ENGINE
SHOWCASE
Virtual Exhibition
JUNE 1 - 7, 2020
Photos from the 2019 ENGINE Showcase
Welcome to the University of Washington Department of Electrical & Computer Engineering’s (UW ECE’s) 2020 ENGineering INnovation and Entrepreneurship (ENGINE) Showcase. It’s a delight every year to invite our industry and campus colleagues to join us as we showcase and celebrate the hard work of our students, who will soon be graduating to become the next generation of electrical and computer engineers.

Because of the unexpected impact of the novel coronavirus, this year’s ENGINE Showcase is a unique, virtual experience. We are featuring over 40 team projects online that cover topics as diverse as computer systems architecture, power electronics, machine learning, communications and robotics. The students here today comprise the majority of our graduating seniors.

ENGINE, our Engineering Entrepreneurial Capstone program, was created to enable students to work in teams on industry-sponsored projects. This program, generously endowed by our alums Milton and Delia Zeutschel, is designed to develop students’ skills in systems engineering, innovation and project management.

Initiated four years ago, ENGINE has grown every year, from just four projects in 2016 to over 40 in 2020. Milt and his business partner John Reece have also spent significant time to give feedback and to shape the program. In addition, John has given several lectures to our students over multiple years on career development, teamwork, entrepreneurship and leadership.

I wish to extend a special thanks to all our industry sponsors for their generous contributions, as well as their flexibility and creativity, helping students adapt their projects to be completed in a virtual setting. I’d also like to thank our faculty mentors; ENGINE Program Director, Payman Arabshahi; College of Engineering Capstone Director, Jill Kaatz; and Associate Dean for Academic Affairs, Brian Fabien, as well as our amazing ENGINE Teaching Assistants, Shruti Misra, Niveditha Kalavakonda, Yana Sosnovskaya, and Brandon Yee, without whom these projects would not have been possible.

Congratulations to all students on the completion of your final capstone projects! The knowledge you have gained from this experience will serve you well in the coming years. I have no doubt that you will build successful and rewarding careers.

In closing, I want to recognize and thank our UW College of Engineering Dean, Nancy Allbritton. She has been a steadfast leader and a great support to UW ECE during these most challenging times.

I look forward to having the chance to talk with you about future collaborations, whether in-person, virtually or via email. Enjoy the ENGINE of UW ECE!

Best to all,

Eric Klavins

Professor and Chair, UW Department of Electrical & Computer Engineering
## 2020 ENGINE PROJECTS

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Drilled Hole Exit Burr Gauge
Camera and Radar Fusion for Object Detection
QuickDraw Game - Shape Detection using AWS DeepLens and Alexa Echo Device
Next-gen CI/CD Factory for Embedded System
LiDAR and Radar Interference and Synchronization using Short Range Communication
Predictive Data Analytics for a Complex System-of-Systems
Fault Detection in HVAC
Modular Closed-Loop Control Board for Infrared Laser Systems
Human Powered Submarine Autonomous Roll Control Module
Dynamic Trailer-Measurements Calculator
Wireless Pulse Oximeter
Robotic Arm Error Analysis and Reduction
Smart Light Trap: Intelligent Crab Monitoring
Cyclotron Radio-Frequency Motion Control System
Categorizing Aviation Events using Machine Learning Techniques
Airbus Urban Mobility Battery Replacement Vehicle
Applewhite Aero Baton
Capstone, Imaging and Astrionics (CIA) Board for Controlling Cubesat Magnetorquers
PROJECT 01

STUDENTS
ADIL ISLAM,
SHAWN HSIAO,
KALYANI MARATHE,
NING WANG

FACULTY ADVISORS
RADHA POOVENDRAN,
BHASKAR
RAMASUBRAMANIAN

INDUSTRY MENTORS
BALA NEERUMALLA,
YUHUI HUANG

SPONSOR
NUTANIX

Open Source Honeypot Management System

Development of an open source honeypot management system that is easy to deploy, operate, and customize and provides options to integrate into a centralized log management system.

PROJECT 02

STUDENTS
GRANT NEUMAN,
BATINA SHIKHALIEVA,
JAMES MANN,
JUNHONG CAI,
SHAHRZAD FEGHHI

FACULTY ADVISOR
PAYMAN ARABSHAHI

INDUSTRY MENTORS
KEVIN HRUZA,
DAMON ZIRKLER,
DEREK CHAN,
COLLEEN PIPER

SPONSOR
ALASKA AIRLINES

Aircraft Software Configuration Tool

Development of a web portal to allow maintenance technicians access to exact software configurations that need to be loaded onto a particular aircraft and give engineers the ability to reliably and accurately update aircraft maintenance information.
**Infrared Camera for HMT-1**

Design, development, and test of a custom PCB and 3D-printed housing for a Lepton infrared camera to interface with RealWear’s HMT-1 headset, maintaining a low-profile, industrial design.

**Smart Server Mover**

The aim of the project is to investigate a full-stack robot system composed of computer, electrical, and mechanical subsystems, to automate the process of server replacement and repair. We attempt to build a mobile manipulator that can detect and localize, pick and place, carry servers and navigate in the server room. Our final system is capable of powering a conveyor, simulating a pick-place procedure, and successfully reaching the server rack in the real world.
**PROJECT 05**

**STUDENTS**
Aditya Jain, Vicente Arroyos, Tyvon Tabadero

**FACULTY ADVISOR**
Howard Chizeck

**INDUSTRY MENTOR**
Vivek Burhanpurkar

**SPONSOR**
Cyberworks Robotics

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**AUTONOMOUS WHEELCHAIR FOR PATIENT DELIVERY**

Development and integration of graceful motion and motion predictive algorithms using a robot operating system with sensor packages to perform autonomous patient delivery in hospital environments.

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**PROJECT 06**

**STUDENTS**
Russell Kook, Nathaniel Rhodes, Faisal Alsallum, Jonathan Casamayor

**FACULTY ADVISOR**
Howard Chizeck

**INDUSTRY MENTORS**
Ricardo Fritzke, Sam Pedigo

**SPONSOR**
Boeing

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**ROBOT NORMALITY SENSOR**

Design, fabrication, and test of a non-contact normality sensor system along with a controller to read the sensors, calculate the pitch and yaw, and display the angles.
**Smart Pill Pack Dispenser**

Development of a pill pack dispenser to improve medication adherence and verify pill authenticity. This dispenser implements machine learning and unique pill patterns to track prescription medications.

**Students**
DAVID ALBERS, ZHONGYI DAI, CHARLIE FISHER, STEVE LAMBERT

**Faculty Advisor**
TAI-CHANG CHEN

**Industry Mentor**
DAVID PROKOP

**Sponsor**
TRUMEDICINES

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**Smart Light Trap: Intelligent Crab Population Monitoring**

Refinement of a sensor package to be deployed on crab traps used to monitor local crab larvae populations. The sensor package is capable of long-term deployment and collection of a range of data, including temperature, salinity, and wave action.

**Student**
MATTHEW PANIPINTO

**Faculty Advisor**
RANIA HUSSEIN

**Industry Mentor**
PAUL MCELHANY

**Sponsor**
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
**PROJECT 09**

**STUDENTS**
MARCUS CHU, WICHWONG PREMVUTI, IAN GOOD, KHAI PHAM

**FACULTY ADVISOR**
HOWARD CHIZECK

**INDUSTRY MENTOR**
NICHOLAS KEEHN, CORINA ARAMA

**SPONSOR**
MICROSOFT

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**AUTOMATED SERVER REPAIR WORKCELL FOR DATA CENTERS**

Development of a computer vision-based platform to repair data center servers with variable pose using two collaborative robotic arms.

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**PROJECT 10**

**STUDENTS**
KATIE PARK, SIMONE DYE, SHU XU, ANDREAS PASSAS

**FACULTY ADVISOR**
BAOSEN ZHANG

**INDUSTRY MENTOR**
LUCIE HUANG

**SPONSOR**
SEATTLE CITY LIGHT

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**ECO-DISTRICTS: DESIGNING GREEN CITIES OF THE FUTURE**

Investigating the feasibility of implementing an Eco-district in the West Campus area of the University of Washington campus including a proposed design and major findings.
RF Link Over Multimode Fiber Analysis

The project attempts to facilitate optical communication within commercial airplanes. Through simulations, we modeled a suitable communication network and measured the performance characteristics of the network.

STUDENTS
ANDREW HALL, FORREST MILLER, KIRILL SEMENOV

FACULTY ADVISOR
ARKA MAJUMDAR

INDUSTRY MENTORS
ALEXANDRE BACOU, BRAD KAUFFMAN

SPONSOR
LATÉCOÈRE

GaN Inverter for Electric Aircraft Propulsion

Development and testing of a gallium nitride (GaN) based inverter for use in electric aircraft motor drive systems. The inverter uses wide-bandgap semiconductors in to improve performance, efficiency, and power density of current electric propulsion systems.

STUDENTS
DYLAN DAY, NATHAN PARK

FACULTY ADVISOR
BRIAN JOHNSON

INDUSTRY MENTORS
NIDHI HARYANI, SATISH RAJAGOPALAN

SPONSOR
AMAZON PRIME AIR
Cooperative Autonomous Distributed Robotic Explorers (CADRE)

Development of autonomous multi-robot system with sensors for collection and processing of scientific data.

Wearable Pet Health and Location Tracker

Design and build of an efficient collar that tracks biometrics and location of pets with integrated user-friendly interface and IoT system for multi-device capability.
CEE Hydo-Cub Bot

Washington State Department of Transportation currently uses the HIVE Bot to survey and record inspections of culverts. However, the HIVE Bot is unable to go through the entire length of the culvert without losing Wi-Fi connection; and has limited camera range, size, and speed control. In this project we improve the current HIVE bot design and address its issues from an electrical engineering perspective.

Cloud-Based Facial Recognition System

Development of a cloud-based facial recognition system for ATMs and financial centers to identify customers and to provide a secondary authentication.

Students

Jina Yoo, Sherman White

Faculty Advisors

Faisal Hossain, Howard Chizeck

Industry Mentors

Cameron Kukes, Kelsie Crawford

Sponsor

Washington State Department of Transportation

Students

Simon Wang, Erik Wheeler, David Yu, Haobo Zhang

Faculty Advisor

Rania Hussein

Industry Mentor

Jim Jenkins

Sponsor

Boeing Employees’ Credit Union
Writing Interface for Collaboration in VR

Design, development, and test of an intelligent interface that enhances a person’s ability to collaborate within Virtual Reality (VR). This involved creation of an interface that allows the user to write onto a wireless pad, giving the user the same feeling as if they were writing on a white board or notepad.

Smart Data-Labeling, Statistics and Analytics System

Analyzing data from telecom operators is a time-consuming process, and the majority of the work requires people working manually to dig out useful information from given datasets. To facilitate the data analysis process, we created a tool to automatically provide basic knowledge of the data, such as statistics, correlations, patterns, relations etc., to aid and direct data scientists towards deeper analysis.
**PROJECT 19**

**STUDENTS**
ANTON BEZRUCHKIN, ZIHAN CAO

**FACULTY ADVISOR**
HOWARD CHIZECK

**INDUSTRY MENTORS**
ANAT CASPI, RICKY ZHANG

**SPONSOR**
TCAT

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**PRECISION VEHICLE POSITIONING IN URBAN AREAS**

This project aims to minimize the error in GPS positioning of vehicles in urban areas. The final deliverable of the project is a cost-effective product composed of a sensor fusion system for positioning, and a visual marker detection system for drift correction.

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**PROJECT 20**

**STUDENTS**
CHENG-YEN YANG, HWAI-JIN PENG, PINZHU QIAN, TYAN TRINH

**FACULTY ADVISOR**
PAYMAN ARABSHAHI

**INDUSTRY MENTORS**
KUMAR MADDALI, CHANGZHENG JIANG

**SPONSOR**
TELENAV

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**AN INCREMENTAL LEARNING BASED SPELL CHECKER FOR LOCAL SEARCH USER QUERIES**

Development of a robust address spell checker that suggests corrections of misspellings in real-time with incremental learning ability.
**Administrative and Financial Web Portal**

Development of a web application with a background database that can be used internally for College of Engineering departments to manage, process and track administrative and financial requests for both students and fiscal staff, including purchasing, reimbursements, travel requests (booking and reimbursements), and procard document submission.

**Detection of Object Features in Images via Deep Learning with OfferUp**

Development of image classification models using Google Cloud AutoML and TensorFlow with image data collected from OfferUp customers. The models are integrated into web and mobile applications to identify images and predict the classes to which they belong, such as distinguishing shoes from clothes, the gender of the items, and the various types of shoes.
T-MOBILE NB-IoT Package Tracker

Implemented an NB-IoT device into packages with the intent of tracking them more closely and accurately to prevent package theft. Integrated the NB-IoT device with sensors that communicate with servers and a web user interface.

STUDENTS
RYAN ROSS,
TYLER LA,
DANIYAL ZULFIQAR,
YITONG SUN

FACULTY ADVISOR
TAI-CHANG CHEN

INDUSTRY MENTORS
JEFF AHMET,
AHMAD ARMAND

SPONSOR
T-MOBILE

Drilled Hole Exit Burr Gauge

Development and testing of an exit burr gauge to measure airplane wing drill hole burrs from the outside, reducing the inefficiencies of the current measuring process.

STUDENTS
ELIZAVETA MANEVICH,
DALIN DU,
JADE JWA,
KUAN-LIN CHEN

FACULTY ADVISOR
TAI-CHANG CHEN

INDUSTRY MENTOR
MITCHELL JOHNSON

SPONSOR
BOEING
**Camera and Radar Fusion for Object Detection**

Development of a system that detects and classifies objects by fusing radar and camera data, and boosts object detection accuracy from camera and localization precision from radar.

**QuickDraw Game - Shape Detection using AWS DeepLens and Alexa Echo Device**

Development of a deep-learning model to detect object shapes from the user drawings by using DeepLens to capture input images and Alexa echo device to interact with the user throughout the QuickDraw game.
**PROJECT 27**

**STUDENTS**
DANIELLE FUNG, ANUJA KALEKAR, KARAN CHAUHAN

**FACULTY ADVISOR**
PAYMAN ARABSHAHI

**INDUSTRY MENTORS**
ADRIEN LEVRAT, CEDRIC VINCENT

**SPONSOR**
WITEKIO

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**NEXT-GEN CI/CD FACTORY FOR EMBEDDED SYSTEM**

Design and implementation of an autonomous CI/CD solution for embedded systems using Fuego and Witekio’s automation lab along with deployment of the OS image updates over the air.

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**PROJECT 28**

**STUDENTS**
BHARADWAJ MUKUND, MEACH TEKHONG

**FACULTY ADVISORS**
SUMIT ROY, ARKA MAJUMDAR

**INDUSTRY MENTORS**
NELSON JAMES, BALTON CHRIS

**SPONSOR**
PACCAR

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**LiDAR AND RADAR INTERFERENCE AND SYNCHRONIZATION USING SHORT RANGE COMMUNICATION**

Design of an embedded platform for LiDAR and Radar synchronization using Peer-to-Peer (P2P) communication to reduce inter-vehicle interference.
**PROJECT 29**

**STUDENTS**
Benjamin Azevedo, Chenyang Bao, Chang Liu

**FACULTY ADVISOR**
Eli Shlizerman

**INDUSTRY MENTORS**
Tom Mittan, Pete Sulcs, Matt Nguyen

**SPONSOR**
Lockheed Martin

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**PREDICTIVE DATA ANALYTICS FOR A COMPLEX SYSTEM-OF-SYSTEMS**

Predictive health monitoring, fault investigation, and failure analysis interface for TO-220AB Power MOSFETs using regression algorithms and neural networks.

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**PROJECT 30**

**STUDENTS**
Robert Rochlin, Tiankai Zheng, Zhenghao Guo

**FACULTY ADVISOR**
Payman Arabshahi

**INDUSTRY MENTORS**
Jon Herlocker, Neil Blavins

**SPONSOR**
Tignis/PSR Mechanical

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**FAULT DETECTION IN HVAC**

Designed a data-driven web application for HVAC system technicians to remotely diagnose and monitor their buildings and enable identification of problems that would otherwise remain obscure.
Modular Closed-loop Control Board for Infrared Laser Systems

The project aims to design a modular closed-loop control system with a user-friendly interface for customizable infrared laser systems. The laser control system is used to provide stable laser power by adjusting the laser control parameters detected by a beam detector module. A laser simulation module is also designed for system testing.

Students
Donghyuk Kim, Jared Schwartz, Peter Tran, Takunda Masike

Faculty Advisor
Howard Chizeck

Industry Mentors
Iris Tsai, Shahab Shahdoost

Sponsor
Access Laser

Human Powered Submarine Autonomous Roll Control Module

Development of an autonomous system for controlling the roll of the human-powered submarine as it navigates through the water. The system is composed of a prototype hardware module with a proof-of-concept vehicle orientation display, a data control loop, and a route tracking system.

Students
Chase Hunter, John Chen, Karine Chen

Faculty Advisor
Sam Burden

Industry Mentors
Eric Jones, Joseph Reck, Nick Valladarez

Sponsor
Booz Allen Hamilton, NUWC Keyport, UW APL
Dynamic Trailer Measurements Calculator

We have designed a system that calculates the length of various trailers and wheelbases using a dynamic turn angle measurement. The system is mountable in its entirety to a Kenworth tractor, and gathers data in near real time. Calculated values are transmitted to the truck over the vehicle CAN network.

Wireless Pulse Oximeter

Development of a wireless pulse oximeter that uses light to measure SpO2, SpCO, and SpMET and displays the measurements on a computer, in real time. This will allow emergency medical teams more flexibility in the field compared to existing devices.
Robotic Arm Error Analysis and Reduction

This project investigates error analysis and reduction methods in small-scale uArm robotics, with the intent to design robust methods that can be scaled to larger industrial machines. The uArms, equipped with touch-screen styluses, are programmed to tap an iPad in one of three test schemes. Data from the iPad is then compared to the expected points to calculate and model the uArm error. Average error functions are then inverted and reapplied to the robot arms in order to reduce the error experienced by the devices.

Smart Light Trap: Intelligent Crab Monitoring

Development of a smart light trap with additional sensor technology and an enhanced user interface to intelligently monitor the surrounding water conditions while capturing megalopae (larval crabs), thereby allowing correlation of megalopae abundance with surrounding water conditions.
Cyclotron Radio-Frequency Motion Control System

Radio Frequency (RF) systems are used in The University of Washington Cyclotron Facility to accelerate particles for various uses including cancer treatment, isotope creation, and advanced materials testing. To achieve a concise, efficient, and stable acceleration for different types of particles, an automatic motion control system for monitoring and regulating the cyclotron's RF motors is designed, built and tested.

Categorizing Aviation Events Using Machine Learning Techniques

Development of an algorithm to classify aviation incidents based on CICTT categories which extracts keywords from the textual report using TF-IDF on n-grams and categorizes incidents via machine learning approaches.
Airbus Urban Mobility Battery Replacement Vehicle

Implementation of charging stations for urban aerial mobility (UAM) vehicles, where a battery replacement vehicle will swap out the old battery for a charged one.

Applewhite Aero Baton

Development of an autonomous delivery drone that is capable of being deployed from moving aircraft. The drone uses GPS and LiDAR for intelligent navigation and is capable of carrying small loads such as a blood transfusion, first aid kit, or a water bottle.
Capstone, Imaging and Astrionics (CIA) Board for Controlling Cubesat Magnetorquers

The CubeSat capstone project deals with designing and implementing a subsystem of the AACT’s cube satellite. This subsystem involves the creation of software and hardware to control magnetorquers, which help control the orientation of the satellite.
The ECE department is enormously grateful for the vision and generosity of Milt (BSEE ’60) and Delia Zeutschel, which has enabled us to develop the ENGINE program to its current scale. Through the magnitude of their endowment of the ENGINE program, the Zeutschels are helping to secure the futures of UW ECE engineers and promote continued local and statewide innovation.

We would also like to thank Milt’s business partner, John Reece, for his unwavering support, having spent significant amounts of time giving feedback to shape the program. Additionally, John has given several lectures to our students over multiple years on career development, teamwork, entrepreneurship and leadership.

The ENGINE program is designed to develop students’ skills in innovation, systems engineering, and project management. Initiated only three years ago, ENGINE has grown exponentially - from just four projects in 2016 to 43 in 2019. Another component of the endowment is the Milton and Delia Zeutschel Professorship in Entrepreneurial Excellence, which was awarded to Professor Joshua Smith. The professorship allows the department to recruit, retain and reward entrepreneurially-driven faculty who will help build and sustain an engineering entrepreneurial ecosystem at the UW.

ECE is also deeply appreciative of our many industry sponsors for their support in mentoring students as part of the ENGINE program.

THANK YOU

Milt & Delia Zeutschel and John Reece

John Reece at the 2019 ENGINE Pitch Day event.
INNOVATION STARTS HERE.

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2020

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