UCONN | SCHOOL OF ENGINEERING

SENIOR DESIGN

DEMONSTRATION DAY

HARRY A. GAMPEL PAVILION

MAY 3, 2019

Senior Design Instructors for 2018-2019

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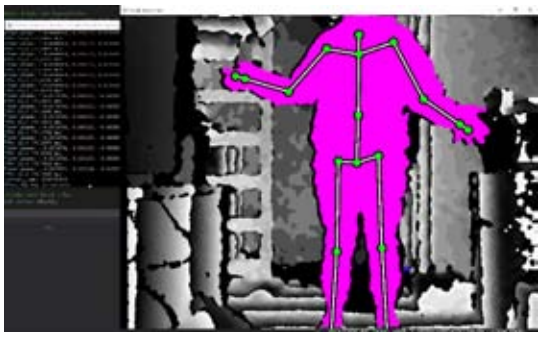
From left to right: Philip Murray, Ashim Ranjeet, Alden Richter, Patricia Alfonso.

COMPUTER SCIENCE & ENGINEERING

TEAM: 1
SPONSOR: Connecticut Children's Medical Center
SPONSOR ADVISOR: Dr. Matthew Solomito
FACULTY ADVISOR: Dr. Don Sheehy

Creation of a Mobile Motion Analysis Lab Using an X-box Kinect



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Frame number: 117
Body Id: 223
Head position: (356.536, -12.9809, 0)
Spine Top position: (365.728, 59.6984, 2743)
Left Shoulder position: (316.363, 51.574, 792)
Left Elbow position: (257.665, 117.025, 1852)
Left Hand position: (176.255, 93.3137, 1721)
Right Shoulder position: (418.9, 41.3453, 2348)
Right Elbow position: (464.994, 129.228, 2380)
Right Hand position: (532.764, 176.074, 0)
Spine Middle position: (364.865, 153.151, 0)
Spine Base position: (362.668, 225.672, 2882)
Left Hip position: (334.633, 223.882, 3650)
Left Knee position: (331.636, 362.119, 1813)
Left Foot position: (323.482, 491.839, 0)
Right Hip position: (395.651, 215.406, 783)
Right Knee position: (401.064, 356.688, 3690)
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Frame number: 118
Body Id: 223
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```

The traditional method of detecting scoliosis in children requires a trained professional watching a patient perform a test called the Adam's forward bend test and subjectively determining a diagnosis. A more advanced and objective methodology requires a large motion analysis lab. This method requires placing markers on different joints and having the patient perform tests while motion sensors monitor these markers. Once all the data are collected, it is possible to make calculations on whether the child may have scoliosis. The goal is to create a portable version of this motion analysis lab.

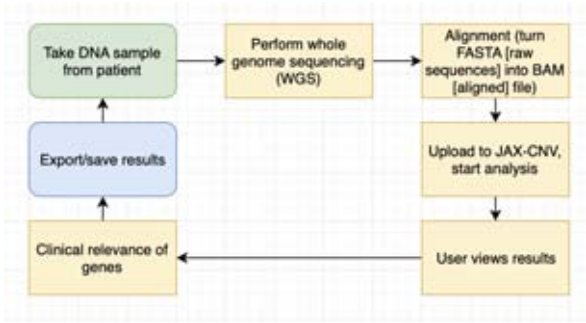
The Xbox Kinect contains hardware allowing for the collection of data necessary to build a mobile motion analysis lab, at a cheaper price and more portable than the current alternative. Another piece of hardware that has similar capabilities to the Kinect is the Orbbec Astra. Depth data is collected using the devices' cameras, translating the position of the joints in three dimensional coordinates. Using this information, a mobile motion analysis lab was developed to determine whether the patient is likely to have scoliosis. Once this app is calibrated, the results are given in a simple yes or no manner. At a routine checkup, the clinician will be able to setup the Astra or Kinect opposite the patient, and start the app and proceed as if it were the usual checkup. If the app determines the patient has scoliosis, the patient could be referred to a specialist. The program can also be used as a safety net, so that a pediatrician can get a second opinion on an unclear or negative Adam's bent test performed on the patient. Thus, the goal of the app is to allow a clinician to collect objective data about a patient and allow for an easier, clearer diagnosis, without changing the experience for the patient.

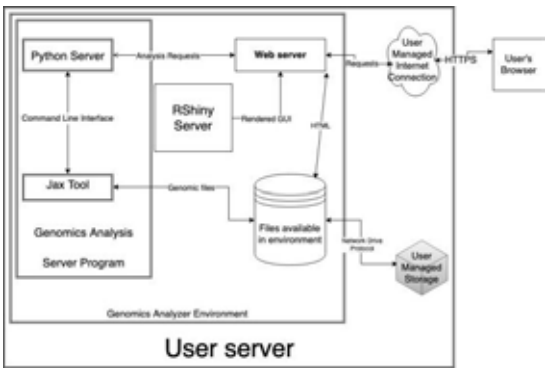
From left to right: Patrick Smith, James Steel, Eric Burt, Samuel Sledzieski.

COMPUTER SCIENCE & ENGINEERING

TEAM: 2
SPONSOR: The Jackson Laboratory
SPONSOR ADVISOR: Dr. Charles Lee and Dr. Wan-Ping Lee
FACULTY ADVISOR: Dr. Dong-Guk Shin

A Web-Based Platform for Genomic Structural Variation Detection in a Clinical Setting





Copy number variations (CNVs) are a type of structural chromosomal aberration that results in the deletion or copying of large regions of the chromosome. CNVs account for a significant portion of variation in the human population and links have been found between CNVs and several diseases, including mental illness, developmental disorders, and cancer. CNV calling is the process of identifying copy number variations in an individual, and is often done in a clinical setting to identify a patient's propensity towards a disease. Widely used assays for detection of CNVs include FISH, PCR-based assays, chromosomal microarray analysis (CMA), and next generation sequencing (NGS). CMA is currently the recommended and most widely used assay to identify disabilities and disorders in patients.

High throughput NGS and advances in computing and data analysis have brought the ability to use whole genome sequencing (WGS) in health care research. Researchers at the Jackson Laboratory have developed a new method for CNV calling which accurately detects large (>50 kiloBase) deletions and duplications that are usually implicated to cause diseases. The goal is for this new CNV calling algorithm, JAX-CNV, to be adopted widely and to enable WGS as a first-tier diagnostic assay to replace CMA. The advanced ability for CNV calling will allow for more specific and sensitive identification of disease in patients and a more personalized health care experience.

To promote the adoption and use of best practices of JAX-CNV in a clinical setting, we develop a web-based application which allows physicians easy access to CNV calling using WGS. Web-based platforms for CNV calling currently exist, but none exist which provide access to state-of-the-art algorithms for CNV detection in a clinical setting. In addition to making the CNV calling workflow easily available to physicians, our application automatically cross references any copy number variations found with commonly-used clinical databases to identify CNVs in genes widely known to be associated with disease, and reports this disease identification to the user. Our application is built using the Shiny platform for R and our own server application written in Python, and will be deployed on Jackson Lab servers to be usable from any modern web browser. This architecture allows for flexible UI design, easily maintainable server management, and widespread accessibility of our tool and JAX-CNV.

From left to right: Mariem Ouni, Richie Viscardi, Fitch Spencer and Zachary Galica

COMPUTER SCIENCE & ENGINEERING

TEAM: 3
SPONSOR: Synchrony Financial
SPONSOR ADVISOR: Daniel Murphy
FACULTY ADVISOR: Dr. Yufeng Wu

Synchrony Financial Voice Experience

Synchrony Financial serves over 60 million cardholders in thousands of retail stores across the United States. The company serves its customers through its MySynchrony web platform and mobile application that allows its users to view and manage their various credit accounts.

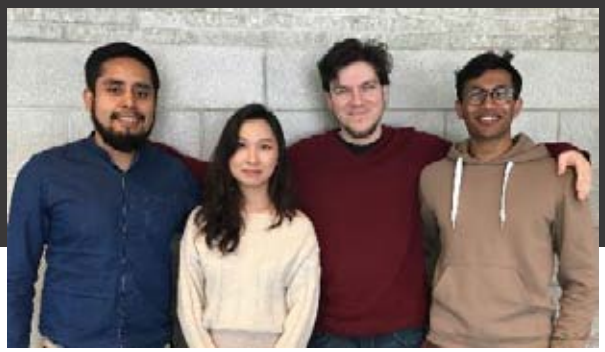
Product sales show that 30 million virtual assistant speakers were sold in 2017 alone, added to that, MarketsAndMarkets predicts that the virtual assistant market will be valued at 18.3 billion dollars by 2023. That's why Synchrony aims to provide basic account data and capabilities to their users over voice using Amazon Alexa and Google Assistant. And that's what our Senior Design Project is all about.

The language used for this project is Javascript and the main development environment is the Google Actions platform. We are also using Dialogflow and Firebase Functions.

The purpose of our project is to create a voice assistant experience that the financial company, Synchrony, can leverage to create a better user experience for their consumers. Currently, Synchrony has a basic voice experience in production. Our task is to expand upon these basic commands and come up with new creative ways that voice can be implemented for Synchrony needs. We implemented features such as:

Make a Payment
Unlock/Lock Card
Check Balance
Check Prior Transactions
Set a Pin

Adding to the features added to Google Assistant, we worked on leveraging multi-platform technology to take advantage of voice recognition technology and screen interfacing. We created a deep link to an Android app from Google Assistant Actions, which allows users to use voice commands to invoke features on the native Android Application.



From left to right: Eiby Angeles, Yanjing Xu, James Breslin, Sujay Alavala.

COMPUTER SCIENCE & ENGINEERING

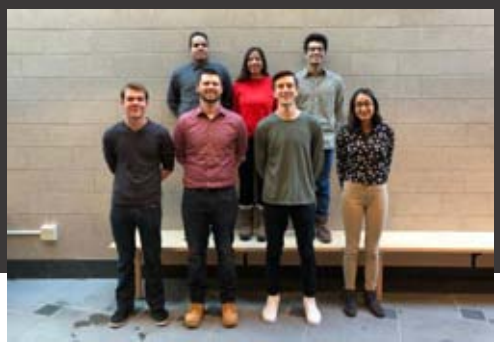
TEAM: 4
SPONSOR: L&T Info Tech (LTI)
SPONSOR ADVISOR: Satya Pandey
FACULTY ADVISOR: Dr. Song Han

Connected Home

LTI, rated as one of the top 20 Global IT Services Companies, is seeking a connected insurance solution to leverage smart homes in the personal homeowner's insurance market. The world has never been more connected, in no small part due to the emerging Internet of Things (IoT). IoT offers many opportunities; connected smart homes are a revolutionizing technology for both underwriters as well as their customers in the insurance market. Insurance companies are moving from indemnification to real-time risk protection. The industry has already seen conceptual and implementation models in connected auto, and now in a connected home space.

Historically, insurance companies have relied on generalized, regional assessments of large areas of housing to perform risk assessment and determine insurance premiums. Such methods are inefficient, specifically they lack individual risk assessment based on abundant customer data. The volume of data that can be harnessed to price risks continues to grow exponentially. Fueling this unprecedented surge in risk data is the massive sensor proliferation across smartphones, wearables, and 'smart' home devices. To compete insurance markets will need the aggregation and analysis of huge volumes of personal, behavioral and contextual data delivered by IoT. This will allow innovation around product development and personalization, proactivity managing clients' risks for differentiated and superior underwriting, and will translate into higher revenues and profitability.

Traditional homeowners insurance protects a person's most expensive and important investments but only mediates disasters that have already taken place. Leveraging our Connected Home Insurance solution will provide novel innovation in the form of risk assessment, loss mitigation, and customer engagement. Ours is a scalable solution for large-scale smart home monitoring and data analysis. Collecting data from heating, burglar alarms, smoke or moisture sensors the system will stream and sort into a distributed SQL database using a Kafka-Spark Cluster. Real-time time analysis using machine learning with Spark is fed into a customized QlikView dashboard for both customers and underwriters. The solution system will ideally provide enhanced pricing accuracy through granular segmentation, focusing on energy conservation, safety, and damage mitigation. This will allow Insurance companies to provide personalized premiums based on risk performance, real time risk monitoring and alerts, tailored insurance coverage, and an understandable claim experience.



Dinelson Rosario, Allysa Garcia, Emil Abraham, William Reid, Andrew Philippi, Evan Langlais, Rania Chowdhury

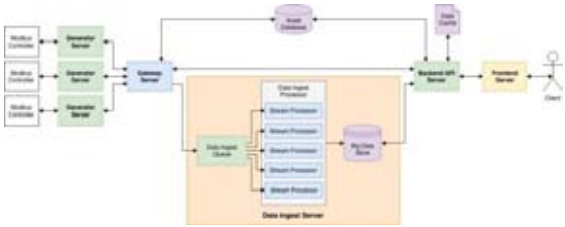
COMPUTER SCIENCE & ENGINEERING

TEAM: 5
SPONSOR: Kinsley Power Systems
SPONSOR ADVISOR: William Schneeloch
FACULTY ADVISOR: Dr. Song Han

Data Collection, Processing, and Visualization for Remote Emergency Generator Systems

KINSLEY
The Energy Solutions Company

Generators are a cornerstone of emergency power infrastructure that ensure critical systems are up and running during power failures due to outside forces such as inclement weather. Periodic generator monitoring and maintenance ensures that in the case of a sudden power failure, important resources are not cut from energy sources. In the event that this operation does not happen immediately and correctly, there can be immediate danger to equipment, data, and even human life. Regular monitoring and maintenance ensure these critical generators are in working order for when the unexpected strikes.



Currently, a technician must travel to a generator whenever it needs to be started, stopped, or monitored for any preemptive or reactionary reason. Kinsley power has a monitoring tool that runs on a laptop connected to the generator via a cable that facilitates the reading of data and events from the generator controller. A robust and responsive remote monitoring system would allow for technicians and clients to spot generator faults and problematic trends while saving the time and money associated with travel.

The primary goal of this project is to remove the requirement for Kinsley technicians and clients to always be at a generator's physical location to view its data. Technicians will access a website that will allow them to view real-time generator data and events, as well as interact with certain generator functions. Travel will still be necessary in the event of failure, and the system will be able to notify technicians when certain concerning events are received. Historical data collected by the system can also identify patterns of failure in order to anticipate when and where more technician attention might be necessary.

Our solution, the PowerPanel System, seeks to leverage several cloud technologies to ingest server data from thousands of remote generator systems using a Kafka cluster, processing that distributed data through Spark, and archiving all time series data in a big data storage cluster utilizing OpenTSDB. Once data is processed and ready for retrieval, a responsive website written in Angular 6 utilizes a Django RESTful API to authenticate clients and technicians to pull generator data for visualization and analysis.

From left to right: Stephen Sam, Warren Davis, Kyle Zielinski, Andrew Curtice

COMPUTER SCIENCE & ENGINEERING

TEAM: 6
SPONSOR: Charter Oak Environmental Services
SPONSOR ADVISOR: Kimberly Ewalt
FACULTY ADVISOR: Dr. Zhijie Jerry Shi

LOAD PM –

Live | Ownership/Operational | Activity/Analytic | Database | Project Management

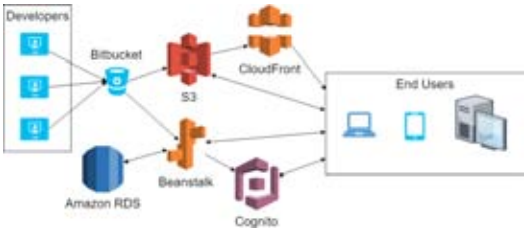
Project Management tool with current development focused on a transport tracking application

CHARTER OAK

Environment | Transportation | Technology

Charter Oak Environmental Services is a consulting and engineering firm that provides integrated and technical experience and expertise to the engineering, consulting, transportation and energy services sectors. A portion of Charter Oak's larger work comes from the transportation and disposal projects, where multiple different parties have to exchange many documents related to the project**.** Their current business transmits all of this data through various channels such as email, fax, text and exchange of paper copies.

The main purpose of this application is to streamline and automate day to day activities. The application delivered has two main functions: allow file exchange between parties and generate reports. As files get updated, the system will keep a record of all previous versions and recover them if necessary. Given the nature of some projects, each client will have varying levels of access depending on their role. When a party wants access to a particular document or project status, no longer will they need to email a Charter Oak representative to gain access.



We achieved our goal by creating an online portal that all stakeholders will be able to access either on their computers or on their mobile devices. To enable us to build such a system quickly, we relied on Amazon Web Services. This platform handles key challenges such as server/database management, authentication, and software upgrades so we can focus on what is important: the application. We used Python Flask to act as the server-side framework to interact with our database running PostgreSQL.

With the introduction of the new system and the automation that it provides, we foresee a number of key benefits. First, there will be reduction of repetitive work for the employees assigned to a project. Also, they can offload the correlation of manifests, weight slips, and truck usage information required for reports to the application. Thus, the same number of employees can support more projects resulting in an overall lower cost of doing business. These cost savings can be leveraged to offer more competitive rates on future project proposals. On-line, real-time access will differentiate Charter Oak from their competitors.

From left to right:
Dhigvijay Jeevanandam, Kenny Wei, Christopher Shank, Dmytro Haydamakha

COMPUTER SCIENCE & ENGINEERING

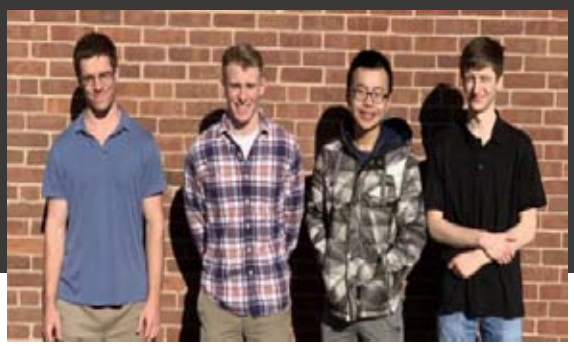
TEAM: 7
SPONSOR: Convention Nation
SPONSOR ADVISOR: Kim Estep, Shaun Gorneau
FACULTY ADVISOR: Dr. Bing Wang

Mobile Event Cross Platform Application for Convention Nation

The main purpose of the project is to create a mobile application for Convention Nation so that the company can provide the service to a wider audience while also providing a more accessible alternative for users using Convention Nation's existing service. The goal was to help Convention Nation make it easy to find highly rated conferences, conventions, and tradeshows no matter where a user is, with the intent of providing attendees with the best possible experience when attending these events.

Convention Nation's mobile application was developed using React Native. We are also using Expo, which is a framework for React Native that allows for easier development and deployment of our application. This allows for a cross-platform distribution on IOS and Android platforms using a single code base. Furthermore, React Native allows us to encapsulate individual parts of our user interface into reusable, independent components. For example, we can program an event card component and reuse that throughout our application. Convention Nation has provided us with a RESTful API to access their event and user data.

A user of the application can sign up or login to the application. Once a user logs into the application, they can see events that are recommended to them based on their profile questions. In addition, a user can look up events that they are interested in that are not recommended. Any events that the user is interested in can be favorited and a user is able to declare that they are going to attend the event. Once a user attends an event, they can review that event. The reviews on events will provide Convention Nation with necessary feedback from the consumers. They can then use this information to optimize their service by generating and recommending better events for the user.

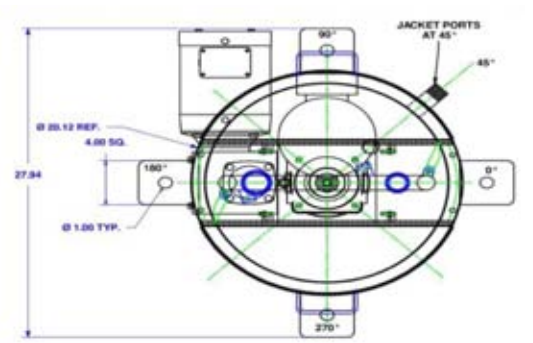


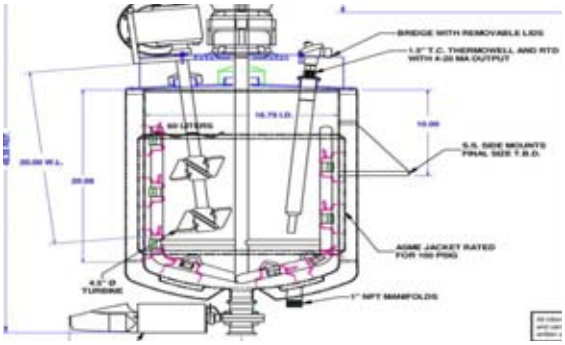
From left to right: Justin Furuness, Mark Violette, Yifei Han, Alex Williams.

COMPUTER SCIENCE & ENGINEERING

TEAM: 8
SPONSOR: Unilever
SPONSOR ADVISOR: Evan Smith
FACULTY ADVISOR: Dr. Wei Wei

Visualization of Process Equipment Setup in Manufacturing






```
    @staticmethod
    def format_attr_strings(input_string):
        def replace_func(replace_char, temp_string):
            temp_string = temp_string.replace(replace_char, "")
            return temp_string

        formatted_string = input_string.lower()
        replace_chars_list = [' ', '.', '&', '-', '%', '/', '(', ')', '\"']
        for char in replace_chars_list:
            formatted_string = replace_func(char, formatted_string)
        return formatted_string


csvfile = CSVFile()
csvfile.csv_from_excel()

tank_list = csvfile.pull_csv_data()
volume = float(tank_list[0].totalcapacityofmixer['data'])
diameter = (float(tank_list[0].vesseltankinternaldiameter['data']) / 1000)
r = diameter / 2
h = ((volume / (math.pi * r**2)) / 1000)
```

Our project was designed to provide visualization tools to engineers who run mixing procedures for Unilever's consumer products, giving them immediate reference for the volume and height of each batch mixture at a given time. The main problem that the engineers face is when the mixing blades overlap with the surface of the batch, creating a vortex and causing air bubbles to form in the mixture. This reduces the quality of the affected batch, making the blades a set of critical regions to avoid. Because the act of producing a batch is often dynamic, abstracting it into a program will make it easier for engineers to avoid mistakes while maintaining a high efficiency. To ensure a longer lifespan for the software, it must be able to read information on a specific mixer using existing spreadsheets, and automatically set up the simulation around that. Without this ability, the software would be limited to a small set of predefined environments, and eventually be discarded when the company decides to produce a new mixer design.

After the problem was understood, a demo for the project was developed in Blender, an open-source program that supports 3D modeling, animation, and scene manipulation. The key goals of this demo were to provide a proof-of-concept for reading the data via Python scripts, as well as create a basic simulation where the height of an object could be changed by user input. After examining the demo's results, we decided to go forward with this plan.

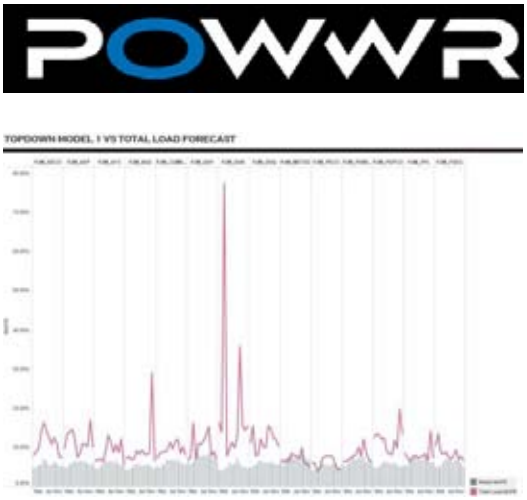
Another key topic of the project was finding a way to distribute this software throughout the company in an easy and efficient way. Rather than installing it on specific computers, the decision was made to store a WebGL build onto an online server, so that it could be accessed using a web browser. This raised another set of problems, however, because an interface was required for employees to reliably access the software without making it publicly accessible. As a solution to these problems, an interface was designed through Django, a web framework for Python. By using this toolset, an interface can be created to allow employees to login with credentials, filtering out unauthorized users while otherwise remaining accessible.

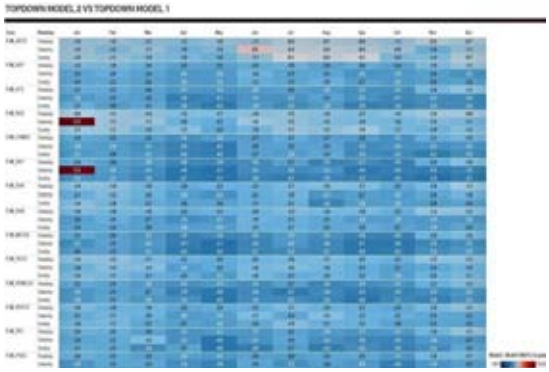
From left to right: Vickram Tulsie, Hayley Allard-Raucci, Jeffrey Eng, Alex Masi.

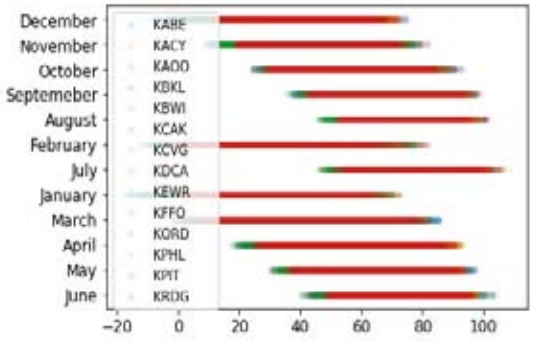
COMPUTER SCIENCE & ENGINEERING

TEAM: 9
SPONSOR: POWWR
SPONSOR ADVISOR: David Yegidis
FACULTY ADVISOR: Dr. Yufeng Wu

Energy Load Forecasting







We were asked to create a model that could predict future energy consumption in megawatt hours (MWh). To do this we utilized a machine learning technique called regression. This allows the model to predict future values based on similar recorded usage from the past. We strictly used recorded hourly usage and weather data from the past to form this model. Partitions along attributes of the large dataset are crucial to increase accuracy in the model. We first approached this problem by partitioning the data by weather station and month, then later adding day of the week. The days of the week were grouped by weekday versus Saturday versus Sunday. Weather station and month alone gave us 168 subsets of data to run our model on. The 168 subsets were obtained by using 14 weather stations within the regional energy transmission organization and the 12 months of the year. Once we split the data further into the days of the week, we got 504 subsets of data. By grouping the data by month and day, it allowed us to compare similar trends within the data. For example, this prevents us from comparing a data point in the month of January to a data point in July where the MWh consumption will differ due to weather anomalies.

One problem we needed to prevent was overfitting the data. Overfitting occurs when the model is too constrained and gives an accurate prediction for the trained data set but not for any other supplied data set. This in turn makes in a poor predictor of future data points. This was avoided by using 3-fold cross validation, which is a method that randomly assigns each of the 504 subsets into one of three categories. Two of the three categories are then used to train the model. The final category of data is then used to validate the model's accuracy. This process is repeated with each possible permutation of two training categories and one validation category. The final result is the average score of all the permutations scores.

In our model we used Random Forest Regressor, Extra Trees Regressor, and AdaBoost Regressor against all 504 subsets. The accuracy of our model was measured using mean absolute percentage error (MAPE). A lower MAPE score means a higher accuracy of the model. Our team was able to successfully achieve a model that produces a MAPE score of 3.63%, an improvement from our goal of 10% error.

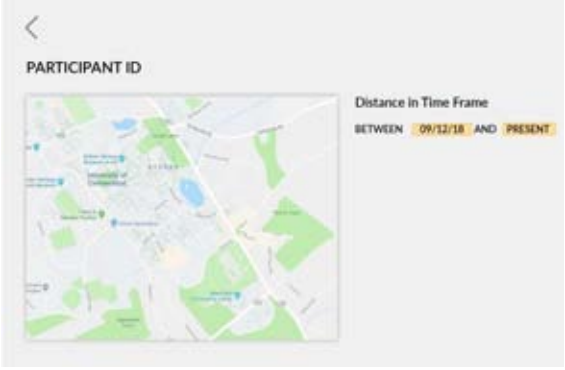
COMPUTER SCIENCE & ENGINEERING

TEAM: 10
SPONSOR: UConn Kinesiology
SPONSOR NAME: Dr. Steven Harrison
FACULTY ADVISOR: Dr. Steven Demurjian

From left to right: Michael Ballard, Jesse Meyer, Mason DeMelo, Renoj Varghes

UCONN
COLLEGE OF AGRICULTURE, HEALTH AND NATURAL RESOURCES
KINESIOLOGY

HuskyTrack: GeoLocation Tracking Mobile Application



The HuskyTrack application is the combination of a mobile location tracking application and a webpage based access panel designed for the UConn Kinesiology Department to aid in future research projects that include the personal movement of volunteers across campus. This application will simply collect data from volunteers who have installed the application on where they are while the application is engaged. This information will then be transmitted to a database where it will be made available to the relevant project's researchers for analysis and study along with a visualization in the form of overlaying the data onto a map of campus, and plotting a path based on these data.

The application has been designed with compatibility for iOS and Android devices in order to reach as wide a base as possible. In order limit the effects that this application may have on the performance of mobile devices, it has been designed as simply as it can be, and only performs location data collection as intended. This not only helps keep requirements low, but also ensures that volunteers cannot see the data of other volunteers in the project.

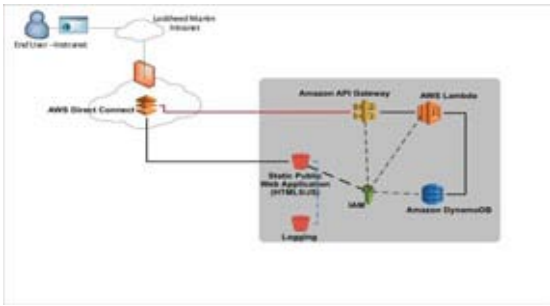
Researchers will predominantly make use of the web-based application that allows them to access the collected data in a meaningful format. All data is categorized per user, and each user is identified based on device only, to help maintain the privacy and objectivity of research data. From the web application, a researcher may search the data for particular fields and view this information, as indicated earlier, in a mapped visualization.

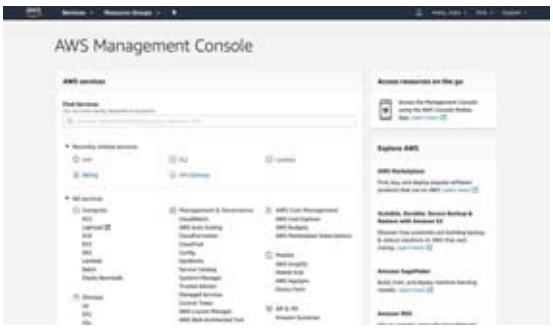
From left to right: Cathryn Jenner, Martin Marx, Andrew Latcherman.

COMPUTER SCIENCE & ENGINEERING

TEAM: 11
SPONSOR: Lockheed Martin
SPONSOR ADVISOR: Patrick Manley & Jessica Chan
FACULTY ADVISOR: Dr. Song Han

Remote Server Automation and Configuration of Amazon Web Services Technology

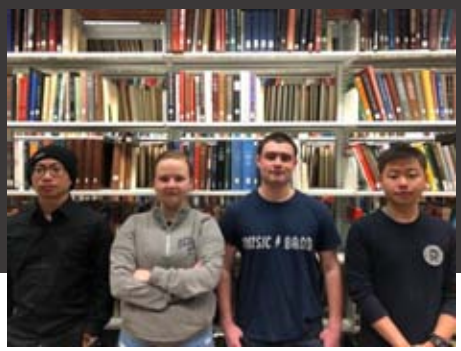




Hosting data carries a multitude of expenses including the power generated for the machinery, controlling server room temperature, maintenance costs, and security to prevent attacks from the outside. With this high paywall, only “tech giants” can afford to host their own servers. Disadvantageous to other companies, external hosting services created a barrier between control and computation. This leads people to ask the billion dollar question, "Why should I pay for runtime I'm not using?”. Amazon Web Services (AWS) provides a cloud computing platform for individuals and companies on a paid subscription basis.

Lockheed Martin is one of the companies that uses AWS servers. They recruited the help of the UConn Engineering program to build a system to remotely turn on and edit their testing environments. Lockheed Martin uses Elastic Cloud Computing (EC2) instances to test their software. Originally only the employees in charge of Amazon Web Services could alter the server configurations. This resulted in 4 AM calls from software developers needing to make urgent changes to their servers. Our application to automate the servers would give users the ability to start servers and edit their schedule. In addition, to save money, EC2 instances can be turned on and off almost instantly based on current demand. AWS will look at this schedule and start or stop an instance accordingly. When the instance is stopped, the company does not pay for it. This application was created in order to save on Lockheed Martin’s expenses and to give more freedom to users to edit their servers on their own time.

The back end of this web application uses multiple AWS services as well as python Lambda functions to communicate to the EC2 Instances. The static website that users see is hosted using AWS S3. Users IAM credentials are authenticated giving access to Amazon API Gateway providing an API we built to access the Lambda functions. Once the user logs in to the web portal, they will see a table of EC2 instances to interact with. These EC2 instances are computed options that Lockheed has stood up to perform various tasks.

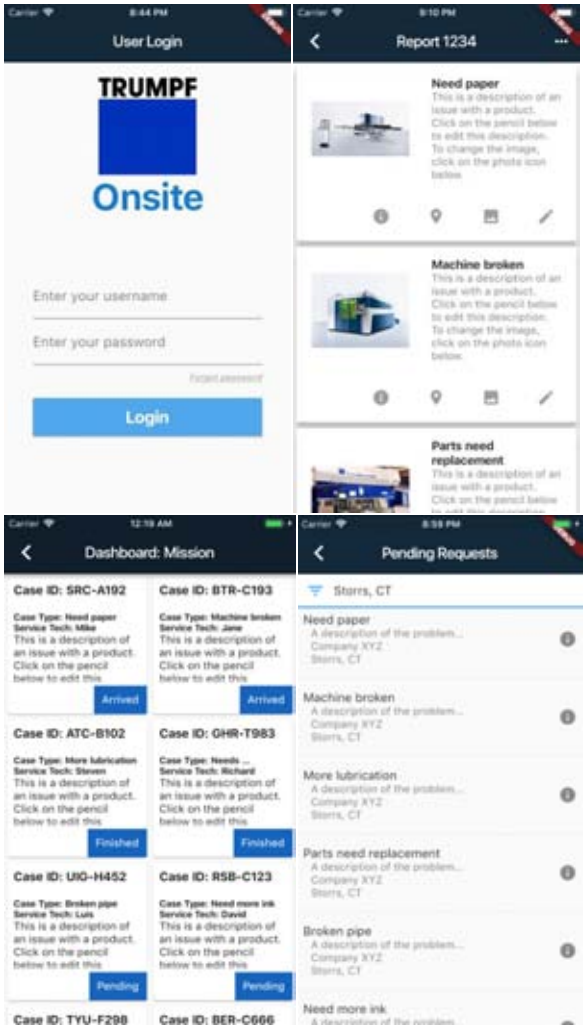


From left to right: Ronald Santos, Inese Duarte, Kyle Boyle, Qi Zhang

COMPUTER SCIENCE & ENGINEERING

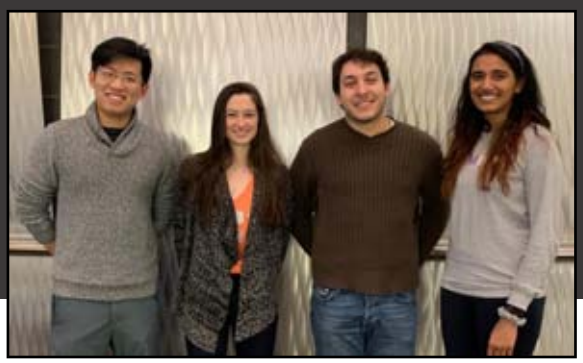
TEAM: 12
SPONSOR: TRUMPF, Inc.
SPONSOR ADVISOR: Theodore Kim
FACULTY ADVISOR: Dr. Bing Wang

TRUMPF Onsite: A Mobile App for Field Technicians



The goal of the project is developing *TRUMPF Onsite*, a mobile application used by service technicians for TRUMPF, Inc. This application will allow any service technician who is active in the field to create or edit a mission report based on a client-reported complaint. Pictures, notes, comments and other relevant information can be added to an existing report to resolve the client's issue. Complaints are usually issues encountered by a customer when working with one of TRUMPF's products but can also have different type classifications including machine breakdown, request and complaint prevention. Its core functionalities are expected to be used by service technicians and managers. Service technicians will be assigned missions based on their geographical regions and notify them of any upcoming reports that need to be submitted. Additional planned features will focus on the manager view, allowing access to functionalities within a dashboard, such as the ability to view the status of the missions and the service technicians on their team. Furthermore, the dashboard can display metrics related to the missions and service technicians. However, the main focus is on providing functionality to the service technicians. The overall goal is for the team to design a functional application that will display the necessary relevant and useful information related to the current task at hand in a concise and informative layout.

The application is designed with a client-server architecture in mind. The server provides a system for users to log in, get details about client requests that are assigned to them, and upload their completed mission reports. The server is written in C# using Microsoft ASP.NET Web API, and connects to the TRUMPF, Inc Service Information System (SIS) database to get client request details and to store completed reports. The Flutter framework, a cross-platform solution for mobile development, was utilized to develop for both Android and iOS devices simultaneously which reduced our overall development time. Additionally, Flutter provides its own user interface elements, so the design is cohesive across both platforms.



From left to right: Mingwei Zhang, Sophia Russell, Mattia Schiano, Susmitha Rayakota

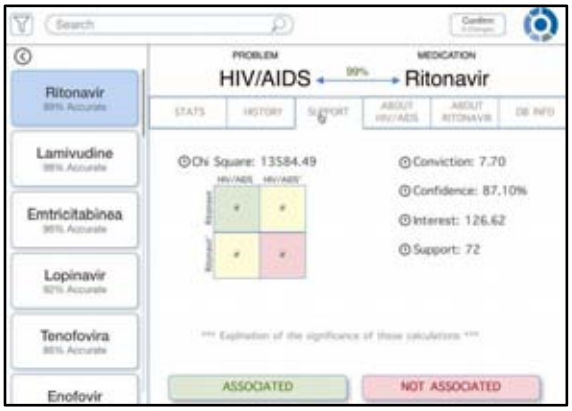
COMPUTER SCIENCE & ENGINEERING

TEAM: 13
SPONSOR: Diameter Health
SPONSOR ADVISOR: Harvard Pan
FACULTY ADVISOR: Dr. Donald Sheehy

The Clinical Inference Project

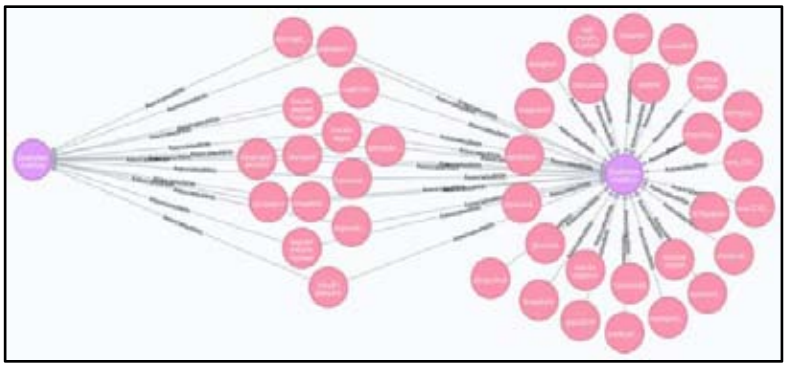
Diameter Health offers medical data normalization, deduplication, enrichment and visualization services for clinicians and analytics to better understand patients' medical information. Without creating a standard enriched data set, the information ends up being collected and viewed in various formats, leading to crucial data being easily missed by clinicians when treating their patients. Diameter Health's services address this problem with their API services. To further enhance their product offering, they would like to design a mechanism through which the system can suggest potentially missing information about a patient to the clinician, which is where our team comes in.

Using associations present in an existing medical dataset, our task is to design and implement a feature that allows users to evaluate these medical associations. These validations will enhance the existing dataset, which allows the machine learning models to produce more accurate results. Eventually, this continuously improving mechanism will be used to predict and suggest missing associations from existing patient records.



The User Interface (UI/UX) is an important design component to achieve success. While the algorithm can be executed to produce results, it is especially important that the results were meaningful to the clinicians who could then use the tool to validate the results. Our design included evidence for why and how the results were produced the way they were. We visualized these analyses with numerical calculations, existing medical data records, node-relationship graphs, and more.

We hope that our developed product will increase the value of the company's services making clinicians' technological experience more informed and efficient.



From left to right: Andy Guo, Max Efrat, Jake Shearman and Sam Li

COMPUTER SCIENCE & ENGINEERING

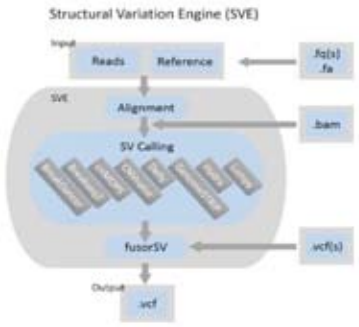
TEAM: 14

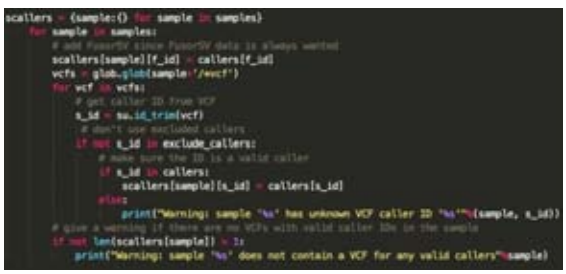
SPONSOR: The Jackson Laboratory

SPONSOR ADVISOR: Dr. Charles Lee and Dr. Ankit Malhotra

FACULTY ADVISOR: Dr. Dong-Guk Shin

Expansion of the Robustness and Accessibility of SV Detection Algorithm





Structural variations (SVs) are a large determinant of the Genetic diversity in humans. These variations, which can be categorized into deletions, duplications, inversions, or insertions, affect large sections of the genome. Despite their importance to genetics and disease, they remain poorly understood due to the lack of robust detection methods. The various existing state of the art algorithms, known as SV callers, have different specialties and detection methods, so they cannot individually detect all different types of SVs with high accuracy. As a solution to this problem, the Lee Lab at Jackson Laboratories has developed the Structural Variation Engine, or SVE, in collaboration with UConn CSE. The SVE utilizes a custom algorithm in order to optimally combine the results of the best known SV callers for maximum accuracy. The current version of SVE contains eight SV callers and FusorSV, a novel algorithm that compares SVE's output with a truth set of known SVs in order to determine the strengths and weaknesses of each caller. The increase of SV detection accuracy will have a large impact in the medical field, including, but not limited to, earlier detection of genetic diseases, as well as being able to provide personalized treatment on various conditions due to small genetic variances.

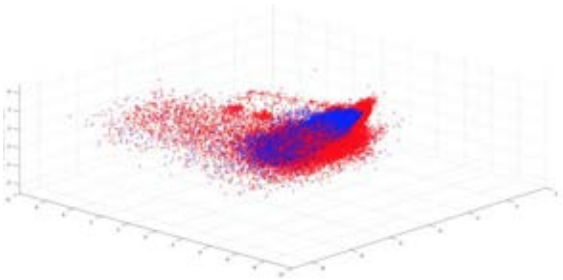
While the algorithm mentioned is effective as is, the SVE does not currently have enough robustness or user-side guidance to enable widespread use. This project focuses on expanding the capabilities and accessibility of the SVE, with the intent of getting the SVE closer to being practical in a clinical environment. This project consists of changes and additions to the SVE itself, as well as introducing new software platforms to be used in conjunction with FusorSV. Changes to the SVE include tasks such as widening valid input options and formats, reformatting the output for clarity, adding new SV callers to the list of ones FusorSV works with, and implementing a third-party population level genotyper (SVtyper). Usability and accessibility are amplified by the updating and testing of a Docker image that bundles SVE with all of its dependencies, as well as the beginning stages of a web portal that will enable a broader range of users to use the SVE to its fullest potential.

From left to right: Jenny Blessing, Mitchell Nethercott, Ryan Blau and Peng Chen

COMPUTER SCIENCE & ENGINEERING

TEAM: 15
SPONSOR: CGI
SPONSOR ADVISOR: Steven Lacroix
FACULTY ADVISOR: Dr. Yufeng Wu

Automation of Data Classification Using Machine Learning Models



Machine learning (ML) is a field of computer science that lies at the intersection of statistics and artificial intelligence. Recent advancements in this field have the potential to provide enormous benefits to healthcare, an industry that collects a large amount of private and legally confidential information about patients, employees, and others. There is a heightened security and privacy risk involving this collected data because this information is commonly stored digitally in large databases where highly sensitive elements are often stored alongside less sensitive elements, and where a single event can cause a collective data breach.

Consequently, for both business and ethical reasons it is important that data is accurately classified based on the type of privacy restriction. Restricted categories include protected health information (PII), payment card industry (PCI) data security standard, personally identifiable information (PII), and Cigna intellectual property (IP). Data protection is easier for the company if it is simple to identify and locate the data that needs protecting.

Currently, CGI performs the classification of different types of privacy manually, a tedious and error-prone process. Automating this process through machine learning is a supervised learning problem, using a redacted spreadsheet containing metadata provided by CGI as the training dataset. The goal of this project is to test out various supervised machine learning models to efficiently automate this classification based on the given training data set. Models currently being explored include Support Vector Machine (SVM), Gaussian Naive Bayes, and Linear Regression.

Our intended final product is an efficient custom ML application that is able to generate a classification indicating whether or not a datapoint would fall under a restricted category with a high rate of precision. Due to the imbalanced nature of the dataset, where data elements are far more likely to be unrestricted than restricted, accuracy alone is an inadequate metric to quantify performance, and so we will also use precision and recall as measures of success.

From left to right: Wesley DeBrusk, Kyle Lockwood, Daniel Bownoth and Vedant Patel

COMPUTER SCIENCE & ENGINEERING

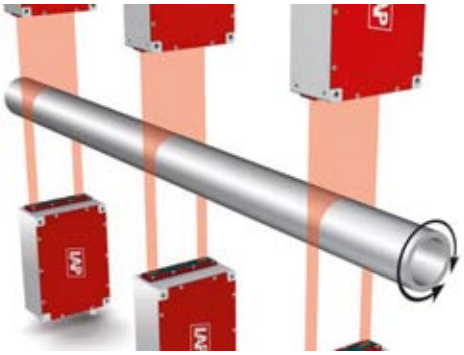
TEAM: 16

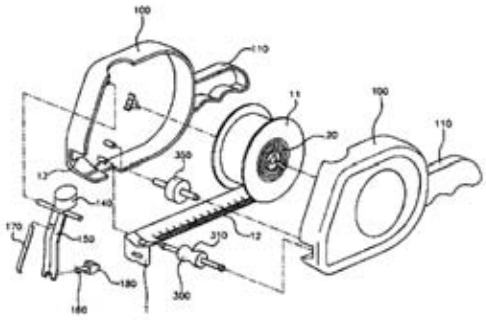
SPONSOR: Stanley Black & Decker

SPONSOR ADVISOR: Allan Gibson

FACULTY ADVISOR: Dr. Wei Wei

Optimization for Inline Camber Detection in Manufacturing





Stanley Black & Decker is a leading manufacturer of industrials tools and household hardware. Their New Britain factory is a large producer of their iconic tape measures. A big issue that arises during the manufacturing process is camber within the tape measure blades. Camber refers to a bend in the steel strip that makes up the blade of the tape measure. Steel strips that have camber cannot be used in the final product. Currently, testing for camber is done once the tape blades have gone through the entire process of heat treatment and tempering. If the blade is found to be outside of the given tolerances, then the blade can either be reworked a single time, or scrapped. Historically, Stanley Black & Decker has a camber rejection rate of around four percent. This solution will save Stanley Black & Decker a great deal of time and money.

Our goal was to create an automated method for testing camber inline before the blades are processed. Our solution involves mounting specialized sensors at certain points in the blade manufacturing line. As the blades pass beneath the sensors, we will be able detect camber before the tape blades go through its final process so that adjustments can be made to correct the error. We will also use the sensors to collect data on the curvature of the steel strips and analyze that data to detect camber in future blades.

We turned to Keyence, a sensor and lasers company, to obtain high quality sensors that we could use in this project. Throughout the year, we contacted representatives from Keyence to identify a sensor that would best suit our needs, and demonstrate the product to us. The sensor that they identified as the most suitable for our problem is a high-speed 2D/3D laser profiler. This sensor is specifically designed for inline profile measurement at some of the fastest speeds on the market.

From left to right: Zyrene Adao, John Paul Henares, Lauren Donald and Jason Yip

COMPUTER SCIENCE & ENGINEERING

TEAM: 17

SPONSOR: Student Affairs Information Technology

SPONSOR ADVISORS: Michael Roberson and Valerie Puffet-Michel

FACULTY ADVISOR: Dr. Swapna Gokhale

Automated Web Application for Exam Accommodations

Every semester, the Center for Students with Disabilities administers thousands of exams for students with disabilities who require special exam accommodations. After an exam is completed and scanned into the system, staff at the Center for Students with Disabilities must open each scanned document, search for the appropriate student's exam request in the system, and manually attach the document to the exam request. With thousands of student requests every semester, manually scanning and attaching each exam becomes overwhelming. It can be time-consuming and prone to human error. Thus, in conjunction with the Center for Students with Disabilities, Student Affairs Information Technology would like to create a way to automate the process.

The Center for Students with Disabilities and Student Affairs Information Technology have previously collaborated to create the web application that creates and stores exam requests, with all of the important information associated with the exam. Instructors are able to open the exam request to view and edit information. Each exam administered through the Center for Students with Disabilities has a cover sheet, which contains all of the information associated with the exam, including class, time, accommodations, and so forth. The purpose of the senior design project is to add a feature to this system which would allow a user to upload a scanned exam, read the information directly off of the scanned document, and automatically attach the scanned document to the associated exam request.

The method used to facilitate the automation is to manipulate QR codes throughout the system. When an exam request is created, it is associated with a specific exam request ID. The exam request ID is encoded into a QR code, which is placed on the exam cover sheet. Thus, the QR code will be present when the cover sheet is printed, as well as when the cover sheet is scanned with the completed exam. When the exam is scanned into the system, the site will automatically scan the QR code, find the associated exam request through the exam request ID, and attach the document to the exam. Therefore, the Center for Students with Disabilities can save time by automatically attaching completed exams, rather than manually taking time to do so.

From left to right: Navarre Pratt, Sarah Torcellini, Vishal Cherian and Anthony Festa

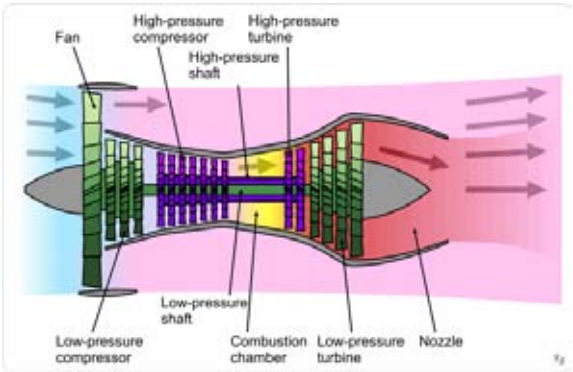
COMPUTER SCIENCE & ENGINEERING

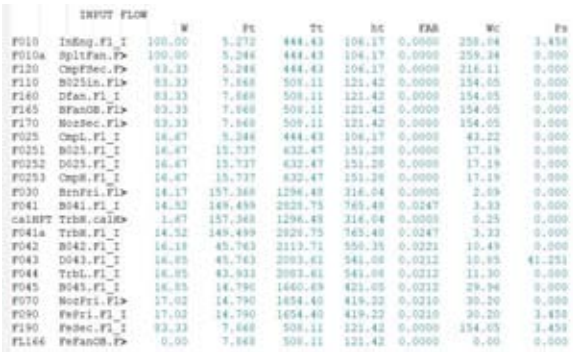
TEAM: 18
SPONSOR: Pratt and Whitney
SPONSOR ADVISOR: Dr. Jeffrey Simmons
FACULTY ADVISOR: Dr. Wei Wei

Numerical Propulsion System Simulation Prognostics and Self-Healing

PRATT & WHITNEY DEPENDABLE ENGINES

GO BEYOND



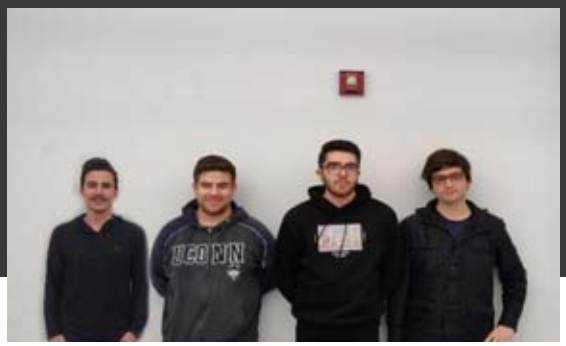


The focus of our project is a gas-turbine simulation known as Numerical Propulsion System Simulation, or NPSS. Pratt and Whitney (PW), a subsidiary of United Technologies (UTC), is an American aerospace engineering firm located in East Hartford, Connecticut, and one of the largest in the world, being one of “The Big Three” aerospace firms (the other two being General Electric and Rolls-Royce).

NPSS is an object-oriented, multi-physics, engineering design and simulation environment that can be configured to model a gas turbine engine. At the heart of NPSS is an iterative numerical solver known as the Newton-Raphson method which during the course of its operation builds a matrix of partial derivatives or sensitivities, referred to as the Jacobian matrix. The Jacobian matrix provides the iteration with necessary direction and magnitude information to close the error terms to within a user specified tolerance thereby allowing the iteration to converge to a solution.

Gas turbine engines are designed to produce thrust while not exceeding certain safety limits on components, e.g. temperature of hot section components. It is further constrained by physical and hardware limits, e.g. how much air can be forced through the compressor, etc. Determining the cause of an NPSS failure can be challenging and, in many cases, the Jacobian matrix can be leveraged to aid in understanding the convergence issue. We will be analyzing these error-cases in order to abstract away the math and give a human-readable output. In order to do this, we must properly identify ill-behaved matrix definitions.

We are required to provide basic documentation of our work on the internal NPSS Solver and create better reporting capabilities for its diagnostics system. Creating a more understandable output will help those who use the simulation in the future comprehend the reason behind the failure. This will greatly reduce the time necessary for an employee to troubleshoot an issue, saving valuable salaried hours for the company and allowing better practices to be developed in the future.



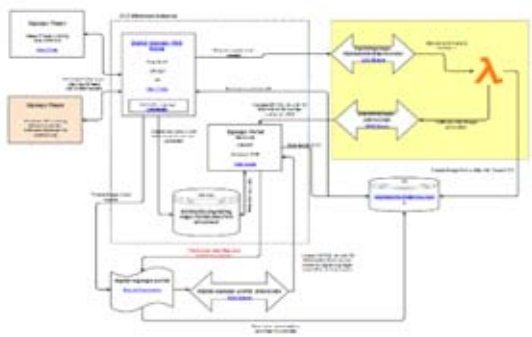
From left to right: Christopher Oldham, Adrian Zygadlo, Justin Auger, Zachary Caisse

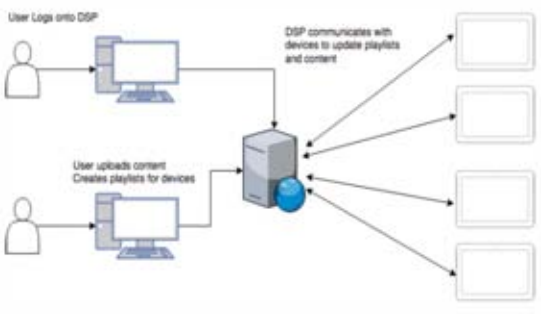
COMPUTER SCIENCE & ENGINEERING

TEAM: 19
SPONSOR: Reality Interactive
SPONSOR ADVISOR: Jack Nork
FACULTY ADVISOR: Dr. Zhijie Jerry Shi

Modernization of platform functions to improve scalability and reduce costs with AWS

reality INTERACTIVE





Reality Interactive assists companies provide product awareness not through advertising but through “experiences” these experiences come from the use of integrated technologies in the space of websites, kiosks, interactive displays and much more. Many retail stores use the portable Android powered displays that show off a product and provide useful insight into the functions and pricing of such a product. One issue with these devices is how to manage all the content that goes into a device, as it is not uncommon for a retail store to move the displays to highlight different products or cycle through a schedule seasonally. To bring a solution to this issue, Reality Interactive started to develop the Digital Signage Portal (DSP) in 2005. The solution supported the company for many years as it continued to grow and constantly increase the number of supported devices.

The aim for this project is to modernize the platform to leverage newer technologies and design patterns that will increase the reliability, scalability and extensibility of the platform as Reality’s customer base grows. To ensure such extensibility, two primary components were evaluated and improved upon. First, to ensure reliability, the process of generating images from the DSP has been replaced with a Lambda function for a massive performance boost from concurrent execution. Second, to better assist future customers, AWS Cognito is used to handle the integration of multiple user management systems, providing a Single Sign On solution that replaces the traditional database approach.

The inspiration for this project comes from the benefits that the new solution directly has with the nearly infinite scale, the ability to be modular with the components, and the reduced risk of bugs and errors. With the massive scale of Amazon Web Services, companies can design systems around a micro-service approach and reduce the need for complete evaluations of the entire system.

From left to right: Junaid Basdeo, Param Bidja, Dylan Brennan, Dance Zhou

COMPUTER SCIENCE & ENGINEERING

TEAM: 20
SPONSOR: DigiPops
SPONSOR ADVISOR: Konstantin Rubchinsky
FACULTY ADVISOR: Dr. Dong-Guk Shin

DigiPops TV Server-less Backend Google Cloud Pipeline

DigiPops is a community run film festival that democratizes film and filmmaker discovery. As a collaborative effort with Google Cloud, this product is unique because it provides a transparent voting process that recognizes stories that move by using shared experience of the community to democratically reward films for their cinematic and story strengths. The impact of such a platform is extremely large, especially in the short film making community as it will allow small scale creators to be recognized for their films in a democratic way.

Film festivals run in discrete units of time throughout the year, not continuously, so the problem is to build a functional back-end for this web-based platform that does not consume resources continuously but rather on an as-needed basis. Not only does the project require compute infrastructure at only some points throughout the year, but those compute resources must also scale with the size of the festivals. As the size of the festivals increase (# of users and films), the number and power of compute resources should scale proportionally with minimal human intervention.

Server-less compute resources provided by Google Cloud, called Functions, are the perfect solution for this problem. Server-less resources are temporary resources that can be called on an as-needed basis. This means that most of our back-end services, like account creation, video creation, etc. do not require dedicated server support but rather use Google Cloud Functions when those actions are needed. This solution requires us to build Functions that respond to distinct requests, like a Function for user creation, a Function for video uploads, etc. - these Functions act as micro-services.

The server-less approach is a novel and innovative approach, as only 21% cloud applications use such an architecture as of 2018. The current standard is dedicated compute resources, i.e. servers, which incur constant cost and require lots of maintenance. The server-less approach is the fastest growing cloud service, as it's expected to be adopted by 75% of all cloud applications in the next 18 months.

The server-less solution is technically sound as it has been tested in many large scale applications prior to ours, i.e Twitter. Server-less suits this project well as this project requires temporary compute resources that can scale, not consistently dedicated resources.

From left to right: Taimoor Khan, Brandon Keeler, Filip Bicki, Haarith Vohra

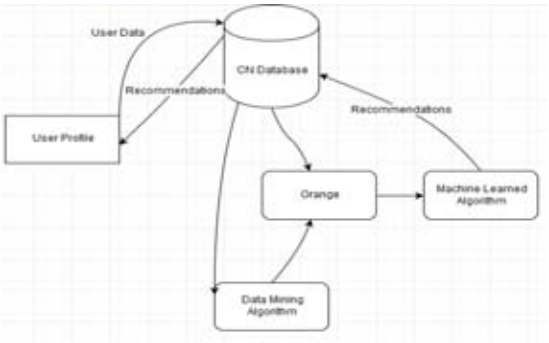
COMPUTER SCIENCE & ENGINEERING

TEAM: 21
SPONSOR: Convention Nation
SPONSOR ADVISOR: Ms. Kim Estep
FACULTY ADVISOR: Dr. Steven Demurjian

Recommendation Engine

Convention Nation is a web-based marketplace that matches conference attendees with events that satisfy their needs. For this project, Convention Nation is seeking to create a Recommendation Engine for their website in order to help their users better find events tailored to a user's specific needs.

The data that users provide can be used very efficiently by this system to save attendees, and their companies, time and effort. There are so many companies that are able to use this data in order to better gain insight about attendees, their prospective customers. Amazon and YouTube are two big examples that use every ounce of data in order to better recommend products to their users. This is Convention Nation's goal: uncovering valuable events and conferences and then making recommendations to their community. Our project is to create a system which is able to do this. With advancements in machine learning and data mining, we set out to utilize the data users have already provided in order to find the way that leads us down this path.



The goal of the recommendation engine is to tabulate the data requests from the site users, mine the database for events that match those requests, and then export that data to a secondary database that can inform listing curators (by way of a dynamic RFP) with sales prospects (i.e. event planners) that can possibly meet a threshold of unmet demand. One of the ways that we are accomplishing this goal is using data mining techniques - we first extract raw data from the Convention Nation database. This includes things like event categories they liked and disliked, location, budget, and more, which were all inputted when signing up to the site. After doing this we stored this data into different tables. We ran data mining algorithms to determine the likelihood of them going to an event. This data is converted into a decision tree and, based on the users' choices, the event is recommended or discarded.

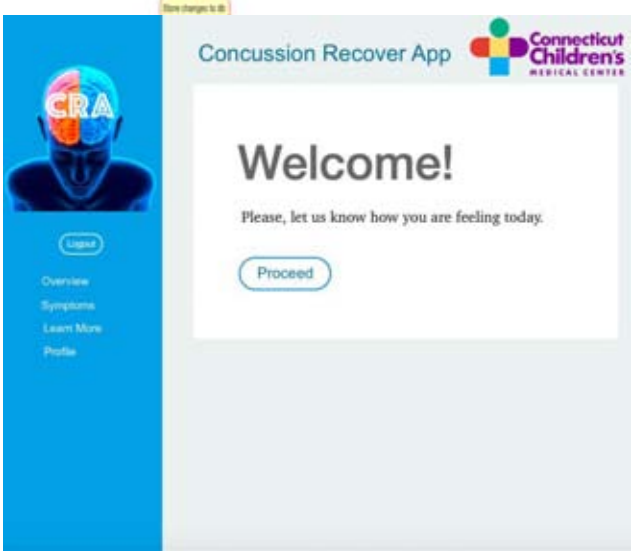
On top of this, we are also implementing a system for event holders to more easily add events to the website. We will be using this information for the other half of the recommendation system since we need as much data from both sides as we can get to make the best possible suggestion.

From left to right: Joshua Garby, Sawyer Conrad, Anastasia Kipor, Michael Belousov

COMPUTER SCIENCE & ENGINEERING

TEAM: 22
SPONSOR: Connecticut Children's Medical Center
SPONSOR ADVISOR: Dr. Kevin Young
FACULTY ADVISOR: Dr. Steven Demurjian

Concussion Recovery Management Study Companion Application



The Concussion Recovery App, henceforth referred to as CRA, is a web-based application designed to assist medical providers at Connecticut Children's Medical Center (CCMC) in conducting a feasibility study on the effects of psycho-education on the management and recovery of concussion patients. To this end, the application we are developing will be usable by both the patients and providers. The provider end will have control over the regular users, with the following features:

- Single account shared between all providers
- Ability to add new patients to the database
- Ability to view all patients' daily symptoms
  - ➢ Export symptom data to Excel files for easy data manipulation and management
- Automatic two week notification of patient trends
  - ➢ Can choose to continue monitoring or release from study depending on patient status
  - ➢ Removing patients removes clutter, but keeps data stored for observing long-term correlations

The patient interface is mostly different, and works as follows:

- Unique accounts for each user
  - ➢ Allows for unique patient data to be tracked (name, date of birth, contact information, etc.)
- Provider-endorsed knowledge base for information about what to expect from a concussion
  - ➢ Daily symptom report
  - ➢ Daily notifications to submit current symptoms
  - ➢ Ability to rate a variety of potential symptoms on a scale from 1-10
  - ➢ Ability to write a short report on how their status improves/worsens over time

All of this data will be accessible by the provider account. The symptom report will automatically generate a graph for the providers to view, making it easy to observe changes over the 2-week study period. Both patients and providers will have access to additional necessary features, such as the abilities to edit their own information, change settings regarding notifications, change their registered passwords and email addresses, and other basic functionalities.

From left to right: Sara Sadiya Saulat, Mitchell Gross, Vernon Billington II, Pengyu Tan

COMPUTER SCIENCE & ENGINEERING

TEAM: 23
SPONSOR: Movia Robotics
SPONSOR ADVISOR: Timothy Gifford
FACULTY ADVISOR: Dr. Yufeng Wu

Depth Camera System for Capturing, Segmenting, and Characterizing Movement

Movia Robotics is a company based in Bristol, Connecticut which designs and develops robot assisted instruction systems to help educators, therapists and parents of children on the autism spectrum. Nearly 1 in 59 children are affected by autism; research has shown that early intervention and therapy for these children can improve their learning, communication and social skills. Movia's mission is to enable children with specials needs to reach their full potential.

Our project utilizes the Orbbec Astra, a depth camera, to capture, segment, and characterize movement specified by the end user. Making use of Unity, in conjunction with Orbbec's development kit, we have developed a mannequin model to mimic the movements captured by the camera.

Another important component provided by Unity is the collision detection portion of the physics engine. By utilizing this feature, we are able to import the skeletal data from the camera and use the mannequin to initiate events. These events include warnings of when the robot should stop movement, as well as granting the ability for the user to initiate the gesture tracking module. This module will record and store the various gestures that the user has performed.

One of the most critical features of this tracker is the implementation of storage. We preferred the exported data to be in a simple, easy to read format; for that reason we chose the .csv file type. These files will be stored and accessed through the data logger module, allowing a user to explore their database of gestures. This module also goes hand in hand with the collision detection, as if an unwanted collision occurs, then an event will be triggered and stored with the relevant details.

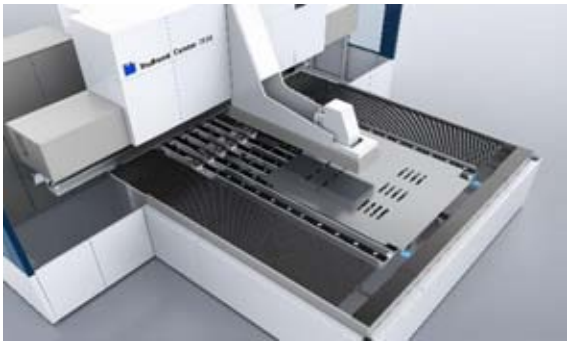
The end goal of this endeavor is to deliver code modules that can seamlessly be implemented into Movia's existing systems.
These modules will be part of our presentation which will include a demonstration of the mannequin model and the gesture tracker; this will allow a user to observe a skeletal representation of themselves which will mimic their movements.

From left to right: Alif Albiruni, Luke Malinowski, Wentao Hu and Scott Gusciora

COMPUTER SCIENCE & ENGINEERING

TEAM: 24
SPONSOR: Trumpf, Inc.
SPONSOR ADVISOR: Austin McKay
FACULTY ADVISOR: Dr. Donald Sheehy

Laser Technology Table Monitoring Application



Trumpf, Inc. is a leading company in the development of laser-cutting technology. They also provide a breadth of services for industrial purposes, including software and smart factory optimization.

Trumpf, Inc. is interested in the development of a web application to maximize efficiency and provide corporate and private users with an interface to pull standardized metrics for their laser machines. These metrics are calculated from their database, which pulls in thousands of queries by the second. They are also interested in moving their architecture to AWS (Amazon Web Services) as a shift from their existing architecture.

LaserTechTM serves as a reference for clients to find standardized metrics for their laser cutting machines. Users can also request a different set of metrics through a query-building page where filters are applied based off of each feature. The web application also features a statistics page which allows clients to draw inferences on existing datasets. LaserTechTM also has a built-in data simulator which generates sample data for testing purposes based off of the filtered data from the query builder.

This application is implemented through a LAMP stack (Linux, Apache, MySQL, and PHP). This allows us to transition easily to AWS's Elastic Beanstalk upon full deployment. Our framework for the LAMP Stack is Laravel, which is used for page generation, representing data, and querying the database. The front-end is implemented in Bootstrap with JavaScript and CSS.

Left to right: Tilun Wang, Alan Maynard, Rahul Kantesaria, Jonathan Duarte

COMPUTER SCIENCE & ENGINEERING

TEAM: 25
SPONSOR: Synchrony
SPONSOR ADVISORS: Daniel Murphy, Ramon Cadeaux and Quincy Chapman
FACULTY ADVISOR: Dr. Bing Wang

mySynchrony Watch Experience

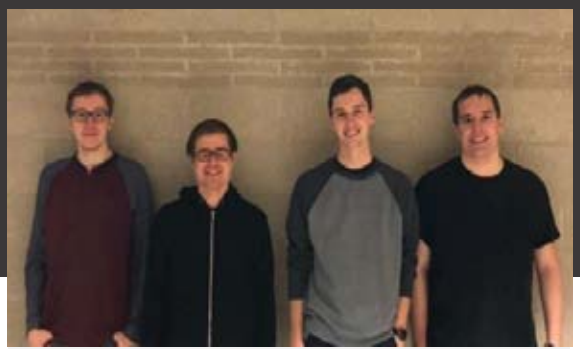
The main purpose of this project is to develop a smart watch application for Synchrony to roll out to their over 60 million cardholders in order to provide them with an intuitive, engaging experience related to managing their accounts. The application will tie in with Synchrony's APIs and existing smartphone application, eliminating the need for their customers to download an additional smartphone application in order to use this new smartwatch companion application.

The application features an easy to use payment suite, through which users can monitor their accounts and pay bills from authorized bank accounts. This area of the application has been designed for speed and efficiency and requires no manual user input aside from tapping to control which balances are paid. This increases overall ease of use and eliminates much of the "hassle" associated with paying bills through mobile applications.

The mySynchrony Smart Watch Experience also features a credit wellness section of the application. This area allows users to track several key performance indicators of healthy credit, which will directly empower the user to be more fiscally responsible with their finances. As this feature is lacking in many of the applications provided by Synchrony's competitors, this aspect of the smart watch experience will enable Synchrony to become an industry leader in credit wellness and overall customer health.

Throughout the application, visual stimuli, such as animated progress indicators and color-coded elements have been used in place of text where possible and appropriate, in order to provide users with a rich, eye-catching and informative experience, but without the clutter of having too much text on such a small screen.

For this project, the main programming interface used was XCode, Apple's proprietary IDE for development on their platforms. In order to allow communication between an iOS application and our watchOS application, we leveraged the WatchConnectivity framework, which is available on both operating systems. Additionally, we used Jira project tracking to streamline development and organize implementation tasks according to agile methodologies.



From left to right: Brandon Renick, Cameron Morris, Killian Greene, and Jacob Boislard.

COMPUTER SCIENCE & ENGINEERING

TEAM: 26
SPONSOR: Pratt & Whitney
SPONSOR ADVISOR: Paul Adamski, Scott Beecher
FACULTY ADVISOR: Dr. Bing Wang

Secure Embedded Architecture for the T1042 Processor

Many industrial and commercial systems currently deployed in the real world utilize integrity checks for security, but there is no guarantee that the code that is being executed is from an authentic source. Furthermore, the loading techniques for these systems do not guarantee the confidentiality of neither the data being loaded nor the methods being used to load it. A solution to this issue is the development of a secure embedded architecture in which one could guarantee both the confidentiality and authenticity of the data and the methods that load it through a secure booting procedure.

We have been tasked with the design and implementation of a secure embedded architecture for UTC Pratt and Whitney. The primary goals for this security system are to protect against cyber security concerns including malicious code modification as well as loss of intellectual property and technology. This architecture will utilize a technique known as secure boot, which will allow us to protect the architecture itself as well as the code or information that it is being used for.

Security in embedded systems involves both physical and virtual protections and considerations, which must be taken into account when deciding how to implement such a system. This means that everything from the choice of which processor that is being used (in our case, the T1042) to the software that is put on it will be factored into the overall security of the device, and that it may be necessary to address traditionally hardware-based attacks from a software perspective in order to make up for the limitations of the physical platform being used. Our design must be tamper-resistant, protecting against simple physical attacks like fault injection or system bus probing. It must also allow for secure updating of both the application and the operating system running on it in such a way that it does not pose a threat to security.

The secure-boot process is a complicated procedure that takes place at a level lower than that of an operating system. With this in mind, we are programming in C and the PowerPC assembly language in order to interface with the processor's hardware more directly than other languages would allow us to. Although security is the ultimate goal of our project, we must also pay close attention to the performance of our architecture. In order to confirm that our finished product is not only complete but also practical, we will properly time each stage of the system so that we can analyze the performance costs of the security features that we implement.

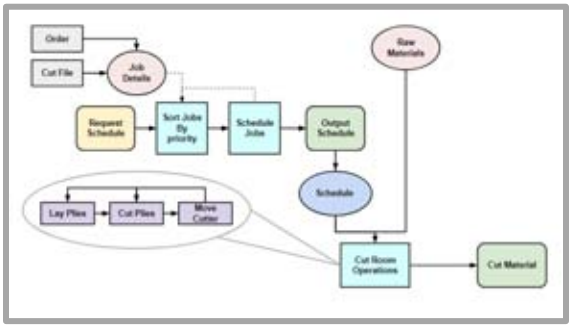
From left to right: Neng Zhang, Syed Asar, Toshiro Hackett and Katherine Tiernan

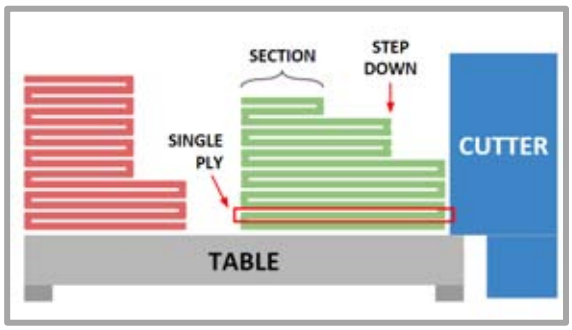
COMPUTER SCIENCE & ENGINEERING

TEAM: 27
SPONSOR: Interface Technologies
SPONSOR ADVISOR: Holly Beum
FACULTY ADVISOR: Dr. Zhijie Jerry Shi

Cut Room Scheduling Software

Interface Technologies





The global textile industry is one of the world's most important industries. With an ever-growing global population, the demand for the production of textiles and fabrics is increasing. This industry has historically been an extremely labor-intensive industry and has been taken advantage of to meet demands. In certain foreign countries workers are mistreated and brought into factories as children. Interface Technology has taken an initiative to solve this global issue through the use of software. This software has the potential to change the setting drastically by being more efficient than its labor-intensive counterpart altering the landscape of this industry.

Cut rooms are factory environments where the cutting of various materials such as fabrics takes place in order to fulfill consumer demands. The fabric is layered and compressed into plies which are then cut on the factory floor. These plies are placed onto tables by workers and are prepared to be cut. A cutter, which travels by rail, is then moved to the table and begins cutting the plies. This process then repeats for as long as there are orders. Currently, cut room managers manually schedule everything from what orders goes on what tables, where materials will be lined up, to where the cutting machine should be. As with anything, there are human errors, which leads to the waste of time and resources and to losses in profit for the company.

The goal of this project is to design and implement a scheduling algorithm that will properly distribute resources in a timely manner. The algorithm itself is a complex heuristic algorithm that has taken much time to devise. This software primarily focuses on the factory floor and utilizes manufacturing order data to generate a schedule for floor operations. The program schedules where and when to lay plies, where the cutter should operate, and when to move the cutter to operate at another table. By utilizing this software companies save time and resources.

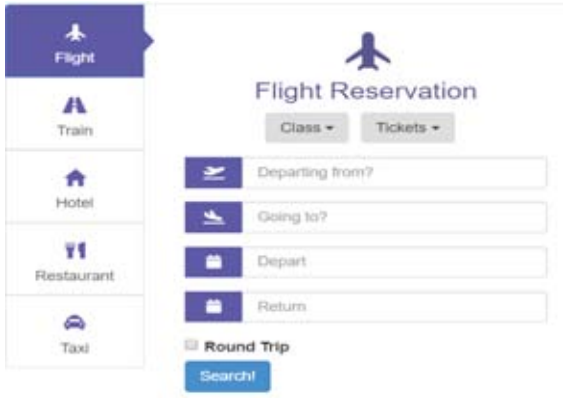
Left to Right: Callie Robinson, Sagar Gohel, Michael Search.

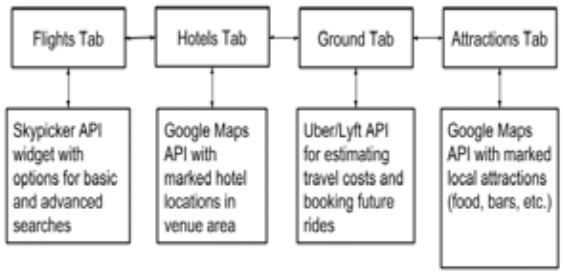
COMPUTER SCIENCE & ENGINEERING

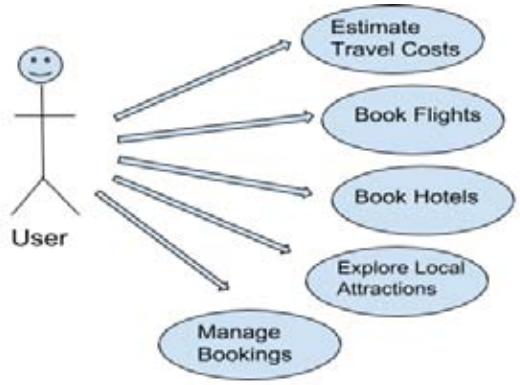
TEAM: 28
SPONSOR: Convention Nation
SPONSOR ADVISOR: Shaun Gorneau
FACULTY ADVISOR: Dr. Yufeng Wu

Integration Nation

CONVENTIONNATION







Convention Nation (CN) is a platform that allows for the discovery and review of professional conferences, conventions, summits, and trade shows being held both on a domestic and international scale. In order to best help potential attendees and visitors of the site, CN is looking to incorporate a trip planning and booking aspect to their pages. This integration would include the suggestions on modes of travel as well as lodging to be utilized the duration of their time at the prospective event. This allows for greater convenience to the event-goer, promoting an effortlessness to the booking process and keeping users on the platform for longer.

This vendor integration system will be an enhancement on the existing CN event page module. This system will be intended to promote a better user experience for the attendee while keeping them inside the CN platform for as long as possible. Using this system, an attendee will be able to view a suggested itinerary for an event they are viewing. This itinerary will include travel and accommodation suggestions including, but not limited to, flights, hotels, and other ground transportation. In addition, nearby restaurants and bars could also be provided as a means of planning after-hours events. Ideally, a user would be able to book reservations from inside the CN site through heavy integration with third-party vendors. This would maximize a user's utility of the CN site and make them more inclined to use it for their travel needs in the future. However, simply providing travel options and sending the user to a third-party site to make the relevant bookings themselves would also be acceptable. The majority if this integration will occur on the event page in the form of locating accommodations nearby to the convention through calls to external APIs. The results will be collected on a map feature to be easily picked out by the user based on their personal preferences. Other results that can't be integrated into a map will be listed nearby, but separately.

From left to right: Taylore Westbrook, Winson Ye, Jeramy Jeffereis, Dr. Wei Wei

COMPUTER SCIENCE & ENGINEERING

TEAM: 29
SPONSOR: Energid
SPONSOR ADVISOR: Jeff Sprenger
FACULTY ADVISOR: Dr. Wei Wei

Developing Actin Example Applications

ENERGID
Robotics and Machine Vision

Actin is Energid's proprietary C++ robotic control software development kit. The engineers at Energid would like to develop another way for users to control robots that serves as an easier alternative to writing actual C++ code. Being able to quickly run demos and live tests right out of the box will allow Energid to craft a user-friendly product that can reach a much broader customer base and still accommodate those who want to dig into the code to perform more complex tasks. This kind of feature would also make Cyton robots an attractive candidate for robotics education in schools.

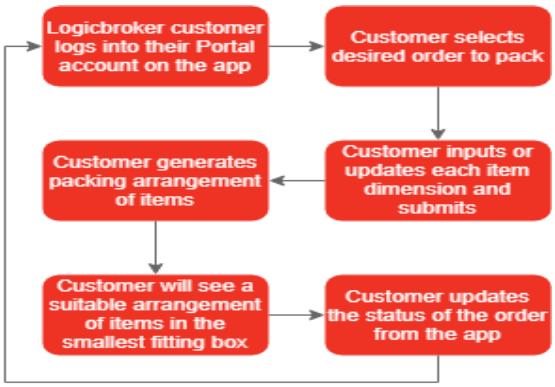
The team's task was to develop software that allowed Xbox controllers to interface with the Actin SDK in order to control a Cyton robotic arm online. The final product has different bindings associated with each button of the controller. There are also two main modes: joint movement mode (JMM) and end effector movement mode (EMM). The user switches between these modes using the left and right trigger buttons. For joint movement, the D-Pad can be used to cycle through the joints, and the joysticks can be used to move the joint. In EMM, the joysticks move the end effectors instead. In addition, when in EMM, the user can use the D-Pad to switch between 4 types of control sub-modes: translational movement, rotational movement, global movement, and local movement. Local movement means moving the end effector relative to the end effector frame and global movement means moving the end effector relative to the global coordinate system. The user can always save waypoints by clicking the joysticks and play them back using the *B* button on the controller. In regards to implementation, the team wrote custom C++ code and packaged it as a plugin for the Actin SDK so that the controller could communicate with the actuators in the Cyton.

From left to right: Hamad Gul, Daniel Little, Jay Gala

COMPUTER SCIENCE & ENGINEERING

TEAM: 30
SPONSOR: Logicbroker
SPONSOR ADVISOR: Siena Biales
FACULTY ADVISOR: Dr. Donald Sheehy

PackABox: A Warehouse Box Packing App



In their current system, Logicbroker warehouse customers use a web-based portal to manage order status and shipping. While this system works, Logicbroker was interested in adding a more direct method for users to interact with their extensive API, which led to the creation of PackABox. PackABox is a mobile application designed to assist warehouse workers with efficiently packing and updating orders without accessing the web portal, all while keeping the simplicity of the system that the workers are used to. The goals of this project are to provide faster information to the workers, to help choose a suitable shipping box and the optimal arrangement of items in it, and to allow the workers to update the status of orders immediately after packing the box.

PackABox is a cross-platform application written using React Native, a JavaScript framework. The application will securely log the employee into their Logicbroker account to display the current orders and their items. PackABox will rely on internet connectivity, the Logicbroker API, and user input in order to initially get the dimensions of each item in the orders. However, those units will then be stored in a cloud-based service for future use across all users. The application will then take the dimensions and quantity of each item, as well as the shipping carrier of the order, to find an optimal shipping box for all the items. Once the box is packed, PackABox will display a suitable arrangement of the items in that box and allow the user to update the status of the order before displaying the remaining orders.

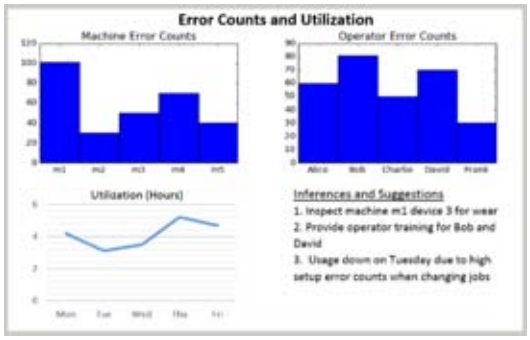
From left to right: John Buynak, Jackie Videira and Gabe Lopes

COMPUTER SCIENCE & ENGINEERING

TEAM: 31
SPONSOR: Blue Crest
SPONSOR ADVISOR: Paul Mayer
FACULTY ADVISOR: Dr. Swapna Gokhale

Inferencing Based on Machine Stoppages using Machine Learning

BLUECREST



Production mail machines (*top picture*) are composed of a series of devices in a pipeline. The machines take material, runs it through several stages, and creates an output product. Data on the stoppages of these machines is collected by a control system. The errors may have been caused by a variety of reasons, including, but not limited to wear over time, operator errors, and setup errors.

In this project, a user-friendly GUI application was built that relies on statistical analysis and machine learning approaches in order to analyze the stoppage data. The application allows inferences and knowledge to be extracted from the data that can assist the company in making decisions regarding how to service and maintain these machines and address operators who may need additional training.

Once the data files are imported into the application, the back-end analysis engine will run and output the results as dashboards, which are collections of various figures, plots, and textual elements. The dashboards contain both inferences the analysis engine made and relevant information, and can also be exported (*middle picture*).

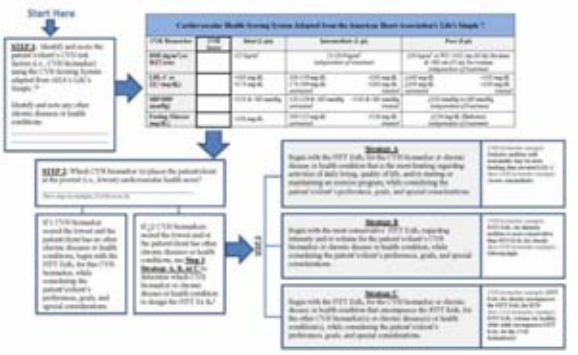
The machine learning component of the inference engine runs using an approach in machine learning model called a neural network. By using a neural network we'll be able to use many different machine learning algorithms to work together and process the complex data inputs from the user. This type of deep learning is also known as the "universal approximator" because it's able to approximate an unknown function by finding correlations between the input and the desired output. The system learns to perform analysis and inferencing tasks with out being programmed with any specific rules. This way, our program is able to make inferences on the machines, parts and operators by comparing it with other outputs as well as user feedback.

From left to right: Terry Pireaux, Timothy Henning and David Plank

COMPUTER SCIENCE & ENGINEERING

TEAM: 32
SPONSOR: UConn Kinesiology
SPONSOR ADVISOR: Dr. Linda Pescatello
FACULTY ADVISOR: Dr. Swapna Gokhale

UCONN
COLLEGE OF AGRICULTURE, HEALTH AND NATURAL RESOURCES
KINESIOLOGY



An Evidence-based Clinical Decision Support System for Exercise Prescription among Adults with Multiple Cardiovascular Disease Risk Factors

Health care professionals (HCP) are faced with the challenge of developing exercise prescriptions (ExRx) for patients who present multiple cardiovascular disease (CVD) risk factors. Dr. Linda Pescatello and her team from UConn's Dept. of Kinesiology have developed an evidence-based, step wise decision guide to develop ExRx for patients with multiple CVD risk factors. Our application attempts to automate this process.

Dr. Pescatello saw an opportunity to develop an application to streamline an otherwise complicated ExRx process, and make it easily accessible to HCP. The software application is usable by students and HCP in the field, without having the need to analyze the input data and trace the paths through several complicated flow charts. The initial version of the application provides a simple mapping between the input data that are entered and specific ExRx alternatives at the output. Subsequent to this initial version, there is the potential for enhancing this project to include essential features such as a database to maintain patient IDs and former ExRx's, as well as aggregating data for future research. Maintaining the patient IDs will allow the tracking of how a patient's ExRx changes over the course of time.

The implementation for this project is based on the Flask web framework, used for rapid prototyping of web based applications. Flask is considered a "micro framework" because it provides functional benefits to an application while being concise and lightweight. It comprises the minimal necessary functionality to get a web application going. A web application allows us to deploy a platform-independent solution, which can function for HCPs anywhere. Flask integrates well with the SQLite3 database system that we use to store patient data. The patient data are a collection of medical records used as inputs to the decision support system as well as the resulting ExRx.

From left to right: Eric Mei, Richard Guo and Vidhi Pandit

COMPUTER SCIENCE & ENGINEERING

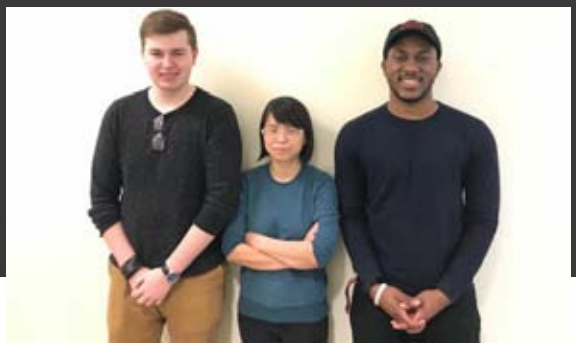
TEAM: 33
SPONSOR: Avitus Orthopaedics
SPONSOR ADVISOR: Neil Shah and Maxim Budyansky
FACULTY ADVISOR: Dr. Swapna Gokhale

Development of a Mobile Solution for Medical Device Distribution Management

The objective of project is to work on a high-impact product that will be directly utilized by a fast-growing, CT based medical device company and its various distributors nationwide. The goal of this project is to develop a mobile app solution to solve an unmet need in the company. The mobile app must enable seamless transmission of data between the company and their sales representatives at various hospitals across the country. Distributors must be able to schedule surgery dates in which the company's products will be used and submit post-surgery data that will be used for tracking inventory, billing customers, and conducting important back-end data analytics. The mobile app will also integrate itself with the current inventory management system that is being developed by Avitus in order to allow Avitus representatives the option to quickly request and process forms on the go. We decided to create an Android app that will implement these requirements and these apps will be available for use by all of Avitus's distributors.

Avitus will distribute this app to external parties that will be able to log in and access Avitus materials as well as manipulate and view data from the main web-based inventory management system (IMS). The Avitus App should streamline basic functionalities and package them all together for customers, distributors, and Avitus representatives to use without the need to go through the hassle of acquiring and storing the information themselves. This App would also allow Avitus representatives and external parties to show, view and store offline media on their devices to showcase Avitus' works without the need of cellular or a WiFi connection.

The later versions of the Avitus App will also be able to connect to Avitus's IMS which will allow Avitus representatives to create input forms, generate PDFs, track shipment materials, serve as a means for Avitus employees and external parties to exchange information through an instant messaging feature as well as be able to process requested materials without needing access to a web-browser.



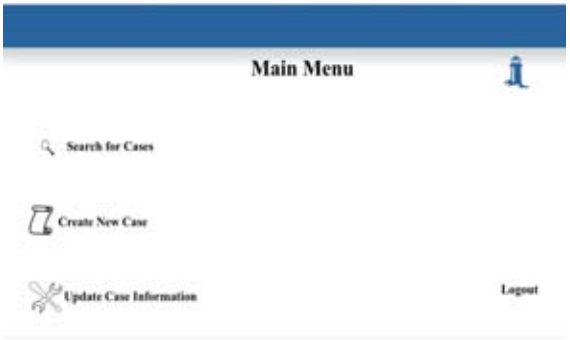
From left to right: Bryan Arnold, Duong Tran, Kevin Hunte.

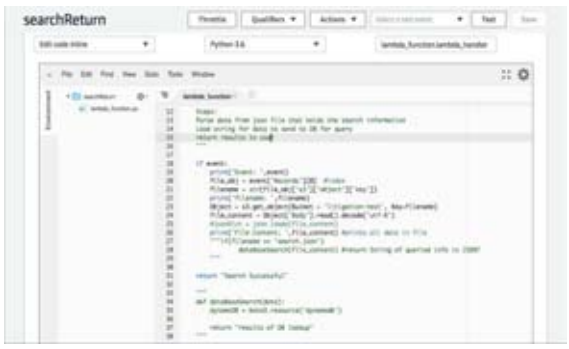
COMPUTER SCIENCE & ENGINEERING

TEAM: 34
SPONSOR: Nassau Re
SPONSOR ADVISOR: Scott Aaron Zweig
FACULTY ADVISOR: Dr. Swapna Gokhale

Litigation Database

NASSAU RE

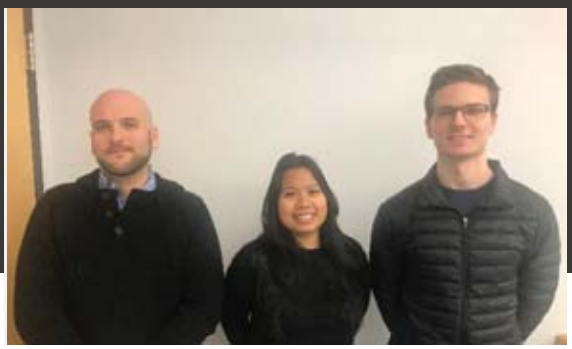




Nassau Re is a financial services company whose business covers four segments: insurance, reinsurance, distribution and asset management. Nassau Re moved its headquarters to Hartford in 2016 after it acquired Phoenix, an insurance company founded in Hartford in 1851. The Nassau Re Legal Department manages litigation relating to insurance as well as the other business areas.

Nassau Re's vision was to develop a user-friendly database to track and store information related to company litigation. This newly designed database would serve as a long-term solution to Nassau's litigation case management needs, with the ability to evolve over time. In addition to tracking case information, the database should have the ability to produce reports on any combination of data elements contained within the database, as well as provide calendar updates through Microsoft Outlook. Ideally, these reports could be exported to Excel or a formatted PDF. The reporting feature should include certain pre-programmed or canned reports as well as being able to be generated "on the fly". Being able to create at any time would allow for easy reuse of a report in the future. Although the primary focus is on functionality, the database should have an intuitive design and modern look.

Our solution is to make this database a web application that will be serverless and hosted on the cloud platform of Amazon Web Services (AWS). The three Amazon technologies that are used are Simple Space Storage, Lambda, and DynamoDB, which will handle static website hosting, data processing and queries, and data storage respectively. Features such as dynamic dropdown lists, single sign-on, and PDF generation of cases will be implemented into web pages with JavaScript/NodeJS.



From left to right: Jeffrey Soule, Nurul Sauffian, and Volodymyr Shvydkyy

COMPUTER SCIENCE & ENGINEERING

TEAM: 35
SPONSOR: Cognizant Technology Solutions
SPONSOR ADVISOR: Ajit Tapaswi
FACULTY ADVISOR: Dr. Dong-Guk Shin

BOTs Development

Cognizant

Cognizant is a multinational corporation that provides IT services, including digital, technology, consulting, and operations services. Cognizant is uniquely positioned to help organizations transform their business, operating and technology models in the digital era. Cognizant advances its customer's services through the introduction of state of the art technologies such as BOTs. These BOTs are individual applications which are created in order to provide a solution tailored to the individual needs of Cognizant's clients. This implementation of machine learning techniques simulates a human activity to decrease level of effort and improves quality. Under the advisement of Cognizant, we (BotConn) developed different BOTs using Machine Learning Techniques from Incident Management and Process Automation standpoints.

User Case 1: Anomaly Detection BOT for build logs to process new system exceptions from the latest build (Quality Issue). This BOT can be used for predicting anomalies in a data feed if they don't confirm or there have invariable deviations from historical data feeds. Through a web application developed by BotConn, the BOT would then notify the end user if it had encountered data that fell outside of its expected range, yielding an anomaly.

Use Case 2: Regression testing can be expensive and may require significant script maintenance efforts. Test prioritization can be planned to achieve intended execution goals. Success of regression testing can be amplified by focusing effectual techniques like code coverage. This BOT can enable focused regression test selection in a smart way by considering the aligned parameters, generating intense benefits. BotConn is focusing on specific industry demand while building this BOT.

Use Case: 3 The Shadow Buddy / Ticket Analysis BOT is used to prioritize incoming ticket requests for a support team. This requires real time analysis and classification being performed on the incoming live request stream. Upon the sorting of the incoming requests, a curated list will be outputted for the support team.

These BOTs help software quality assurance beyond mere automation by moving toward a system of artificial intelligence (AI).

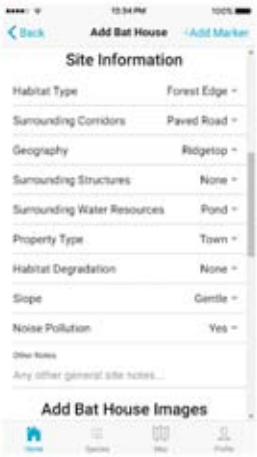
From left to right: Clayton Michael, Mark Cabanero, Samantha Gustafson and Ruicheng Li

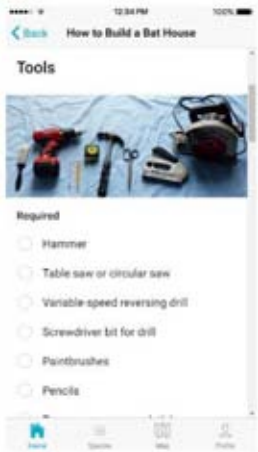
COMPUTER SCIENCE & ENGINEERING

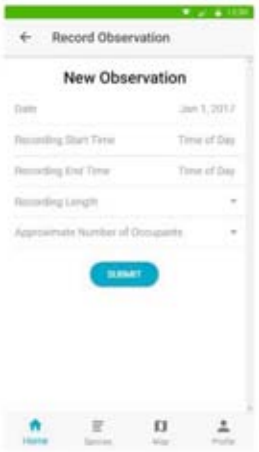
TEAM: 36
SPONSOR: UConn Natural Resources/Environment
SPONSOR NAME: Dr. Laura Cisneros
FACULTY ADVISOR: Dr. Steven Demurjian

Citizen Science Bat House Monitoring Application

BAT HOUSE MONITORING PROJECT







Bat population has taken a hit with the devastation from White-Nose Syndrome affecting many North American species. In attempts to help scientists understand the impact, it is important to monitor and record bat populations. With the Citizen Science Bat House Monitoring Application, we empower citizens to help in this effort. More specifically, this app gives scientists information on how different environment and landscape variables influence occupancy of bat houses by different bat species, as well as a way to monitor changes in population. The goal is to make this as intuitive and simple for citizens to use, while giving a large amount of data to scientists for further processing.

To make participation easy to as many citizens as possible, the app will be cross-platform for Android and iOS devices. Using modern web technologies, we aim to utilize single codebase to support both platforms for easier development and less overhead from maintaining multiple systems. This application will communicate with a REST API to not only let citizens store and retrieve their information but also enable scientists to query and analyze the data. With private information (location data) being communicated between app and server, secure transfer and responsible indicators will be used to protect user security.

For any app user, ease of use and simplicity is the goal to encourage interaction and repeated observations. Since bat population monitoring would not occur year-round, the app will support reminders for citizens to check. It will similarly alert scientists for potential leads to confirm the presence of bats with methods to record additional data (images, ultrasonic acoustic device recordings). The app also aims to assist citizens that are willing to help but do not know where to start. It will emphasize the importance and motivation for bat monitoring, instructions on how to build and install a bat house, as well as properly monitoring for bats.

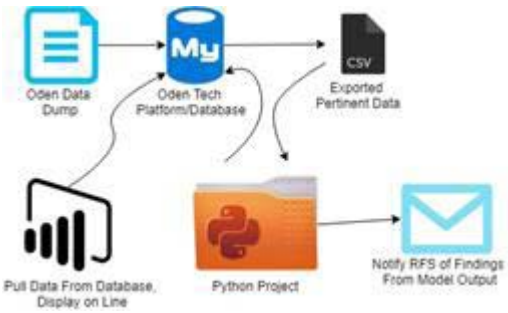
Overall, this application aims to aid scientists as well as keeping citizens involved. Data collection and aggregation for any statewide activity is already hard enough. However, with the capabilities of mobile phones and a small amount of citizens' time, we hope to aid scientists to study and understand best management practices to help protect North American bat species.

From left to right: Nathan Hom, Mike Marandino, Kyle Barry, and Jon Simonin

COMPUTER SCIENCE & ENGINEERING

TEAM: 37
SPONSOR: Radio Frequency Systems
SPONSOR ADVISOR: Joel Cacopardo
FACULTY ADVISOR: Drs. Song Han, Mousumi Roy

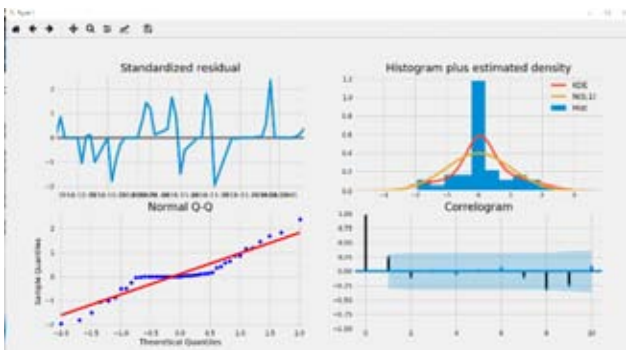
Predictive Maintenance through Digitalization of Manufacturing Indicators



First, humanity saw the agricultural revolution. People gradually went from hunter-gatherer livelihoods to cattle and farm sustenance. Then the first industrial revolution exploded onto the scene. Labor began to be supplemented by mechanical devices, and industry began to boom across the classes and continents. In efforts to get ahead of the next impending technological revolution, Industry 4.0 has been the driving term describing automation and data exchange in manufacturing technologies.

By focusing on existing sensor outputs from one particular foam extrusion cable manufacturing line, our team is developing a platform for operators and managers alike to turn illogical data into useful insights. This project allows Radio Frequency Systems (RFS) to act before catastrophic failure during manufacturing with more agility than ever before, by orders of magnitude over old systems. Such predictive analytic platforms serve for perpetual growth fueled by a proactive management.

Our project works by establishing a safe baseline using conventional statistical models. If any individual reading, from voltage to rpm, deviates from safety it is flagged. If the deviation strays too far, into the danger zone, it garners higher priority. By identifying indicators of potential failure along the manufacturing line, proactive measures can be taken on the floor to increase output and decrease waste in the form of damaged product. After establishing such baselines, the model turns to feed itself through machine learning algorithms. This allows flexibility of the baselines across production lines and over time, as equipment and worker habits slowly shift.



Monthly generated reports coupled with a live-time operator's dashboard allow management to stay in the loop on a less-integrated basis while enabling operators to understand the results and report and respond to irregularities as efficiently and effectively as possible, enabling RFS to drastically reduce waste product and enhance productive output across manufacturing lines.

Left to right: Eli Udler, Marissa Neiman, Alexander Slocum

COMPUTER SCIENCE & ENGINEERING

TEAM: 38
SPONSOR: Convention Nation
SPONSOR ADVISOR: Kim Estep
FACULTY ADVISOR: Dr. Bing Wang

Social Media Integration and Interaction Analysis Using Natural Language Processing

The goal of this project is to implement a customer reward system for Convention Nation, a company that provides its users with information about conventions that are relevant to them. The company would like to create incentives for users to interact with their online presence through gamification, which applies game-design principles to non-game contexts. For this project, this means the creation of a “point system” for users of Convention Nation’s website. These points will serve to incentivize interaction with Convention Nation’s online presence, including its Facebook page, Twitter account and LinkedIn profile. These interactions can include likes, comments and shares. When a user that has a profile on any of the aforementioned networks associated with their Convention Nation account interacts with any of Convention Nation’s profiles, the system will increase the user’s point count.

We focus on two aspects that are central to the project: The first is developing and implementing a framework that makes use of the APIs provided by Convention Nation and the three social networks (i.e., Facebook, Twitter and LinkedIn) to extract data from the social networks and transfer it to Convention Nation. The second is designing and implementing a system that analyzes the interactions and relays possible instances of abuse to Convention Nation. Specifically, our software will analyze the patterns in user interactions, noting suspicious activity, using natural language processing. Large numbers of interactions performed by a single user over a short period of time may indicate that the interactions are being generated by a bot. In addition to these precautions, we hope to discourage unproductive and inappropriate interactions by using natural language processing tools to perform sentiment analysis on comments and tweets.

The other component of the system is a server and a REST API for testing and presentation purposes, where the interactions are registered, and the users are assigned points based on the number of user interactions. People will be able to contribute to our project by interacting with our system, including social media profiles associated with our project.

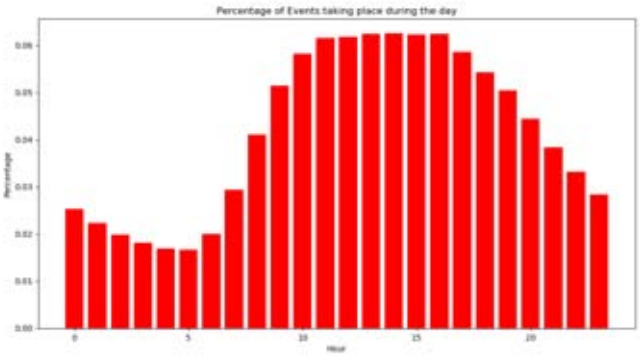
From left to right: Kyle Fujio and Finian O'Connor

COMPUTER SCIENCE & ENGINEERING

TEAM: 39
SPONSOR: Eversource
SPONSOR ADVISOR: Diana Mahoney
FACULTY ADVISOR: Dr. Zhijie Jerry Shi

Eversource RSO Optimization Model to Reduce Average Customer Power Interruption

EVERSOURCE



Eversource is an electric, gas, and water delivery company serving Connecticut, Massachusetts, and New Hampshire. One of its duties is to respond to and service all outages to the electric distribution system. To respond to outage events, Eversource created a Response Specialist Organization (RSO). This organization works 24/7, traveling to reported outages and restoring power to all affected customers. The quicker the RSO restores power, the lower the CAIDI, an industry standard that measures the average time a customer is without power. In order to best respond to all outages, Response Specialist teams are split up by state, and in turn by zone. Each zone is a section of the state and is assigned a specific number of RSOs who respond to outage events in the zone. The main goal of this project is to determine the optimal allocation of RSO workers to assign across the state, while minimizing down time for customers and increasing productivity of the RSO.

The approach taken to create this optimization algorithm and perform data analysis involved the Anaconda platform in Python. In order to make accurate assumptions, Eversource supplied the team with outage data from 2015 to present. Since this data set is large (almost 350,000 different events), we started the process by examining the data and removing events that were not relevant to our project. After the data size was reduced, we analyzed trends in the data to learn more about outage events in Connecticut. We developed a program to look at each zone, find the median number of events for each day of the week in a month, and then calculate the average CAIDI by day, week, and month. Based on these results, the program determines how many events an RSO worker must manage and how the CAIDI of a zone correlates to the number of RSO workers. It can figure out which zone's CAIDI would increase the least when an RSO is removed, or which zone's CAIDI would decrease the most when an RSO is added. The answers to these two questions are then used to evaluate the impact on CAIDI if workers are removed, added, or moved from one zone to another. Based upon these findings, the program generates the optimal placement of RSO workers to minimize outage time for customers.

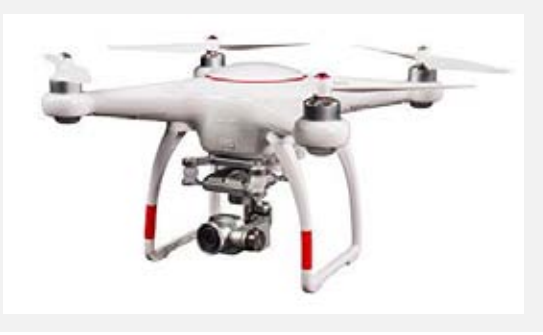
From left to right: Alan Kan, Frank Zappulla, Chris Dipietro

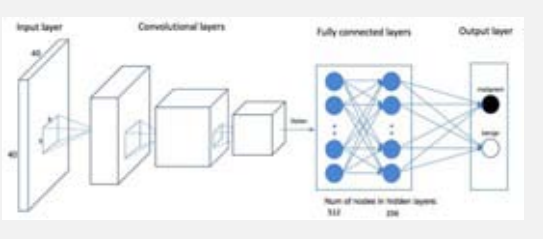
COMPUTER SCIENCE & ENGINEERING

TEAM: 40
SPONSOR: Naval Sea Warfare Center
SPONSOR ADVISOR: Gary Huntress
FACULTY ADVISOR: Dr. Wei Wei

Drone Detection via Acoustic Processing with Machine Learning

NAVSEA WARFARE CENTERS NEWPORT





In the modern day technological landscape there has been a drastic increase in both the accessibility of data and the processing power of computers. These two factors have thusly enhanced the ability of machine learning systems to provide otherwise unavailable insights into the underlying patterns of the data of businesses, government, and our everyday lives. With support from the Naval Undersea Warfare Center (NUWC) our team is developing a project to apply a machine learning model to detect drones via acoustic information. Presently, drones are used by civilians as well as the military. Civilian drones are often relatively safe and used for the purposes of photography and videography, whereas military grade drones can carry out precision attacks remotely, removing the risk of injury or death to a human pilot. The Navy is thus highly motivated to develop a system to detecting drones and alert military personal of their presence. Making use of the machine learning libraries Tensorflow and Keras, our project aims to develop an acoustic classification system capable of identifying drones. In order to achieve a high level of accuracy we will employ the use many deep learning and advanced data preprocessing techniques.

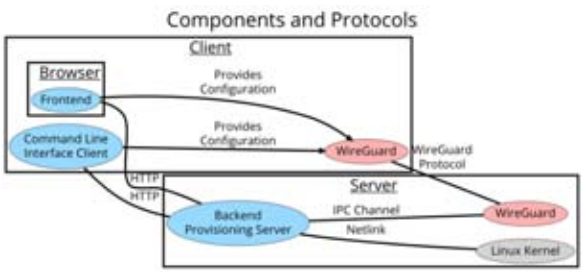
Our model's structure will be that of a supervised learning classification algorithm. We will collect and process acoustic drone data using our own Autel X-Star Premium quadcopter and audio data available on websites such as *youtube.com*. The model will be trained on said data and return a discrete output indicating the presence, or lack thereof, of a drone in a specific audio sample. Our hope is to eventually use a similar approach for identifying the location of the drone using closely related image classification techniques. We have elected to utilize a convolutional neural network (CNN) as the deep learning model for our project. This CNN will be built on top of an existing model designed to accomplish a similar task. Such a process is called transfer learning. This will reduce the time and data costs of training and will allow us to produce highly accurate results and a model that should easily generalize to the needs of the NUWC in their own future drone detection endeavors.

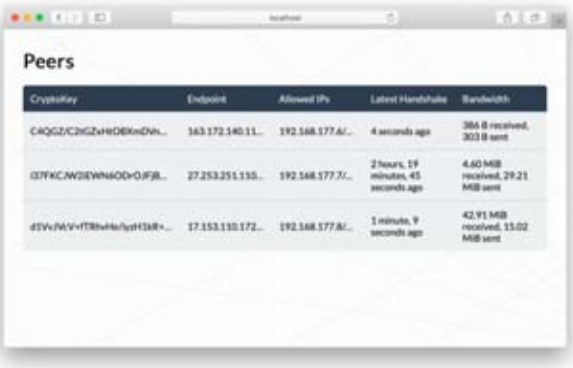
Brandon Cheng

COMPUTER SCIENCE & ENGINEERING

TEAM: 41
SPONSOR: UConn CSE Department
FACULTY ADVISOR: Dr. Bing Wang

WireGuard Web App Provisioning Server: Design and Implementation





The goal of the project is to develop a Web App Provisioning Server (WAPS) for the WireGuard Virtual Private Network (VPN) protocol. WAPS is designed as an open source, white-label software product which will interface with WireGuard to administer end-user network connections.

WireGuard itself is an emerging VPN solution that aims to be faster and simpler than existing alternatives. The protocol and its first-party software implementations have been in active development since 2016. Despite being a work in progress, it has been praised by Linus Torvalds as "a work of art" compared to OpenVPN and Cisco IPSec.

For VPN providers, the finished WAPS product will contain everything necessary to deploy a WireGuard network in a secure and easy manner. For subscribers to a VPN provider, the product will enable a user-friendly mechanism to retrieve configuration files for connection setup on personal devices. Since the protocol was announced only three years ago, few commercial providers currently offer it as a solution; WAPS has the potential of increasing WireGuard adoption dramatically by making it easier to setup for all types of users.

The architecture of the project is designed with a strong security focus. It is written with a Rust backend enabling WAPS to be fast while free from memory corruption vulnerabilities. A simple SQLite database is interfaced with the Diesel Object-relational Mapping (ORM) tool and stores users and network information. For distribution, it is packaged as a single command line binary package for Linux systems.

A demo is available at https://wireguard.brandoncheng.me