

The Capstone Experience



From Students...to Professionals

COMPUTER SCIENCE AND ENGINEERING 2022-2023



MICHIGAN STATE
UNIVERSITY

Auto-Owners
INSURANCE



The Capstone Experience

CSE 498, Collaborative Design



Dr. Wayne Dyksen
Professor of Computer
Science and Engineering

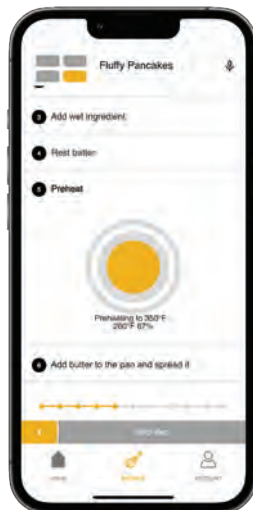


James Mariani
Professor of
Instruction

The Capstone Experience provides the educational capstone for all students majoring in computer science at Michigan State University. Teams of students build software projects for corporate clients.

During the Capstone Experience, students

- design, develop, debug, document, and deliver a software project for a corporate client,
- work in a team environment,
- develop written and oral communication skills,
- become proficient with software development tools and environments, and
- consider issues of professionalism and ethics.



Corporate clients are local, regional, and national including Ally, Amazon, Anthropocene Institute, Auto-Owners Insurance, 0Atomic Object, Bosch, Dow Chemical, CSAA Insurance, Delta Dental, Evolutio, General Motors, Google, Herman Miller, Kellogg's, Kohl's, Lockheed Martin Space, Meijer, Microsoft, Mozilla, MSU Federal Credit Union, Proofpoint, RPM, Stryker, Roosevelt Innovations, TechSmith, United Airlines, Urban Science, Vectorform, Vectra, Volkswagen, and Whirlpool.

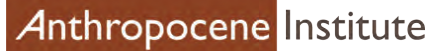
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Ally Financial Ally Employee Recognition Platform

Headquartered in Detroit, Michigan, Ally is one of the top 25 financial holding companies in the United States and a leader in digital financial services. Ally offers financial products for consumers, businesses, automotive dealers, and corporate clients in their commitment to developing platforms and digital experiences for a variety of needs.

Ally takes pride in their organization culture. They believe the ability to influence change comes from the people and community that are found within their business. Ally puts a strong emphasis on such company values so their employees continue to flourish from the positive impact of a healthy work environment.

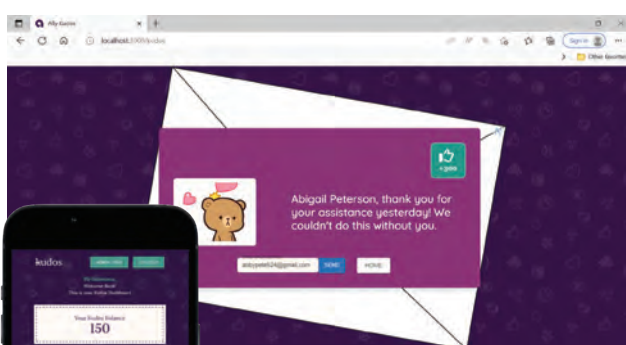
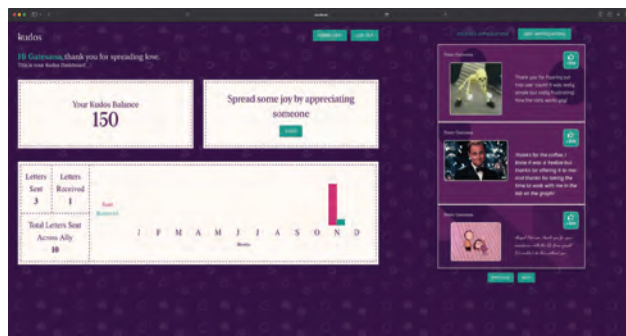
Ally employees use our web application, Ally Kudos, as an intuitive way to strengthen the connections among coworkers. Employees log into Ally Kudos to send recognitions and 'Kudos' points to their coworkers. Kudos can be sent for anything ranging from a coworker sharing their hot chocolate to someone giving guidance and training to a less experienced coworker.

Our application shows users their messages sent and received over time along with their current Kudos points, which they can redeem for rewards.

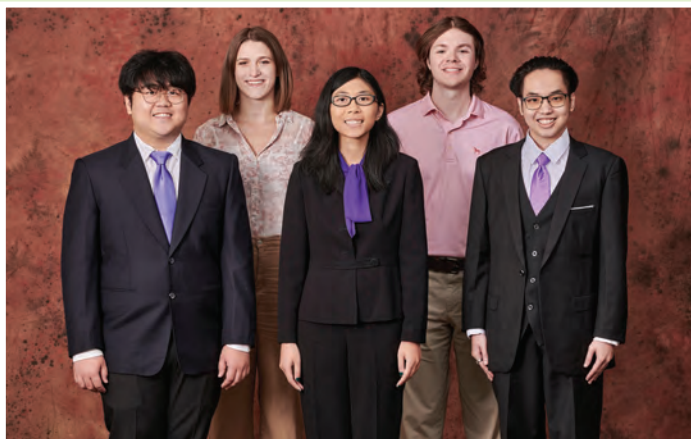
When sending Kudos, users type a personalized message or use suggested phrases for ideas. With added touch-ups to the message such as gifs and text styles, our application offers a more fun and rewarding experience that improves upon basic thank-you emails.

Having pleasant interactions between one another boosts company morale and overall productivity. Ally Kudos enhances the appreciation Ally employees share with one another.

Ally Kudos is written in HTML, CSS and JavaScript and is powered by the React framework. Our web app interacts with employee data using Sequelize and Express to connect to AWS RDS and offers machine learning capabilities using Python.



ally



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Amazon

Amazon Review Confidence Tool

Amazon, founded by Jeff Bezos in July 1994, is renowned for its influence in the electronic commerce industry. Amazon initially started as an online marketplace for books but quickly expanded into a multitude of product categories and is currently one of the world's largest online retailers.

With over 300 million active customers interacting with their online platform, Amazon is trying to ensure that users have the most authentic, reliable, and trustworthy shopping experience. To safeguard their product standards, Amazon has developed a review framework in which customers can get insights and feedback on products while shopping. However, with the multitude of reviews, there is an ever-growing problem of review legitimacy.

Our Amazon Review Confidence Tool combats this legitimacy problem by conducting product review analysis to calculate review authenticity within a visually intuitive browser extension and web application.

Users have access to a browser extension that displays confidence scores for each review of a selected product. The Review Confidence Tool then calculates an adjusted total average rating after filtering reviews with low confidence scores, enabling users to get a more accurate rating without low legitimacy reviews.

The tool is also equipped with a web application that provides a visually intuitive summary of review authenticity. This solution reduces customer confusion and preserves sellers' reputations within two easy-to-use applications.

The tool's infrastructure is built entirely on Amazon Web Services, referencing the AWS Well-Architected Framework to create a responsive and scalable environment. The serverless web app uses AWS Amplify, Lambda, and DynamoDB to minimize unnecessary overhead, and Amazon SageMaker is the tool's all-in-one solution to machine learning.




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Anthropocene Institute Public Opinions on Nuclear Energy from Social Media

The Anthropocene Institute is an organization that partners with researchers, governments, experts, and investors to address the climate change crisis. The organization provides support to projects related to clean energy, anti-pollution efforts and climate innovation and takes care of any political or financial barriers they may experience.

The Anthropocene Institute is an advocate for nuclear energy as it has the potential to play a crucial role in the fight against climate change and the transition to clean energy. However, the public is divided when it comes to this energy source. Furthermore, public debate on this issue is often plagued with misinformation and confusion.

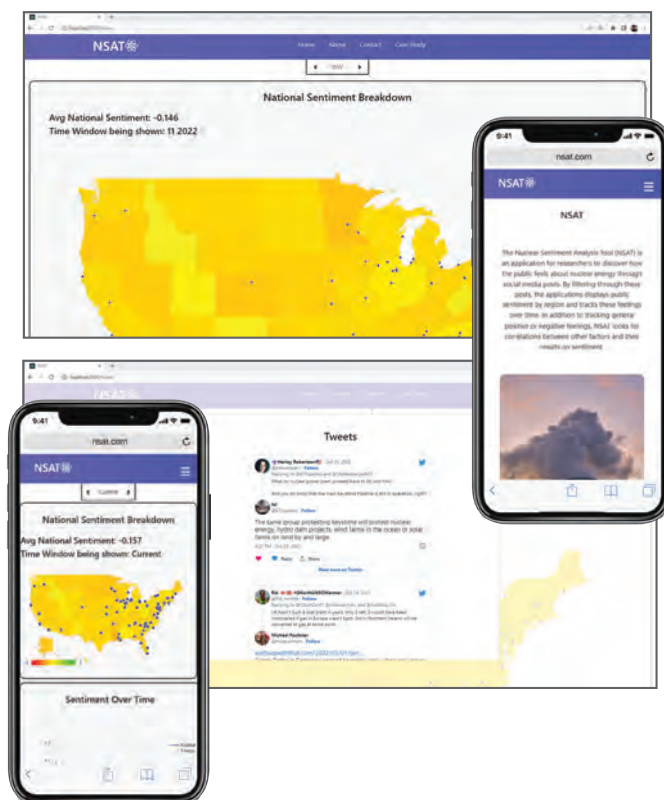
Our Nuclear Energy Web Application tackles this problem by providing users with an easy way to view public opinion on nuclear power with easy-to-read charts and graphics within one simple web application.

Our application collates and analyzes public opinion information from social media posts on Twitter. This information is presented on an attractive dashboard, which provides users with several easy-to-use web pages of data visualizations.

Users can see geographic trends in opinion using an interactive map that illustrates opinion in each state. The dashboard also contains several charts and graphs to help visualize more general data. The dashboard is updated constantly ensuring all data is fresh and up to date.

Through this application, the Anthropocene Institute can utilize a constant flow of formatted, visualized data to further their mission of creating a better, greener world.

The front end is built using HTML, JavaScript, React and the Google Charts Library. The back end is built using Python, Google Cloud Platform and the Twitter API.



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Atomic Object

Custom Data Visualization Dashboard

Atomic Object is a custom software design and development consultancy that builds mobile and web apps, creates device IoT software, and provides cloud capabilities to their clients. They are an employee-owned organization with branches in Ann Arbor, Chicago, and Grand Rapids.

Each Atomic Object office has a dashboard displayed on a television. This dashboard highlights important individual employee metrics such as billable hours and employee blog-post due dates. This dashboard is essential to keep track of employee metrics, but it is currently outdated and needs to be reworked to increase efficiency.

Our Custom Data Visualization Dashboard enables users to view this important employee data more easily and effectively than ever before within a new, attractive application.

This dashboard includes blog post deadlines and billable hours, and many other components including an events calendar, trending blog posts, and charts highlighting revenue and utilization rates.

Our admin page enables Atomic Object employees to customize each office's dashboard separately. Employees can edit a dashboard by turning on and off displays as they choose. The admin page provides a few preset combinations to display components from specific categories.

The built-in presets include Financial, which shows the financial metrics, and Social, which includes company events and an employee spotlight. The Default preset shows a combination of the two. Employees may save their edits as new presets to make changing visualizations easy.

Our dashboard is a React application that uses HTML/CSS, JavaScript, and Bootstrap for the front end. For the back end, we combine internal data from Atomic Object pushed to our Firebase database with Google Sheets data and user preset information.



ATOMIC OBJECT



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Auto-Owners Insurance A-O Merch Search

Auto-Owners Insurance is a Fortune 500 mutual insurance company that provides automotive, home, life and commercial insurance to nearly 3 million policyholders in 26 states. Auto-Owners Insurance is headquartered in Lansing, Michigan.

Auto-Owners offers company merchandise that their associates can purchase to support and represent the company.

Currently, the purchasing process revolves around paper and pencil order forms. Similarly, when an Auto-Owners administrator wants to analyze purchase data, they must parse the paper records manually, which can be a daunting task.

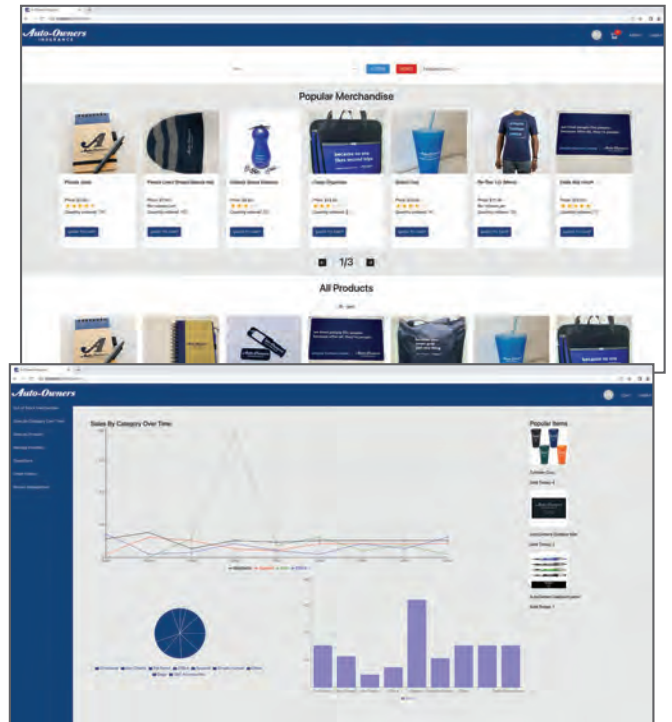
Online shopping has become increasingly popular in the last decade, providing a better shopping experience for consumers and an easier way to keep track of purchase data. Auto-Owners is looking for a way to modernize their 'merch' shopping experience.

Our A-O Merch Search is a web application that functions as an online store and improves the process of purchasing company merchandise for Auto-Owners associates. In addition to purchasing items, associates have the option to read and write reviews for items and view recommended items to help them choose a product that best suits their needs.

Auto-Owners associates use our system to filter, browse and purchase company merchandise from their personal devices using any browser. Purchase history data updates as orders are placed, enabling administrators to see real-time trends for popular items and categories.

Our system improves the efficiency of analyzing purchase data for Auto-Owners administrators by generating relevant graphs and charts.

Our A-O Merch Search system uses React for the front end, Spring Boot for the back end, and Microsoft SQL Server for hosting the database.



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CSAA Insurance Group

Synthetic Image Generation via Random Noise

CSAA Insurance Group, headquartered in Walnut Creek, California, is one of the largest AAA insurers in the country. They offer home, auto, and other lines of insurance to seventeen million people in twenty-three states and the District of Columbia.

In the span of a few short years, the insurance industry has become information driven, meaning CSAA requires large quantities of data to compete. However, data is difficult to access due to how it is typically captured, privacy concerns, and the relative infrequency of losses.

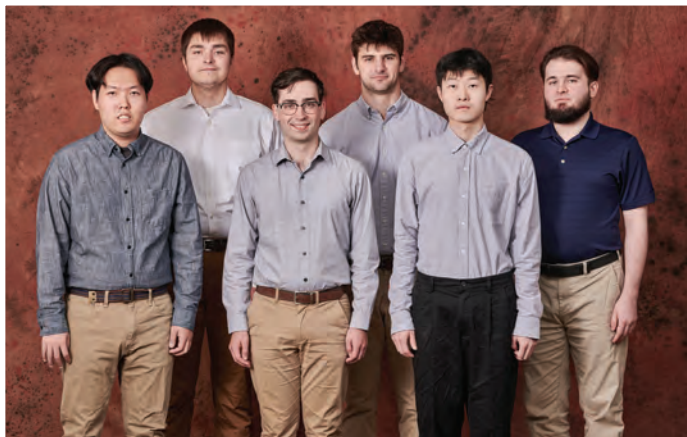
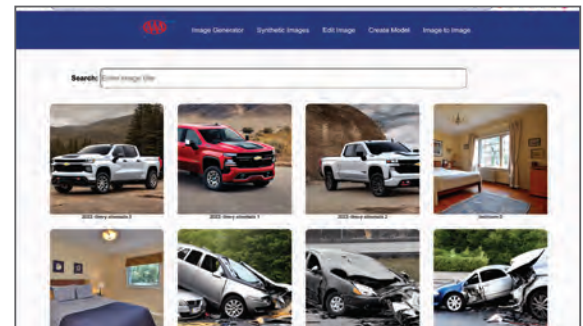
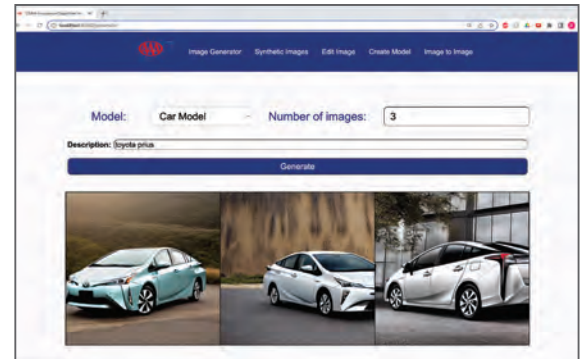
Our Synthetic Image Generation via Random Noise system provides an easy-to-use web application for CSAA data scientists to generate realistic image datasets. Our robust system is able to generate an image dataset for any subject of interest while eliminating privacy concerns, as the generated images are completely synthetic and do not depict any real people or vehicles.

Our application is a one-stop shop for all dataset generation needs. Users submit a text description of the images to generate, select the number of images desired, and quickly receive the dataset.

In addition to generating useful synthetic datasets, our system enables CSAA data scientists to update current dataset generators, as well as create new synthetic image generators quickly and effortlessly.

CSAA data scientists use our datasets for a variety of purposes, including providing concern-free data to CSAA's third-party partners, improving the claims process for losses without documentation, and general insurance data needs.

Our web application utilizes Python Flask along with HTML, CSS, and JavaScript. The Stable Diffusion and Glide Diffusion models that our software uses are trained and run in Amazon Web Services EC2 instances with dedicated GPUs. The resulting datasets are stored in an AWS S3 Bucket.



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General Motors

Augmented Reality Utilizing IoT Technology

General Motors is one of the top automotive manufacturers, selling over 6 million vehicles annually worldwide. GM is headquartered in Detroit, Michigan, and is known for brands such as GMC, Buick, Chevrolet and Cadillac.

As augmented reality becomes more accessible to large companies, new ways of utilizing this technology emerge, from remote training to visualizing 3D models in real time. GM has explored many possible corporate implementations of augmented reality, yet one unexplored area is augmented reality interacting with hardware.

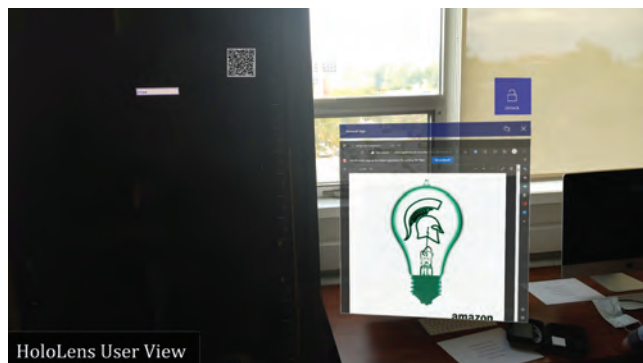
Our Augmented Reality Utilizing IoT (Internet of Things) Technology is an augmented reality headset that facilitates virtual interaction with the physical world. Our system employs the headset as a replacement for a physical key allowing access into restricted areas and content.

When a user needs access to a locked container, they put on the headset and open our application. A holographic button is displayed directly in front of the user that shows the status of the physical lock.

Once the button is pressed, the lock receives a signal to unlock, and the holographic button reflects this new status. Inside the container is a physical QR code that the headset scans. This QR code generates a hologram in the visual field of the headset to instruct the user in completing their task (shown on the right).

Our software integrates augmented reality with physical devices and demonstrates the viability of augmented reality and its uses for General Motors.

Our front end consists of an Unreal Engine 4.27.2 program running on a Microsoft HoloLens 2. The back end is a Flask server hosted on a Raspberry Pi. The server controls a Servo motor that is connected to a sliding deadbolt.



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Google

Android Exploit Fuzzing Analysis

Google is a Fortune 500 technology company headquartered in Mountain View, California. It specializes in creating connected products such as its search engine, smart devices, and advertising services. One of its most widespread products is the Android mobile operating system, which runs on upwards of 3 billion devices worldwide.

Due to the vast number of Android devices currently in use, Google needs to guarantee optimal performance and quality in their software. To achieve this goal, Google developed a bug detection tool called Syzkaller. This tool uses a process known as fuzzing, which enables engineers to detect bugs by passing random inputs into the target program.

Our Android Exploit Fuzzing Analysis tool utilizes Syzkaller to test Android software for bugs and displays the metrics on an intuitive dashboard for analysis by Google professionals.

The home page of the dashboard displays a snapshot of a Syzkaller fuzzer with the intent of giving engineers an overview of fuzzer performance. This overview is complete with attractive visualizations of analyzed data in the forms of charts and graphs.

The orchestration tab enables the user to stop and start Syzkaller instances with unique configurations. Our tool also displays unusual behavior found by the fuzzer on the crashes tab.

The insights tab provides an in-depth visualization of a fuzzer's performance, which enables engineers to find ways to improve the active fuzzers to detect more bugs. These features enable Google engineers to locate Android bugs that need to be fixed.

The back end uses a Node.js API to connect Syzkaller and the MySQL database that is hosted on the Google Cloud Platform. The API also manages Docker instances that contain Syzkaller fuzzers. The front end is written using Angular 14 and utilizes our API for the dashboard.



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Kellogg's Templatize R Development via Design Thinking

Kellogg's, one of "America's Most Trusted Brands," is a leading producer of snacks and cereals. The Battle Creek, Michigan company produces popular items such as Pop-Tarts, Cheez-Its and Frosted Flakes with the assistance of its 31,000 employees.

Kellogg's has a market presence in 180 countries and interacts with an abundance of customers. The Kellogg's Global Business Services (GBS) team ensures communication between employees and customers remains mutually beneficial and accessible. The GBS team achieves this through a large suite of applications.

With many applications focused on features and use cases, it is inevitable that some of them may no longer have the official Kellogg's look and feel.

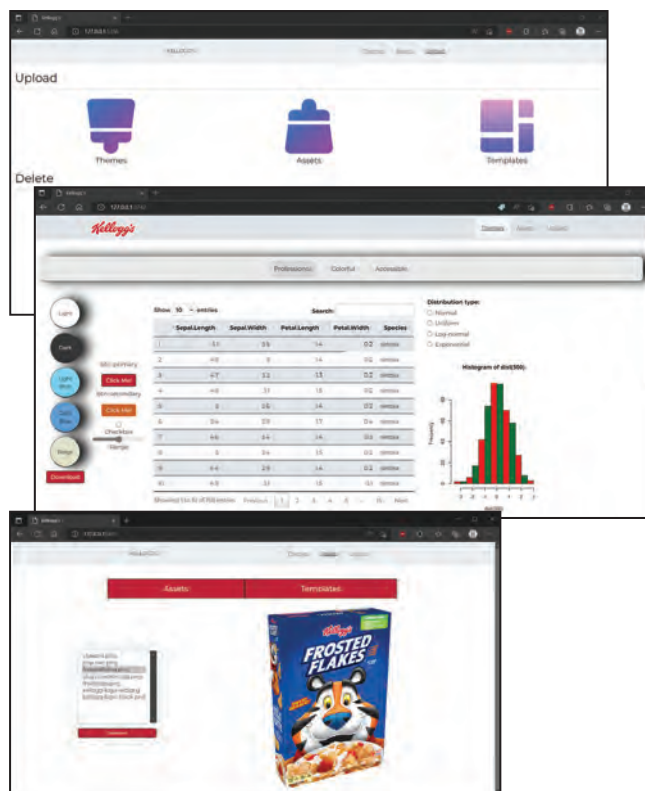
Our Templatize R Development via Design Thinking system provides a platform to help Kellogg's employees create new applications and update existing applications while conforming to all of Kellogg's current design requirements.

Employees can preview and download various standardized application elements by using a series of dashboards housed on our platform. This removes the need for developers to manually confirm that they are conforming to all requirements.

Our theme-previewing system displays common webpage elements and themes, which enables developers to quickly decide on a predefined look for their next application and not worry about design standards.

Using our app, Kellogg's employees can unite the look and feel of the GBS applications by applying consistent themes and branding material to upcoming projects and applications, thereby producing a seamless company image.

Users access the dashboards via a web app built in R, with R-Shiny for the user interface. The data is stored in MySQL, and the themes are created using CSS.



The Kellogg's logo, featuring the brand name in its signature red, cursive script with a registered trademark symbol.



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Kohl's Backstage's Back Alright

With over \$15 billion in sales, Kohl's is the second largest department store chain in the United States. Headquartered in Menomonee Falls, Wisconsin, Kohl's has 1,161 stores across 49 states and employs nearly 100,000 people.

Like many other retail stores, Kohl's has had to adjust to a significant increase in online sales in recent years. This greater online presence is supported by Kohl's software developers who work on several projects at a time, each using multiple applications.

It has become cumbersome for the software developers to manage their different projects as they navigate through all of the related applications.

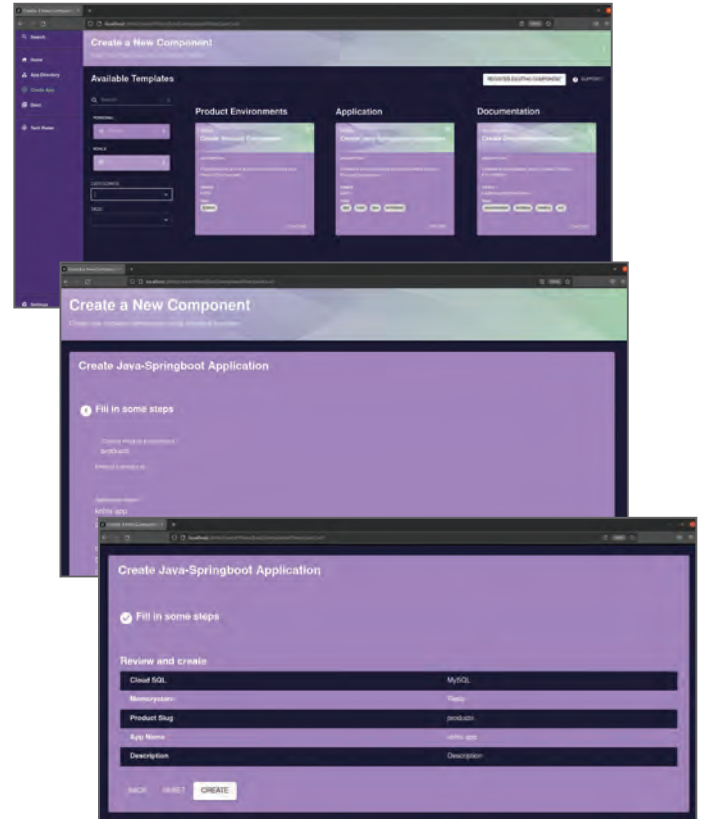
Our Backstage's Back Alright system provides a developer portal, which is a hub for the tools most frequently used by Kohl's software developers.

There are two main functionalities in the system which provide developers a way to quickly and intuitively see the statuses of all their projects and kick-start new development projects with our easy-to-use development templates.

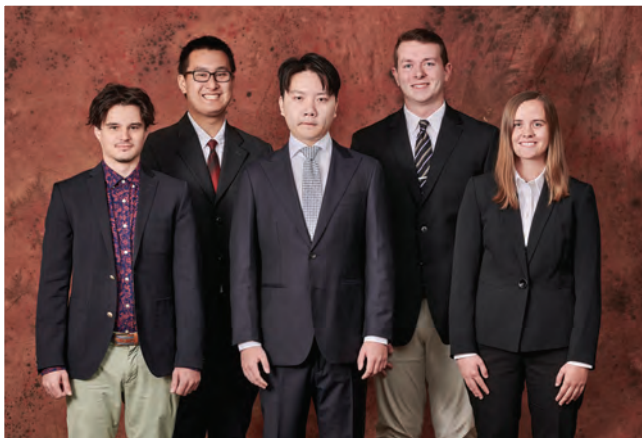
The system enables developers to quickly view all of the projects and related information on a single page.

Another page of our system streamlines creation of new projects. Developers simply specify what type of project they want and the programming requirements, and the system automatically creates the project, allowing developers to focus on other tasks.

TypeScript and React form the front end of our system. The back end is connected to external technologies including GitLab, Dynatrace and OpenShift.



KOHL'S®



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Lockheed Martin Space LiDAR and Image Fusion for Autonomous Navigation

Lockheed Martin Space, headquartered in Denver, Colorado, employs over 16,000 people to develop satellite systems, spacecraft, and space probes.

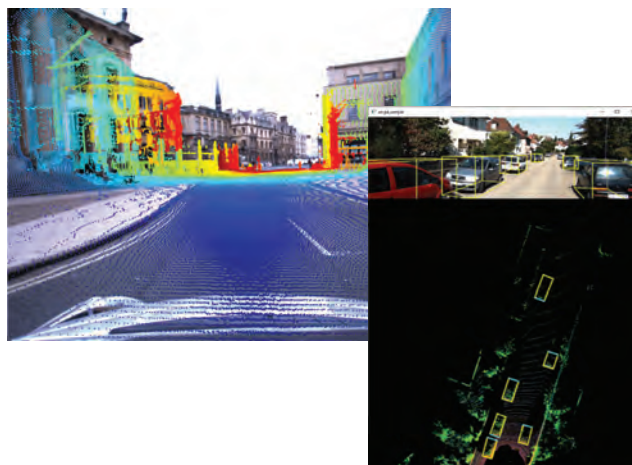
Recently, in a partnership with General Motors, Lockheed Martin Space is endeavoring to develop a transportation solution for NASA's upcoming Artemis mission in the form of the Lunar Mobility Vehicle (LMV).

In the LMV's navigation of the lunar environment, an accurate sensor system is essential to ensure safe traversal. Such a sensor system has different system requirements than a typical autonomous vehicle in that it must be redundant, performant, and capable of operating in the lunar domain.

Our LiDAR and Image Fusion Solution for Autonomous Navigation enables the LMV to detect the lunar environment by providing a lightweight and redundant software solution capable of running on the vehicle's onboard systems. By utilizing both LiDAR data and stereo-camera data, our solution accurately detects its environment. Additionally, our robust system can maintain effective operation in scenarios where a sensor fails through a redundant imaging setup.

Given the nature of the LMV, our system exists in an environment with limited computer systems and resources. Optimizing our fusion solution and underlying detection software guarantees its functionality in this restrictive environment.

In practice, our system is a network of ROS nodes, each node being a discrete computation module. Our LiDAR and stereo-image data are fused into a singular point cloud in the system and then fed through a YoloV4-based 3D object detection model for inference using the ONNX runtime. The entire system runs on an NVIDIA Jetson TX2, with Imaging-Source cameras and Intel Realsense LiDAR sensors providing data.



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Magna Dashboard for Data Visualization

For more than 65 years, Magna has been delivering innovative solutions tackling the automotive industry's toughest challenges. As a mobility technology company and North America's largest automotive supplier, Magna's capabilities span across the entire vehicle, working with all major global automakers including BMW, Nissan and GM.

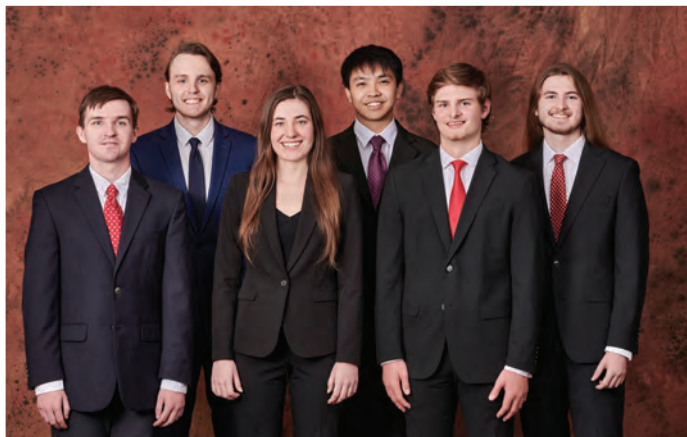
With the goal of significantly reducing last mile delivery costs and carbon emissions in cities, Magna built an all-electric, autonomous delivery robot, leveraging hardware and software from Magna's automotive products. The delivery robot is a pilot program and has delivered hundreds of pizzas since March 2022.

Magna monitors the performance of these robots and collects vast amounts of raw data, which can be challenging to understand and interpret. Our Dashboard for Data Visualization system presents this data in ways that make it easier for Magna engineers to organize, understand and interpret.

Magna employees and their partners access the dashboard from their company website and see the simplified data of the fleet on a daily, weekly, monthly or lifetime basis. These dashboards show trends in the data for things such as battery consumption and travel distance.

Our software shows clear trends, thereby enabling Magna engineers to implement any necessary modifications to improve efficiency of the fleet.

Magna acquires the data on its fleet through the vehicle sensors and GraphHopper routing API. Magna holds this data in an Amazon Web Service (AWS) database. The data is pulled into MySQL by a Python script, which sends information to Amazon QuickSight, where the dashboards are created. The dashboards are integrated into Magna's website, hosted by AWS, and coded using the Vue.js framework.



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Meijer Meijer Simply Give Automation

Meijer is a Midwest supermarket chain headquartered in Grand Rapids, Michigan. Pioneers of the supermarket concept, Meijer has over 250 stores across six states.

Simply Give is a signature program that partners with local food pantries to feed hungry families and has raised over \$75 million. Customers have the option to purchase \$10 Simply Give donation cards in-store or during an online order, which are converted to food-only gift cards and donated directly to local pantries. Meijer wants to extend the reach of the Simply Give program and analyze the community's support toward local pantries.

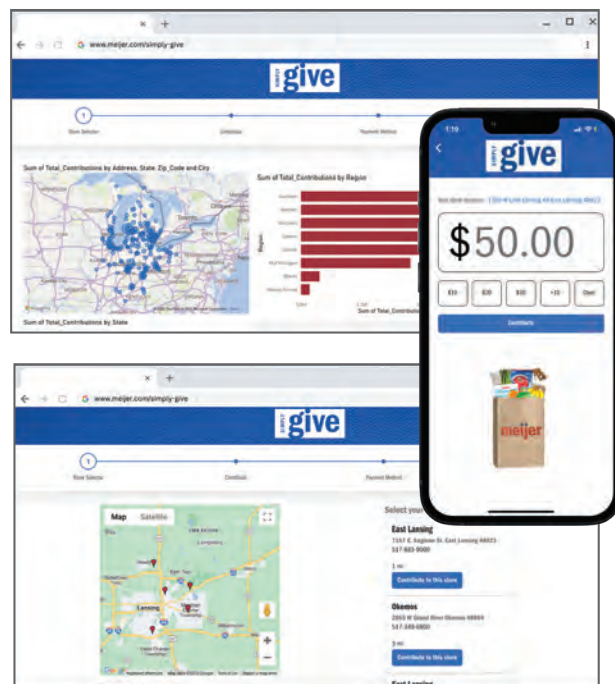
Our Meijer Simply Give Automation system is a standalone digital giving option, enabling customers to make Simply Give contributions directly to the Meijer store of their choosing. Our app makes it possible for anyone to contribute any amount from their phone or computer.

Users pick the Meijer location they want to contribute to and view the specific food pantry partnered with each store. This gives users the option to contribute to any community, which was previously not possible. No account is necessary, however users with mPerks accounts can sign in to use saved payment methods and easily contribute to their home store.

Contribution data is analyzed automatically, and produces analytics reports for Meijer employees. This helps Meijer identify issues and make corrective actions for the Simply Give program.

Simply Give Automation increases the program's digital customer contribution and expands the ability to digitally market the program to provide additional assistance to communities.

Our system is a web and mobile app. The front ends are developed with ReactJS and React Native, respectively. Our back end is written in Node.js and is connected to an Azure SQL database.



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Michigan State University Mobile App for Remote Recording

Michigan State University's Sociolinguistics Lab in the Department of Linguistics, Language, and Cultures hosts a research project called Michigan Diaries, which records changes to the lives and languages of Michiganders.

During the COVID-19 quarantine, MSU Linguistics needed a way to maintain their research safely. This led to the creation of MI Diaries, a way to remotely record and transcribe audio. As more researchers and programs realized the value in remote data collection, new features were added, including notes, photos, etc. More niche cases arose and the MSU Linguistics program found that the application had unexpected limitations that would require native software solutions to fix.

Our Mobile App for Remote Recording is a flexible solution that enables subjects to easily record sound, add images, and upload data directly to a server for research purposes. Our solution is a redesign of existing software with an emphasis on user experience and customization.

Our solution facilitates all sound-based research with a modular design that enables researchers to easily toggle features on or off. The simple and intuitive user interface makes it easy for anyone to record and upload samples for research. Users can record their audio, select pictures on their device, and upload content to the server with just a few clicks.

Customizing the application for any kind of research is as simple as copying the codebase and changing just a few lines of code.

Our application makes it easy for researchers to gather large amounts of multimedia data without programming knowledge, increasing data collection efficiency and speeding up research.

Our software is built in Kotlin for Android and Swift for iOS. The existing server-side pipeline is used to ensure seamless transition between versions.



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Microsoft Making STEM Papers Accessible to ASL Users

Microsoft is a multinational and industry-leading technology company best known for developing numerous operating systems, software, and online computing service platforms. Microsoft is also an active supporter of open-source development, as they hold a firm belief that contributing to open-source projects greatly accelerates innovation.

A roadblock that slows down the progress of this innovation is the lack of English-to-ASL translation for STEM-related words and other technological jargon. Those who sign with ASL that graduate high school have the reading comprehension of a 4th grader on average, making it harder to contribute to scientific studies.

Our Making STEM Papers Accessible to ASL Users system gives ASL users an easily-accessible resource that both translates scientific words of the reader's choosing and gives them suggestions for words they might be interested in translating.

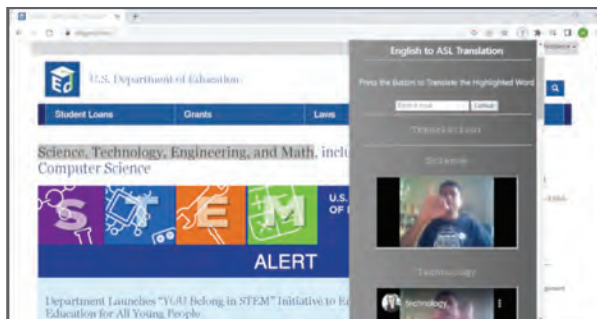
Our translator takes the form of a Google Chrome extension. It is accessible on a wide variety of webpages, increasing its usability.

Words are selected by highlighting them on the page with the mouse before activating the extension. Once the word is selected and the extension is activated, a video of that word's ASL translation is embedded inside a pop-up.

Words that do not have translations can be manually highlighted to show the user a similar word's ASL translation video. If similar enough words do not exist, a link to YouTube search results for that word's translation is displayed.

Our software makes it quick and seamless for ASL users to translate words from English to ASL, improving reading comprehension of ASL users.

The front end of our translator is written in HTML, CSS, and JavaScript. The back end is written in Python. The front end is connected to the back end via Flask.



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MSU Federal Credit Union

Digital Transformation of Member Data

Established in 1937, MSU Federal Credit Union (MSUFCU) has been serving Michigan State University and the greater Lansing area for over 84 years. With over 20 branch locations statewide, 331,000 members, and managing nearly \$7 billion in assets, MSUFCU strives to help its local communities thrive and achieve financial freedom.

To encourage community engagement and outreach, MSUFCU partners with local businesses by offering discounts and rewards to MSUFCU members through a program known as Local Loyalty.

The benefits are mutual for both members and businesses; MSUFCU members have access to rewards and discounts – keeping their MSUFCU cards top-of-wallet, while local businesses gain free exposure and generate more business.

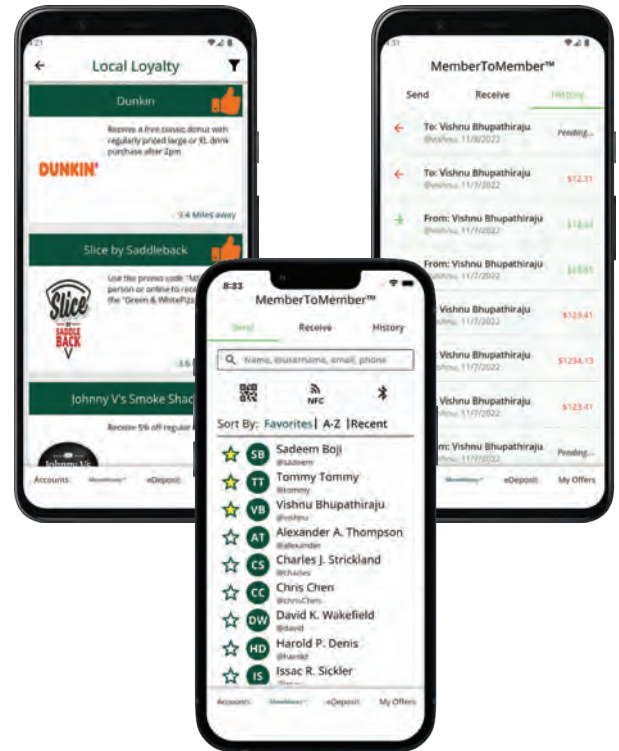
Our Digital Transformation of Member Data mobile application enhances these benefits by increasing awareness of the Local Loyalty program and providing members with a more robust member-to-member fund transfer experience.

Our application analyzes a user's transaction history and suggests partner companies that provide similar services to businesses where members are already shopping.

For example, if a member goes to an out-of-network coffee shop regularly, our application sends a notification suggesting a locally-partnered coffee shop offering a similar service at a discount if they use their MSUFCU card.

MSUFCU members can also use our improved fund transfer system, which now includes usernames, QR code scanning for physical device readers, and NFC tap-to-pay functionality.

Our application is available on Android and iOS devices. It is built on the Flutter SDK, using the Dart programming language to deploy on both platforms. It connects to a remotely hosted MySQL server whose data is analyzed with Python.



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Roosevelt Innovations Provider Anomaly Analytics Toolkit

Roosevelt Innovations, LLC is the first technology solution to deliver a simple, seamless, and smart platform for health insurance companies. With industry-leading claims processing capabilities, Roosevelt can transform operations, enabling insurance carriers to focus exclusively on their customers and growing their business.

With advanced machine learning techniques, Roosevelt Innovations performs analysis that identifies potentially anomalous attributes of healthcare provider claims for review. A key focus of this analysis is the identification of providers who may be engaging in fraud, waste, and abuse (FWA) activities. When found, providers potentially engaging in FWA are added to a manual watch list that places their future claims under scrutiny.

Our Provider Anomaly Analytics Toolkit streamlines this process by compiling the data sources and visualization tools necessary for FWA analysis into an interactive web application.

Upon opening the app, users are presented with a table of providers flagged as potentially problematic by machine learning algorithms. From this table, the user selects providers of interest and navigates to either a summary or comparison view for further investigation.

The summary view automatically displays data for a single provider, while the comparison view visualizes user-specified fields for multiple providers. Users leverage this information to confirm or deny potentially anomalous behavior.

By optimizing the identification process of problematic providers, our toolkit effectively reduces carrier vulnerability to FWA while improving the expected quality of care and cost of insurance for members using the Roosevelt platform.

Our toolkit is written in Python with Streamlit as the front-end framework. Data is stored in a Snowflake database and the outlier identification models are developed using scikit-learn and PyTorch.



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Roosevelt Innovations DSL IDE Test Harness

Roosevelt Innovations is a software company that creates solutions for insurance providers. The team at Roosevelt Innovations started at Delta Dental of Michigan, where they produced software that enabled Delta Dental Plans Association to insure over 83 million Americans. Roosevelt Innovations branched off from Delta Dental of Michigan to create company-agnostic software for all insurance providers.

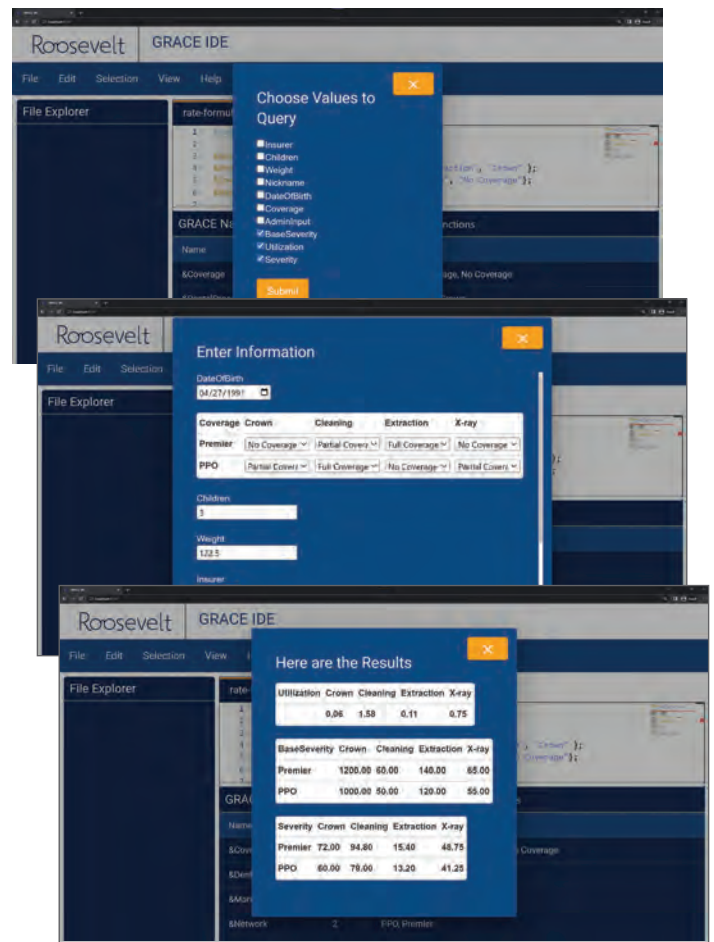
A ubiquitous challenge faced by insurance companies is accurately assessing risk. Actuaries and underwriters develop complicated formulas involving many factors, which must be updated frequently to appropriately charge for coverage. A common solution to this problem utilizes complex spreadsheets that actuaries and underwriters must learn and maintain to calculate their coverage rate.

Our DSL IDE Test Harness reimagines how actuaries and underwriters assess risk and facilitates the calculation of rates. Our application extends Roosevelt Innovations' revolutionary approach to rate calculation by providing a way for actuaries and underwriters to test their formulas quickly and conveniently.

Using our software, testing a formula is as easy as selecting it, entering the appropriate information, and clicking 'Submit.' After submitting their data measurements, a rate calculation is displayed to the user.

Our application streamlines the process of developing, testing, and distributing formulas used by insurance companies among actuaries and underwriters. This enables companies to appropriately assess risk, which ensures that they remain profitable.

Our application's front end is built using Angular and dynamically displays input fields when a test is run. The back end utilizes a Java microservice that provides the rate calculation files and performs the calculation once the input is provided.



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RPM

RPM Drive™ Mobile App Extension and Enhancements

RPM is an international logistics corporation which specializes in end-to-end transportation of freight and automobiles. On a monthly basis, RPM's carriers deliver 40,000 automobiles and 15,000 freight shipments. The company has headquarters in Royal Oak, Michigan and in Amsterdam, Netherlands.

The logistics and shipping industry is extremely competitive and dynamic, with carriers ranging from one-man operations to mega fleets. Thus, building carrier relationships is critical. While on the road, carriers use their phones to locate deliveries, making RPM's app an integral part of its business.

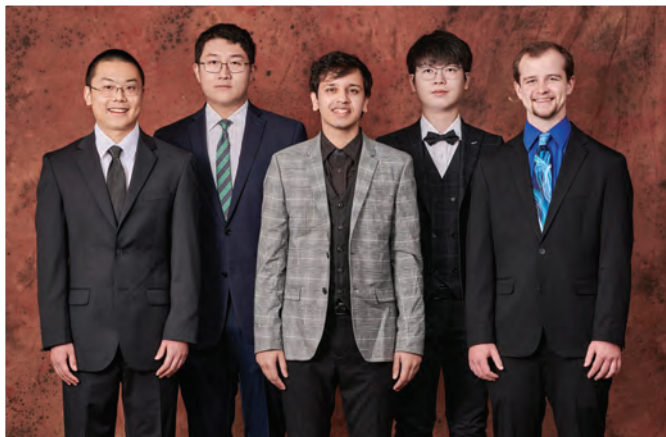
Our RPM Drive Mobile App Extension and Enhancements system improves the in-app experience for carriers, thus increasing client retention.

Our innovative bidding system provides an opportunity for carriers and RPM to negotiate the optimal price for each shipment through an intuitive, elegant and interactive bid engine. Carriers see shipment details, bid on preferred shipments, check auction status, and receive notifications on their bid status.

The suggestion page displays personalized shipments for carriers in one place, eliminating the hassle of manually finding loads that meet their criteria. An accompanying search page gives carriers the freedom to refine a lookup.

The rewards program incentivizes client loyalty. Users accumulate rewards points as they complete well-executed shipments. Drivers are able to select from a selection of gift card offerings, redeem their points in app, and receive their gift card virtually.

Our system utilizes C# and Xamarin to enable platform-agnostic development on the front end. The back end employs tools and databases from Microsoft Azure, and Python's scikit-learn library enables our machine learning models.



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Stryker

Technology Driven Inventory Optimization

Stryker is a Fortune 500 company that provides world class medical equipment to hospitals worldwide. From surgical equipment to neurotechnology, Stryker impacts more than 100 million patients annually.

With so many medical kits being shipped internationally, Stryker must ensure that every single kit is accounted for and tracked in their system, which requires a reliable history of transactions to determine the progress of each kit in the supply chain.

Our Technology Driven Inventory Optimization increases transparency throughout every step of the delivery process using a web application.

When a user opens the dashboard, they are shown statistics about all medical kit deliveries along with a map of their locations. This map is updated in real time and can be selected for a more in-depth view. GPS sensors attached to each medical kit provide up-to-date location data.

Statistics such as shipment history and status are viewable from the dashboard. To ensure the shipment history is secure, transactions are logged on the blockchain which provides safeguards against malicious actors. Moreover, to take further precautions against potential inaccuracies, all transactions written to the blockchain are processed automatically based on GPS location. This helps eliminate the potential for human error and increases the overall accuracy of inventory.

Stryker personnel use the dashboard and map view together to identify any problems that have occurred during shipping to address them immediately.

Our software provides much-needed transparency during each step of delivery of medical supply kits, increasing efficiency and aiding in discovering any problems as soon as they occur.

The front end of the web app uses ReactJS, while the back end is built on AWS's Amazon Managed Blockchain Service. Pebble sensors are responsible for sending location data which is queried by AWS AppSync and stored in a DynamoDB table.



stryker



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Targets' Tip

Sharing Advice on Academic Harassment

Targets' Tip is a start-up headquartered in Okemos, Michigan. Founded by Morteza Mahmoudi, Targets' Tip was created to provide support for targets of academic harassment and supply data on the incidences, types, and contextual behaviors of academic harassment to improve the overall academic organizational health.

Academic harassment is a serious issue that affects all disciplines and people. One main issue is a lack of reliable and easily accessible resources available for targets of academic harassment.

Our user-friendly Sharing Advice on Academic Harassment software mitigates this problem by enabling targets to connect with those who can support them and provides options for users: as a target or survivor of academic harassment, and as a professional advisor.

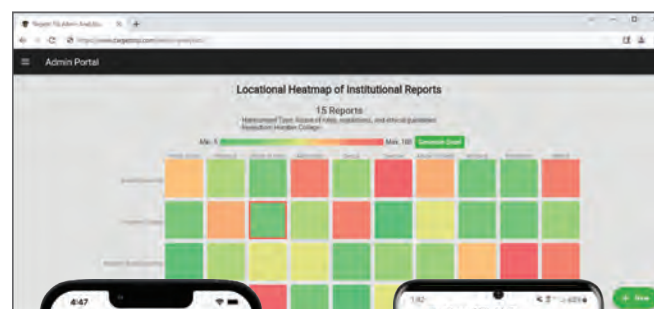
Professional advisors are required to produce credentials in order to be approved by a system administrator.

After users on the platform sign up for an account, they select which specific types of harassment they are either struggling with or for which they can offer advice.

Based on the user's selections and an advisor's rating, the platform proposes matches for a target with an advisor or vice versa. The user requests to connect with one of their matches, and upon approval from the match, can chat online. After a conversation, the target is asked to rate their advisor, which factors into the rating of their advisor, helping future targets pick their match.

While keeping user data secure, Targets' Tip collects instance data and feeds it into a customizable dashboard for administrators to view. This system is separate from the public platform.

Our application is available to access online and natively on iOS and Android. The front end is written in Dart utilizing Flutter while the back end utilizes Firebase.



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TechSmith

TARA: TechSmith Asset Recommendation Assistant

TechSmith is the global leader in screen recording and screen capture software and solutions. The company's mission is to empower people to create remarkable videos and images that help share knowledge and information. TechSmith's flagship products, Snagit and Camtasia, have more than 73 million users worldwide.

TechSmith provides users with the software to easily create video content, but not everyone is great at the editing process or familiar with the features the TechSmith Asset Store provides. The procedure of converting raw footage to something that captivates an audience can be very time-consuming. Even with thousands of pieces of media from the asset store, users struggle to find the right material to help upgrade the quality of their content.

Our TARA: TechSmith Asset Recommendation Assistant web application enables users to efficiently edit their video or audio content by providing them with curated material from the asset store. This saves time and ensures that the provided assets complement the original content.

When a user uploads video or audio to the website, the file is split and analyzed for keywords. Each segment is associated with suggestions from the TechSmith Asset Store. The suggestions display the name of the asset, a short description of the material itself, and a corresponding link to its location in the asset store. The assets can be downloaded with the provided link.

Our software makes it easy for users to quickly create high-quality videos by suggesting assets for inclusion, cutting the time spent searching the asset store for appropriate files.

Our web application is made using HTML, JavaScript, and CSS. Text data is extracted using Microsoft Azure's Speech Services API and Cognitive Services Computer Vision. Keywords are extracted from the text using Gensim. Our web application, file storage and database are hosted on Microsoft Azure.



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Union Pacific Mobile Train Handling Simulator

Union Pacific, founded in 1862, is the leading railroad transportation company in North America. With over 32,000 miles of track, 8,000 trains and 30,000 employees, Union Pacific plays a major role in the transit of goods throughout the nation.

Traditionally, trains were powered by one locomotive group at the front, whereas contemporary trains can have up to three locomotive groups throughout. This is known as distributed power. Distributed power requires the engineer to manage the throttles of each locomotive group in order to maintain a delicate balance between the train cars, a task that becomes more difficult as terrain changes over the train's route.

Locomotive engineers today have a heavy responsibility, overseeing many tons of cargo and many passengers. To make sure engineers are trained properly, there is a pressing need for accurate and accessible distributed power training simulators.

Our Mobile Train Handling Simulator lets users control an expansive collection of real-world trains over realistic terrains. Users interact with throttle and brake controls for up to three locomotive groups and try to minimize the push (buff) and pull (draft) forces between cars of the train. Our system uses cutting-edge physics simulation and comprehensive train conditions to ensure the simulations are realistic and informative.

With intuitive controls and simple two-dimensional visuals, our simulator is realistic and easy to use. This makes it an accessible solution for locomotive engineers while avoiding costly resources such as proprietary and stationary train hardware.

The simulator is developed with Unity, a software development environment and game engine. Additionally, our system incorporates a proprietary train physics API from PS Technology, a Union Pacific subsidiary. This makes our simulator highly accurate, warranting its use in training locomotive engineers.



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United Airlines Data on Demand App

Headquartered in Chicago, Illinois, United Airlines serves as one of the largest commercial airlines in the world. While maintaining a workforce of over 84,000 employees and a fleet of more than 850 aircraft, United Airlines also provides immense passenger service with thousands of flights to over 350 global airports daily.

The Airport Operations Safety Leadership team at United Airlines often finds it useful to access raw data on employee injuries and aircraft damages on demand. However, the team is currently unable to access data in a timely manner during key conversations. This information is also not accessible on mobile devices.

Our Data on Demand App delivers raw data to the fingertips of Airport Operations Safety Leadership via a robust mobile website.

Airport Operations Safety Leadership can quickly access the website and select the desired data domain, either injuries or damages, to initiate their analysis. Upon choosing a data domain, the user can provide filterable conditions regarding the occurrence, such as a date range, a location, and the status of investigations. This enables Airport Operations Safety Leadership to immediately view the total number of incidents accordingly.

In search of more information on specific incidents, the user can click the resulting figure indicating the total number of occurrences, and a table of incidents with deeper information corresponding to the figure is displayed. The user can share this data along with the associated filter options via email.

With our system in place, United Airlines can ensure and maintain a safer workplace environment for its employees.

Our Data on Demand App is written in ReactJS, an open-source Java Script framework. The data is being accessed via a REST API, which is developed using Node.js.



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United Airlines Audit Management System

United Airlines, based in Chicago, Illinois, has been one of the most important airlines in the United States for almost a century, flying over a hundred million passengers each year on its fleet of over 850 aircraft.

Maintaining this incredible fleet requires constant maintenance, and United Airlines has a network of vendors across the globe to keep its planes in good condition. Vendors repair and replace airplane parts with frequent inspections by United Airlines' auditors, who make sure each vendor is following the best practices.

Our new Audit Management System makes this process easier for auditors with the implementation of a virtual portal that enables auditors to move smoothly through the list of audits and checklists, reducing the chance for mistakes.

Auditors access our app on an iPad when visiting vendors. During the audit, they can log any issues directly on the iOS app and keep track of the progress they have made.

Our iOS app saves an audit and automatically uploads it to our website accessible by the vendors so the vendor associated can respond to any issues found by the auditor. After the vendor responds, our iOS app displays their response next to the respective finding on the audit.

Historical audits for the vendor are always shown, so that auditors can quickly view past errors, assess the fixes, and be confident that all issues are properly resolved.

Online audits are standardized, so any auditor can easily compare and understand information from past audits, further decreasing the risk of inconsistencies.

With the Audit Management System in place, United Airlines can make sure that the airline is safer than ever.

Our application is written in Swift and connects to a back-end database through an API hosted by Amazon Web Services.



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United Airlines

Efficacy Testing within United's Cornerstone LMS

United Airlines is the world's third largest airline with a fleet of over 850 aircraft that fly a total of 4,500 flights a day to more than 300 cities across five continents. To maintain this fleet of aircraft, United Airlines has 41 instructors helping to shape the students into capable aircraft technicians.

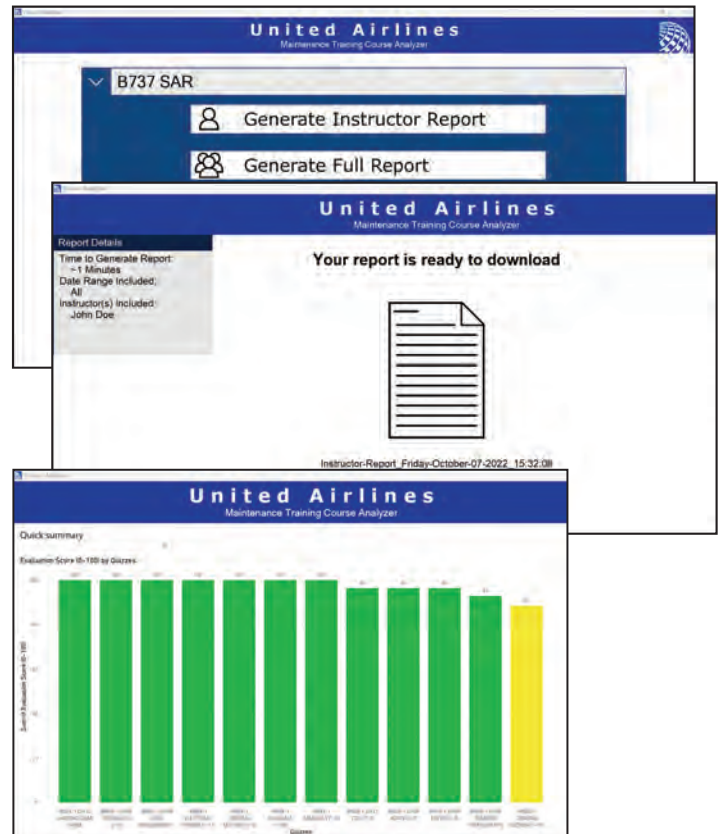
Nothing is more important to United Airlines than safety, so having a crew of well trained, professional technicians is essential. Technicians learn plane and airport maintenance through United Airlines training courses. To increase instructor quality and technician training, it is imperative that United Airlines has up-to-date statistics about courses and instructors.

Our system provides a way for United Airlines to ensure the content of the 737 SAR course is accurate, and that instructors are continuing to effectively train United Airlines aircraft technicians on the Boeing 737 aircraft and all its variations.

The system enables users to generate reports from course data. This report analyzes important factors such as whether course materials contain relevant information, student performance metrics, if questions are worded properly, and the performance of the instructors' teaching.

The application takes the course content results along with the course preparation materials, and outputs a statistical breakdown for United Airlines to review. Each exam is assigned a score from 0 to 100, which helps instructors color code the exam performance with Traffic Light Protocol.

Our course analyzer is built within Python. For the front end, Tkinter is utilized along with Python packages like NumPy and Pandas. The course learning materials and exam results are hosted on Microsoft SharePoint. Data visualization and statistical analysis can also be viewed using Microsoft Power BI dashboards.



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Urban Science Dealership Parts and Service Telematic Insights

Urban Science is a global data-driven company headquartered in Detroit that has provided tailored insights and solutions for the automotive industry since 1977. As a global company that has served every major automaker, Urban Science analyzes the market to pinpoint issues and propel success for their clients.

Cars are generating more data than ever, from data on tire pressure and engine status to error warnings and alert acknowledgements. Although dealerships are saving this data, they do not know how to use it effectively. With this lack of data utilization, dealerships may be missing opportunities to gain insights on their business that are present in this telematic data.

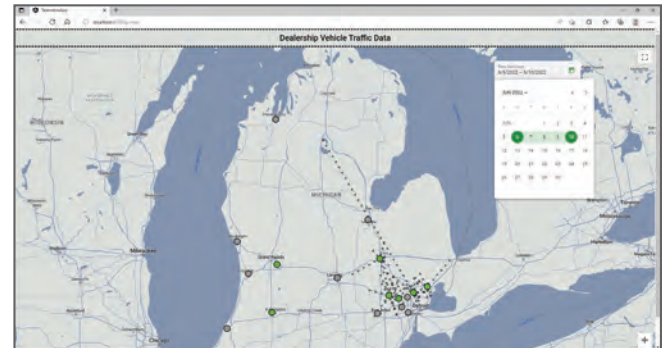
Our Dealership Parts and Service Telematic Insights web application solves this problem by drawing insights through analytical processing and visualization.

Our web application can be used on any web browser, ensuring that all users have the ability to utilize its functions. Dealers have the choice of viewing telematic data as a filterable table or as an interactive map. Dealers select a date range to decide what data and insights are shown on the table and interactive map.

The filterable table holds relevant data to improve the speed of access of related telematic data. Data can be displayed on a dealership-by-dealership basis and filtered with the use of the search bar.

The interactive map visualizes the journey of cars to dealerships in order to resolve various vehicle alerts. Dealers have the option to select a dealership and navigate to the filterable table to find information on the business of the dealership.

The front end of our Dealership Parts and Service Telematic Insights application is built using Angular, Typescript, HTML, and CSS. The back end uses the .NET Core 6.0 framework APIs in C# that are connected to a SQL Server database.

A screenshot of a web application titled "Telematics App". It displays a table with columns for various data points. The table is filtered to show data for a specific date range. The columns include: ID, Brand, Model, Year, Make, Mileage, Color, Status, and Location. The table lists multiple vehicles and their associated data.

URBAN SCIENCE.



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Vectorform Time Cube

Founded in 1999, Vectorform is headquartered in Detroit, Michigan. Vectorform is an invention company that prides itself on its expertise and talent to solve complex technological problems. They combine a variety of technologies such as the Internet of Things, augmented or virtual reality, and other emergent systems to develop solutions for their clients.

Vectorform employees are responsible for tracking their time while working on numerous projects throughout the day. It is important to keep totals of time that are accurate to both the company and client. Manual time tracking leaves room for errors while also being a tedious, time-consuming approach. Additionally, automatic trackers running on a computer can be privacy-invasive.

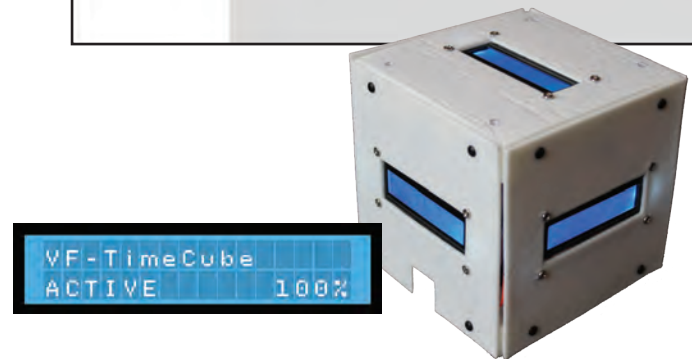
Our Time Cube system is a physical desktop device that tracks totals of time on projects with a flip of the cube.

Our web application populates the Time Cube with a task on each surface. From there the user starts timing and the device tracks the task facing up on the cube. By rotating the device, a new time entry begins and the web application updates automatically. Timing can be paused by flipping the cube upside-down, indicating a break.

Users can edit the data and correct any user error before confirming their time entries and sending the data to Vectorform's billing department.

Our system of tracking time provides employees with a fun, tactile approach to their workday. It incorporates manual and automatic processing to diminish the disadvantages of each process.

The web application incorporates ReactJS in the front end and utilizes back-end services including Node.js and SQLite. The Arduino MKR Wi-Fi 1010's firmware is written in C++ and communicates with our front-end system through Bluetooth Low Energy.



Vectorform
an NTT DATA Company



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Volkswagen Group of America

Volkswagen Electric Vehicle Recommender App

Volkswagen Group of America is the North American operation headquarters and subsidiary of the Volkswagen Group, one of the world's leading automobile manufacturers. They have 6,000 employees in the United States and sell their vehicles through a 1,000-strong dealer network.

Automotive industry analysts predict that by the year 2035, approximately 45% of all new car sales will be electric vehicles. The main concern new electric vehicle buyers have is “range anxiety,” defined as the fear of being stuck without fuel or a viable charging option, charging station availability, and charging timeframes.

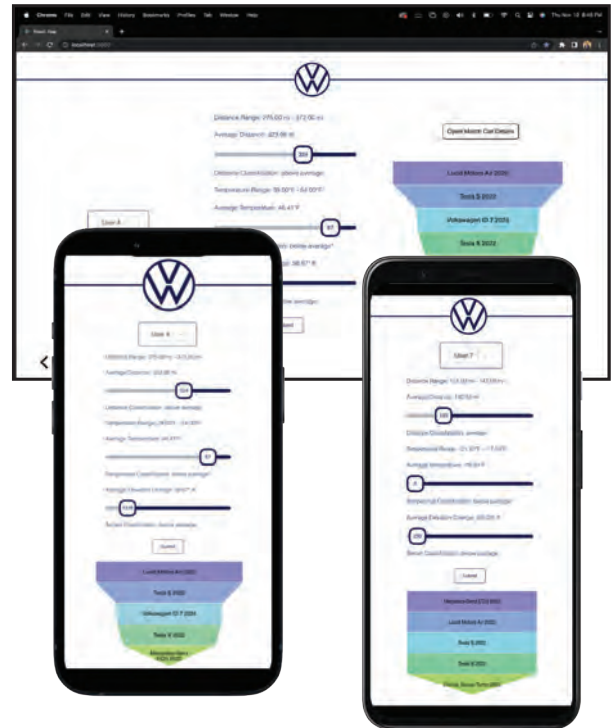
Our Volkswagen Electric Vehicle Recommender App quells buyers' fears by matching users to electric vehicles which best suit their custom driving profiles.

Users can either use their preexisting Volkswagen profiles or they can enter new preferences in the app to get recommendations for suitable electric vehicles. These profiles contain essential information about the conditions the user typically drives in. Many aspects of a driving profile affect a car's range, so factors such as local temperatures and elevation are considered.

The application also gives users the option to select aspects of vehicles they desire most. They can filter by certain characteristics such as car types, different horsepower ranges, and number of seats. While these options are not as pressing as range anxiety, they give buyers a choice.

Users are presented with attractive visualizations describing why the recommended vehicles fit their profile. Algorithm analysis is included to further showcase how and why each vehicle is suggested, and how they compare.

Our Volkswagen Electric Vehicle Recommender App is a reactive web-based application. Our system uses API calls for database communication and is written in Python, React, and Flask.



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Whirlpool Corporation

Guided Recipe Augmentation

Whirlpool Corporation, headquartered in Benton Harbor, Michigan, is the world's leading major home appliance company with approximately \$22 billion in annual sales and 69,000 employees. Whirlpool's goal is to improve home life through the production of a variety of home appliances.

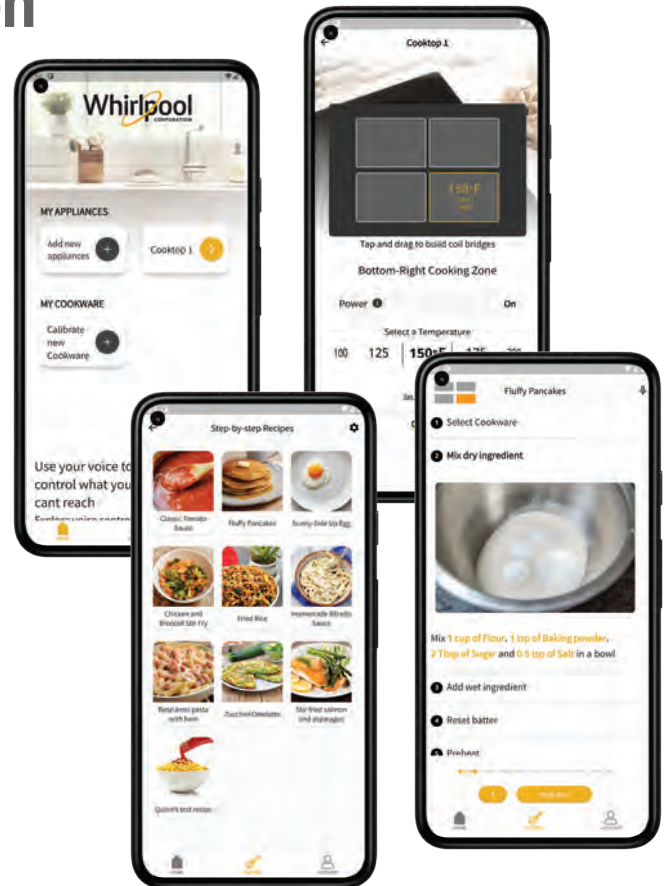
With this in mind, our Guided Recipe Augmentation system eliminates the variability of home cooking through the Assisted Cooking with Temperature (ACT) mobile application that guides users as they cook at home, ensuring they get the best results.

One of the largest hurdles a new home cook can encounter is properly managing the cooking temperature of their stovetop. The ACT mobile application converts traditional power level cooking into a more intuitive cooking experience using real temperature values to ensure the perfect meal every time.

Utilizing Whirlpool's induction cooktops, the ACT mobile application is able to seamlessly assist a home cook, step by step, through a recipe while automatically adjusting the temperature of the cooktop without any user intervention. Additionally, users are able to control the recipe instruction process with voice commands or gestures to command their mobile device back and forth between different recipe steps.

Our ACT mobile application streamlines the cooking process to alleviate the stress of home cooking, thus bringing it to more homes. All of the recipes are hand-crafted by Whirlpool's food scientists to ensure steps are simple and easy to follow.

The ACT mobile application is built using Dart, a programming language developed by Google for simultaneous Android and iOS development. Our application communicates with the induction cooktop via a WebSocket protocol. Lastly, storage is being handled using MongoDB hosted by Microsoft Azure.



Whirlpool



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DESIGN DAY

At the end of each semester, the College of Engineering sponsors Design Day, at which student teams from throughout the College showcase their Capstone projects throughout the Engineering Building.

Computer science capstone teams demonstrate the software projects that they have designed, developed and delivered for their corporate client. Teams compete for four awards, which are conferred by a panel of corporate judges.



Interim President Teresa Woodruff learns about Team Auto-Owners capstone project "A-O Merch Search" from Caroline Gomerly.



College of Engineering Dean Leo Kempel presents Ross Hacker of Auto-Owners Insurance with a commemorative framing.

THANKS TO AUTO-OWNERS INSURANCE

Auto-Owners
INSURANCE

We thank Auto-Owners Insurance, a Fortune 500 company headquartered in Lansing, Michigan, for their continued support of Michigan State University and the Capstone Experience, including the printing of The Capstone Experience booklet.

Check out the Capstone Experience web site at www.capstone.cse.msu.edu. For more information about the capstone experience or becoming a capstone project sponsor, contact Dr. Wayne Dyksen by email (dyksen@msu.edu) or by phone (517-353-5573).



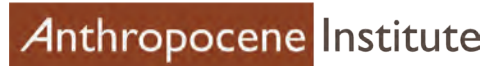
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Ally Financial

Ally Offers Ecosystem

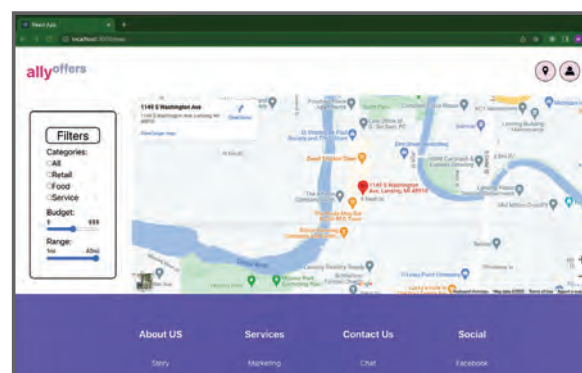
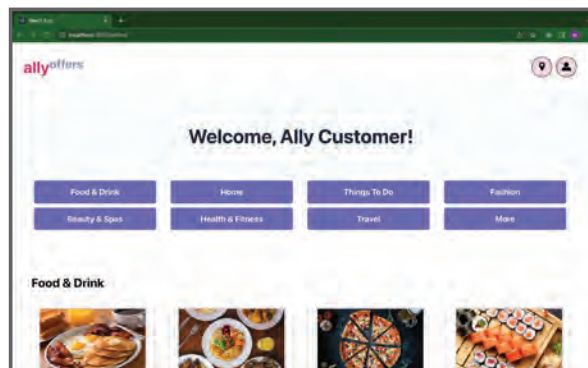
Headquartered in Detroit, Michigan, Ally is a top 25 financial holding company in the United States and a leader in digital financial services. Ally provides financial products for consumers, businesses, automotive dealers, and corporate clients in their commitment to digitalizing and innovating a seamless customer experience. As their name implies, Ally is committed to being an ally to their small business customers.

Ally customers and small businesses use our web application, Ally Offers Ecosystem, to help communities thrive and stay vibrant. Small businesses are often unable to gain traffic in their stores, as well as advertise themselves to a larger audience due to inexperience with technology or lack of a digital platform. Our Ally Offers Ecosystem helps small businesses reach a much broader audience, which in turn, benefits Ally customers too.

The platform gives access to businesses to register and upload their offers on a personalized dashboard. These offers are available to and accessible by all of Ally's customers. A business can access a personalized dashboard with analytics displaying their performance. Depending on the success of their deals, they can upload, edit, or delete any ongoing offers they would like to advertise to their customers.

Ally customers access a separate dashboard with a multitude of categories of offers to choose from, as well as save their coupons on their profile. Customers can set filters to personalize their interests, which are reflected in a map view of nearby offers. This shows Ally customers appropriate deals and ways to save when visiting businesses partnered with Ally.

Our application is written in HTML, CSS and JavaScript and is powered by the React framework. Our web app interacts with MongoDB and Express to connect to AWS and offers machine learning capabilities.



ally



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Amazon

Amazon Group Buying Tool

Amazon is a multinational technology company that has grown to become the world's largest online retailer. Founded in 1994 by Jeff Bezos, Amazon has since expanded into various industries, including cloud computing, digital streaming, and artificial intelligence.

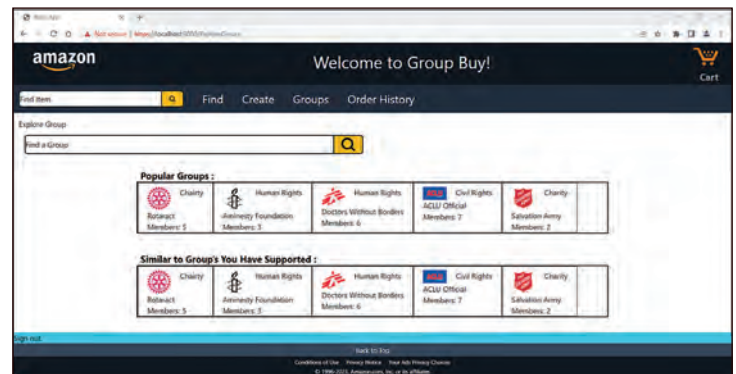
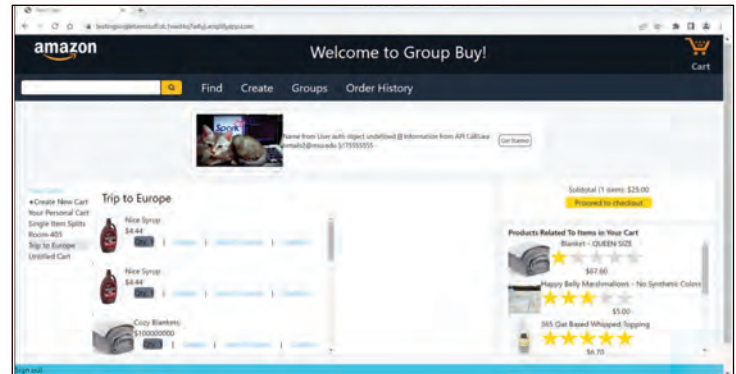
By practicing customer obsession, Amazon delivers products that bring joy and utility to their customers. The company provides shoppers with an intuitive purchasing experience, enabling items to be added to a customer's cart quickly and seamlessly. Amazon is consistently thinking about different features to enhance their product purchasing process. Currently, customers must utilize third-party services to share expenses, without a way to do so on the Amazon retail website.

Our Amazon Group Buying Tool enhances the shopping experience by enabling users to form groups, initiate purchases with other customers, and share costs among group members. The tool also helps users to search for products and receive product recommendations based on group information and products in their cart.

Our software significantly reduces the time needed to buy items in collaboration with other customers. It also simplifies the process of purchasing items that may be challenging to afford individually, leading to an increase in sales.

The tool also makes donating to organizations easier than ever by giving users a simple method to find and contribute to group wallets. Overall, our tool provides value to a wide variety of people.

The web application is responsive and scalable due to a robust set of Amazon Web Services. The front end is hosted on AWS Amplify and back-end requests are swiftly handled by API Gateway, Lambda, and DynamoDB. Product recommendations are managed by AWS Comprehend.



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Anthropocene Institute Machine Learning for Numeracy Training

The Anthropocene Institute is an organization that supports researchers, universities, and start-ups in a quest to advance necessary technologies for a better future. Their focus is currently on alleviating the current climate crisis.

In the modern day, critical thinking about numbers is a required skill for success. Being able to make quick, informed judgments with numbers is vital. Topics like government spending, bills, investing, and many more require this skill. However, many people today are currently lacking these abilities.

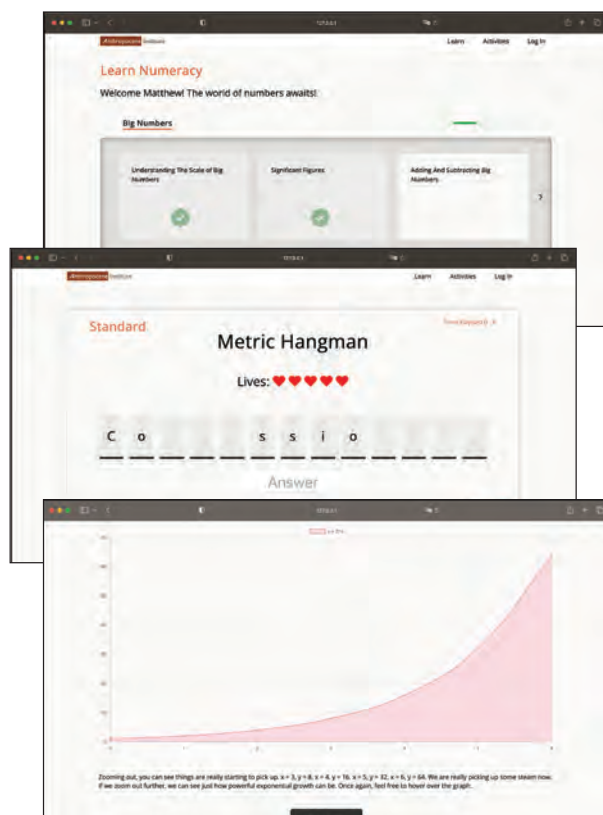
Our Machine Learning for Numeracy Training software alleviates this issue by educating the public about numeracy with an easy-to-use website that both teaches and challenges users.

The first component of our software is the instructional content, composed of three modules: big numbers, scientific notation, and units of measurement.

Each module holds a set of lessons. These lessons contain text, graphics, and questions that users interact with to master the topics. The user's progress is saved and viewable from the learn page indicated by progress bars. The user can interact with an AI chatbot for assistance at any time during their learning process.

The second component of our software is the activities. There are two main games offered: metric hangman, and estimates. Metric hangman is a classic game of hangman; however, users input metric prefixes as their guesses, either the literal prefixes or their numerical value. Estimates is a guessing game in which users are prompted with quick questions to answer about a range of topics. Their answers are graded on both speed and accuracy.

The front end of our software is written in HTML and JavaScript. The back end is composed of a MySQL database and Flask for storing and rendering content for games and user information. The software utilizes OpenAI's GPT-3 API to support the chatbot.



Anthropocene Institute



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Auto-Owners Insurance

The Summarizer

Auto-Owners Insurance is a Fortune 500 company headquartered in Lansing, Michigan. Auto-Owners is represented by 48,000 licensed insurance agents in 26 states and provides insurance to nearly 3 million policyholders.

As a major insurance agency, Auto-Owners receives thousands of feedback reports, employee surveys and branch audits. These documents provide Auto-Owners general information on how customers and employees view the company.

Currently, Auto-Owners employees manually review and extract key takeaways from these documents, a labor-intensive and time-consuming process.

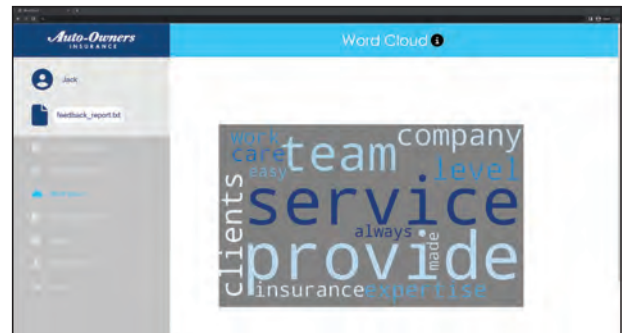
The Summarizer is a web application that reduces the time needed to review documents by quickly processing them and distilling them down to key components for the user to view.

Users start by uploading a document they want summarized to the web application. Our software then processes the document and displays key metrics such as word frequencies, the overall sentiment of the document, as well as a document summary.

The metrics are displayed in a visually intuitive interface which includes tables, graphs and a word cloud. Users can click between tabs to view the different aspects of the summary report. Administrators can also view summary reports from previously uploaded documents.

Our software cuts down on the time Auto-Owners' employees spend to understand the feedback they receive and gives them more time to act on it. This gives Auto-Owners the ability to make quick and effective changes so they can continue to deliver excellent service and quality products to their customers.

Our front end of the application is built with HTML, CSS and JavaScript, while the back end is implemented with Python Flask. The data for the application is stored in an SQLite database.



Auto-Owners
INSURANCE



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Bosch

Web Interface for CarMaker Simulation Tool

Bosch, founded by Robert Bosch, is a German multinational engineering and technology company headquartered in Gerlingen, Germany. Bosch is a leading global supplier of automotive technology and services, having more than 100 locations all over the world.

Bosch is a world leader in developing solutions for autonomous vehicles, and is on the forefront of creating, prototyping, and testing both hardware and software for these vehicles. Bosch utilizes the CarMaker simulation software to run complex simulations to test autonomous vehicles. However, CarMaker must be run on specialized workstations not present in every office, making it difficult for Bosch staff to use CarMaker on the fly.

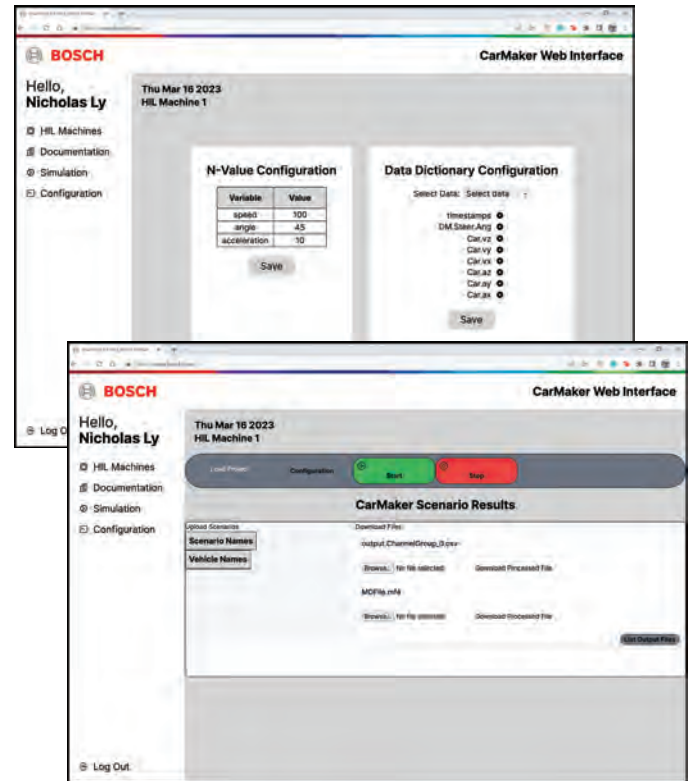
Our Web Interface for CarMaker Simulation Tool provides an easier, more efficient way for Bosch engineers to communicate with CarMaker simulators to load, run, and view the results of their simulation without ever having to touch a physical computer or install any software.

Bosch engineers have the ability to load scenarios and vehicle models, change parameters in the scenarios, start and stop simulations, view the simulation status, and download simulation results remotely, utilizing an easy-to-use web application.

Users can select the specific machine they want their simulations to run on, giving the maximum amount of control to engineers so they may further fine tune tests.

Through this application, Bosch engineers can utilize our web application to provide safer and more secure autonomous vehicles in the future.

Our web application is built using SvelteKit, Tailwind CSS, and SQLite. The web application interacts with each of Bosch's HIL machines through their own instance of a Flask REST API, allowing for control over the CarMaker simulation through HTTP requests.



BOSCH
Invented for life



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DRIVEN-4

Driven Connect Application, Server, and Backend

DRIVEN-4, recently founded in 2016 and headquartered in Saint Joseph, Michigan, provides industry-specific expertise and technological solutions to clients in the areas of Product Lifecycle Management (PLM), connected product development (IoT), connected operations (IIoT), cloud services, and cybersecurity.

Currently, DRIVEN-4 utilizes two core technologies for connected product development and operations: PTC's ThingWorx and Digi's Remote Manager. Together, they provide decentralized management and monitoring of remote devices. Users connect their devices to the Internet, monitor device health and storage, manage device firmware, download data from devices, and perform data analytics and visualizations.

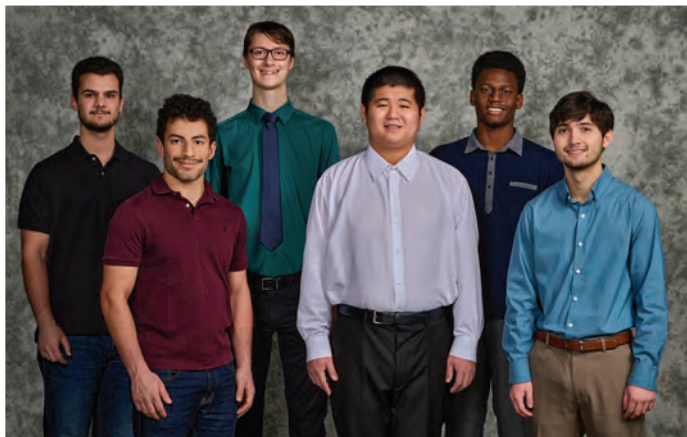
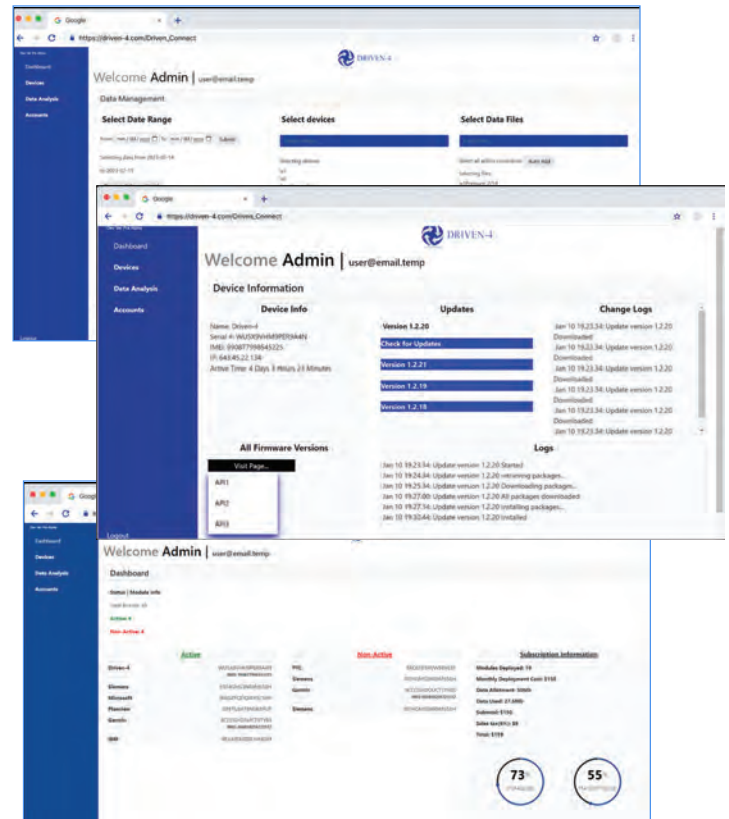
As DRIVEN-4 scales up in size, they are developing their own IoT Driven Connect Board that collects data from the device's sensors. Hosting, interacting with, and storing data from these new boards require a robust and cost-effective solution.

Our Driven Connect Application, Server, and Backend tool solves this issue with a single, streamlined web application. Registered users of an organization connect with their devices over the Internet where they can view and download device data. Users can perform custom data analytics and visualizations on collected data.

Within an organization, administrative accounts manage their users and boards. This includes adding new users, along with updating existing users' settings, and pushing mass firmware upgrades or downgrades, to any selected boards.

Lastly, DRIVEN-4 server administrators manage all organizations' users and admins, implement system level settings on devices, push firmware and enable/disable devices.

Our application is built using Python Flask, MySQL databases, and an FTP server for over-the-air firmware updates.



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Evolutio #BIKES4ERP Tracking

Evolutio, based in Chicago, brings visibility, simplicity, and usability to complex enterprise platforms. Evolutio and its parent company EPI-USE, are part of the groupelephant.com nonprofit. One part of this nonprofit, #BIKES4ERP, donates bicycles to rural children, mobilizing them to realize their dreams at school.

Unfortunately, there have been cases of these bikes being lost or stolen, with minimal chances of recovery.

Our #BIKES4ERP Tracking tool solves this issue by providing live tracking and alerts for the statuses of bikes through an intuitive web application.

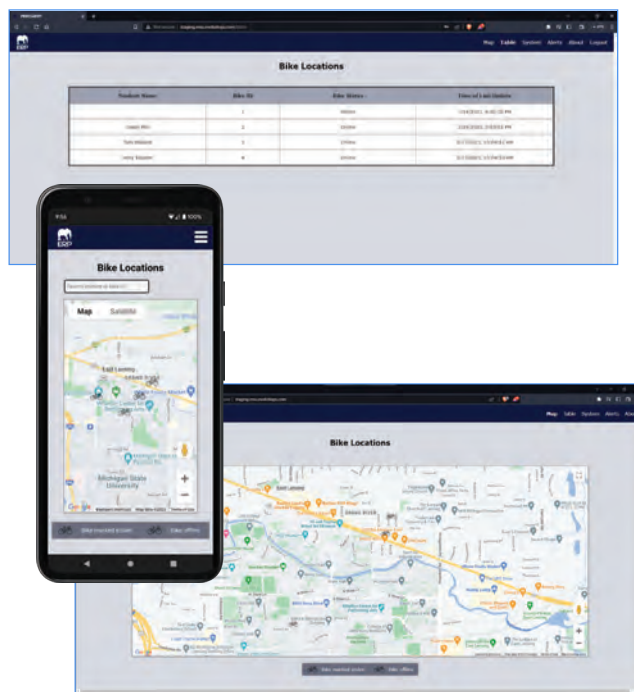
In our tool, admins can add bikes and users of any lower-tiered role to the system. Once added to the system, a bike icon appears on the map on the home page with the color denoting its status.

Teachers with bikes assigned to them by an admin can add a student and pair them with their bike via the system page.

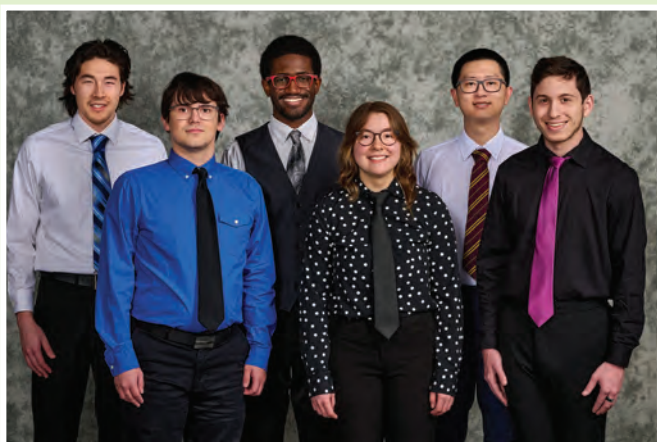
The status of a bike can be updated either automatically or manually. The system marks a bike as possibly stolen if it detects suspicious activity, such as traveling at a high speed or going offline for too long. The status remains as such until manually reverted. All users can make manual status updates to bikes determined by their role. Admins and mechanics can update the status of all bikes in the system, while students and teachers can only change the status of a bike assigned to them.

When a bike is marked as stolen, the assigned teacher and student receive a notification via email and text. The teacher, student, mechanics, and admins are all informed through an alert on the alerts page.

Our system uses TypeScript-based ReactJS for the web page proper. Data communications are received and processed using Amazon Web Services (AWS). The Harness CI/CD software delivery service keeps our system updated.



ēVOLUTiO



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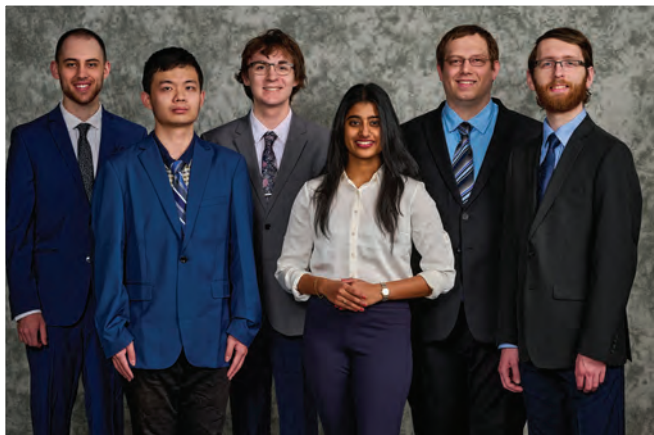
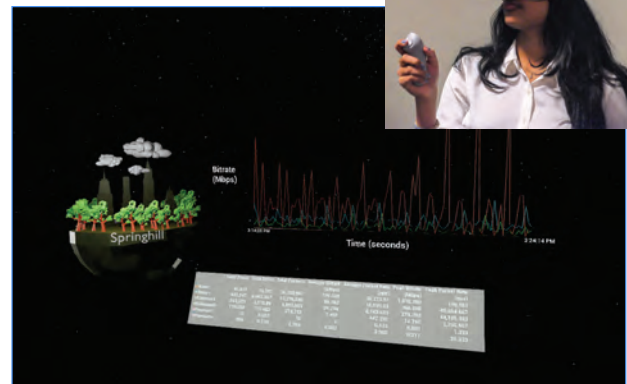
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MySQL is used for packet information storage, and Wireshark is used to read the packet capture data file, enabling easy exporting of data into various formats.



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General Motors Application Lifecycle Framework

General Motors is an American automotive manufacturing company headquartered in Detroit, Michigan, and is the top automaker in the United States.

Application distribution is vital at General Motors given the diverse set of engineering and design applications needed during manufacturing. This distribution process is handled in a secure and efficient manner by an Application Lifecycle Framework.

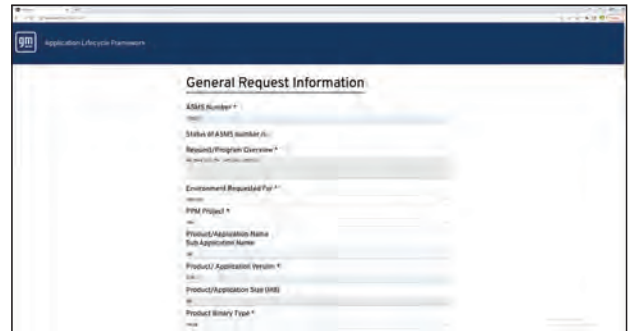
Unfortunately, General Motors' current application distribution solution is expiring, which necessitates the move to a new solution. The new solution replicates the functionality of the old application but also improves upon the existing process.

Our Application Lifecycle Framework facilitates easy request-submission for applications as well as providing a central hub for status information. It gives administrators, engineers, and testers fine-grained control during the distribution process.

When an employee needs an application on a company device for a work-related task, they submit a request to start the approval process. After submission, an administrator approves or denies the request before assigning a priority as well as an engineer for the next step. Finally, the engineer coordinates with cross-testers and distributors to complete the process. To keep all stakeholders updated, each stage of the process generates a notification.

Our web application features an easy-to-navigate user interface for non-technical personnel as well as an intuitive email notification system to keep users updated at every step of the process. This increases transparency and clarity, reducing internal errors.

For the front end, our application uses Angular, HTML, and CSS. Our system uses a MariaDB server running on Ubuntu for the back end. To communicate between the back end and front end, our application uses Tomcat with Spring Boot to serve HTTP endpoints.

A screenshot of a web application interface showing a table titled "User Requests". The table lists various product requests with columns for Product Name, Version, Date, Request ID, ASMS, Platform, and Status. Each row has a corresponding "Request" button.

Product Name	Version	Date	Request ID	ASMS	Platform	Status
Git	3.0.0	10/16/2022	1489	50324	linux	Engineering
Winsock	4.2.0	10/16/2022	1489	5334	linux	Cross testing
Visual Studio	6.0.0	01/12/2019	1479	40325	ubuntu	Certification
Excel	42.0.88	03/12/2020	3078	93324	macintosh	Admin Review
Microsoft Word	3.1.1	05/16/2021	3045	12345	macintosh	Certification
Auto CAD	33.0.5	10/14/2021	1470	23489	ubuntu	Engineering
Adobe Photoshop	5.1.0	12/04/2020	2134	62345	macintosh	Admin Review
Proman	4.0.0	11/1/2018	3153	23750	ubuntu	Cross testing
Adobe Acrobat	10.2.3	8/1/2019	2713	34534	linux	Engineering
Chrome	75.0.3	10/10/2019	1962	48231	macintosh	Certification



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Kellogg's GHG Scope 3 Automation

Kellogg's is a Fortune 500 company that operates both domestically and in over 180 international markets. They are most famous for their cereal and snack brands, such as Cheez-It®, Pop-Tarts®, Froot Loops® and Frosted Flakes®.

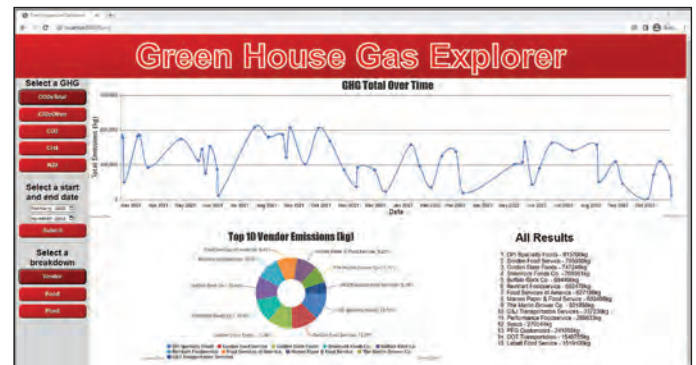
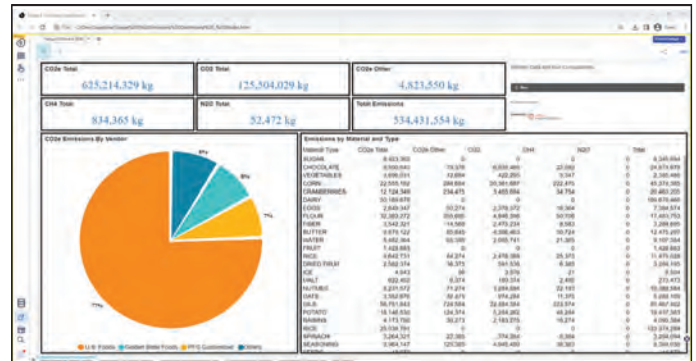
Kellogg's is committed to people and their well-being through their Better Days Promise initiative. Kellogg's plans to reduce 45% of scope 1 and 2 greenhouse gas (GHG) emissions and 15% of scope 3 emissions by 2030. Scope 3 emissions are value chain emissions that include processing of sold products, business travel, waste generated in operations, end-of-life treatment of sold products, etc.

To accomplish their emissions reduction goals, Kellogg's uses an external agency for which GHG scope 3 data must be collected and analyzed manually due to their complexity. Automating the calculation and creation of easily understood visuals reduces labor costs and reliance on external assessors.

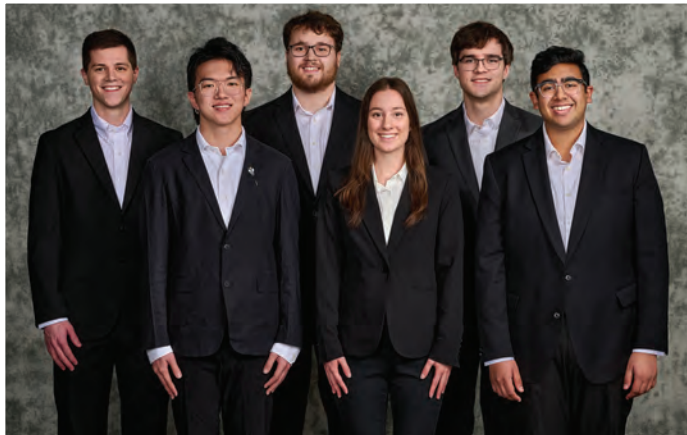
Our GHG Scope 3 Automation tool presents relevant GHG emissions data in the form of charts and graphs in a visually intuitive dashboard accessible by Kellogg's employees. Kellogg's employees directly interact with the dashboard to view and analyze the effects of different food products, factories, and vendors. In addition to the dashboard, the GHG Scope 3 Automation website provides users insight on process metrics such as kilograms of greenhouse gas emissions, what ingredients are causing the emissions, and the gases that comprise the emissions.

Our tool helps Kellogg's automate a process, leading to significant savings in both time and money.

The GHG automation process takes place in the Celonis machine learning workbench. A Python script runs within the Jupyter Notebook to perform calculations and store them. The Flask back end of our website connects to a SQL database with the calculated data. Our JavaScript front end visualizes all of the data.



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Lockheed Martin Space SmartSat™ Software Development Kit & AI Platform

Lockheed Martin Space is a division of Lockheed Martin headquartered in Littleton, Colorado that employs over 16,000 people to build satellite systems and spacecraft.

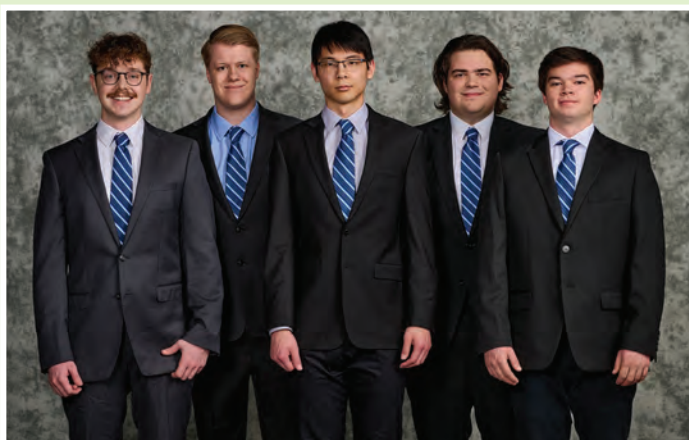
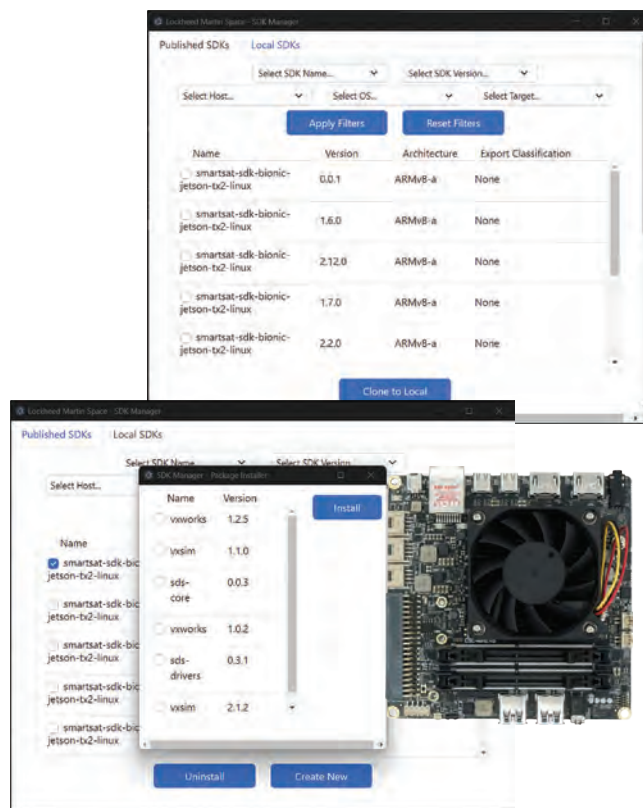
Satellite operation is being fundamentally reshaped by SmartSat™, a software-defined satellite architecture developed by Lockheed Martin Space that enables the reprogramming of satellites while in orbit. SmartSat™ also facilitates the use of artificial intelligence onboard satellites to analyze and make decisions from collected data, such as overhead imagery and spacecraft telemetry.

Software development for SmartSat™ is done via software development kits (SDKs) provided by Lockheed Martin Space. Each SDK is a collection of several different development tools that interact with each other. As the variety of hardware supported by SmartSat™ grows, managing the rising number of SDKs becomes cumbersome.

Our SmartSat™ Software Development Kit Manager provides a straightforward way to view, install, modify and publish SDKs for SmartSat™.

The application displays relevant available SDKs based on the development system and target satellite, as well as currently installed SDKs, in a separate table. Users select an SDK listing to inspect the contents of an SDK or manage its installation status. System administrators publish new, either built from scratch or updated from an existing version, SDKs for download.

Our system's main component is a command-line utility written in Python Flask that communicates with a MySQL server to store and retrieve SDKs. The front end is a desktop application powered by Electron and written in JavaScript. Onboard an AMD V1000 series APU, inferencing is powered by ONNX Runtime using AMD ROCm for hardware acceleration.



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Magna Dashboard for Data Visualization

Magna International Inc. is a worldwide automotive supplier headquartered in Canada, with their U.S. headquarters in Troy, Michigan. They have been ranked in the Fortune Global 500 for 20 years straight. Magna is the largest automotive parts manufacturer in Canada, and 4th largest in the world.

One of Magna's goals is reducing last-mile delivery-related emissions in large cities. To this end, they are piloting a program that operates an all-electric fleet of autonomous delivery robots.

Each bot generates countless data points that provide insight into delivery efficiency. Through trip data, Magna can efficiently track fleet performance and make any adjustments that will improve the efficiency of their autonomous delivery fleet.

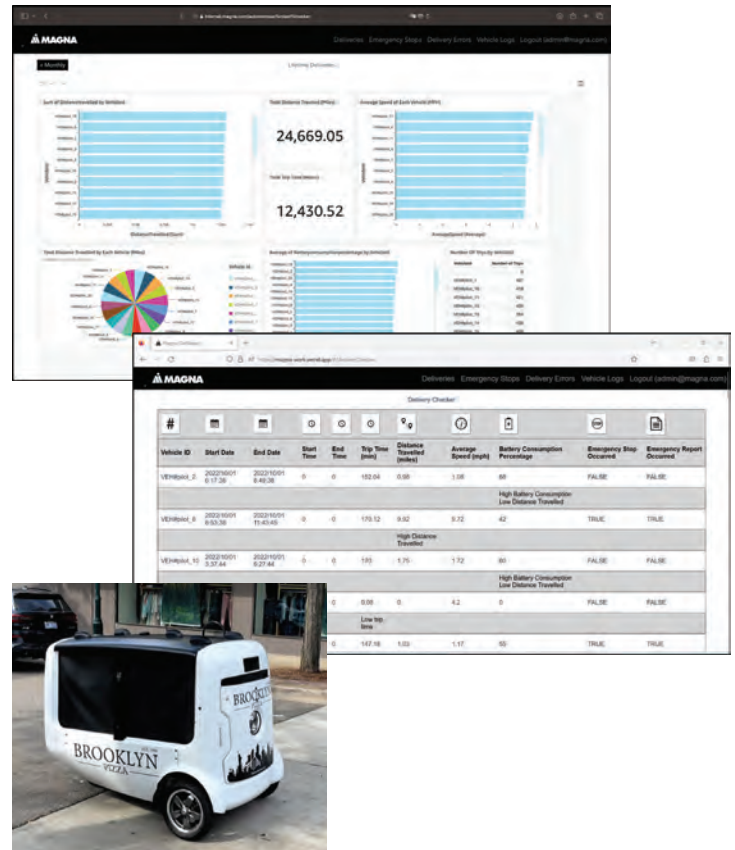
Our Dashboard for Data Visualization provides a web app for Magna employees to track autonomous delivery data in real time.

Graphs and charts are a vital asset for being able to visualize the information from trips. Within these graphs, employees see various metrics such as battery consumption, distance traveled, trip time, average speed, emergency stop information and more.

All visualizations are updated dynamically as new data is added with respect to the database, providing Magna employees with up-to-date information for analysis of the fleet's performance.

Using our tool, Magna ensures they are reducing emissions while still providing flawless service to their employees and customers.

Magna stores data in an Amazon Web Service (AWS) storage solution. The data is cleaned with custom AWS Lambdas and delivered to Amazon DynamoDB and then QuickSight. The visualizations created in QuickSight are rendered to Magna's internal LMDD website using the Vue.js framework.



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Meijer Organization Efficiencies Utilizing WiFi Locationing

Meijer is an all-in-one retailer with over 265 locations throughout six midwestern states. Meijer is constantly increasing the efficiency and flow of their stores to improve their offerings and services, and in turn improve customer satisfaction.

One of these systems is Mobile Shop & Scan, available to all Meijer mPerks customers. Shop & Scan enables shopping in-store with the customer's phone as they place products in the physical cart. Customers may scan items to add them to the mobile cart, clip coupons and promotions, and see the immediate offering value in the Meijer Mobile application.

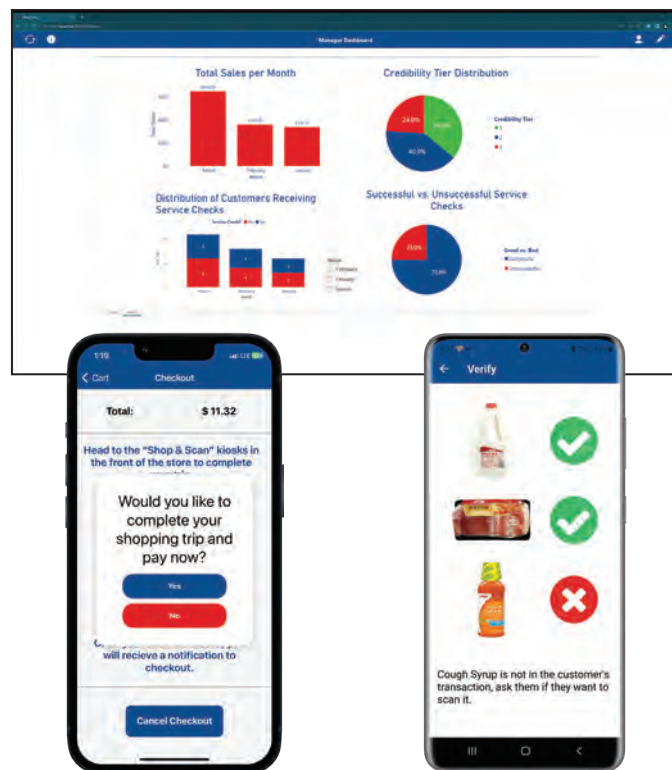
Our Organization Efficiencies Utilizing WiFi Locationing tool expands the scope of the Shop & Scan process to decrease the checkout time for shoppers. Meijer Mobile shoppers have the option to pay entirely on their mobile device without checking out traditionally.

Our software provides a dashboard that shows the manager of a Meijer location a heat map of where customers in the store are physically located, along with different metrics that can be used to make informed decisions about each employee's assignment.

Our system makes use of MIST wireless access points located throughout a store that connect to user smartphones to triangulate their location accurately. We pull live data from these access points to make predictions of customer location, as well as locations of customers who might need assistance.

If a customer requires assistance, a Meijer attendant uses our dashboard to locate the customer and perform a Service Check to help the customer quickly resolve any issues they are having.

The consumer mobile app and employee mobile app are built using React Native, while the web app is powered by ReactJS with a Microsoft Power BI dashboard. Each application uses data from an underlying Microsoft SQL database.



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Michigan State University Improved Peer Review in CourseLib

The Michigan State University Department of Computer Science and Engineering leads several state-of-the-art graduate and undergraduate programs for more than 1,700 students. The department is committed to providing a high-quality educational experience to all of its students.

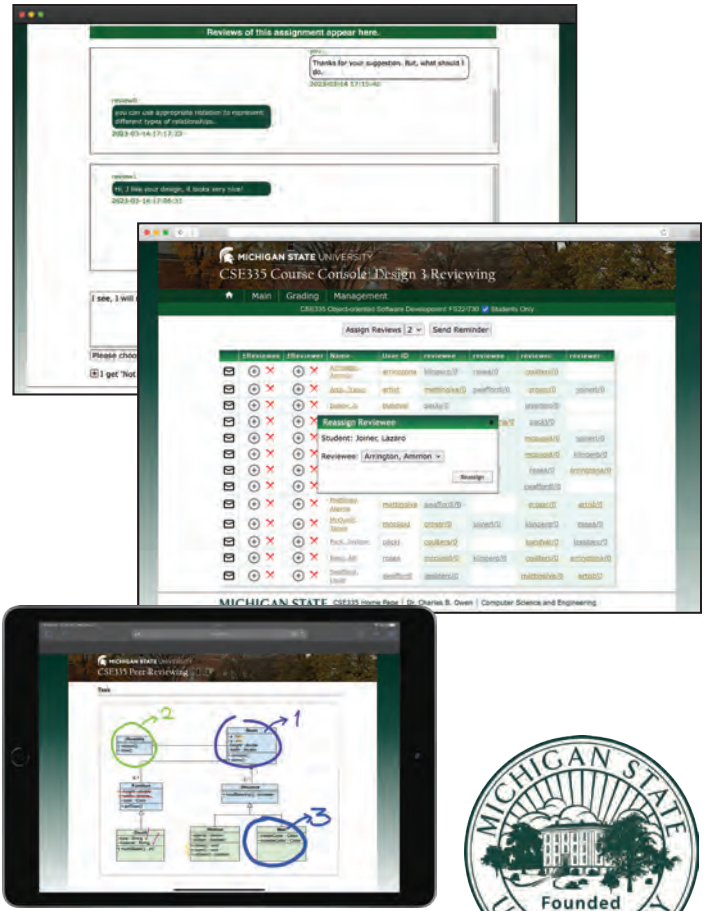
The Department of Computer Science and Engineering keeps up with growing interest by maintaining a high level of adaptability. This is achieved via CourseLib, a system of components used to create course websites. CourseLib facilitates learning through detail-oriented instruction and hands-on activities.

CourseLib's peer review system enables students to improve upon industry-valuable skills such as giving informative critiques of someone else's work, accepting feedback from others, and turning feedback into impactful improvements. The peer review system within CourseLib, while effective, has areas for improvement.

Our improvements to the CourseLib peer review system make it easier than ever for students to receive feedback on their work. Reviewers and reviewees can now have a real-time dialog with one another, making crucial communication easier than ever before.

The feedback process is enhanced through the addition of submission image annotation, allowing users to know exactly where they can make improvements. The new submission association feature makes clear which submission is being discussed. The email notification system is redesigned to effectively provide notifications in all circumstances. Instructors can now reassign individual reviewer-reviewee pairings. Finally, instructors are now notified when students submit and have not been assigned a peer review assignment.

CourseLib uses a JavaScript front end using Vue for a responsive interface and webpack for bundling. CourseLib's back end is built using PHP and SQL.



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Michigan State University Build-an-App for Humanities Researchers

The Michigan State University Linguistics Department formed the MI Diaries team in 2020 in response to the COVID-19 pandemic. Using the MI Diaries app, the team collects and analyzes audio data to understand how people's lives and language change over time.

The MI Diaries app is an audio recording app that collects audio remotely to use in research studies. This app provides a user-friendly interface that can be used by people of all ages and technical abilities. The app collects audio data, stores it in a database, and provides basic statistics for participants.

The MI Diaries team wishes to expand the reach of their app and allow researchers from across the world to utilize its audio recording capabilities. These researchers often do not have the tools necessary to collect audio data and want to focus on their study objectives instead of the technical details of building an app.

Our Build-an-App for Humanities Researchers provides an easy way to customize the MI Diaries base app without having to touch a line of code. Researchers with minimal technical experience can produce a feature-complete and fully customized long-form audio recording app that is ready to use in their studies.

The App-Builder supports full customization of the colors, logos, and fonts, while also supporting gamification stat screens. The app can be configured to allow sign-up in-app or through an external form. While the main functionality of the app remains the same, users can create a uniquely styled app for their research.

Our solution provides an easy way for researchers to create applications tailor-made for their data collection, saving time and resources over building from scratch.

The main MI Diaries app is built using Flutter to provide a cross-platform app and can be connected to any back-end server.

The front end of our App-Builder is built using Angular 15, while the back end is implemented using Python Flask.



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Moi AI

Image Similarity System

Moi AI is a multinational MSU-born startup founded in 2019 in Troy, Michigan and Chennai, India. Moii provides real-time alerts and video feed analysis using state-of-the-art artificial intelligence technologies to increase ergonomic flow and improve home security.

Object detection requires artificial intelligence that is trained for detecting specific objects of interest. Moii currently has a system that is able to very accurately detect a limited number of objects. To expand the usability of this system, Moii is focusing on a robust system to detect many more objects at the same time.

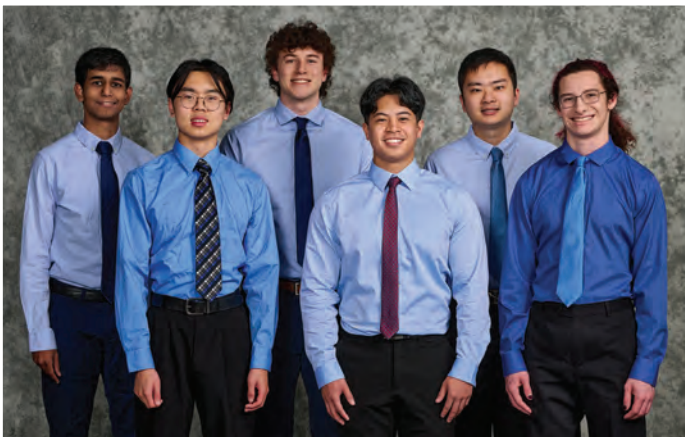
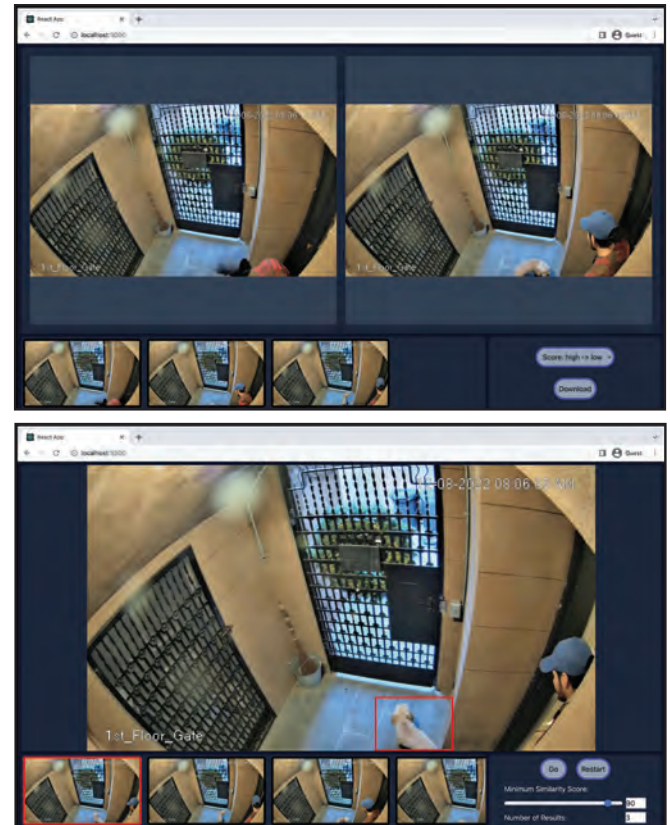
Our Image Similarity System makes searching for any type of object within Moii's expansive image database possible. A large problem is collecting enough images of a particular object to be able to detect the object reliably.

To this end, users start by uploading images and drawing boxes around the object of interest. Our software then uses machine learning to scan through hours of video footage to find images of similar objects, to provide more examples and, in turn, improve Moii's object recognition.

New images of an object are displayed on a separate page along with the original images and a score indicating how similar the found object is to the object of interest.

Using our system, Moii can quickly determine if a person or object appears in their footage with high accuracy and low cost. Using this software, Moii can more accurately inform their clients about their business and create a more secure environment.

Our system uses Google Cloud Storage to handle transfer of images, Firebase Realtime Database to sync between our front end built on React and the back end, and Google Cloud Platform to host our model. Based off a proprietary machine learning model from Moii, our PyTorch model is trained for deep template matching.



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MSU Federal Credit Union Predictive Chatbot Experience

Established in 1937, MSU Federal Credit Union (MSUFCU) has been serving Michigan State University and the greater Lansing area for over 86 years. With over 20 branch locations statewide, 335,000 members worldwide, and managing nearly \$7 billion in assets, MSUFCU strives to help its local communities thrive and achieve financial freedom.

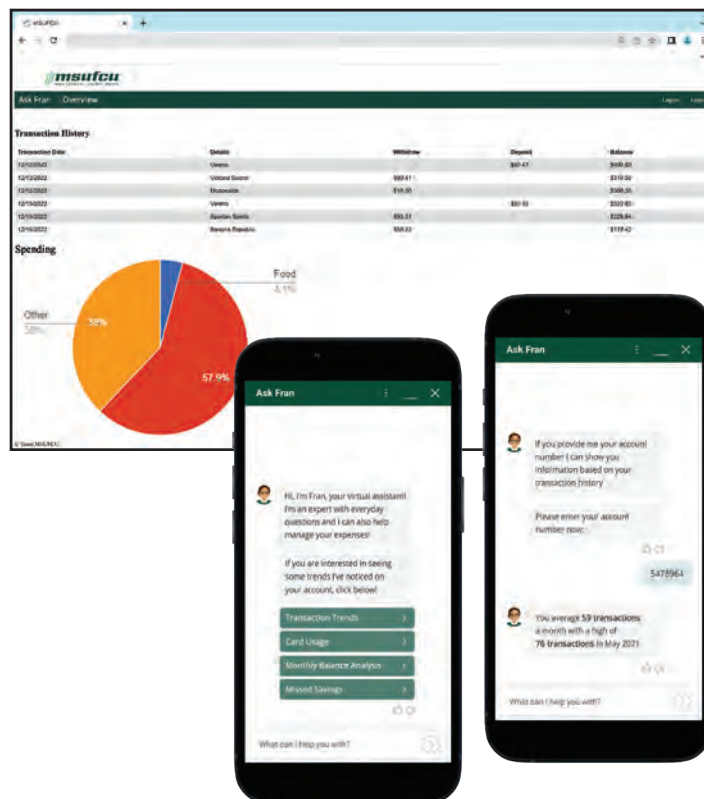
MSUFCU offers a robust digital banking experience for members to check their balances, transfer funds, and manage all aspects of their accounts virtually. Providing exceptional banking tools is something MSUFCU already does, but they are now focusing on tools to assist members with their finances.

Our Predictive Chatbot Experience turns Fran, the MSUFCU chatbot, into a more informative and useful tool for members. Fran analyzes members' history and provides supportive financial assistance. Looking at users' accounts, our version of Fran can identify low points in their accounts, suggest when to pay bills to avoid overdraft fees, and schedule recurring bills.

For example, if a member regularly pays a bill on the 10th and Fran recognizes that the balance is low on that day, she instead suggests the member wait to pay the bill until after their payday on the 13th.

Members also can set spending goals and track them over the month, as well as request a breakdown by category of the spending in a month.

Our application is web-based and written in HTML with JavaScript and CSS. It connects to Boost.AI's chat panel and a remotely hosted MySQL database. The chatbot's logic is done in Boost.AI's low code management platform is used to train the artificial intelligence.



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Roosevelt Innovations Provider Analysis Toolkit

Roosevelt Innovations, LLC is the first technology solution to deliver a simple, seamless, and smart platform for health insurance companies. With industry-leading claims processing capabilities, Roosevelt has transformed operations, enabling a total treatment cost savings of \$972 million. Additionally, Roosevelt has more than 22 million users on its platform and an industry-leading auto-adjudication rate of 95%.

When processing many insurance claims, there is a large amount of data generated. Data that is anomalous for any reason is cause for further investigation.

Our Provider Analysis Toolkit gives data analysts of Roosevelt Innovations a streamlined, efficient, and verbose view of the data that comes from processing claims. Users can view real-time data, exchange their thoughts with other analysts on specific data, and share reports with other analysts.

Our solution identifies statistical anomalies within the data that can help them further investigate the causes for these anomalies. Data is filtered for the analysts so that the most anomalous data is easily accessible to them in a simple, quick, and efficient manner, requiring no further mathematical calculations on the analysts' end.

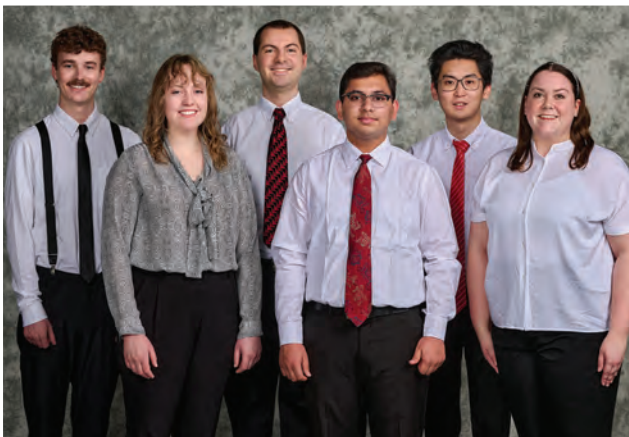
Data visualizations are also provided. Whether the data is represented in tables or charts, everything is laid out in a way that is streamlined and easily digestible.

Our solution automatically flags anomalous data and provides a suite of tools for further analysis, increasing productivity of analysts.

The web application is written in Python with utilization of the Streamlit library for the front-end framework, as well as FastAPI are used for construction of the web application's APIs. The anomaly detection machine learning models were developed using the PyTorch framework and scikit-learn library, while the data is stored within a Snowflake database.



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Roosevelt Innovations Model-Driven UI Framework

Roosevelt Innovations, headquartered in Okemos, Michigan, is a software solutions company owned by Delta Dental of Michigan. Its software solutions include customizable data services, customer portals, billing services, and industry-leading claims auto-adjudication. Roosevelt Innovations extends its services to several insurance companies across the country. Altogether, Roosevelt Innovations has over 22 million users on its platforms.

At Roosevelt Innovations, many different user interfaces are developed for insurance companies and their customers. Each new user interface is developed from scratch. This process can be very time-consuming, often requiring hours of effort from developers.

Our Model-Driven UI Framework streamlines the process of designing and building a website, creating dynamic and complex user interfaces with ease.

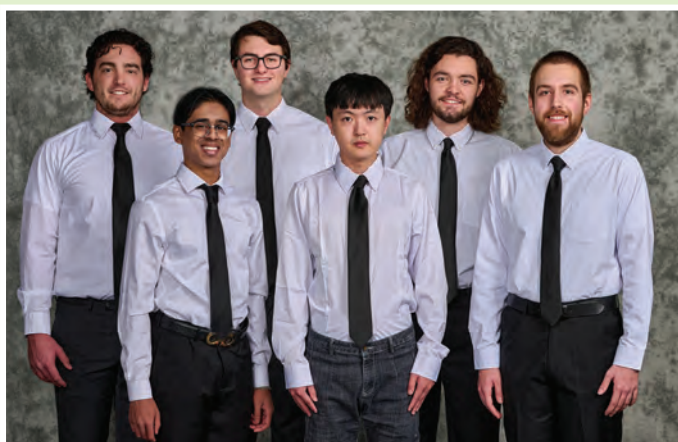
Our framework documents strategies and formats for creating the skeleton of a form. Once that skeleton is created, it is read by the web application and the form is displayed on the screen. Users can interact with this form and populate the data fields. Upon completing the form, users click on the submit button, at which point the entered data is validated and saved.

In addition to quicker build times, the developers can use the framework to easily create complex forms. The framework contains guidelines for validating user-entered data as well as a structure for creating fields that appear conditionally, making it very versatile. The same system can be used to create many highly customized forms specific to each customer's needs.

The framework expands upon JSON with custom keywords allowing for additional validation and manipulation of elements. The front end is built using Angular reactive forms to dynamically draw form elements on the webpage. The back end uses Quarkus to process objects and requests from the front end.



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RPM

Building Shipments using Machine Learning

RPM is an international logistics corporation which specializes in end-to-end transportation of freight and automobiles. On a monthly basis, RPM's carriers deliver 50,000 automobiles and 15,000 freight shipments. The company's headquarters are in Royal Oak, Michigan, and Amsterdam, Netherlands.

The logistics involved in the automotive industry are complex and shipments need to fit to customer specifications while adhering to carrier restrictions. Curating shipments using machine learning takes every specification into consideration.

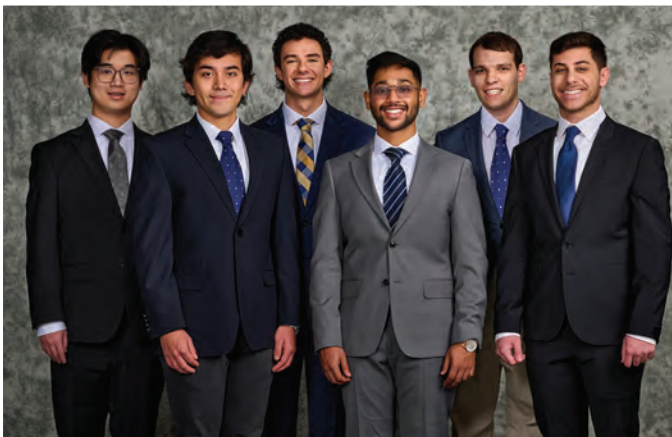
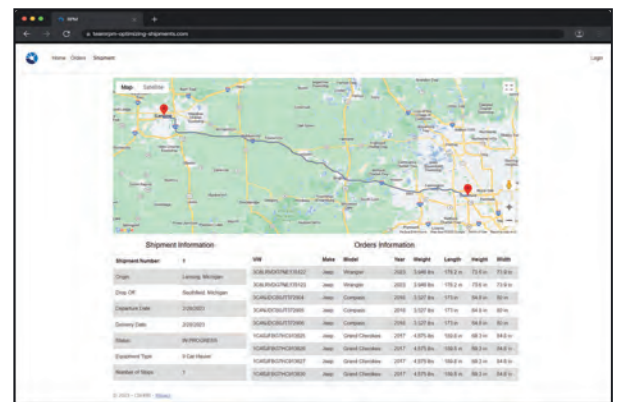
Our Building Shipments using Machine Learning web application organizes shipping orders based on features and pick-up/drop-off locations to create shipment schedules with the fewest possible stops. It also suggests the best carrier for such shipments to optimize the shipping process.

New orders are input by RPM through CSV or manual data entry, finally being verified by the user to ensure the shipping information is correct.

The process considers the VIN for each individual vehicle, make, model, and all the different vehicle specifications to organize orders and create optimized shipments. An optimized shipment has the least amount of stops and shortest route while also keeping trucks full. This improves the utilization of shipments and improves delivery time.

Our software uses various methods for creating shipments and suggesting carrier vehicle types that users can compare to select what fits their needs the best. We also provide tools for users to analyze and make necessary changes to their shipments.

Our system is built on .NET for front end development and Microsoft Azure for back-end tools and databases. Python's scikit-learn library is used to develop machine learning models to optimize shipments through clustering.



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Targets' Tip Documenting Academic Harassment

Targets' Tip is a startup based in Okemos, Michigan, founded by an assistant professor at Michigan State University, Dr. Morteza Mahmoudi. The company's primary objective is to foster a safe academic environment for targets experiencing academic harassment. Targets' Tip offers support for targets of academic harassment by providing resources for them to report incidents and receive the help they need.

The fight against academic harassment has two major challenges: the absence of proper documentation surrounding incidents, and a tendency for cases to be forgotten or dismissed.

Our application, Documenting Academic Harassment, provides a user-friendly platform for secure documentation of academic harassment incidents to make sure that no case goes unnoticed.

Users of this application have a place to store their experiences and evidence where they do not go unrecorded and undocumented. Users can specify the date, location, and category of specific harassment incidents. The application generates a personal portfolio where the user can review and edit their reports. Both time series and pictorial visualizations of their history automatically update for the user to view a cohesive summary of their experiences.

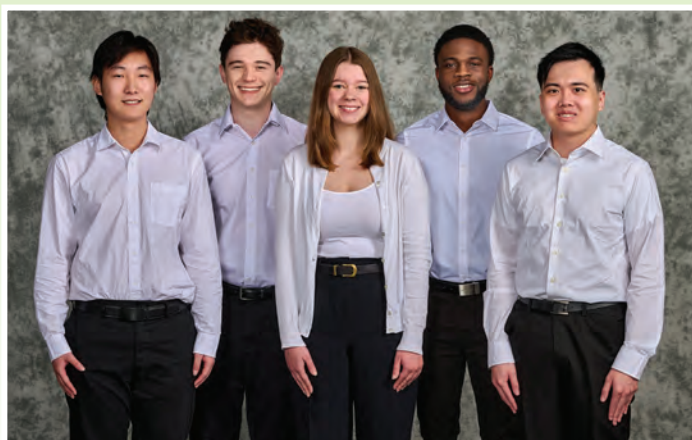
Data collected from this application from its users is utilized to create an overview of cases from every university in the world. Incident occurrences are displayed in a heatmap visualization that filters by country, state, region, type of harassment, and department. Administrators can analyze and export the data in the heatmap to identify problems within institutions globally.

Through our application, users can have the peace of mind that their experiences are well documented and safe.

The front end of our Targets' Tip application is built using Dart and Flutter, while the data, storage and authentication is handled with Firebase.



Targets' Tip
Make Academia Safe for Everyone



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TechSmith

CAVE: Collaborative Audio/Video Editor

TechSmith's mission is to empower people to communicate and share knowledge using media capture and editing software. Based in East Lansing, Michigan, TechSmith's products are used by 73 million users worldwide and by every Fortune 500 company.

Collaborating with a team to create content can be challenging. Doing so often results in an individual coordinating the efforts of multiple team members or organizations, restricting the creative workflow that is essential to digital media creation. This disjointed process of indirect collaboration limits users to working sequentially and prevents all voices from being included.

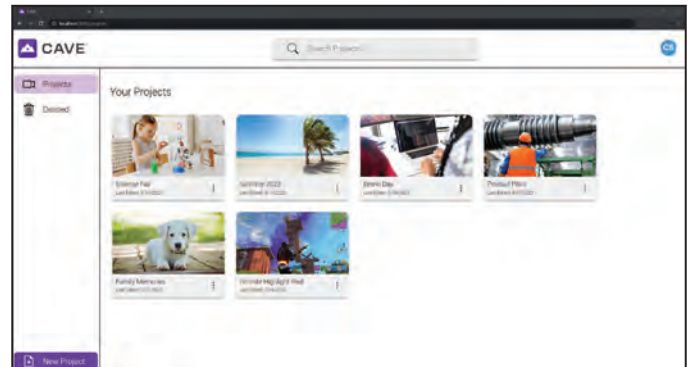
Our CAVE: Collaborative Audio/Video Editor web application streamlines collaboration on media projects by enabling users to edit synchronously.

Users upload video, image, and audio files and arrange them with an intuitive timeline UI. Editors then preview the edited video at any time, and when completed, the final video can be downloaded for distribution across various platforms.

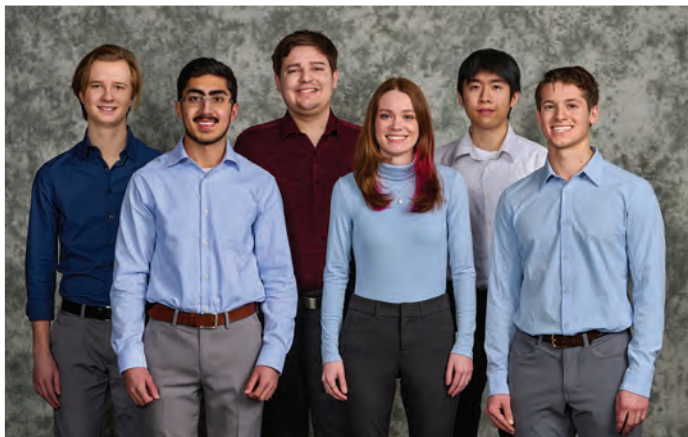
All media projects and their associated media are stored securely in the cloud where users can invite others to collaborate. Collaborators log in securely and can begin working on their project independently or together in real time.

Users need not worry about others overwriting their changes as the application ensures synchronization of contributions. By enabling team members to collaborate seamlessly, the final product better highlights the contributions of individuals and reflects a shared voice.

Our web application is built on JavaScript and ReactJS. FFmpeg runs on the client side to process media previews and the final exported project. Edits from simultaneous users are kept in sync with WebSockets. The back end is built using Node.js and is hosted on Microsoft Azure.



TechSmith®



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Union Pacific Switch Alignment Mobile Game

Union Pacific is one of the largest railroad companies in the United States, which has over 32,000 miles of track in 23 states in the west. The company primarily transports agricultural, industrial and customer products.

Misaligned switches can cause problems, such as damage to equipment, delays in train schedules and derailments. With the goal of being the safest, most reliable and most efficient railroad in North America, it is important to train newly hired field employees in a safe space with sufficient practice.

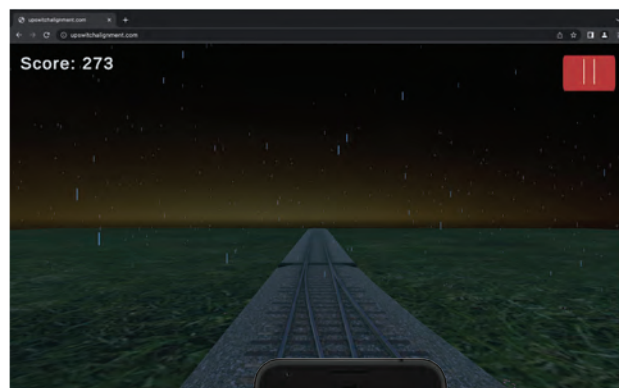
Our Switch Alignment Mobile Game teaches players to learn to identify differently aligned switches from the first-person view of a train on the railroad. The game is an infinite-runner game, with dynamically changing time and random weather conditions, such as sun, rain, and snow.

To access the gameplay, tutorial, leaderboard, and settings, the players must use their Union Pacific employee IDs. During gameplay, a train runs on an infinite random path populated by railroad tracks, and the player must identify switches correctly. Switches may be left-aligned, right-aligned, or misaligned. As gameplay progresses, new challenges are introduced, such as changing time of day and weather conditions reducing visibility.

The tutorial shows the rules of the game, as well as the leaderboard, which shows the rankings of the player's scores based on their performance. Additionally, the players can adjust the volume and other preferences in the settings menu.

Our software offers a realistic simulation for players to learn and practice switch alignment. With our software, Union Pacific can train new employees safely and practically.

Our software is developed with Unity3D and scripted with C#. The back end for the software is Oracle database, which is connected to front end through REST API.



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United Airlines

Airline Passenger and Baggage Application

United Airlines is the third largest airline in the world, flying to and from over 340 destinations worldwide with a fleet of over 900 aircraft. They employ over 80,000 people, with well over 28,000 personnel working in passenger service. Due to this, nothing is more important to United Airlines than safety.

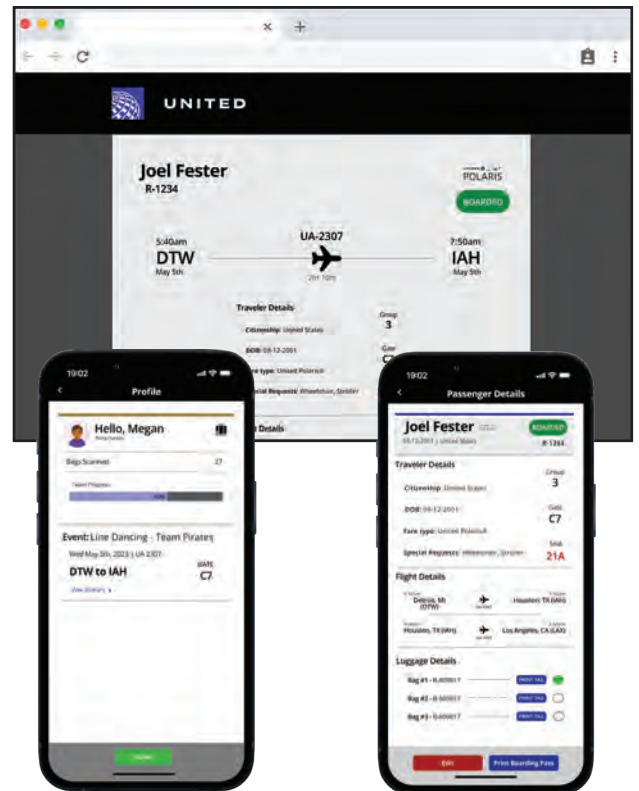
United Airlines holds Safety Rodeo events to train their staff in safety, efficiency, and accuracy in a friendly and realistic training environment. These rodeos require dozens of fake passengers and a significant amount of effort to accurately simulate standard airport operations, making it difficult for United Airlines employees to hold these vital rodeos.

Our Airline Passenger and Baggage Application tackles these issues by simulating the tools that are currently used by Customer Service Representatives and Ramp Service Employees within intuitive web and phone applications.

Our Airline Passenger and Baggage Application enables the creation of randomized passengers and bags to aid Customer Service Representatives and Ramp Service Employees in their training.

Our system employs support for phone camera and physical scanner readings of embedded QR codes on baggage tags and boarding passes to connect with our database of passengers and associated bags. Ramp and Customer Service employees have the option of checking in the associated passenger or bag. Realistic passenger and bag data errors are integrated seamlessly into the data to test the employee's attention to detail.

The front end of our application was created with the Flutter framework and Dart language to facilitate ease of cross-platform development. The back end of our application works with an Amazon Web Services Elastic Cloud Computing instance hosting our MongoDB database and our API endpoints.



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United Airlines Aircraft Appearance Assessment Tool

United Airlines is a major U.S. airline headquartered in Chicago, Illinois. Since its founding in 1926, it has grown to be the third largest airline in the world, with routes both across the U.S. and to all inhabited continents. Due to its size, history, and ubiquity, it is a staple of the U.S. skies.

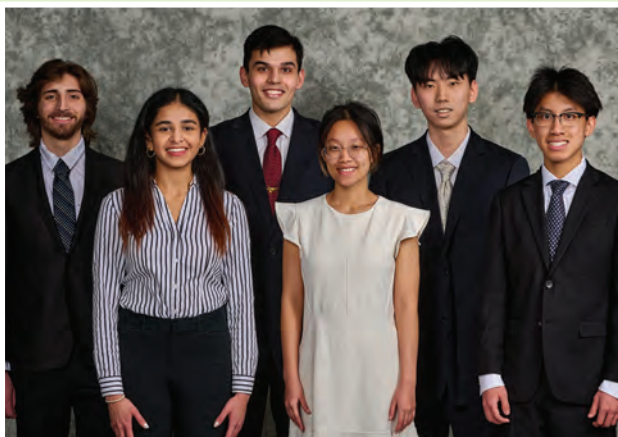
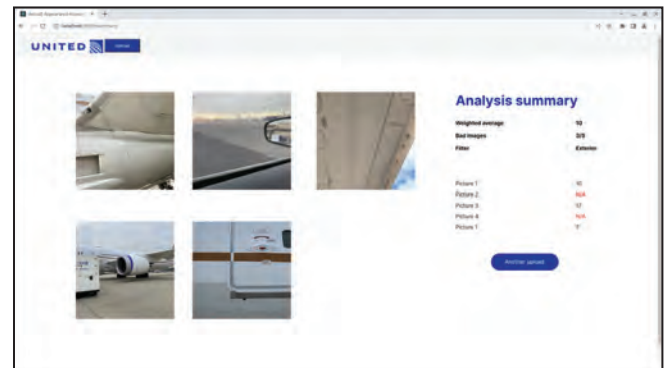
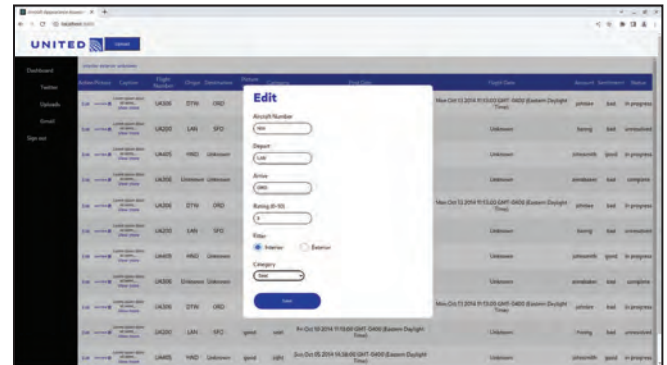
Innovating and growing as a major airline means to constantly strive for an increasingly high level of quality across a very large fleet. This requires being able to quickly identify issues so that they may be addressed promptly. However, the aforementioned fleet size makes efficient problem discovery a requisite for prompt action. As United Airlines strives to further its goals towards an ever better response, recognizing issues stands as the current bottleneck to address.

Our Aircraft Appearance Assessment Tool enables this focused and swift response by bringing problems to those who can solve them quickly within an easy-to-use web application.

Our tool uses image recognition to scan photos for actionable issues inside and outside the plane. Images are retrieved through employees manually uploading them, through emails sent to United Airlines, or through social media posts from passengers. Issues are automatically found, analyzed, and categorized from these images so engineers may fix problems as soon as they are found.

Additional sentiment analysis helps to evaluate feedback from customers obtained via Twitter posts. This sentiment data, in particular, further specifies image urgency automatically.

The web app utilizes an image recognition algorithm trained with a Convolutional Neural Networks model. The algorithm training is implemented in Python, TensorFlow, and Keras. The front end of our web app is built using ReactJS, with a Python Flask back end and MySQL database hosted on iMacs. The machine learning model is connected to the web app with TensorFlow.js.



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United Airlines Adaptive Assessment Generator for Tech Ops Training

Based out of the Willis Tower in Chicago, United Airlines is one of the world's largest airlines with a current fleet size of over 875 aircrafts and plans to acquire 500 more. They currently operate over 4,000 flights per day spanning five continents, 74 different countries and more than 300 airports across the globe.

Maintaining a high level of safety and reliability is critical to United Airlines, and their maintenance staff undergo a series of rigorous training courses taught by United Airlines. However, manually generating assessments is a time-consuming and challenging task for instructors. To ensure that their technicians receive the best training possible, United Airlines places a strong emphasis on providing the right training platform.

Our Adaptive Assessment Generator for Tech Ops Training offers a highly interactive and collaborative platform for delivering and teaching a wide range of training topics. Designed to cater to both students and instructors, the system offers two perspectives that provide a comprehensive learning experience.

Students can browse through corresponding course materials, gaining a comprehensive understanding of various maintenance topics. Once they feel confident in their knowledge, students take quizzes to test their comprehension.

Alternatively, instructors can generate questions using our machine learning model, which creates questions that test students' understanding of the course materials. Instructors have full control over the training process, with the ability to manage students, material, and assessments through our web application. Instructors can also track individual student progress, as well as the overall milestones of the group.

Our application utilizes ReactJS for the front end, Python and Django for the back end, and Firebase for storage. The machine learning model is built using Python.



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Urban Science OfficeBuddy

Urban Science, headquartered in Detroit, Michigan, is a consulting firm that supports every global OEM and numerous major automotive companies by providing them with service in the most efficient and effective way to increase the company's profitability and market share.

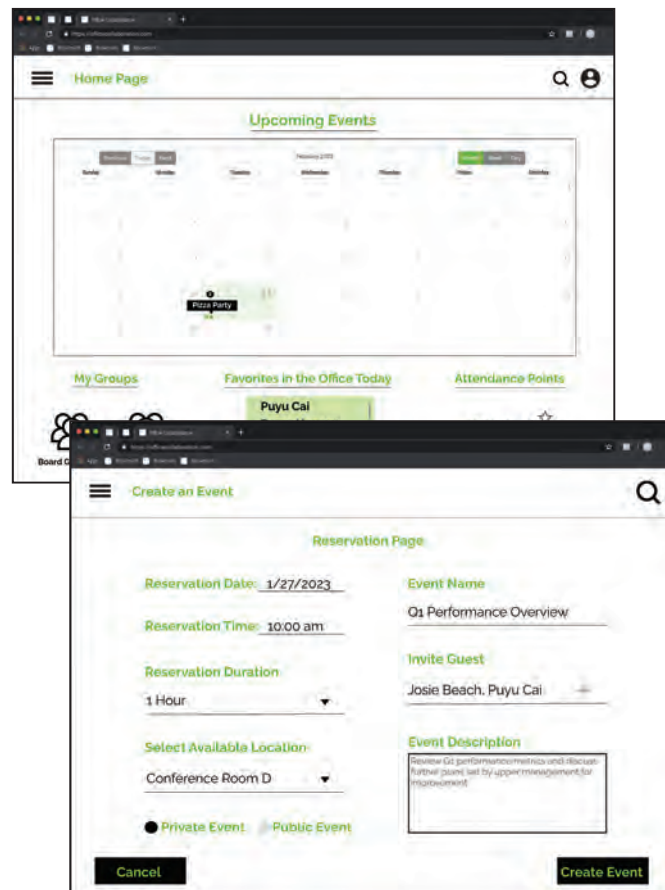
Since COVID-19 hit in early 2020, employees that work in the office have realized how convenient working remotely from home can be. However, this has caused a significant decline in socializing amongst coworkers. Urban Science conducted a study that discovered upwards of 80% of employees would be more encouraged to return to the office if they could socialize with their coworkers and rebuild bonds with their team members.

Our OfficeBuddy web application assists office workers in their transition back to in-person work by creating a convenient and robust social environment within the workplace.

OfficeBuddy enables users to select their seat before they come to the office, allowing them to sit by their friends. Users can add coworkers to their favorites list and track what days their favorite coworkers are going into the office.

Users can create public or private events that can be used for official meetings or fun events with coworkers. Users can also create groups with other users that can then be used to invite an entire group of people to attend a private or public event. Users are rewarded based on attendance, encouraging employees to utilize the office in a new and unique way.

OfficeBuddy gives employees the chance to regain the relationships within the office that might've been hurt by the COVID-19 pandemic. The OfficeBuddy application is composed of an Angular front end that utilizes HTML, CSS, and TypeScript, a .Net Core Web API, and an Azure SQL database.



URBAN SCIENCE.



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Vectorform, LLC

Flexible VR Training

Vectorform, LLC is a cutting-edge technology company committed to accelerating change and solving society's most complex problems. Headquartered in Troy, Michigan, with four global offices and over 100 employees in design, engineering, and product development services, Vectorform is dedicated to creating the newest, most innovative technologies.

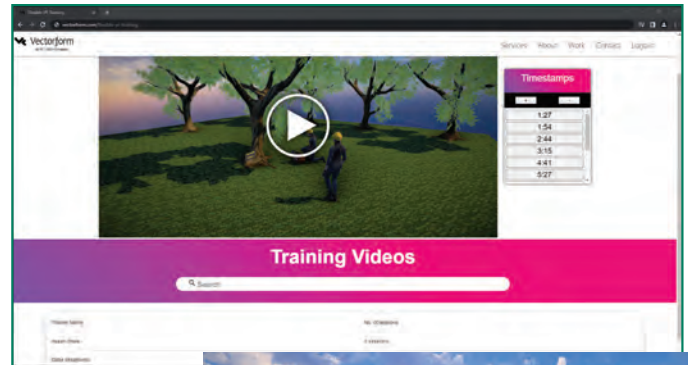
Certain careers require dangerous, time-consuming, and costly workplace training, such as law enforcement, firefighting, and construction. Traditional training methods compromise the safety of the trainee while attempting to replicate real-life situations. We have a solution: immersive technologies.

Our Flexible VR Training system provides trainees with a fully digital workspace environment that replicates life-like scenarios they will face on the job. The instruction is customizable based on company preferences, and the application supports two different training methods: a real-time human trainer and a human-like AI trainer. The AI trainer learns and adapts from live training sessions. Company officials can view recorded training sessions through our web application.

Our web application provides access to recordings of previous training sessions and information about each. Employers can set timestamps during these recordings as reference points for training evaluation.

Overall, the Flexible VR Training system is a cost-effective and safe way to train employees while providing realistic training scenarios.

The VR application is incorporated through Unity and a Meta Quest Pro VR headset. The back end is implemented with Node.js and a Microsoft Azure SQL database/mobile server. The web application uses Angular and WebGL, while the AI trainer utilizes an OpenAI API.



Vectorform

an NTT DATA Company



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Vectra

Predicting Malware Command and Control Channels

Vectra is a cybersecurity company that provides artificial intelligence-driven threat detection and response that is capable of defending against threats that bypass traditional security tools. Serving customers across the globe, Vectra redefines the standard of what it means for a network to be secure.

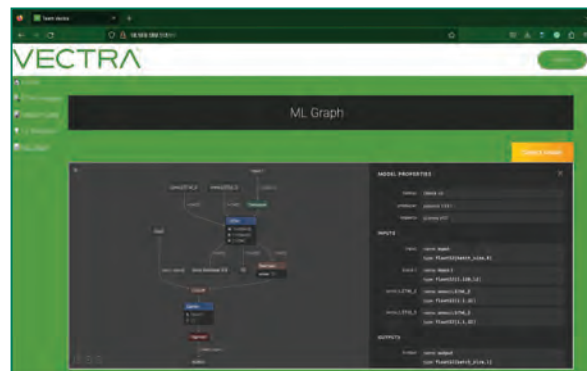
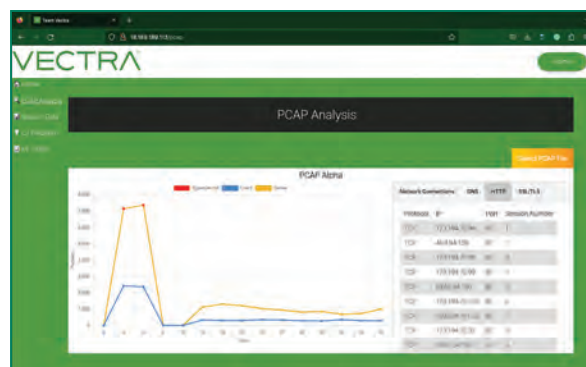
Traditional intrusion detection systems use an extensive list of previously recorded attacks known as signatures. These signature-based detection systems work well when met with known attack techniques, but when met with novel attack techniques, they fail to recognize them as threats.

Our Predicting Malware Command and Control Channels system is centered around combining signature-based intrusion detection and artificial intelligence-based intrusion detection, creating a singular robust system that draws from the strengths of both.

Our machine learning models detect command and control channels. Command and control is a technique that malicious actors use to communicate with an infected machine and send instructions for it to perform. A common factor behind many types of attacks, the presence of a command and control channel is a reliable way of detecting system compromise.

Using our web application, users gain a better understanding of the performance of our models by comparing where the signature-based system alone detects threats versus where our system detects threats. Visual representations of how our models are structured are also included to show the flow of a prediction. These tools make it easier to detect command and control channels, improving security.

Our machine learning models are built in Python using PyTorch, scikit-learn and LightGBM. Suricata is our signature-based intrusion detection system. Flask, JavaScript, and an SQLite database power the web application.



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Whirlpool Corporation

SmartCook: Smart App for Induction Cooktop Cooking

Whirlpool Corporation is based out of Benton Harbor, Michigan and is one of the world's best known home appliance manufacturers. They are a Fortune 500 company with approximately \$20 billion in annual sales and 54 manufacturing and technology research centers across the globe.

Recently, Whirlpool has been focusing on introducing more smart appliances for the kitchen to assist chefs of all backgrounds.

One of these appliances is the Assist Cooking with Temperature (ACT) Cooktop. This is a smart induction cooktop that assists in the automation of the cooking process with its precise temperature control and smart recipes alongside a mobile app called SmartCook.

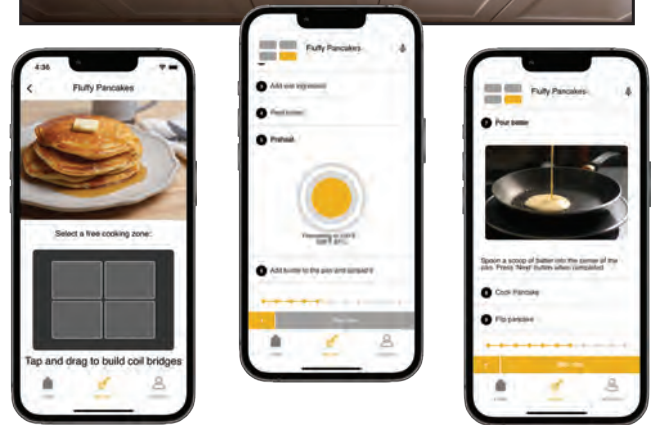
Our SmartCook application improves the quality of the user's cooking experience through automation features such as pan recognition and auto-recipe progression.

As the user cooks, the application controls the pan's temperature and autonomously progresses through a chosen recipe based on predictions of recipe progress. This minimizes the time users spend on their phone leaving more time for cooking their meal.

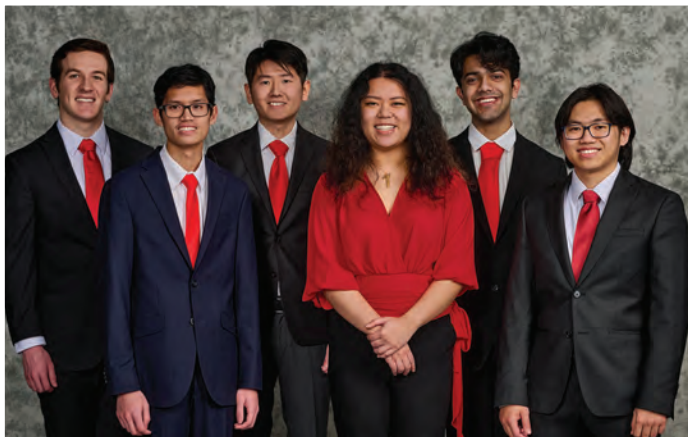
While cooking, the user is guided through each instruction, which is displayed on their iPhone or Android device. During each step of a recipe, the ACT Cooktop gathers data from the sensors on its surface. Our machine learning algorithms analyze the cooking data to determine when a step has been completed, after which the app instructs the user what to do next.

Our application helps Whirlpool achieve their vision of making cooking easy and accessible to everyone. Our app simplifies the overall cooking process and makes it less stressful for everybody from amateur to professional chefs.

The back end of our SmartCook app uses a Firebase server to store recipe data and employs scikit-learn for machine learning. The front end is created using the cross-platform SDK called Flutter.



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Design Day Award Winning Teams

Fall 2022



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Team Amazon



MSU Federal Credit Union Praxis Award
Team Lockheed Martin Space



TechSmith Screencast Award
Team Ally



Urban Science Sigma Award
Team Whirlpool

Spring 2023



Auto-Owners Exposition Award
Team Michigan State University Linguistics



MSU Federal Credit Union Praxis Award
Team Moii



TechSmith Screencast Award
Team Whirlpool



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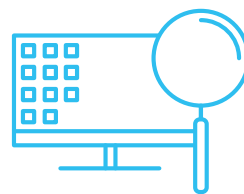
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ranked in the
Fortune 500 every
year since **2002**



90% of our associates
say their work
atmosphere is great



our IT division has
750+ associates in
45+ departments



we employ over
480 Spartan grads
companywide



**For more information about
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