler process to the existing Robot Studio software where a user begins by connecting to an ABB Robot Controller on the same network, then selecting various signals they may want to track through a tree of checkboxes. Once their desired signals have been tracked, live graphs of all tracked signals will be automatically displayed and separated into categories based on a signal's unit of measurement. Then the user can begin logging data to a csv file where timestamps and data of every tracked signal will be added based on the user's chosen update frequency. These recording files can then be utilized and manipulated in any way the user desires. This project is a foundation for enhanced ABB Robot Data Acquisition in the CCSU Robotics Lab that sets up a framework and system for future teams or practical Engineering applications.

Augmented Reality Infrastructure Inspection System

Kelly Ruiz

Computer Science - Honors

Advisor: Dr. Stan Kurkovsky

This project focuses on using Microsoft HoloLens 2 as an augmented reality interface to help identify structural problems in bridges. The system uses a computer vision model called YOLO, which stands for You Only Look Once, to detect common defects such as cracks, and corrosion. By combining augmented reality with artificial intelligence, the goal is to make bridge inspections more efficient and easier to understand. The system is developed using Unity, which also acts as the connection between the HoloLens and the backend. It captures images through the HoloLens 2 camera and sends them to a backend environment using a ROS TCP connection. The backend runs YOLO inside a ROS environment that is containerized within Docker. After processing, the detection results are sent back to the HoloLens and displayed in the user's field of view as visual overlays. This lets users see where defects are in real time. The system also includes interactive features that let users click on a button and learn more about each detected defect, including descriptions. Unity and MRTK3 make it possible to create simple interactions like pressing a button to take a picture and view results directly in the augmented reality environment. With the right hardware, AI enhanced detection can provide detailed metrics on microcracks or other precursors of structural defects, which can inform inspectors of our infrastructure's current state and further actions that may need to be taken as a result.



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Undergraduate Demonstrations – AIH Lobby

Location: AIH Lobby

Time: 12:00 PM – 2:00 PM

CNC Metal Lathe

David Stolarz

Mechanical Engineering

Advisor: Dr. Reza Ghodsi

This project details the design and manufacture of a CNC lathe. The objective of the project is to create a portable lathe with a small footprint capable of turning metal. This lathe is redesigned from 2 other previous iterations. The quantitative goals were to reduce part tolerances to $\pm 0.001''$ and a $\pm 0.0005''$ runout in the spindle. The scope of the project was originally to redesign the spindle assembly and frame, but several additional features were added during manufacturing. These included way covers, end stops, an electronics enclosure with a touch screen, upgraded motors, and an improved quick-change tool post. One of the results of the project is a fully parametric CAD model with 112 individual critical components not including hardware, grease, and gasket material. The budget of the lathe was \$700 which was surpassed, reaching a total of \$1232.40. This increased cost consisted of unexpected changes which occurred during the manufacturing portion of the project. Portability was a design constraint set at the beginning of the project. The goal was to keep the project under 120lb. The lathe ended up weighing around 105lb. The previous iteration of the lathe had a runout in the spindle of $\pm 0.015''$ contributing to vibrations resulting in an unacceptable surface finish and part tolerances. The measured runout in the spindle is now $\pm 0.0005''$ which satisfies the projects requirements.



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PEP26 Workforce Development Competition, Planing Boat

Dephtany Ayala, Dihn Doan, Skylre Hine

Mechanical Engineering Technology

Advisor: Dr. David Sianez and Dr. Reza Ghodsi

For our Senior Capstone project, our group has designed and fabricated a 14-foot planing boat and electric motor to take to the PEP26 Workforce Development Competition taking place in Virginia on April 14. The team started with generating MasterCam files out of plans purchased from Boat Builder Central. These files were CNC cut out onto marine grade plywood to serve as the foundation and frame of the boat. A strongback was built to keep proper alignment during the building process. After these panels were connected and properly aligned, the team fiber-glassed both the inside and the outside of the vessel. The transom, bulkheads, and decking were all fiber-glassed with small strips to create reinforcement in normally weak locations. While fabrication of the boat was happening, in the background the group was conducting research on electric motor components to purchase. Flotation foam was poured into the front and back decks to ensure the boat would remain above water in case of damage or capsizing. Fairing compound was applied multiple times to create a smooth surface both on the inside and outside of the boat, with each layer being cured and sanded in between. Once the main fabrication steps of the boat were completed, the team started assembling the motor components and mounting the outboard to the transom. The purchased electric motor was mounted to a Short-tailed Mud Motor Outboard Assembly, and brackets were machined to support the weight of the outboard on the transom. The battery, controller, solenoid, throttle, and kill switch were mounted into the middle bench, and PVC tubing was run through the boat to protect the wires from water exposure. FEA, as well as FEA hand calculation verification was performed on the boat. The team also created a gannt chart and cost analysis of the boat, as well as a thorough risk assessment. Competition deliverables required a white paper and video presentation to be submitted by March 24, 2026, so the team was completing those in the background. The boat has been tested in the water for both safety and functionality and will be taken to competition on April 13, 2026. The overall goal is to complete the race, but the team also aims to place well.



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Motor Thrust Stand

Andrew Behrendt

Mechatronics Robotics Engineering

Advisor: Dr. Hassan Shibly

Accurate measurement of thrust and associated performance parameters is essential for evaluating small electric motor-powered systems used in drones and experimental applications. This project presents the design and implementation of a low-cost, microcontroller-based thrust measurement system utilizing a 10 kg load cell and HX711 amplifier to quantify motor-generated force. The system integrates a vertically mounted brushless motor with a rigid test stand made of aluminum, where the motor produces lift upwards. Calibration was performed using 5 different known masses to ensure accurate conversion from raw sensor data to force in Newtons. RPM of the motor is measured using an IR sensor and an additional load cell is used to measure torque that the motor creates. The moment of inertia is calculated within the code based off how far from the center line the torque is being measured. A 1000kV and 2200Kv motor are being used as well as several different propellers. This will allow users to see the fluctuation that different motors, rpm, and propellers cause in thrust and torque readings. I really hope that this project can help future engineering students and additionally helps to increase their knowledge and understanding of how these motors and propellers work together.

pH Bot: Robotics to help your Lab Spaces

Winston Sanchez-Martinez

Robotics and Mechatronics Engineering Technology

Advisor: Dr. Sarah Maurer

Laboratory processes, such as measuring pH values of samples, in chemical inquiries are precise, but time-consuming, thus automation of those processes is vital to the field, especially university-level chemistry laboratories. While the creation of pH measuring automation is not a discovery, creating a cost-effective robotic solution while remaining effective and accurate is what was explored and tested. Using a 3D printer as the base, the robot moves a pH probe into and out of samples, sending the signal to an Arduino Nano that reads the pH value. The result is passed on to the host python code and commands the printer via g-code commands. Finally, the robot has 3D printed parts attached and added to transform it of its use. This results in a low-cost automated pH measuring process that could accurately read and store pH values of samples, acting as a cheaper addition for college chemistry labs.