



SENIOR

DESIGN



DEMONSTRATION DAY 2022

HARRY A. GAMPEL PAVILION APRIL 29TH

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COMPUTER SCIENCE AND ENGINEERING



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CT National Guard Cyber Range

The CT National Guard Cyber Range 2021 Project focuses on working with the ongoing project that was developed last year. This year, the goal was to move the cyber range to the cloud for remote access. Currently, the cyber range simulates two blue team scenarios: a ransomware attack and a vulnerable Active Directory access page. As cyber attacks—more specifically ransomware attacks—are rising in use, this cyber security project holds real world, practical applications. With this year's team, each scenario is now remotely deployable, allowing CTNG trainees to practice National Guard battle plans from wherever. The project uses Amazon Web Services for cloud compute virtual machines, with Terraform for automating virtual machine deployment. Furthermore, practice scenarios are now easily addable due to the abstraction that was made possible through virtualization. The current scenarios are built with a variety of technologies, from Powershell scripts and Active Directory on Windows to Apache on Linux, but a wider variety is possible with ability to build and add any scenarios desired. Making the ongoing project more easily modifiable and adaptable allows the CTNG and any further teams to build quicker. This is essential as cyber security is now more important than ever, and any solutions in the field must be able to evolve quickly.

COMPUTER SCIENCE AND ENGINEERING



TEAM 2

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Connecticut's Health Equity Dashboard

In this project, we are creating a health equity dashboard for Connecticut. Our goal is to bring different data sources together and display to the users to show what types of programs or services should be provided in the different places in Connecticut. In order to accomplish this, we will be using Connecticut's Census data along with datasets from Centers for Medicare & Medicaid Services. We hope our webpage will be informative of the services we should provide in the various towns and counties of Connecticut.

COMPUTER SCIENCE AND ENGINEERING



TEAM 3

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Burns & McDonnell

Burns & McDonnell Project Management Software

As an engineering, construction and consulting company, Burns & McDonnell often focuses on program and project management for their clients. While they use a variety of industry leading technologies to provide their services, they also augment these tools with their own project management software. The goal of SDP CSE Team 3 was to modernize and optimize one specific piece of software used for workflow automation and report distribution. We worked towards setting up a relational database in order to have a centralized location to save automation configuration (aka tasks). In addition to that, there has been significant work put into updating the format that is used to load and save tasks, it had previously utilized an old format called XML which has been changed to JSON. This required updating the mechanisms for all existing task and module types for how the necessary information is saved and loaded. The software had also been streamlined by eliminating code and configuration that has been deprecated. Additional steps towards modernization were taken by updating the communication protocol that certain tasks utilize from communicating with a SOAP to utilizing REST commands.

COMPUTER SCIENCE AND ENGINEERING



TEAM 4

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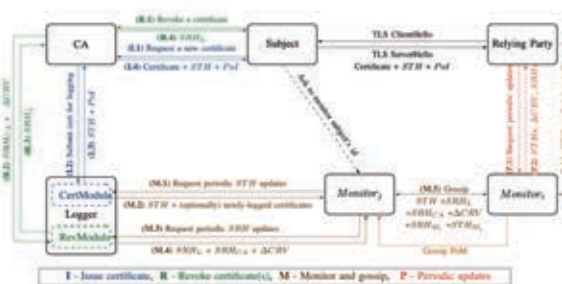
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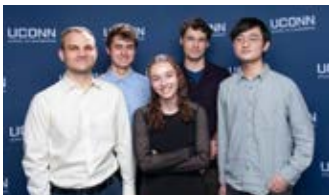
COMPUTER SCIENCE &
ENGINEERING

CTng: An Improved Public Key Infrastructure Scheme

Web Public Key Infrastructure (PKI) is core for allowing web browsers to create secure connections with websites. Certificate Transparency (CT) is the system used by modern browsers to implement PKI. Certificate Transparency Next Generation (CTng) is a proposal for a new system by Hemi Leibowitz, Haitham Ghalwash, Ewa Syta, and Amir Herzberg which create, monitor, and audit digital certificates that prove the ownership of a cryptographic public key. CT as it is today has several issues including the abandonment of the “No Trusted Third Party” principle and insufficient support for the revocation of certificates. CTng is an existing redesign of CT which seeks to solve these problems while maintaining some backwards compatibility with existing CT infrastructure. Our project has two parts: First, given the CTng security design document, create an implementation specification to outline a standard method by which various entities would interact. Second, implement this design while following accepted software engineering practices.



COMPUTER SCIENCE AND ENGINEERING



TEAM 5

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TERADYNE

Secure Sandbox Server

The goal of this project was to create an application which would allow for a client to easily deploy a given Docker Image to a server. The team was required to completely secure all communication between the client and the server, as well as protecting the server from potential attacks and ensuring the process of deploying Docker Images is completely fault tolerant.

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TEAM 6

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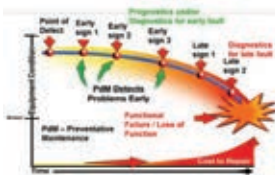
Wei Wei

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Machine Learning and Artificial Intelligence for Jet Engine Health Management

Jet engine health management is important for airlines' profit in commercial engine market and fleet readiness for military customers. It has the goal of doing the right maintenance at the right time and the right place. Doing the right maintenance will help reduce the maintenance cost by only conducting the needed work other than spending the resource to deal with false alarms; Doing the maintenance at the right time features the so-called Condition-Based Maintenance (CBM) where the maintenance is only conducted when it is really needed other than scheduled so that the maintenance cost is reduced and engine time-on-wing is extended; Doing the maintenance at the right place allows the needed facility and part inventory are in place to support the maintenance (for commercial airlines, this is usually the hubs). As an engine OEM, Pratt & Whitney is committed to provide dependable jet engine health management. The key to support doing the right maintenance at the right time and the right place is to identify a failure accurately and reliably at an early stage so that there will be ample time for the aircraft to get to the right place for maintenance. For most engine components, a failure is a state of the component that a fault is progressed to. By definition, a fault is a physical imperfection or impairment that is responsible for failure while a failure is a state of inability to perform a normal function. As shown in the P-F curve in Figure 1, the earlier a fault is detected, the less cost to repair would incur. It is well-known that the earlier a fault is detected, the more likely the detection is a false alarm. Excessive false alarms would defeat the propose of doing the right maintenance. Also, some of the fault may lead to safety critical failures, in which case, the recall rate of the detection has to be 100%. Overall, the goal for this project is to implement a machine learning algorithm which can accurately identify and diagnose engine faults.



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TEAM 7

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Emanus LLC
Jose Torres

PEACE Project

PEACE is a cloud-based multi-party communications platform that enables parents, law enforcement officials, governments, etc. to monitor and be notified of who is driving a vehicle and who the other occupants are, particularly prior to the engagement of law enforcement officials with the driver/occupant of the vehicle (during a traffic stop or another encounter). In a preferred embodiment, PEACE's proprietary mobile app platform provides omnipresent awareness and communication between various stakeholders that is triggered by electronic and visual cues at the scene of a police traffic stop prior engagement with vehicle occupants. The system provides advanced information (e.g., age, medical condition, relevant prior history, etc.) about who has been authorized to drive the vehicle and others having permission to be in the vehicle. A goal of the system is to notify law enforcement officials during a traffic stop and prior to engagement that the driver/occupants have pledged to be compliant with police and law to avoid violent confrontation.

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TEAM 8

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IoT Energy Consumption Analyzer

Battery powered IoT devices are a common tool in today's jobsite. However, the downtime required to charge or replace dead batteries is costly at a large scale, so it is in a company's best interest to optimize the battery life of their IoT devices. It is not uncommon to produce a noticeable decrease in the battery life of a device after even the slightest of updates to its firmware. Therefore, it is valuable to have the ability to run constant checks to ensure a device's expected battery life stays within a tight range. Our project will provide companies and technology developers an easy means of testing firmware changes before finalizing device updates in order to catch these power-draining bugs. We have partnered with Triax Technologies to develop an open-source continuous integration (CI) testing platform for analyzing the change in power consumption of a device following any update. Our goal is to simplify the user experience by creating a modular and highly-configurable framework that allows developers to use the CI platform and power profiler of their choosing and have complete control of all aspects of the testing. The output to the user includes graphical interpretations of the analysis and readable results that can be sent via email or added as a comment on a pull request.

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TEAM 9

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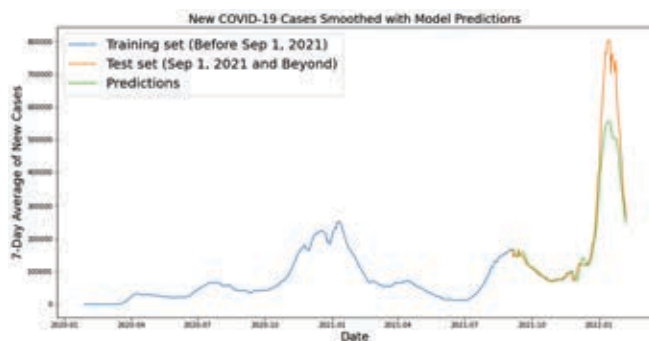
Suining He
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CGI_Infection_Rates_ML_Modeling

Our team has spent the past two semesters working on machine modeling approaches to modeling COVID-19 infection rates in the United States. Our goal for this project was to create at least one model that performs better than the popular models currently available. We have gained professional experience working with data science and machine learning throughout the process. Specifically, we applied data collection, data preprocessing, analysis, machine learning model development, training, evaluation, and parameter tuning skills. We started with simple linear regression and autoregressive integrated moving average (ARIMA) models to set a baseline. Next, we shifted our focus to long short-term memory (LSTM) neural network models. Overall, we achieved two models that performed significantly better than existing models on the national scale. We then shifted to modeling COVID-19 infection rates in smaller regions, where we had more data to make the model more accurate.



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TEAM 10

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Whelen Cloud Platform - Fire Feature

The project is focused on creating and implementing two features on The Whelen Engineering Company's web-based application: the Whelen Cloud Platform (WCP). WCP provides a real-time vehicle tracking service to emergency services with an interactive map that displays the locations and status of all vehicles. Our job was to implement two features for the the Live Map designed to be useful for coordinating fire fighting services during an emergency. While these features were originally specific to fire trucks, we designed them in such a way that they could be useful for any organization that Whelen provides services for, whether it be law enforcement, emergency medical services, or even the Department of Transportation.

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TEAM 11

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Webquity Web Accessibility

The team has created a prototype Google Chrome extension to adapt website content to be more accessible. The tool adjusts color schemes, font size, font family, and line and letter spacing to benefit users diagnosed with dyslexia and minor visual impairments. The resulting software will allow users to have equal opportunity to access and digest information online.

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TEAM 12

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Synchrony Cyber Range

A cyber range is a virtual environment in which users can simulate cyber attacks, test cybersecurity technology, host competitions, etc. In order to address the current limitations of cyber ranges, our team proposes that a domain specific language (DSL) should be used for cyber range development. A DSL within a cyber range would allow for customization of cyber range scenarios and standardization of scenario development. Our team will create a prototype of a DSL that could be implemented within a cyber range using Xtext, and write an NSF proposal supporting the use of DSLs in a cyber range. Our project also addresses the lack of accessibility with current cyber ranges. We suggest a hybrid licensing model, as well as more cost effective platforms to run our cyber range on (Raspberry Pi, existing cyber ranges, etc.).

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TEAM 13

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UConn Kinesiology

Use of UWB and Vibro-Tactile Biofeedback System for Indoor Positioning and Navigation in Emergency Response Situations

Our project develops software for a specific vibro-tactile biofeedback system. This system is designed to help firefighters navigate smoke filled buildings. Our vibro-tactile biofeedback system uses patterns of vibration felt on the body to provide new ways of perceiving direction. UWB radio based positioning system is used to determine the ranging values and location of a mobile unit. These systems are integrated together to create a prototype device that can be used to blind-navigate around an indoor environment.

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TEAM 14

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PW Secure Embedded Architecture – Post-Quantum Cryptography (PQC)

The goal of our project is primarily about implementing three post-quantum signature verification algorithms to be run on the Xilinx ZCU102 development board and running performance tests on said algorithms. We seek to use the performance metrics in order to determine which algorithm has the best trade off between speed and security, especially in the context where the ARM processor must be reset and the boot time minimized.

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TEAM 15

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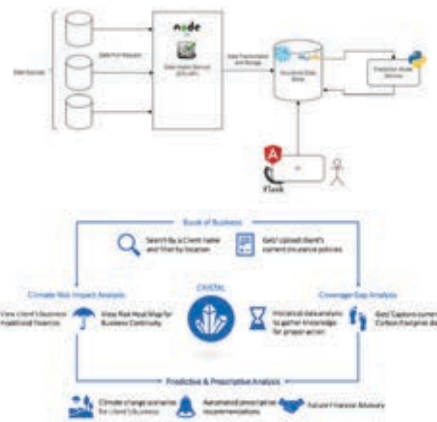
Sheida Nabavi

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Climate Risk Strategy Analyzer

When climate disasters occur and damage properties, insurance companies are expected to pay for losses covered by a client's policy. The issue, however, is that many of these policies are determined by historical data. This historical data determines how much an insurance company is expected to pay if a claim is made and under what circumstances a claim is valid. This past data is rapidly becoming more and more dissimilar to what is happening today due to changes in the frequency and severity of climate disasters. It is vital that better solutions are developed in order to reflect the current circumstances. It is for these reasons that the project Climate Risk Strategy Analyzer (CRISTAL) was created. The purpose of CRISTAL is to act as a tool for broker agencies to evaluate their clients current insurance policies and determine what further coverage may be needed when the current climate situation is taken into consideration. By combining a climate risk analysis and a coverage gap analysis, CRISTAL will provide users with predictive and prescriptive analyses. Such analyses will include possible climate events that can affect a client's business, automated recommendations related to their policies, and advisories about potential financial changes. In order to achieve this goal, our aim is to implement three main features focused on flood events: a historic analysis of flood claims made in proximity to a given address, a simulation of a potential flood event, and a prediction of what damages may be incurred during such a flood event.



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TEAM 16

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AR Mobile Application for Visualizing Spatially Anchored 3D Models

For this project, Sonalysts would like to have the students design and develop an AR application that interacts with static exhibits. Our project is an augmented reality mobile application that is able to render animated 3D holograms in real-time and geospatially anchor them on physical objects and/or tags in the real world. It is capable of image recognition, object detection, geolocation mapping, marker recognition, and it can support an augmented reality view that contains spatial awareness and AR sessions. In addition to this, our application is able to render animated 3D object models, retrieve and fetch them from a cloud database in real-time, contain a secure user authentication and authorization service, and should have a friendly and interactive user interface.



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Synchrony CareCredit

Synchrony, a financial services company, is looking to build upon their existing CareCredit application. This application provides avenues for customers to pay their medical bills. In its current form, one of the app's key functions is to allow customers to pay healthcare providers directly for the portion of their medical expenses that insurance will not cover. However, in CareCredit's current state, this key functionality is inefficient. As a result, Synchrony is interested in an enhancement of this feature, which would allow patients to scan their healthcare bills with their phone camera and autofill details. In addition, a check-in functionality will be implemented to allow a patient to check-in to an appointment on the app from their car, rather than having to enter the facility. A provider will see this check-in request and be able to approve or deny the patient using the application.

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TEAM 19

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Lockheed Martin Virtual Reality Robot

Students will provide a virtual reality experience where a remote user in a VR headset can peripherals can control a telepresence robot to solve macro and micro scale problems.

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TEAM 20

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**TEAM 21**

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LabOnFHIR: An mHealth App for Patient Disease Tracking

One of the major trends in healthcare is an increasing desire for patients to exert more control over their protected health information (PHI) which contains data that they create and control and data that is maintained in the different health information technology systems that are deployed at hospitals, clinics, medical offices, test laboratories, imaging centers, pharmacies, etc. The LabOnFHIR mobile health application is a mHealth application that allows users to manage diabetes, heart disease, and fitness related data. The front end of LabOnFHIR has a side for the patient, in which patients can input and view their diabetes, heart disease and fitness related data such as glucose levels. Data can be visualized in such a way that is easy for patients to recognize and possibly correct negative patterns such as poor glucose levels or weight gain. This immediate knowledge of a patient's glucose levels will be helpful for doctors to detect abnormalities in patients much sooner than they would otherwise.

**TEAM 22**

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Diameter Health FHIR API Documentation Website

We've created a website which hosts documentation for Diameter Health's Fusion API. Besides serving as a new centralized user-facing source of documentation, the website allows users to test the API's functionality through its built in sandbox feature. The Fusion API (application programming interface) cleans and de-duplicates healthcare information such as patient records. The purpose of which is to allow interoperability between different healthcare IT systems which may not all structure their data the same way.

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TEAM 23

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TEAM 24

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AcceleratED Learning

AcceleratED Learning LLC. is a web application that features an on-line reading intervention platform that supports students struggling with reading by providing a community of trained tutors that provide virtual research-based instruction during school. We are focused on creating a kid-friendly video teleconferencing platform that will be able to support students during school.

**TEAM 25**

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Gamification of Data Capture and Analysis from Physical Objects

Pitney Bowes is a global technology company providing commerce solutions that power billions of transactions. Clients around the world, including 90 percent of the Fortune 500, rely on the accuracy and precision delivered by Pitney Bowes solutions, analytics, and APIs in all aspects of shipping, from ecommerce fulfillment to international shipping. As commerce has evolved information about a package or mail piece has become almost important as the item itself. The USPS has continued to place more and more data within barcodes on envelopes and packages. This data can be used to gain insights into the behaviors of the shippers, carriers and technology providers. Pitney Bowes has initiated several programs to encourage employees to send images of the mail and packages they receive to a central location for analysis, but each one quickly lost steam and engagement dropped. Our goal is to gamify the process of scanning labels on mail and packages to increase user engagement and provide crucial data for Pitney Bowes to use to improve their services. The platform will be an app on users phones with a cloud-hosted backend that keeps track of teams and points as well as decoding and parsing the images submitted.

**TEAM 26**

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Shared Environmental Layout Data Structure of Human Position and Posture Representation for Human Robotic Interaction Control

The purpose of the project is to create a system that can take video data from two input devices and combine the data into one global environment. This will allow MOVIA to supplement their Kebbi Air Robot Platform with data from additional devices, improving the ability of the system to interact with subjects. The project will be implemented using Unity and Microsoft's world locking tools. The system will have a module that is responsible for tracking subjects' positions and locations using fixed real-world objects (glyphs). This module will be installed on multiple devices and will feed all the data to a second module. The second module will combine that information using coordinate transformations and create a unified global coordinate space. The global coordinate space will check for duplicate data or errors and will create a single representation of each subject in the environment. These virtual representations will be displayed as the output on a laptop. This document outlines the exact details and design decisions for the system described above, and will also present the action plan for completing the project.

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TEAM 27

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Whelen Engineering UConn Senior Project

Whelen Engineering produces lighting and control systems for police and emergency vehicles. With Whelen's control system, customers are able to track the location and status of various functions of their vehicles. The goal of our project was to expand Whelen's platform to handle new signals sent from vehicles. To do this, we updated Whelen's platform to receive the additional signals from the vehicles. Having sent the signals from the vehicles to the cloud, we added functionality to Whelen's live map on their web platform to reflect these signals on the vehicle icons.

COMPUTER SCIENCE AND ENGINEERING



TEAM 28

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Wearables in Healthcare

Using public API our team will compile health data and personal wearable device data to make determinations on health status and display this on an application dashboard. Our specific direction for the project was to research the idea of how financial status might affect one's health status in the USA. To do this we will examine the gross income of people in different states, then analyze the number of reported hospitalizations/illnesses/covid patients there are with respect to the total population.

COMPUTER SCIENCE AND ENGINEERING



TEAM 29

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Value Stream Mapping

Value Stream Mapping is a project sponsored by Aerospace Alloys, Inc (AAI). Value Stream Mapping or VSM is a visual tool which allows a company to visualize their production for current and future capacity depending on the current and forecasted demand from clients. Using Excel, Python, and eVSM, the workflow of value stream mapping for Aerospace Alloys has been optimized so that it only takes a matter of days to complete instead of months. The original raw data is provided through an Excel spreadsheet generated by AAIs ERP system. The Pandas library in Python is used to analyze the raw data which includes sorting through all the data and calculating cycle times, quantities demanded, and other production measurements. The results are written to Excel sheets by their product family. A dashboard is also generated by combining all the important data into one Excel sheet. This Python program automates the data analysis so that it takes seconds or minutes to compute. The resulting data is then used in the eVSM software to produce the value stream. The goal of this project is to allow Aerospace Alloys to optimize their production workflow throughout the year and actively prepare and succeed as demands change and new challenges arise.

Aerospace Alloys - All Product Families - VSM Dashboard																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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**TEAM 31**

Prateek Kapoor
Kelsey Mitchell
Jake McNamara
Matthew Togher
Aikambir Walia

ADVISOR

Dongjin Song

SPONSOR

Anomaly Detection for Internet-of-Things Appliances

Budderfly is an energy management company that uses innovative solutions to help businesses and other institutions save energy. One of these solutions is accomplished through the installation and monitoring of energy efficient appliances through Internet of Things (IoT) devices. Given time series data on freezer and bread oven monitors, the goal of our project was to analyze the power levels of these appliances. We first visualized the data to better understand it, and then pre-processed the data to get rid of noise and outliers. Then, using different machine learning models, we were able to detect anomalies among the freezer and bread oven monitors. One method we used was K-Means clustering with soft DTW as the metric, which grouped monitors into clusters and helped us identify which monitors were behaving irregularly. Finally, we used an alternate LSTM machine learning model to detect anomalies and compared this with the K-means clustering.

**TEAM 32**

Mohammad Habib
Connor Lynch
Saumya Shah
Qianrui Xia
Xuehuan Zhu

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Jonathan Clark
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Cigna Mental Health Social Media

Our task is to develop an application that integrates with an existing and popular social media platform such as Twitter to allow users to monitor and be alerted when one of their friends might be having a mental health challenge. The app would analyze photo images and textual posts in a social media feed to perform sentiment analysis. The sentiment score would be presented to the user and give them potential insights that allow them to be a real “friend” and provide the community support that is needed. This might be done through prioritizing the news feed, proactive alerting, or even giving users the ability to place certain contacts on a their personal watch list. Sentiment scores might also be graphed over time to show the ups and downs of their community of friends and potentially correlate these extremes to personal or public news events.

COMPUTER
SCIENCE AND
ENGINEERING



TEAM 33

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ADVISORS

Karl Berntorp
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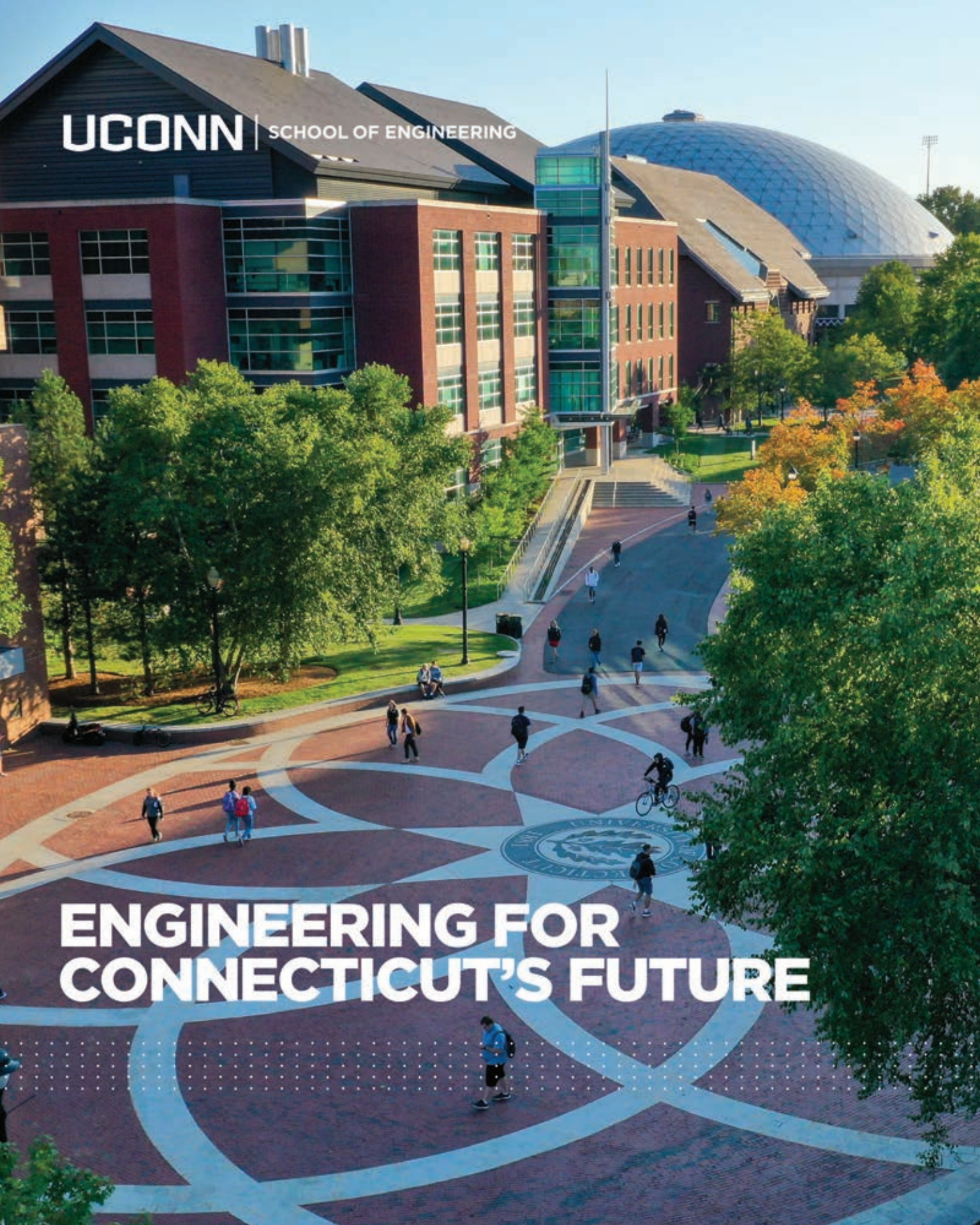
SPONSOR



MERL path planning with deep neural nets

Autonomous path planning vehicle simulator and RC car using deep learning.

Our team collaborated with Electrical and Computer Engineering Team 7 on this project.



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