

A young man with short brown hair, wearing a blue t-shirt and a dark blue face mask with "BYU CAPSTONE" printed on it, is leaning over a piece of laboratory equipment. He is looking intently at a component inside a clear safety enclosure. The background shows a well-lit industrial or laboratory setting with overhead fluorescent lights and metal structures.

BYU
CAPSTONE

CAPSTONE REVIEW
2020-2021

CAPSTONE OBJECTIVE

**Help students become
design professionals
who can blend creative,
technical, interpersonal, and
management skills to develop
products that are both
desirable and transferable.**

A Message From Capstone

Welcome to BYU Engineering's 2020-21 Capstone Review. Here, we've included descriptions of the 53 unique Capstone projects completed by students in Mechanical, Computer, Electrical, and Manufacturing Engineering this year.

This Capstone year has been unlike any previous year due to the complications inherent with a global pandemic. We are exceptionally proud of the accomplishments of our student teams under restrictive conditions and unique circumstances. This year, teams worked remotely as much as possible and followed strict safety guidelines when working together in person. We all learned new ways to work together efficiently and effectively. As engineers do, our students faced this year's challenges head on and found ways not only to get by, but to truly excel.

We are very grateful to our sponsors who not only place their trust in us to assist in guiding their projects forward, but who also willingly give of themselves to provide mentorship and support to the students in this culminating experience of their undergraduate education. The experiences provided to students through these real-world projects cannot be duplicated in a "regular" classroom environment and are an invaluable educational tool. We thank each of our project sponsors.

Finally, we express our deepest gratitude to each of the Capstone students. Your dedication, diligence and resilience truly reflect the values of Brigham Young University. It is a pleasure to work with each of you and we wish you all the best as you embark on your careers.

The BYU Capstone Executive Team

Carl Sorensen, Capstone Director
Brian Mazzeo, Capstone Co-Director
Brian Jensen, Capstone Instructor
David Long, Capstone Instructor
Lisa Barrager, ME External Relations Manager
Allyson Gibson, ECEn External Relations Manager
Paula Harper, Capstone Office Manager



PROJECT SPONSORS

- ▶ 4th D Solar
- ▶ Air Force Research Lab/ISSI
- ▶ BD Medical
- ▶ BYU Applied Biomechanics Engineering Lab
- ▶ BYU Electrical and Computer Engineering
- ▶ BYU Mechanical Engineering
- ▶ BYU Gill Laboratory
- ▶ BYU Theatre and Media Arts
- ▶ Baker Hughes
- ▶ Burr OAK Tool
- ▶ CGIS
- ▶ CSL Plasma
- ▶ CaptionCall
- ▶ doTERRA
- ▶ Flowserve
- ▶ Gold Family Farms
- ▶ Idaho National Laboratory
- ▶ Konexus
- ▶ L3Harris Technologies
- ▶ LacNation
- ▶ Lawrence Livermore National Laboratory
- ▶ Los Alamos National Laboratory
- ▶ MP Solar and Power
- ▶ Mercury Systems
- ▶ NKFG
- ▶ National Oilwell Varco
- ▶ Neff Aeronautics
- ▶ Nevada National Security Site
- ▶ Northrop Grumman
- ▶ Novva Data Centers
- ▶ Nu Skin
- ▶ Polar Bears International
- ▶ Raytheon Technologies
- ▶ Sandia National Laboratories
- ▶ Stadler US
- ▶ Varex Imaging Cooperation
- ▶ Ward Hardware, Inc

2020-21 PROJECTS



PAGE	TEAM #	PROJECT TITLE
11	1	Expandable Portable Tracking Solar Array
11	2	Ceramic Turbine Integration
12	3	Sub-Plate Mounted Valve Improvement
12	4	Withheld Pending Patent Process
13	5	Improved Tool Press Feed System
13	6	Electrospinning Process For Nanofiber Masks
14	7	IEEE AP-S Array Beam Forming Design Contest
14	8	Samoan Reef Characterization
15	9	Animatronic Cougar Mechanical Design
15	10	Animatronic Cougar Software Design
16	11	Above Ground Polar Bear Detection System
16	12	Underground Polar Bear Den Detection
17	13	Freeform Conversation Bot
17	14	Lip Syncing With Machine Learning
18	15	Plasma Bag And Solution Inspection Station
18	16	Post-Distillation Essential Oil Purification
19	17	Control Valve Gasket Fixture and Testing
19	18	Automated Potted Plant Loading System
20	19	Malcom Analytics Pipeline
20	20	Nuclear Fuel Rod Profilometry Device
21	21	AlertSense Panic Button
21	22	Network Traffic Generator and Analyzer
22	23	Small Form Factor Large Aperture Antenna
22	24	Powdered Milk Mixing and Packaging System
23	25	High Speed Image Processing to Remove Blur
23	26	UAS Landing Pad Capture System
24	27	Microsphere Insulation Removal and Containment
24	28	PDV GHz Frequency Analyzer
25	29	Compartmentalized Process Tank Digital Model
25	30	DDRx Memory Module Tester
26	31	Microcontroller for Off-Grid Power
26	32	Real-Time RFID Drill Pipe Identification
27	33	Hydrogen Energy Testbed System
27	34	Applied AI for Early Illness Detection
28	35	Next Generation Vacuum Compton Detector
28	36	UV-C LED Reference Design
29	37	Integrated Smart Operations for a Mobile Factory
29	38	Robot Implementation for Hyperscale Data Center

**FAST
FACTS**

963

**PROJECTS
COMPLETED**
1990-2021

31

**YEARS OF
CAPSTONE**
1990-2021

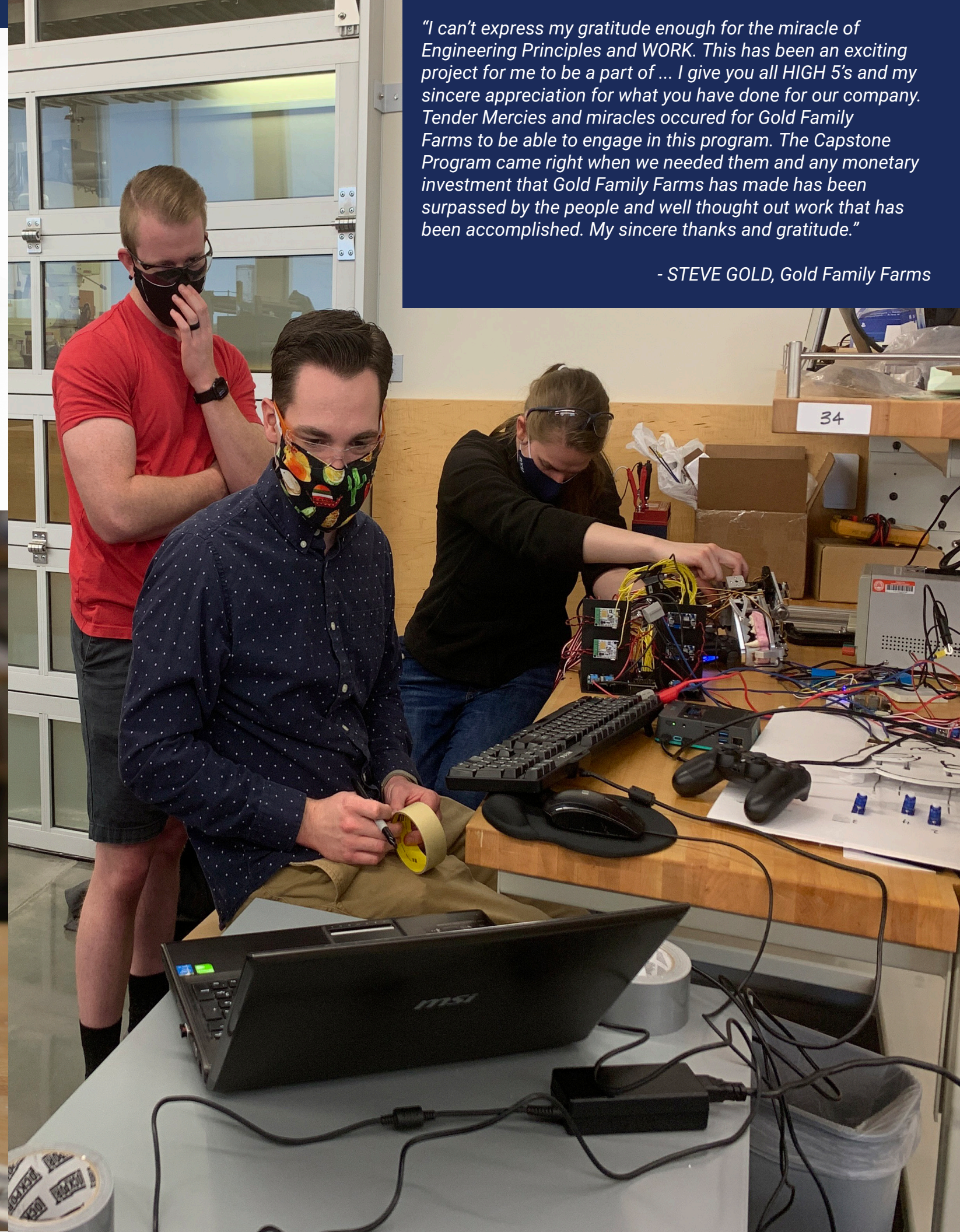
362

**SENIOR
ENGINEERING
STUDENTS**
2020-2021

53

PROJECTS
2020-2021

PAGE	TEAM #	PROJECT TITLE
30	39	Skin Strain Measurement Tool
30	40	Autonomous RF Mapping Octocopter
31	41	Remote Controlled Server Room Robot
31	42	Applied Machine Learning for Vehicle Detection
32	43	Encapsulation Vacuum Chamber
32	44	Firmware Re-hosting Support for Zephyr RTOS
33	45	High Acceleration Impact Test System
33	46	Step and Handrail System for Passenger Trains
34	47	X-Ray Tube Focal Spot Measurement
34	48	Automated High Speed Seed Packet Filler
35	49	DOE Collegiate Wind Competition
35	50	Autonomous Rocket Altitude Control Unit
36	51	University Rover Challenge
36	52	Supermileage Competition: Reduced Friction Valve Train
37	53	Baja SAE Competition: Wireless Telemetry System



"I can't express my gratitude enough for the miracle of Engineering Principles and WORK. This has been an exciting project for me to be a part of ... I give you all HIGH 5's and my sincere appreciation for what you have done for our company. Tender Mercies and miracles occurred for Gold Family Farms to be able to engage in this program. The Capstone Program came right when we needed them and any monetary investment that Gold Family Farms has made has been surpassed by the people and well thought out work that has been accomplished. My sincere thanks and gratitude."

- STEVE GOLD, Gold Family Farms

PROJECT DESCRIPTIONS



Expandable Portable Tracking Solar Array

TEAM 1

SPONSOR: 4th D Solar

PROJECT DESCRIPTION:

The team, in conjunction with 4thD Solar, was tasked with designing, building, and testing an integrated, high-power photovoltaic system uniquely suited for situations where portability, robustness, and efficiency are paramount. Specifically, the aim was to design a system that tracks the sun, can be carried by two people, fit in the back of a truck, and that can collapse down to a small 2D footprint. A significant challenge was to create a design that is strong, light and weatherproof for use in a broad range of weather conditions. The array is designed to produce at least 1000W of continuous power throughout the day in sunny conditions by accurately tracking the sun through the sky.



TEAM MEMBERS:

Chandler Buth, Matthew Heath, Ryan Melander, Tanner Michelsen, Clark Roubicek, Aaron Ruben, Jaxon Smith

TEAM COACH: Jeff Niven

Ceramic Turbine Integration

TEAM 2

SPONSOR: AIR FORCE RESEARCH LABORATORY / INNOVATIVE SCIENTIFIC SOLUTIONS INC.

PROJECT DESCRIPTION:

Researchers working at the Air Force Research Lab tasked the team to develop a ceramic turbine blisk to use in the JetCat P400 engine. The aim of this new ceramic blisk is to increase the engine's thermal efficiency and thrust to weight ratio. Typical turbine blades are made of metallic superalloys, but ceramics are more resistant to heat. Ceramic turbines have the drawback of being more brittle and weaker in tension than their metal counterparts. In order to use a ceramic as the blisk material, it must be validated by finite element analysis and experiments. Modifications to the blisk design were recommended to prevent failure from the rotational velocity and thermal gradient. This project set the basis for future FEA on the ceramic blisk and has identified which design features contribute most to stress reduction.



TEAM MEMBERS:

Andrew Bedke, Matthew Cable, Daniel Deveraux, Eric Green, Josh Halliday, Ben Johnson, Corey Smithson

TEAM COACH: Hans Ottosson



Sub-Plate Mounted Valve Improvement

TEAM 3

SPONSOR: BAKER HUGHES

PROJECT DESCRIPTION:

Baker Hughes designs and manufactures equipment for deep-sea drilling. One key piece of equipment is the Sub Plate Mounted Valve (SPM). The SPM is a hydraulically activated valve with two-way functionality. SPM valves are proven designs that have been around for many years. The valve design has been refined over time after field use and in-house testing. Even with its extensive service life, there has not been much documentation about its flow characteristics. The most typical failure mode seen on the valves is the Delrin ring. The internal valve makes a seal against it when the pilot valve opens. The ring that makes up the seat has been found to crack and deform with repeated and excessive pressure when firing the valve. Approximately 5,000 valves are either installed or have the internal valve components replaced annually which costs the company millions of dollars every time they need to be changed. To help with this problem, the team had benchmarked and documented current operating limits for the Sub-Plate Mounted Valve (SPM) in various sizes; including flowrate, cv, pressure response, and cycle life.

TEAM MEMBERS:

Mitchell Baker, Samuel Bowden, Brad Davis, Mack Huntsman, Alyssa Spencer, Taylor Whedon

TEAM COACH: Hans Ottosson

Improved Tool Press Feed System

TEAM 5

SPONSOR: BURR OAK TOOL

PROJECT DESCRIPTION:

Burr OAK Tool Inc. delivers machines, tools, and expertise to the world's heat exchange and tube processing industries. One machine that they manufacture is a stamping press that makes fins for cooling systems. This machine uses a feed bar to move the material forward and position the fins to be cut to the correct size. This design features over 100 individually moving pins. The complexity of the current feed bar design has made the cost of manufacturing, assembly, and cleaning higher than desired. The team was tasked with simplifying the design. The solution consists of a hydraulically actuated pin plate with pins all fixed to the plate. This reduced the complexity of the design by limiting the number of moving parts. By connecting all the pins to one moving piece, the individual pins no longer get stuck. This design requires less cleaning and issues resulting from the debris created during the manufacturing operation.



TEAM MEMBERS:

Brody Barton, Kyle Callahan, Serah Hatch, Tanner Larsen, Adam Petersen, Nathan Turner

TEAM COACH: Jeff Niven



Withheld Pending Patent Process

TEAM 4

SPONSOR: BD MEDICAL

PROJECT DESCRIPTION:

Project Description currently unavailable while awaiting patent application.

TEAM MEMBERS:

Aaron Bell-Cares, Nate Christiansen, Alyson Devenport, Ross Knutson, Caleb Larson, Brenda Williams

TEAM COACH: Dorothy Taylor

Electrospinning Process for Nanofiber Masks

TEAM 6

SPONSOR: BYU APPLIED BIOMECHANICS ENGINEERING LAB

PROJECT DESCRIPTION:

Researchers from the BYU Applied Biomechanics Research Lab (BABEL) saw a great need for PPE as the global supply chain was disrupted and shortages occurred during the covid pandemic. BABEL wanted to bring new technology closer to the public by creating a low-cost electrospinning machine to tackle the problem of supply chain shortages and pollution by creating a device to make mask filters locally. The team's challenge was to create an electrospinning device for under 100 USD that can spin N95 equivalent filters (commercial machines can cost over \$20,000). The team focused on creating a simple machine that can be built with materials available world-wide. The resulting design includes only the essential components – a frame, pump, and power supply. Information for this simple design is now available online through open-source instructions to allow anyone to start electrospinning. This will not only give availability to those in need but may also stimulate local economies. The intent is to bring the technology of electrospinning to new markets and allow for further development of this technology.



TEAM MEMBERS:

Spencer Curtis, Benjamin Farnsworth, Joseph Furner, Juston Goldade, Denton Markwalter, Devry Smith, Connor Stephenson

TEAM COACH: Jacob Morrise

BYU Electrical & Computer Engineering

TEAM MEMBERS:
Batsaikhan Ariun-Erdene, Ben Francis, Elias Guanuna, Whitney Kinnison, Keaton Shurilla

TEAM COACH: Annette Steed



TEAM MEMBERS:
Dan Co, xKevin Hatch, Bryce Hillman, Jeremie MacDonald, Reilly McKendrick, Marcus Price, John Webster

TEAM COACH: Terri Bateman

IEEE AP-S Array Beam Forming Design Contest

TEAM 7

SPONSOR: BYU ELECTRICAL AND COMPUTER ENGINEERING
PROJECT DESCRIPTION:

IEEE Antennas and Propagation Society holds a yearly Student Design Contest. This year, the challenge was to propose a setup that demonstrates the design of an array with beamforming capability for Direction of Arrival (DoA) determination in a practical application, and provide educational material to explain it. The team designed a fixture that allows a user to simply walk around the installation with a handheld radio transmitter while the display shows the waves coming from their direction. This setup creates an easy way for students to see and for educators to explain the technique of beam forming and direction of arrival calculation. The installation will remain at BYU as both an educational tool and display for the department. The team advanced to the final round of the contest, which will be held in December 2021 in Singapore.

Samoan Reef Characterization

TEAM 8

SPONSOR: BYU GILL LABORATORY
PROJECT DESCRIPTION:

The reefs surrounding Samoa are ecologically significant because of their high levels of biodiversity, but the reefs are poorly characterized. The Gill Laboratory at BYU is characterizing the reefs and performing a long-term study of how climate change and marine protected areas (MPAs) are affecting the reefs. To assist in their study, the Capstone team designed and built a modularized, autonomous above-water vehicle that will capture and store high quality stereo images of the reef. A commercially available autonomous boat was fitted with sensors and cameras, and a custom GPS navigational system was designed to guide the boat over the reef in a repeatable pattern. This custom boat will be used for years to gather data and study the effects of climate change and MPAs on coral reefs.

Animatronic Cougar Mechanical Design

TEAM 9

SPONSOR: THEATRE AND MEDIA ARTS
PROJECT DESCRIPTION:

The BYU Theatre and Media Arts (TMA) department reached out to Capstone to create a life-sized cougar animatronic, creating a unique educational opportunity for students from engineering and TMA to work collaboratively. The engineering students would design the framework and controls for the animatronic, and TMA would make the cougar look life-like. This Capstone team designed and built the mechanical structure of the cougar, creating a cougar framework with 24 degrees of freedom. They also worked with the TMA team to ensure the design fit the needs for costuming and consulted with the TMA team on the best ways to integrate the external features with the mechanical structure.

Animatronic Cougar Software Design

TEAM 10

SPONSOR: BYU THEATRE AND MEDIA ARTS
PROJECT DESCRIPTION:

The BYU Theatre and Media Arts (TMA) department reached out to Capstone to create a life-sized cougar animatronic, creating a unique educational opportunity for students from engineering and TMA to work collaboratively. The engineering students would design the framework and controls for the animatronic, and TMA would make the cougar look life-like. This Capstone team designed and built the control and power systems for the cougar. A puppeteer uses a simple pair of PlayStation4 controllers to make the cougar come to life, controlling facial movements including multiple degrees of freedom for the eyes, nose, mouth, and ears of the cougar.



TEAM MEMBERS:
Abby Ellefson, Oliver Hauver, Alicia Kuhn, Clare Lore, Laura Richardson, Jeremy Stephens, Josh Vause

TEAM COACH: Dexter Francis



TEAM MEMBERS:
Brandon Baum, James Bond, Joe Eddy, Ethan Harris, Parker King, Ryan Smith

TEAM COACH: Allyson Gibson



Above Ground Polar Bear Detection System

TEAM 11

SPONSOR: BYU WILDLANDS RESEARCH LAB

PROJECT DESCRIPTION:

There are regions in the far Northern Hemisphere where the lives of humans and polar bears intersect, sometimes surprisingly. The number of encounters has increased over time, leading to increased risk to human lives and increasing polar bear deaths. With funding from the World Wildlife Fund, BYU Plant and Wildlife Sciences challenged the team to create a radar-based polar bear detection system to limit these harmful interactions. The team designed a radar detection system and corresponding app that allows users to view the location of polar bears in their region, providing an early detection system that ensures both the safety of humans and polar bears.

TEAM MEMBERS:

Student Levi Fleming, Mark Hayden, Jared Marchant, Parker Owen, Kyle Pulsipher, Gabe Saunders

TEAM COACH: Wood Chiang



Underground Polar Bear Den Detection

TEAM 12

SPONSOR: BYU WILDLANDS RESEARCH LAB

PROJECT DESCRIPTION:

In recent years, polar bears in Alaska have been moving inland toward residential areas in search of a secure home and food to build their underground dens. With their close proximity to populated areas, polar bear dens are being disturbed, leading to bear deaths and human injury. Funded by Polar Bears International and sponsored by BYU Plant and Wildlife Sciences, this team was tasked with determining if Synthetic Aperature Radar (SAR) could accurately detect underground polar bear dens in Alaska. The team determined the efficacy of using SAR to detect underground dens by simulating polar bear dens in a snowy area and processing data from SAR imagery gathered during fly-overs of the location.

TEAM MEMBERS:

Christofer Aniel, Tyler Christiansen, Kyle Evans, Tayler Livingston, James Smith, Katherine Wright

TEAM COACH: Evan Zaugg

Freeform Conversation Bot

TEAM 13

SPONSOR: CAPTIONCALL

PROJECT DESCRIPTION:

With the rise of chatbots comes the opportunity to deploy the technology in previously untapped audiences. This Capstone team designed and built a chatbot that was trained to be conversational in nature and to respond to simple comments and questions without a particular end goal in mind. While still in its infancy, the bot will be trained over time to become a friendly companion to its target audience.



CaptionCall
Life is Calling

TEAM MEMBERS:

David Chang, Nathan Cox, Ethan Evans, Ethan Johnson, Jacson Tenney

TEAM COACH: Brian Saville

Lip Syncing With Machine Learning

TEAM 14

SPONSOR: CAPTIONCALL

PROJECT DESCRIPTION:

The National Institute on Deafness and Other Communication Disorders (NIDCD) estimates that one in eight people in the United States aged 12 years or older has hearing loss. Some studies have shown that intelligibility increases when the listener can see the lips of the person speaking. This Capstone team developed software that could generate videos of lips from the audio input of a phone conversation to help the listener better understand the conversation. The team developed and trained software to create videos of lips moving with the audio and measurably improved intelligibility with their audience.



CaptionCall
Life is Calling

TEAM MEMBERS:

Gabriel Arancibia, Opus Fontillas, Daniel Hutchings, Brian Nelson, Joseph Nelson, Joel Syphus

TEAM COACH: Eric Quist



Plasma Bag and Solution Inspection Station

TEAM 15

SPONSOR: CSL PLASMA

PROJECT DESCRIPTION:

CSL Plasma is a subsidiary of CSL Behring, a global biopharmaceuticals company that develops plasma-derived medicine to treat a variety of serious and rare diseases. CSL Plasma operates one of the world's largest and most sophisticated plasma collection networks. During the plasma donation process, two bags of solution are used—anti-coagulant and saline. The inspection process for these solutions is heavily labor driven, expensive, and has significant variability in both inspection and defect identification. The team has designed and prototyped an automated inspection system for bags of anti-coagulant solution using various methods to detect a wide range of possible defects. The automated inspection system prototype gives CSL a working design that they can hand off to an automation vendor to refine and upscale to meet their production goals. A fully working automated inspection system will significantly decrease labor cost and inspection variability, and it will increase the throughput of inspected bags.

TEAM MEMBERS:

Nate Jacobs, Kalliyay Lay, Levi Meyer, Noah Smith, Ethan Starkweather, Ken Weir

TEAM COACH: Donna Clayton



Post-Distillation Essential Oil Purification

TEAM 16

SPONSOR: DOTERRA

PROJECT DESCRIPTION:

Founded in 2008, dōTERRA was built on the mission of sharing highest quality essential oils with the world. dōTERRA's goal is to keep their sourced oils completely natural and safe and thus tasked the team to design, prototype, and test a process that would remove water from the oil while ensuring that no chemical components of the original oil were altered. The student designed system will allow dōTERRA to produce the highest quality oil at a faster rate and much more efficiently than their current process.

TEAM MEMBERS:

Kaley Brinkerhoff, Justin Smith, Jacob Stirling, Naoki Takamasa, Ben Varela, Justin Ward

TEAM COACH: Darrel Goff

Control Valve Gasket Fixture And Testing System

TEAM 17

SPONSOR: FLOWSERVE

PROJECT DESCRIPTION:

Flowserve designs and manufactures valves for many different applications. A critical measure of valve performance is whether or not the fluid inside the valve leaks out of the valve. There are many different factors that affect the valve's ability to prevent this leak path. Flowserve challenged the team to find which factors are the most influential in controlling this seal. The team was tasked with designing a test fixture that will allow Flowserve to test different factors and to quantify leakage. The team's approach was to mimic the valve geometry while allowing for changing the interaction between parts of the valve. This system is contained within a vacuum chamber so that pressurized helium can be used to measure how much the particular set of factors leaks. This project will allow Flowserve to test and quantify how best to seal their valves and allow for improved troubleshooting of repairs and rebuilds.



TEAM MEMBERS:

Claudio Alvarez, Nathan Anderson, David Durfee, Enoch Groberg, Briant Packard, Caden Watts

TEAM COACH: Steve Wilson

Automated Potted Plant Loading System

TEAM 18

SPONSOR: GOLD FAMILY FARMS

PROJECT DESCRIPTION:

Gold Family Farms grows various plant products for sale to garden centers, landscapers, and re-wholesalers across the US and Canada and outperforms competitors through extensive use of automation throughout their business. This automation results in consistently higher quality plants produced at a lower unit cost. One of their operations involves the transportation of plants from a conveyor belt to a flatbed trailer. This process is currently being performed manually by employees. The team's project was to develop an automated system that allows variously sized potted plants to be moved and loaded onto the flatbed trailer without the use of manual labor. The solution involves a series of conveyor belts that will transport and organize the pots as they are received from the previous station. Once the pots are correctly positioned on a final conveyor belt, an overhead gantry will push the pots from the conveyor belt onto their desired location on the flatbed trailer. This automated system will increase efficiency and eliminate the need for repetitive heavy lifting. This allows employees who previously conducted this task to be utilized in higher value activities throughout Gold Family Farms.



GOLD FAMILY FARMS, INC.

TEAM MEMBERS:

Jacob Dean, Clark DeFranco, Joseph Schafer, Zach Snyder, Grant Stagg, Nathan Woolley

TEAM COACH: Ryan Butters



Malcolm Analytics Pipeline

TEAM 19

SPONSOR: IDAHO NATIONAL LAB

PROJECT DESCRIPTION:

Electronic messages have the potential to be intercepted, altered, or replaced with malicious messages. As part of its Homeland Security division, Idaho National Laboratory (INL) has developed and maintains a network analysis tool called Malcolm. Malcolm processes machine communication protocols locally to look for malicious traffic. This Capstone team helped integrate a sub-tool to parse the Bristol Standard Asynchronous/Synchronous Protocol (BSAP) and detect malicious traffic on the line. A graphical interface designed by the team clearly displays needed information, including possibly malicious data.

TEAM MEMBERS:

Danielle Davidson, Colin Gorski, Regan Hanson, Chet Taylor, Brandan Williams

TEAM COACH: Rich Ziegler



Nuclear Fuel Rod Profilometry Device

TEAM 20

SPONSOR: IDAHO NATIONAL LAB

PROJECT DESCRIPTION:

Idaho National Laboratory (INL) is the nations leading laboratory for the development and testing of nuclear technology. A significant part of their research includes testing new solutions for accident resistant fuels and materials. As part of this research at INL, fuel rodlets are deformed during testing in a nuclear reactor. INL challenged the team to find a way to increase the accuracy and speed at which the deformities of the rodlets are measured. In order to accurately measure the deformities the team's solution had to have the capability to measure accurately to just a few thousandths of a millimeter and obtain a measurement along the length and width of the fuel rodlet. This resulting device is able to fit and be assembled inside a typical glovebox. The teams design will help INL make better and faster judgements about how different materials behave in a nuclear reactor. This ultimately will lead to better and safer nuclear reactors in the future.

TEAM MEMBERS:

Stephen Gagnon, Caleb Lewis, Alden McLean, Brian Merritt, John Phillips, Grant Schroedter, Tayvin Woodall

TEAM COACH: Oliver Johnson

AlertSense Panic Button

TEAM 21

SPONSOR: KONEXUS

PROJECT DESCRIPTION:

Konexus' next-generation emergency notification and critical event management platform is the easiest way to alert your team and coordinate your disaster recovery in an emergency. This Capstone team was challenged to create a mesh network of panic buttons that are able to route data through individual devices, rather than having each device be tethered to a router. The team delivered a system that creates a simple solution for institutions to implement a panic button infrastructure.



TEAM MEMBERS:

Linsey Bennett, Chase Dietz, Dallin Miner, Evan Nuss, Christopher Stevens, Mad Thompson

TEAM COACH: Gavin Ransom

Network Traffic Generator And Analyzer

TEAM 22

SPONSOR: L3HARRIS TECHNOLOGIES

PROJECT DESCRIPTION:

L3Harris produces tactical radios, avionics and electronic systems, antennas, and wireless equipment for use in the government, defense, and commercial sectors. In order to test their equipment, they use commercial network testers that are expensive, bulky, and have a larger set of features than necessary for L3Harris. This Capstone team created a cheaper, smaller, and more portable network traffic generator and analyzer to supplement L3Harris' commercial test equipment. Having a portable, inexpensive network testing solution allows L3Harris to perform more targeted network testing in a shorter amount of time. Designing the tool for an FPGA also makes it much easier to send and use in distant locations.



TEAM MEMBERS:

Keaton Carlson, Chandler Harris, Brendon Jensen, Ethan Snell, Walker Thornley, Max Warner

TEAM COACH: John Snow



Small Form Factor Large Aperture Antenna

TEAM 23

SPONSOR: L3HARRIS TECHNOLOGIES
PROJECT DESCRIPTION:

L3Harris is constantly striving to provide cutting edge technology that helps both the military and first responders successfully address the challenges they face. Communication is crucial to a successful operation, but often the equipment is large and bulky, taking up valuable space while being transported. There is a great need for an antenna that can be easily transported, carried and assembled by someone with minimal training. The team's solution was to develop an inflatable antenna that could be described as a parabolic balloon. The design is extremely lightweight and can collapse down to roughly the size of a shoe box. The antenna is designed so that there is minimal assembly required. The user inflates the balloon, and then the antenna is ready for use. This simple inflatable antenna provides versatility and convenience to its users.

TEAM MEMBERS:

Zach Bons, Jonathan Claridge, Tommy Garate, Jennifer Gillis, Anna Knutson, Fletcher Miller

TEAM COACH: David Barker



Powdered Milk Mixing and Packaging System

TEAM 24

SPONSOR: LACNATION
PROJECT DESCRIPTION:

LacNation is a startup company that produces nutrient-rich, shelf-stable human breastmilk in the form of sterilized powder. This powdered milk is a novel product intended to increase the availability of human breastmilk for NICU infants. To safely deliver this product to infants, LacNation challenged the team to devise a sterile and hospital-friendly delivery system. Using data from interviews with NICU nurses, the team determined LacNation should deliver its product in a way that would allow NICUs to use much of their current milk-preparing protocol and equipment without forcing them to adopt radically new preparation procedures. Extensive testing was done to understand the powdered breastmilk's ability to reconstitute and simple directions were prepared to instruct NICU nurses how to properly reconstitute the packaged breastmilk powder with water and prepare it for infant feeding. By safely packaging and shipping shelf-stable breastmilk, there is great potential for LacNation to spread its product globally and save infants worldwide.

TEAM MEMBERS:

Harrison Christensen, Mitchell McCre, Jeremy Mueller, Arianna Reay, Greg Sabin, Mickelle Tanner-Wood

TEAM COACH: Amy Wood

High Speed Image Processing To Remove Blur

TEAM 25

SPONSOR: LAWRENCE LIVERMORE NATIONAL LAB
PROJECT DESCRIPTION:

Lawrence Livermore National Laboratory (LLNL) was established in 1952 to meet urgent national security needs by advancing nuclear weapons science and technology. LLNL continues to deliver solutions for the nation's most critical security challenges. They challenged the Capstone team to design software that removes motion blur on photographs of fast-moving objects. The team delivered, creating a design that significantly reduces motion blur and provides a graphical user interface for simple operation.

UAS Landing Pad Capture System

TEAM 26

SPONSOR: LAWRENCE LIVERMORE NATIONAL LAB
PROJECT DESCRIPTION:

Lawrence Livermore National Laboratory (LLNL) partners with industry, academia, and government to advance science and technology that enhances national and global security. Partnering with Capstone, LLNL challenged the team to design an Unmanned Air System (UAS) landing pad with the ability to center and reorient the UAS on the pad. An Unmanned Air System can perform functions, like package delivery, very efficiently and return home with minimal impact, however, landing these drones upon their return can be non-trivial. The team designed and built a UAS landing pad that has the ability to center and reorient the UAS on the pad as well as secure the drone in unstable weather conditions. This ensures the UAS is in place and ready to go for its next mission without loss or delay.



TEAM MEMBERS:

Joey Hewitt, Dave Nuttall, Jared Payne, Levi Pike, Wesley Stirk, Adam Whipple

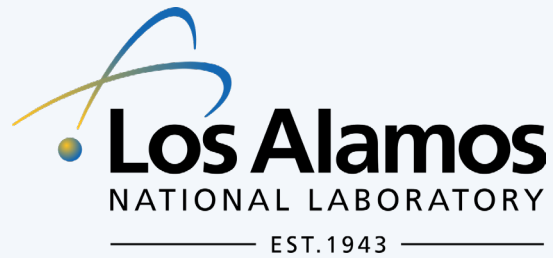
TEAM COACH: Steven Allen



TEAM MEMBERS:

Brandon Chidester, Michael Dinsdale, Mitchell McCarty, Tanner Oldham, Isaac Sampson, Damon Williams

TEAM COACH: Dexter Francis



Microsphere Insulation Removal And Containment

TEAM 27

SPONSOR: LOS ALAMOS NATIONAL LAB
PROJECT DESCRIPTION:

Los Alamos National Laboratory (LANL) asked the student team to design a system that would allow them to more easily reuse small containment vessels that have been insulated with tiny microspheres. The current microsphere removal process requires a technician to manually remove the microspheres from the vessel within a glove box. The team's project was to design and create a prototype microsphere removal system that would cleanly remove 99% or more of the microspheres and contain these microspheres from the vessel with little human input. The team devised a system that inserted a stream of high-velocity air into the bottom of the vessel, and allowed the air and microspheres to escape through a port on the top of the vessel. The system removes nearly 100% of the microspheres in the vessel effectively solving Los Alamos' microsphere extraction problem.

TEAM MEMBERS:

Rebecca Anderson, Trevor Christensen, Tim Greene, Dylan Howlett, Sarah Michaelis, Seth White

TEAM COACH: Brian Iverson



PDV GHz Frequency Analyzer

TEAM 28

SPONSOR: LOS ALAMOS NATIONAL LAB
PROJECT DESCRIPTION:

At Los Alamos National Laboratory (LANL), there is a long history of explosives research. Recent improvements in technology allow the measurement of shrapnel speeds up to 11,000 mph. Scaling experiments up is an issue presently due to the high cost of equipment. The team's goal was to explore cheaper equipment options to cut down costs and allow experiments performed at LANL to be scaled up. The team's solution will save LANL hundreds of thousands of dollars in equipment costs in the future and make experiment expansion a viable option.

TEAM MEMBERS:

Davin Fish, Bryan Henningson, Chris Krueger, Sharisse Poff, Craig Roundy, Colin White

TEAM COACH: Scott Lloyd

Compartmentalized Process Tank Digital Model

TEAM 29

SPONSOR: CGIS
PROJECT DESCRIPTION:

The team was tasked with the creation of a digital twin software program that can model the functions and processes of large vessels used for mixed-media material separation. These processes separate target substances from the rest of the solution for easy extraction. The team's digital twin software puts the complex math and physics behind the process into code, including considerations for temperature, chemical reactions, and flow. The modeling software should enable end users to build an understanding of how to maximize equipment life and allow them to experiment with different input parameters, including physical vessel geometry and user set points. Three-dimensional graphics programmed into the software by the student team should allow a wide range of users to get a sense of the digital twin's outputs for modeling existing or hypothetical vessel configurations.



The World's Best Workplace

TEAM MEMBERS:

Stephen Griffith, Dillon Johnson, Josh Laney, Blake Lyons

TEAM COACH: Steve Wilson

DDRx Memory Module Tester

TEAM 30

SPONSOR: MERCURY SYSTEMS
PROJECT DESCRIPTION:

Mercury Systems is an aerospace and defense company that manufactures DDRx memory modules. Currently, the test to determine the functionality of these memory modules is expensive and time-consuming. Mercury challenged the Capstone team to design a faster, less expensive tester. The team's tester makes verification of memory modules more efficient by weeding out the modules with more obvious issues before putting them through the more expensive, time-consuming, and intensive testing.



TEAM MEMBERS:

Christine Akagi, Brianna Alexander, Kelly Clingo, Sabrina Gibby, Kyle McBride, Riley Short

TEAM COACH: Previn Menon

Microcontroller For Off-Grid Power

TEAM 31

SPONSOR: MP SOLAR AND POWER
PROJECT DESCRIPTION:

The series of recent blackouts due to wildfires has left California's electrical system exhausted. People who have solar power have also been losing power because they are connected to the grid even though their PV panels generate their own electricity. This Capstone team was challenged to design and build a system using a low-cost microcontroller that would allow solar power users to disconnect from the grid and have a functioning power system that would allow them to be grid independent. The team delivered a functioning prototype that works on the nano-grid scale that can be scaled up based on the system where the product is installed.

TEAM MEMBERS:

Jake Carter, Jake Jones, Matt King, Tate Lloyd, Ben Morgan, Cade Patterson

TEAM COACH: Stephen Schults

Hydrogen Energy Testbed System

TEAM 33

SPONSOR: NEFF AERONAUTICS
PROJECT DESCRIPTION:

Neff Aeronautics has teamed up with the Air Force Research Laboratory to develop a novel fuel system concept for potentially powering an airship. The challenge with airships is controlling the amount of lift and minimizing the weight of fuel needed to power a traditional energy system. The question that catapulted this research project is: "Is there a lightweight, alternative fuel system that is more efficient and capable of providing an airship with perpetual energy without having to land?" The team's challenge was to explore this question by designing, constructing, and testing a novel, hydrogen-based fuel system testbed and understanding the constraining factors. The system collects water vapor from ambient air, separates it into hydrogen and oxygen gas by electrolysis, and stores the hydrogen safely and efficiently which is then passed through a hydrogen fuel cell to generate electricity. This project benefits Neff Aeronautics by providing the foundational proof-of-concept necessary for them to invest the time and effort into manufacturing a large-scale hydrogen fuel system that could be tested on a real airship.

TEAM MEMBERS:

McKay Ashton, Jonah Griffith, Taylor Skousen, Dallin Stout, Joshua Taylor, Daniel Tebbs, Hunter Vaughn

TEAM COACH: Andy George



Real-Time RFID Drill Pipe Identification

TEAM 32

SPONSOR: NATIONAL OILWELL VARCO
PROJECT DESCRIPTION:

National Oilwell Varco (NOV) is an international energy company involved in developing technologies for oil, gas and renewables. Their expertise includes design and manufacture of systems and components, digital platforms, and services for energy exploration and production. In drilling for oil, thousands of feet of drill pipe of various diameters are used and re-used in subsequent drilling sites. Tracking the usage history of these drill pipes is desirable to improve reliability of operations and minimize risk. The current NOV system reads RFID tags on drill pipes of a particular diameter, but the system is not adaptable to the various diameters of pipes used in drilling. The Capstone team added enhanced functionality to NOV's current product by designing a single antenna capable of reading RFID tags on pipes of all diameters. The enhancement will be added to future iterations of NOV's product.

TEAM MEMBERS:

Joshua Broekhuijsen, Will De Leon, Wyatt Houston, Jared Nysetvold, Will Okazaki, Nate Porter

TEAM COACH: Ken Hardman

Applied AI for Early Illness Detection

TEAM 34

SPONSOR: NEVADA NATIONAL SECURITY SITE
PROJECT DESCRIPTION:

The Nevada National Security Site (NNSS) helps ensure the security of the United States and its allies. Scientists, engineers, mathematicians, and technicians partner with other national laboratories and the defense and intelligence community to execute high-level experimental, research, and training activities in support of national security. The work of NNSS covers a broad range of technologies. For this project, NNSS challenged the Capstone team with designing an AI system capable of implementing an algorithm to detect early-warning signs of serious illness. This prediction is made based on multiple physiological parameters passed to the system. The team's design lays the groundwork for future innovation that may one day help limit the spread of communicable disease.



TEAM MEMBERS:

Ethan Angerbauer, Esteban Garcia, Jeremy Lyman, Tyrel Stembridge, Andrew Swain, William Wallace

TEAM COACH: Cory Estes



Next Generation Vacuum Compton Detector

TEAM 35

SPONSOR: NEVADA NATIONAL SECURITY SITE
PROJECT DESCRIPTION:

Vacuum Compton Detectors (VCDs) have been around for a long time and are used to detect and measure fission gamma from nuclear blasts to determine the intensity of the blast. Nevada National Security Site continues to improve the design of VCDs for accurate detection. They challenged this year's Capstone team with developing the next iteration of the Vacuum Compton Detector (VCD). In the footsteps of the work of last year's Capstone team, this team produced a new iteration of the VCD with improved impedance matching and improved vacuum leakage rate, incorporating the lessons learned from the prior year of the project. Their solutions provide less expensive options for NNSS in the manufacturing and deployment of VCDs.

TEAM MEMBERS:

Aaron Bardsley, Matthew Christian, Christian Lopez, McKay Sperry, Jacob Stratford, Jackson Wightman

TEAM COACH: Rob Messenger



UV-C LED Reference Design

TEAM 36

SPONSOR: NKFG REFERENCE DESIGN
PROJECT DESCRIPTION:

NKFG is a leading manufacturer of LEDs that emit UVC light for use in disinfection systems. In past years, NKFG has sponsored multiple projects to develop specific products that use the UVC LEDs. This year, NKFG tasked the Capstone team with creating a reference design that highlights the design requirements to be considered when creating a new product using their LEDs. The reference design uses forty LEDs and addresses requirements for safety, heat dissipation, and optimal exposure rates for targeted media. NKFG will be able to distribute this to future customers as an added value to their line of LEDs.

TEAM MEMBERS:

Spencer Mitton, Nathan Paskett, Ryan Pedersen, Sam Richards, Darren Rowe, Daniel Wing

TEAM COACH: Patrick Murray

Integrated Smart Operations For A Mobile Factory

TEAM 37

SPONSOR: NORTHROP GRUMMAN
PROJECT DESCRIPTION:

Northrop Grumman Corporation (NGC) is a leading innovator in the aerospace and defense industry. NGC has been exploring the use of Smart Manufacturing technology to better manage their extensive manufacturing assets and improve the overall performance of their facilities. They provided the team with a "mock-factory" demonstrator that uses a robot and a laser to cut paper airplanes, along with an industrial automation and augmented reality software package. The team's challenge was to showcase the capabilities of Smart Manufacturing using the provided demonstrator and software package. The enhancements that the team delivered utilize automation and augmented-reality technologies to improve the overall factory experience through maximizing the capabilities of a system's existing hardware to substantially increase product quality and decrease cycle time. The team's augmented-reality solution showcases the power of hands-free AR in an industrial environment. An AR experience was created to assist technicians and operators perform necessary maintenance procedures and receive real-time information about the demonstrator.



TEAM MEMBERS:

Sherif Aboumandour, Adrian Choquevilca, JT Frandsen, Joseph Hutchins, Christopher Kitras, Ryan Ward

TEAM COACH: Yuri Hovanski

Robot Implementation For Hyperscale Data Center

TEAM 38

SPONSOR: NOVVA DATA CENTERS
PROJECT DESCRIPTION:

NOVVA Data Centers builds and operates data centers for enterprise customers and is currently building the largest data center in Utah, a 100-acre location in West Jordan. Their top concerns include physical and logical security, operation stability, reliability of services, power, and cooling. To that end, NOVVA is integrating a Boston Dynamics SPOT robot as part of its security monitoring system. The team worked to provide an autonomy and surveillance package for SPOT that will allow its operator to effectively observe conditions in the data center from a remote location, reducing security and monitoring costs long-term.



TEAM MEMBERS:

Derek Benham, Evan Berger, Aaron Brown, Ken Flinders, James Green, Joey LeCheminant, Jake Sundet

TEAM COACH: Abraham Teng



Skin Strain Measurement Tool

TEAM 39

SPONSOR: NU SKIN

PROJECT DESCRIPTION:

Nu Skin's research and development team regularly works with skincare devices, such as the LumiSpa device, which cause human skin to stretch and move in order to promote healthier skin. One problem that Nu Skin has with developing products of this type is finding a way to measure and compare the amount of strain the product produces on human skin. The team designed a prototype to validate both a simulated skin to mimic human skin qualities and a strain measurement system. The resulting system measures strain values with less than 2% error and produces repeatable results with less than 1% variance. Nu Skin's Engineers will begin using the teams product immediately to further test the Lumi Spa and other new devices.

TEAM MEMBERS:

Jacob Davis, Quinn Everett, Derek Hansen, Cameron Hernandez, Andrew McLane, Niall Stoddard

TEAM COACH: Richard Gee

Remote Controlled Server Room Robot

TEAM 41

SPONSOR: RAYTHEON TECHNOLOGIES

PROJECT DESCRIPTION:

The healthy functioning of servers in Raytheon Technologies' server rooms is critical, so it is necessary that they be closely monitored. This means checking the temperature of the room and servers regularly, monitoring for security breaches and other dangerous hazards like fires, and sometimes interacting directly with individual servers that need attention. This surveillance is often done remotely, so Raytheon challenged this Capstone team with designing and building a remote-controlled robot that can accomplish these tasks. The team delivered with a remote server room robot capable of monitoring the server room and quickly responding to server emergencies, saving Raytheon both time and money by keeping work flowing and minimizing equipment damage.



TEAM MEMBERS:

Justin Blanscett, Tyler Duncan, Austin Kerr, Spencer Scott, Tyler Sweat, Stephen Warren, Tyler Whiting, Tyler Wyatt

TEAM COACH: Steven Charles



Autonomous RF Mapping Octocopter

TEAM 40

SPONSOR: RAYTHEON TECHNOLOGIES

PROJECT DESCRIPTION:

Raytheon Applied Signal Technology builds reconnaissance systems and remote sensing technologies that monitor space, airborne and terrestrial environments. In partnership with Raytheon, the focus of this project was to integrate and refine the work of previous Capstone teams. The team designed a single system to incorporate a phased array antenna with an octocopter to create a robust, autonomous system, including housing and mounts, with enhanced RF mapping abilities.

TEAM MEMBERS:

Alexa Goodman, Chris Horne, Morgan Hunter, Stu Myers, Kyle Schvaneveldt, Cooper Thacker, Camron Tye

TEAM COACH: Jason Weaver

Applied Machine Learning For Vehicle Detection

TEAM 42

SPONSOR: SANDIA NATIONAL LABS

PROJECT DESCRIPTION:

Sandia National Laboratories provides technology for national security and disaster response. The remote sensing group at Sandia is developing algorithms to detect vehicles in aerial images. The Capstone team designed and developed code to compare the performance of two common classifiers on a large dataset of images. Their algorithm can be used by Sandia to develop an accurate system for automatic vehicle detection in aerial images.



TEAM MEMBERS:

Stephanie Ashby, Rachel Harris, Jordan Hawkes, Zac Jarman, Sam Johnson, Christopher Wilson

TEAM COACH: Gregg Cowley



**Sandia
National
Laboratories**

Encapsulation Vacuum Chamber

TEAM 43

SPONSOR: SANDIA NATIONAL LABS

PROJECT DESCRIPTION:

Sandia National Laboratories develops advanced technologies to ensure global peace. Those methods often require the use of encapsulated electronics. The development and testing of the encapsulation is an integral part of this research. A common issue working with plastics is void formation due to air trapped inside the poured material. Vacuum chambers are often used to help degas the material. In order to work on multiple assemblies at once, a chamber that allows for pouring plastic into several molds is desirable. Sandia tasked the team to provide a solution to meet this need. The team's solution consists of three subsystems: vacuum chamber, plastic delivery apparatus, and turntable. The newly designed vacuum chamber will allow Sandia to save time and money by increasing their capabilities in this area.

TEAM MEMBERS:

Jacom Gerber, Nathan Hale, Shadrach Jones, Nathan Roylance, Nate Smith, Aaron Thorum

TEAM COACH: Tom Atkins

Firmware Re-hosting Support For Zephyr RTOS

TEAM 44

SPONSOR: SANDIA NATIONAL LABS

PROJECT DESCRIPTION:

Sandia National Laboratories created HALucinator, a generic CPU emulator, to remove the hardware dependency of firmware security research. This allows device security researchers to work faster and at a larger scale than ever before. With HALucinator, firmware can be thoroughly evaluated for security weaknesses without requiring the presence of a physical device. HALucinator currently supports several classes of devices, however it does not support firmware compiled for a real-time operating system (RTOS). The Capstone team produced a solution that adds support for the Zephyr RTOS to HALucinator's existing capabilities.

TEAM MEMBERS:

Chad Beardall, Ryan Beazer, David Clark, Josh Pope, Andrew Pulsipher, Max Thomas

TEAM COACH: Roger Andersen

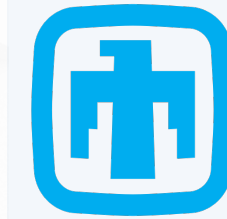
High Acceleration Impact Test System

TEAM 45

SPONSOR: SANDIA NATIONAL LABS

PROJECT DESCRIPTION:

Sandia National Laboratory's historical roots stem from the 1940's in nuclear weapon design, testing, and assembly. Their unique responsibilities in the nuclear weapons program create a foundation from which they leverage capabilities, enabling them to solve complex national security problems. The team worked to design, prototype, and test a precise and repeatable impact system. This system works to provide and record a highly repeatable acceleration pulse to a solid mass without damage to the specimen under test. The team's solution utilizes a vertically-oriented pneumatic piston as the method of impact. The team designed and constructed a structural frame to support the piston and accurately position the specimen under test. The design also provides a method to ensure the repeatability of impacts, and allows the impulse to be precisely measured. This impact test system will be the basis for small scale impact testing at Sandia. It will be used to provide data in order to predict the response of their specimens at high accelerations, improving understanding of the specimens.



**Sandia
National
Laboratories**

TEAM MEMBERS:

Ryan Clark, Mitchell Gehlbach, Solei Hunter, Chase Oliphant, Glenn Stapley, Maxwell Tree, Katie Varela

TEAM COACH: Jake Merrell

Step And Handrail System For Passenger Trains

TEAM 46

SPONSOR: STANDLER US

PROJECT DESCRIPTION:

Stadler designs and manufactures passenger trains for rail networks around the world. Their current and long tested design is designed to accommodate a single platform height which is common in Europe. In the USA there is not one common platform height so Stadler tasked the team to create a functional prototype of a step and handrail system that can access platforms at heights of 8in and 15in above rail. The stair and handrail systems had to be fully automated and retract completely into the train profile. When retracted the stairs have to fit into a 10 by 11 by 46-inch space. The team's solution has three steps, each extended with an independent gear motor. The handrail was required to have minimal pinch points, so the team's solution created a handrail loop that rotates about one single point. Additional testing and improvements will be made to prepare the product for large scale production.

STADLER

TEAM MEMBERS:

Naomi Debaene, Boongkey Freeze, Allison Johnson, Sterling Larsen, Ryan Tanner, Eric Yugawa

TEAM COACH: Rich Smith



X-Ray Rube Focal Spot Measurement

TEAM 47

SPONSOR: VAREX

PROJECT DESCRIPTION:

Varex designs and creates custom X-ray tools for medical, security, and industrial needs. Many of their X-ray tubes are very sophisticated, containing not one, but almost 100 X-ray emitters. These are used for systems similar to MRIs, scanning your whole body. Because there are so many emitters, they need to be aligned to allow the system to measure appropriately. This Capstone team was tasked with designing a system to properly align the emitters. Their solution reduced alignment time from days to only minutes, greatly reducing human interaction time and lessening the risk of exposure to employees.

TEAM MEMBERS:

Bryce Bickham, Darci Billmire, Kyler Haag, Carson Knight, Sam Smith, Chantz Yazzie

TEAM COACH: Doug Cook

Automated High Speed Seed Packet Filler

TEAM 48

SPONSOR: WARD HARDWARE, INC

PROJECT DESCRIPTION:

Ward Hardware is a small business that produces gardening seed packets. The majority of their business is conducted through online services such as Amazon. An opportunity for growth in the business appeared with more people staying at home gardening through the pandemic. Demand for seeds soared and Ward Hardware's current automated seed packet filling machine could not keep up. Ward challenged the team to design a piece of automated machinery to supplement or replace their current machine to meet the high demand. The team's solution is a modular machine that is low cost, yet efficient that allow for increasing production by simply building more machines. This approach allows Ward Hardware to efficiently package their seeds and gives them the opportunity continue to grow without a large upfront cost for machinery.

TEAM MEMBERS:

Jeremy Burgin, Scott Dayley, Jared Hale, Danny Mutz, Nick Olsen, Blake Pottle, Thomas Richardson

TEAM COACH: Scott Cutler

DOE Collegiate Wind Competition

TEAM 49

SPONSOR: BYU DEPARTMENT OF MECHANICAL ENGINEERING

PROJECT DESCRIPTION:

This team was sponsored by the BYU Department of Mechanical Engineering to compete in the U.S. Department of Energy Collegiate Wind Competition (CWC). The team's project aims to offer a unique solution to a complex wind energy challenge, and pave the way for future generations of BYU CWC teams in the coming years. The model wind turbine the team created consists of four subsystems: blades, generator, controls, and mechanical systems. Combined, they make up every aspect of the turbine from the nacelle to the circuitry. The project opens doors to future opportunities for BYU to be recognized as a school that develops and educates outstanding engineers who are passionate about renewable energy and giving back to the community. Looking toward the future, a place has already been secured in next year's competition for next CWC capstone team. The team meticulously detailed their design work and progress to ensure that next year's competition team can build on this year's work.

Autonomous Rocket Altitude Control Unit

TEAM 50

SPONSOR: BYU DEPARTMENT OF ENGINEERING

PROJECT DESCRIPTION:

The BYU Rocketry High Power Team participates in an international competition every year called the Intercollegiate Rocket Engineering Competition. Part of this competition is to launch a rocket with a payload to an altitude of 10,000 feet above ground level. The closer the rocket gets to 10,000 feet, the more points the team receives. The purpose of this year's project was to create a device that can be added to the rocket in a modular fashion that will tailor its drag so it reaches the target altitude within a one percent margin every time. The autonomous rocket altitude control unit, or air brake system (ABS), utilizes a planetary gear system driven by a servo motor to rotate four flat plates (paddles) out from inside the rocket and into the wind. This increases the drag of the entire rocket by increasing the area of the rocket normal to the flow direction. The timing and amount of actuation of these paddles is controlled by a flight computer which receives data from accelerometers, altimeters, and gyroscopes to determine the rocket's current position and projected altitude. Built to last, the ABS has been designed to survive the dynamic forces of flight and recovery.

BYU ENGINEERING

TEAM MEMBERS:

Erik Barbosa, Ruth Belnap, Sarah Cheng, James Cutler, Jace Davis, Logan Hardy, Wesley Holt, Heidi Johnson, Samuel Johnson, Eric Lee, Nathanael Nelson, Jake Roberts

TEAM COACH: Andrew Ning

BYU ENGINEERING

TEAM MEMBERS:

Brett Coles, Jason Glenn, Alex Jordan, Josh Kjar, Ben Lee, Ryan Merrell, Jon Rice, Josh Ross, Ryan Thibaudeau

TEAM COACH: Mark Colton

BYU ENGINEERING

University Rover Challenge

TEAM 51

SPONSOR: BYU DEPARTMENT OF MECHANICAL ENGINEERING

PROJECT DESCRIPTION:

The BYU Mars Rover Team developed a planetary rover that is capable of performing a set of specific tasks as defined by the University Rover Challenge (URC) rules, building on the work of past teams. These tasks include traversing rough terrain while carrying objects, autonomously traveling to GPS coordinates and detecting markers, taking and analyzing soil samples to detect life, and manipulating doors, switches, and other objects.

TEAM MEMBERS:

Adam Aposhian, Bridget Beatson, Zach Broyles, David Chin, Daniel Ellis, Alan Felt, Tanner Green, Jared Hanson, Garrett Hawkins, Tyler Hulse, Kurt Jensen, Alysia Larsen, Nathan Larson, Parker Murray, Ashton Palacios, Jordi Ramos Chen, Jason Redding, Christian Rosenvall, Chad Samuelson, Haley Sanders, Bryton Smith, Bryson Tanner, Spencer Webb, Sebastian Zapata

TEAM COACH: Marc Killpack

Supermilleage Competition: Reduced Friction Valve Train

TEAM 52

SPONSOR: BYU DEPARTMENT OF MECHANICAL ENGINEERING

PROJECT DESCRIPTION:

The BYU Supermilleage team competes in the Shell Oil Ecomarathon every year. BYU's vehicle is updated, refined, and modified each year for improved performance by a capstone team. This year, the team was tasked with reversing the rotational direction of the engine and reducing the friction within the engine. The overarching goal is to improve the car's fuel efficiency to over 1400 miles per gallon. To meet these goals, the team modified the engine's starter motor and its interface with the engine, changed the engine timing, and added piston coatings for friction and heat transfer optimization. Additionally, parts were added to the valvetrain to reduce its friction, and a bearing was added to the connecting rod to improve performance of the crankshaft-conrod interface.

TEAM MEMBERS:

Kyler Christensen, Dallin Clawson, Janson Lesser, Robert Stapp, Sandra Thomas, Aaron Tobler, Tyler Wilkes, Tyler Woolley

TEAM COACH: Richard Gee

Baja SAE Competition: Wireless Telemetry System

TEAM 53

SPONSOR: BYU DEPARTMENT OF MECHANICAL ENGINEERING

PROJECT DESCRIPTION:

BYU Baja is a competition team geared toward designing and manufacturing an off-road vehicle that fulfills specified SAE requirements and limitations. In past years, the team has not been able to validate their design with an on-board telemetry system or to depict real time data such as engine RPM, speed, and fuel level. The focus of this year's Capstone project was to create such a system. The new telemetry system will be particularly valuable for design verification. The BYU Baja team is currently in the process of transitioning the vehicle from two wheel drive to four wheel drive. Being able to see the RPM of various drivetrain components is invaluable in ensuring that the system is properly designed. It will also be very valuable during the Baja competition where the gathered data will be beneficial for the pit crew and driver. Additionally, the product has been designed so that future Baja teams will be able to alter and add onto the current capabilities of the telemetry system.

BYU ENGINEERING

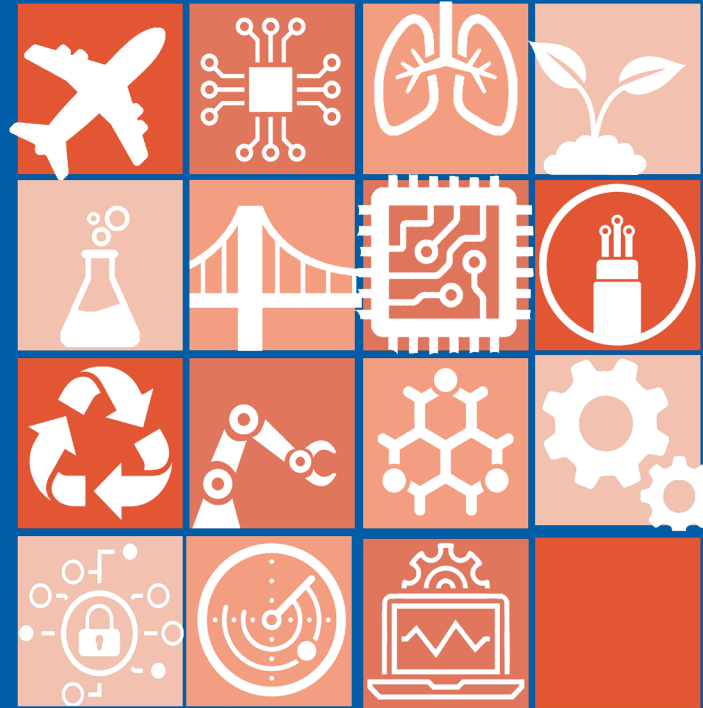
TEAM MEMBERS:

Taylor Barton, Ben Brenkman, Dunstan Chi, Ben Crawford, Ryan Davis, McKay Gleason, Adam Jackson, Mark Johnson, Justin Miller, Joshua Rosche, Tyler Sorenson, Gideon Stowell, Taylor Trendler

TEAM COACH: Jess Colton

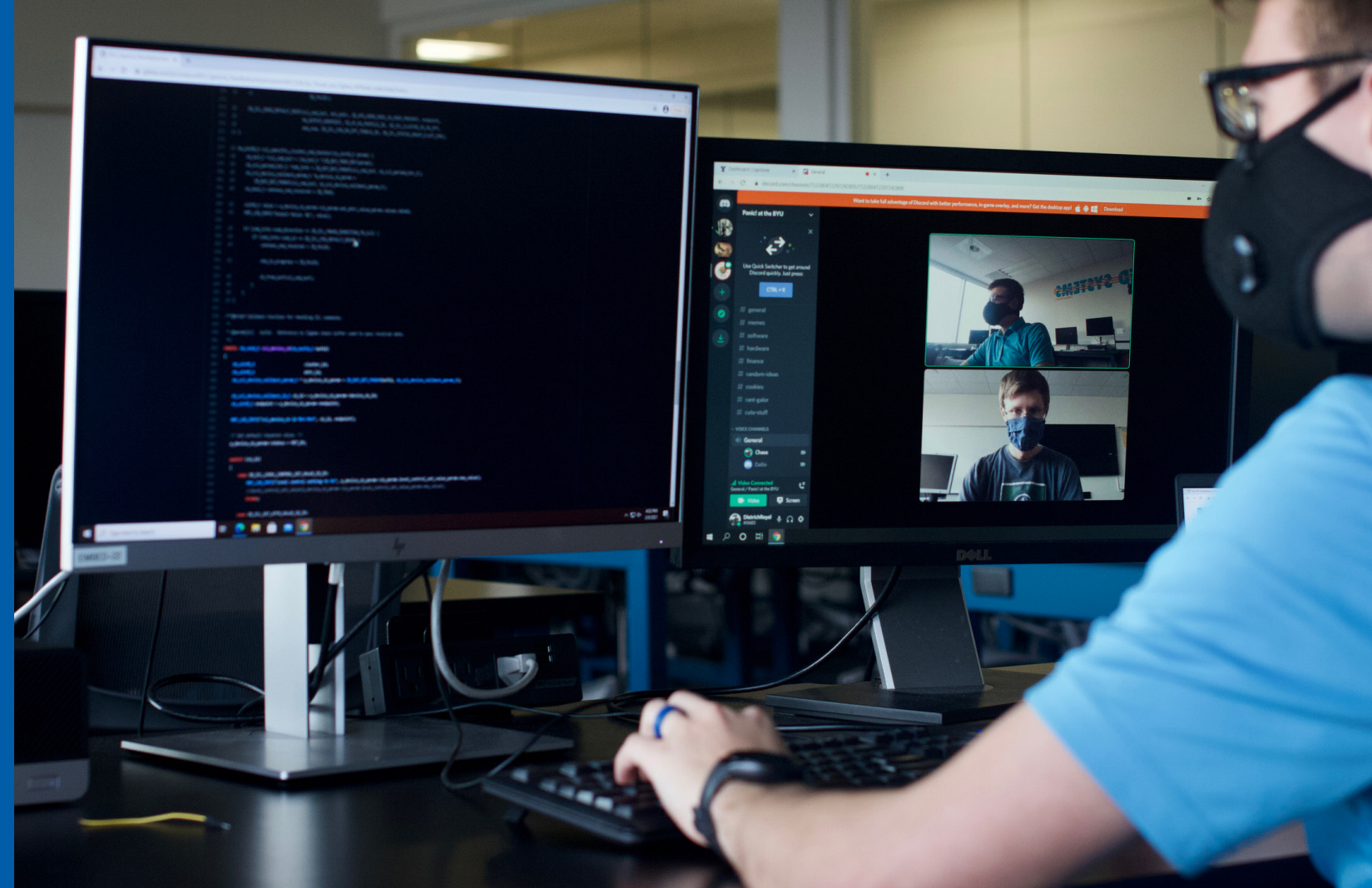
BYU ENGINEERING

IRA A. FULTON COLLEGE OF ENGINEERING



DEGREES OFFERED

- CHEMICAL ENGINEERING
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- CONSTRUCTION & FACILITIES MANAGEMENT
- CYBERSECURITY
- ELECTRICAL & COMPUTER ENGINEERING
- INDUSTRIAL DESIGN
- INFORMATION TECHNOLOGY
- MANUFACTURING ENGINEERING
- MECHANICAL ENGINEERING
- TECHNOLOGY & ENGINEERING STUDIES



CAPSTONE TEAM SUPPORT NETWORK

INSTRUCTING PROFESSORS

Four engineering professors serve as instructors for the course, providing technical oversight to every team. They teach lectures, lead design reviews, and oversee all teams.

FACULTY COACHES

Each team is mentored by a dedicated faculty coach. Coaches provide mentorship and leadership, assisting teams with soft skills, pointing them to technical resources as needed, and guiding them through the product development process.

EXTERNAL RELATIONS MANAGERS

External Relations Managers are seasoned engineers who work with sponsors to define projects, advocate for sponsors throughout the project, and assist student teams to ensure sponsor needs are met.

SUPPORT STAFF

Capstone teams are supported by a full-time staff who manage purchasing, arrange travel, plan and carry out events, and handle the day to day details of administering the Capstone course.

SPONSOR LIAISON ENGINEERS

Each Capstone sponsor designates a liaison engineer (or engineers) to work with the Capstone team. The liaison engineer communicates with the team about an hour each week, usually remotely. Liaison engineers assist the team in understanding the changing needs of the sponsor, the technical needs of the project, and the sponsor's priorities.

SPONSORS

Sponsors form the foundation of our Capstone program. Real-world projects provide experiential learning that cannot be duplicated in the classroom. Sponsors provide functional requirements and technical challenges that inspire students to investigate, experiment, and evaluate solutions.



WHAT IS REQUIRED TO SPONSOR?

A REAL PROJECT that is specific in outcome but open-ended in process that would take approximately 400-600 hours in-house.

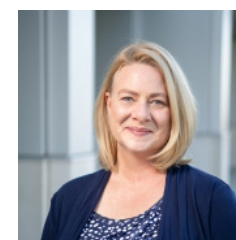
A LIAISON ENGINEER who communicates with the team regularly

\$22K SPONSORSHIP FEE payable as an educational grant



CAPSTONE.BYU.EDU

TO DISCUSS YOUR PROJECT IDEAS OR INITIATE A PROJECT, PLEASE CONTACT:



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