

The Capstone Experience



From Students...to Professionals

COMPUTER SCIENCE AND ENGINEERING 2023-2024



MICHIGAN STATE
UNIVERSITY

Auto-Owners
INSURANCE



The Capstone Experience

CSE 498, Collaborative Design



Dr. Wayne Dyksen
Professor of Computer Science and Engineering

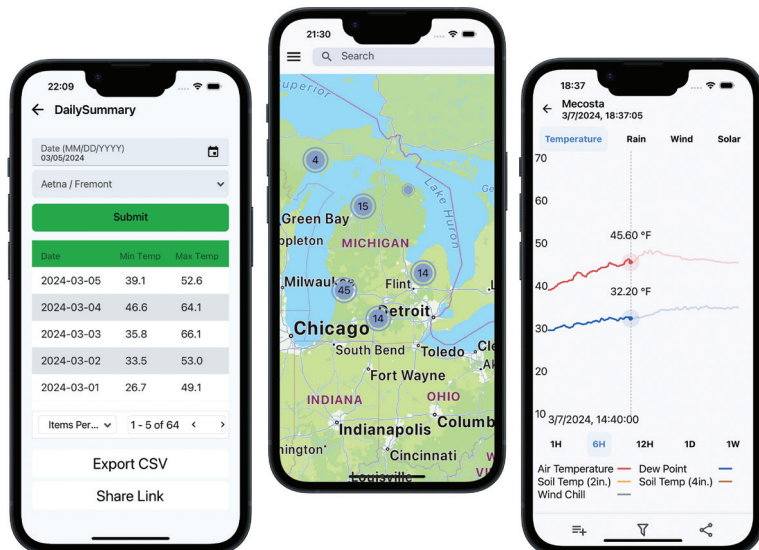
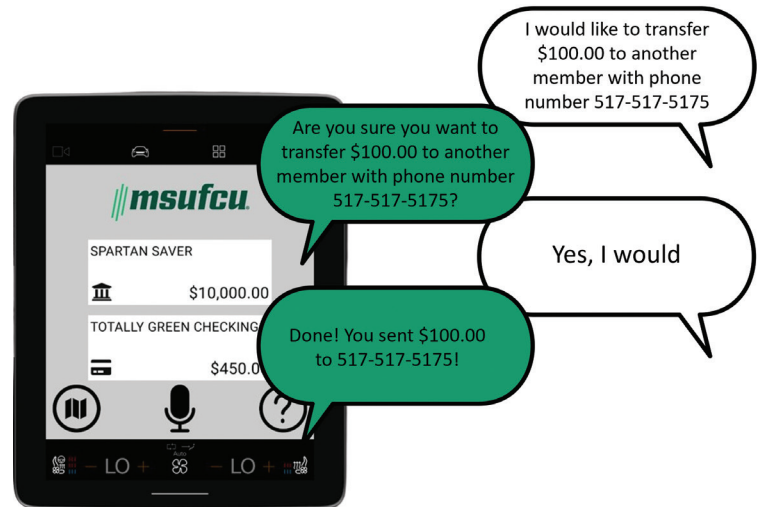


James Mariani
Professor of Instruction

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, Bosch, Dow Chemical, Eloktrorit, Evolutio, General Motors, Google, HAP, Kellanova, Kohl's, Lockheed Martin Space, Meijer, Microsoft, MillerKnoll, Mozilla, MSU Federal Credit Union, RPM, Stryker, Roosevelt Innovations, TechSmith, United Airlines, Union Pacific, Urban Science, UWM, Vectra AI, Volkswagen, Whirlpool, and WK Kellogg.

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Ally Financial Money Moves: Ally Financial Education Platform

Headquartered in Detroit, Michigan, Ally Financial is one of the top 25 financial holding companies in the United States and is a leader in digital financial services. Ally provides financial products for consumers, businesses, automotive dealers, and corporate clients in their commitment to continuously meet and exceed the needs of their clients by constantly changing and evolving the methods they use to help.

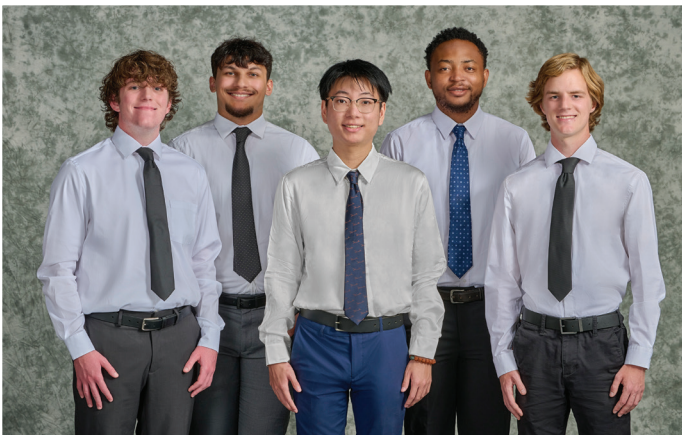
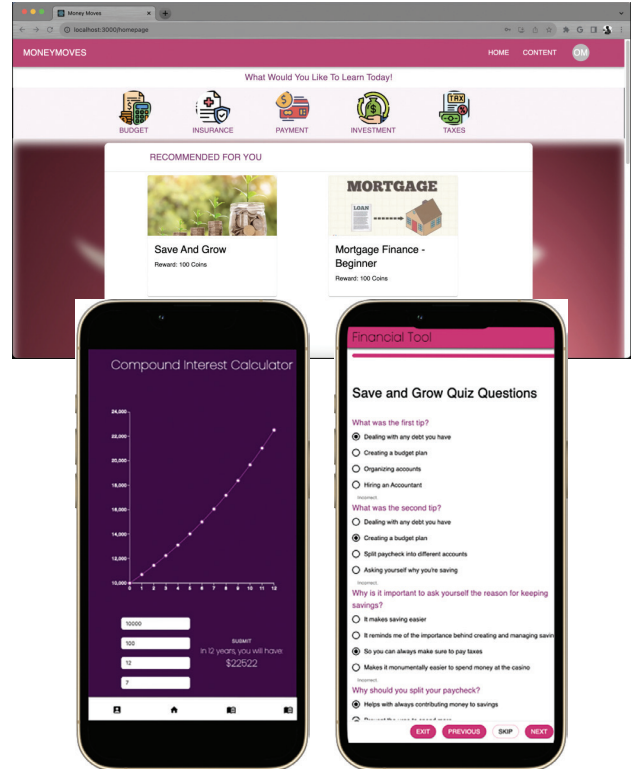
To achieve this goal, Ally looks to not only assist their clients in improving their finances, but also to improve their financial knowledge. Assisting customers and businesses with their financial situations can be complicated, as occasionally a customer is not well versed on a particular aspect of finance.

Our Money Moves application teaches customers about the various financial topics and services Ally provides, which ensures that they feel more confident with their finances afterward. This, in turn, saves money for the customer and improves Ally's image.

Money Moves supports profile creation tailored to a customer's interests and experiences, which our software uses to recommend various courses. Users select a course and are taken through content consisting of text, images, and videos. Each medium educates the customer on a current topic. Upon completion, users are quizzed and rewarded with coins based on their performance. With these coins, users can progress through levels. As users level up, they are recommended more difficult courses and unlock specialized financial tools such as interest and loan calculators.

Our software educates customers on many financial topics, saving them money and improving Ally's brand image.

Our application is written in HTML, CSS, and JavaScript, and utilizes the React framework. The application interacts with Express, Docker, and MySQL to gather and store user data, and utilizes Amazon Web Services for infrastructure.



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Amazon Email Improvement Tool

Amazon, founded by Jeff Bezos in 1994, is the world's largest online retailer, operating in over 50 countries around the world. The multinational technology company focuses on e-commerce, cloud computing and digital streaming. Amazon insists on the highest standards and focuses on earning their customers' trust.

As a part of maintaining these qualities, Amazon oversees thousands of emails that are sent daily to sellers worldwide. This task can be time consuming and complex when managing thousands of Amazon teams and millions of lines of code.

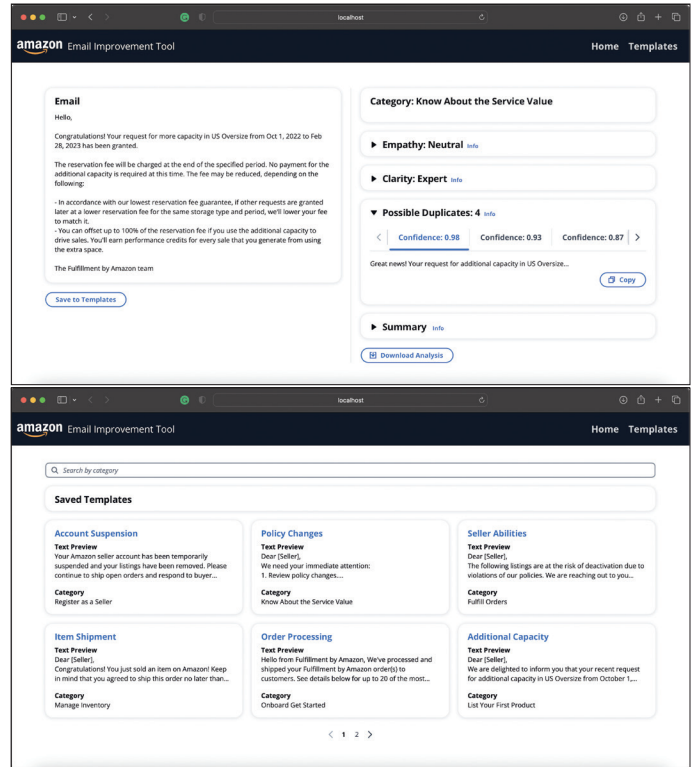
Our Email Improvement Tool is a web application that utilizes machine learning to analyze and provide feedback on uploaded emails. The analysis page of our application, shown on the right, enables Amazon content creators to view generated feedback in an easy and efficient manner. Topics of analysis include empathy, clarity, categorization, summarization and duplicate detection.

Organized by topic, each tab provides a quick preview of the feedback with a detailed description available under each dropdown. These descriptions consist of suggestions, confidence scores and ratings based off the analysis to be viewed by the user.

The duplicate detection feature provides a faster way for content creators to find similar previously written emails during the writing process. The summarization feature creates a quick overview of email content to make analyzing emails easier than ever.

Our system assists users in writing effective and clear emails, improving communication and efficiency at Amazon.

Our web infrastructure is built with a React framework and Amazon Web Services to create a responsive and scalable environment. We also use AWS Amplify, API Gateway, Lambda, DynamoDB and Simple Storage Service to minimize unnecessary overhead. Amazon SageMaker and Amazon Comprehend are used to provide the machine learning solutions.



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Anthropocene Institute Machine Learning for Optimization of Carbon Removal

The Anthropocene Institute is an organization founded by Carl Page in 2012 and is focused on making the Earth sustainable by knowing and investing in the right technology. They partner with entrepreneurs, investors, governments, nonprofits, and universities to foster science, influence policy, promote clean, sustainable energy, and more.

As climate change has become a more serious issue over time, it has become increasingly beneficial for companies and organizations to invest in lowering their carbon footprint. For example, one fourth of Fortune 500 companies have pledged to be carbon neutral by 2030. Investing in carbon removal technology is hard enough for the world's biggest companies, but smaller organizations often don't have the time or resources to effectively do so.

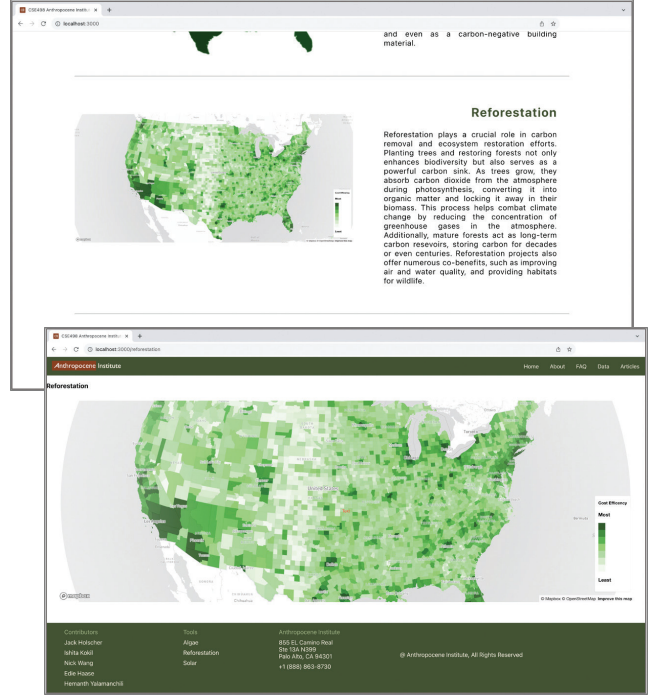
Our Machine Learning for Optimization of Carbon Removal tool is a website used by government agencies, private companies, entrepreneurs, investors, and the public to become informed and to help them make investment decisions.

Our website displays fully interactive and responsive heatmaps for three major carbon capture technologies on their own web pages: kelp farms, reforestation, and direct air capture.

On each page, users are greeted with a heatmap that displays how cost effective it is to implement the specific carbon removal technology for each state and county in the United States.

Users can select other relevant metrics to overlay onto the heatmap, such as the potential number of trees that could be planted in each county. These metrics assist users in selecting the most effective way to maximize carbon removal and minimize costs.

The website is developed as a web application which uses a React framework and utilizes Python machine learning libraries, publicly available data, and the Mapbox JavaScript API to generate the heatmaps.



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Auto-Owners Insurance Help Me See!

Founded in 1916, Auto-Owners Insurance is a Fortune 500 company employing more than 4,700 associates to provide nearly 5.6 million insurance policies across 26 states. Auto-Owners Insurance has been headquartered in Lansing, Michigan for over 100 years.

One of Auto-Owners insurance offerings is home coverage. Making a claim relating to home coverage represents a significant expense for both the company and policyholders. To minimize these claims, Auto-Owners wants a way to provide homeowners with understandable and comprehensive insurance and loss prevention information for common at-risk items.

Our Help Me See! application utilizes the HoloLens 2, an advanced mixed reality headset (shown on the right), and augmented reality to inform homeowners of the insurance information surrounding common household objects.

Users select from two modes, overlay and object detection. In overlay mode, policyholders choose from a variety of common objects, such as refrigerators, toasters, and fire extinguishers. The selected object appears in holographic form in front of the user to be moved and placed within the virtual space. When a user presses the information button on the object, the loss prevention and insurance information appear next to the object.

In object detection mode, the application captures an image to analyze for insured objects that a homeowner has in their home. Detected objects have the same information button seen in the overlay mode. The insurance information can then be displayed for the given object in a similar manner to overlay mode, this time with existing objects.

Help Me See! is built in Unity and written in C#. The object detection mode utilizes Azure AI services to detect and track real world objects.



Auto-Owners
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Bosch Trailer Safety Tool Using Computer Vision

Bosch, founded in 1886 by Robert Bosch in Stuttgart, Germany, is a leading global provider of technology. Bosch employs over 400,000 associates worldwide to produce automotive components, industrial products, and IoT software.

Bosch is a leading developer of vehicular safety technology and software. While some of Bosch's products are dedicated to driving vehicles without trailers, there is also a major need for safety solutions for trailering. If a trailer is not properly hitched to a vehicle, the trailer could detach while on the road, causing an accident. Thus, a trailer must be continually checked if it is still properly hitched to the vehicle to maintain driver safety.

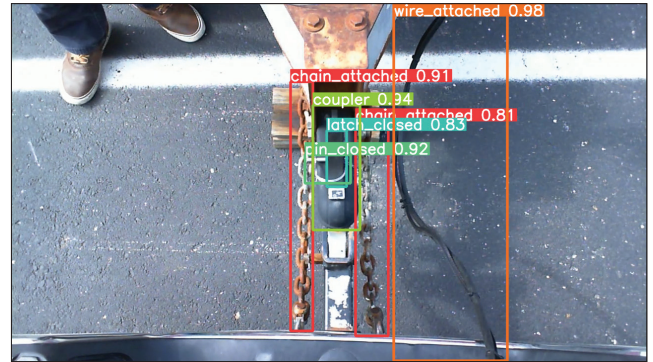
Our Trailering Safety Tool combats this problem by providing users with a clear and simple way to check if their trailer has been connected correctly and that the trailer connection is maintained during a drive.

Our software tool analyzes an image or video and determines if the components of a successful connection are present. All components are presented to the user in a simple application, with boxes surrounding each hitching component for easy identification.

Users can see a checklist of all necessary components for a successful connection, and whether all parts are present in the image or current frame of the video. The dashboard also displays whether the connection is correct or failed.

This application is used by Bosch to clearly determine if a trailer is connected correctly in a quick and intuitive manner. Our software is also used to continuously check the connection during driving. Our tool assists Bosch to further develop and create software to make trailering safer for consumers.

Our Trailering Safety Tool utilizes Python for our front-end interface, PyTorch for our back-end machine learning model, and the entire tool is containerized using Docker.



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DRIVEN-4

DRIVEN-4 Connect Update and Upgrade

DRIVEN-4, based in Saint Joseph, Michigan, specializes in providing strategies and technology solutions for delivering traditional and connected products and services to clients in the areas of Product Lifecycle Management (PLM), connected product development, connected operations, cloud services, and cybersecurity. Currently, DRIVEN-4 leverages PTC’s ThingWorx and Digi’s Remote Manager for remote device management and monitoring.

As they expand, DRIVEN-4 continues to develop their own Internet of Things (IoT) devices with onboard sensors for gathering device data. Hosting and storing data from these IoT devices requires a versatile, yet cost-effective, solution for users to take control of their data.

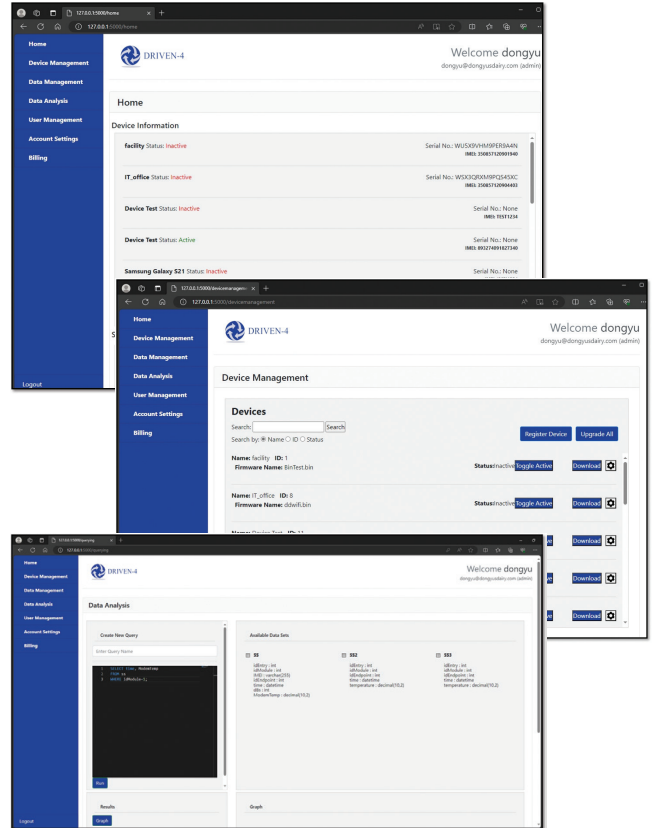
Our DRIVEN-4 Connect Update and Upgrade tool improves DRIVEN-4’s data storage and hosting with a streamlined web application where manufacturers and users can manage devices as well as analyze data transmissions.

Users within an organization manage their IoT devices’ operation over the internet and can visualize their IoT device data quickly and easily using our intuitive web application.

Administrators of an organization are responsible for adding or removing users, tracking user activity, uploading firmware to selected boards, making payments with a credit card, and constructing custom tables for any organization device selected.

Using our software platform, DRIVEN-4 employees, as well as their customers, enjoy improved efficiency and cost when dealing with managing IoT devices.

Our application’s front end uses HTML, CSS, and JavaScript, while the back end is implemented with Flask, MySQL, and SQLAlchemy. An FTP server makes the connection between the MySQL databases and the IoT boards.



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Evolutio Evo Observability Platform

Headquartered in Chicago, Illinois, Evolutio is a software solutions company dedicated to bringing visibility, simplicity, and usability to a client's complex enterprise platforms. They provide the necessary solutions through four specialized practices: observability, security, data science and analytics, and automation.

As applications grow increasingly complex, locating issues becomes more and more difficult. Engineering teams are looking to switch to low-cost alternatives for effective application performance monitoring. Evolutio sees an opportunity to further improve and add to existing observability software.

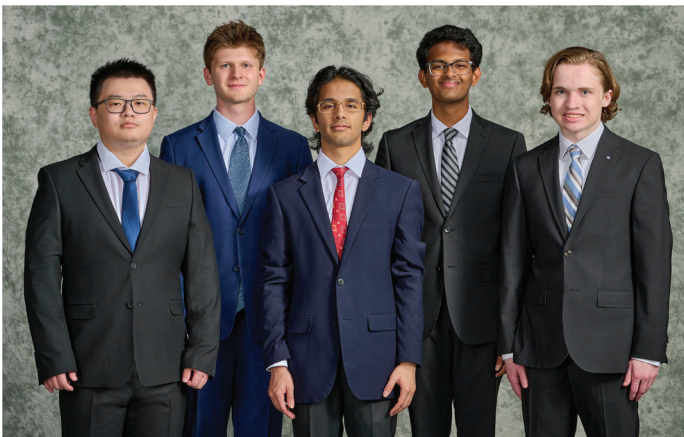
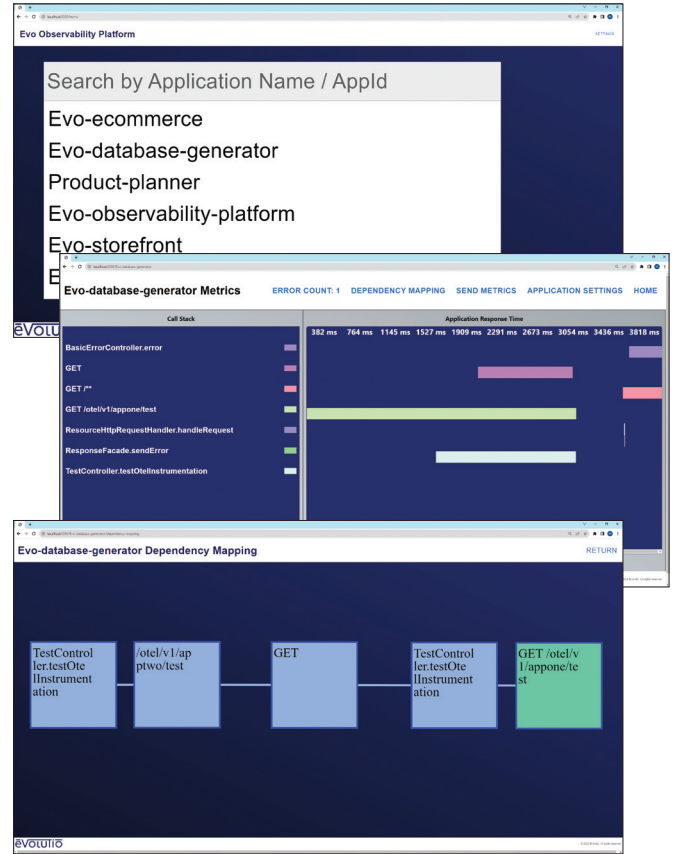
Our Evo Observability Platform is a robust and scalable tool that leverages cost-effective observability tools. Our platform assists developers and system administrators in monitoring the performance of applications in real time and provides extensive visibility into the behavior of each application.

Users can select an application and visualize its performance on our easy-to-read dashboard. The dashboard displays metric information and statistics about the application, such as the average elapsed time for a response and the number of accumulated errors.

Our dashboard offers robust tools, such as an intuitive dependency map to visualize an application's internal flow, an alert notification system that informs users of performance deviations, and a log of application errors to quickly diagnose software issues.

Engineers use our system to improve their efficiency and accuracy while monitoring complex software systems, saving significant time and money.

Our software is built on Python and Flask. Our front end uses ReactJS. The back end uses OpenTelemetry for data collection, Apache Kafka for data streaming, and Apache Druid as the database. We use Kubernetes for containerization, Amazon Web Services for infrastructure hosting, and Harness for continuous integration.



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General Motors Application Lifecycle Framework 2.0

General Motors (GM) is an automotive company based in Detroit, Michigan. They are the largest automotive manufacturer in the United States and one of the largest automotive companies in the world.

As one of the largest automakers, GM produces a lot of software that needs to be reviewed, deployed and managed. This process needs to be tracked, validated and delivered to relevant engineers. Additionally, GM has many engineering standards that must be met during deployment.

Our GM Application Lifecycle Framework 2.0 provides a better system for managing the workflow of application distribution requests within the company.

Application teams submit requests for software distribution through several forms, which dynamically update based on the use scenario. Once a software distribution request has been submitted, our system analyzes the content of the request and customizes the approval process automatically based on the context of the request.

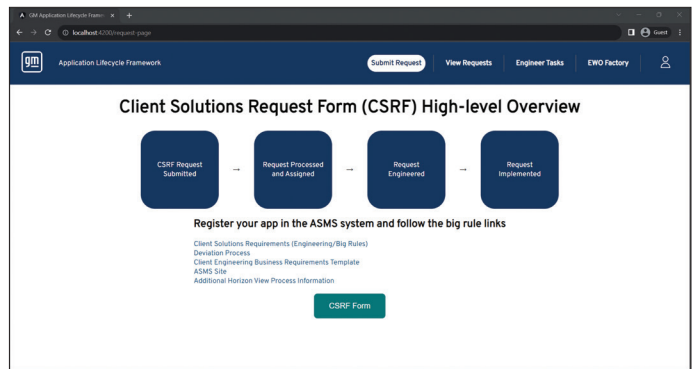
The system automates much of the validation of requests, ensuring correct information is always submitted. This previously lengthy process now seamlessly catches any input errors as soon as they occur.

Administrators can also view site logs to verify that the process is correct and to get a top-down view of the workflow. Information about each request, such as date and status, is easily viewed and managed.

Our software automatically tracks and validates software deployment requests thereby improving productivity, reducing error rate, and saving time.

Our front end is an Angular application. The back end is built with Java Spring Boot running on an Apache Tomcat server. Our database utilizes MariaDB.

ID	EWO	Application Name	CSRF Link	Requirement Review	Engineering	Cross Testing	UAT/IAT	Certification
130		DOORS	106490	requirements review	engineering	cross testing	UAT/IAT	certification
129		Reflection Desktop	106487	requirements review	engineering	cross testing	UAT/IAT	certification
128		Reflection Desktop	106487	requirements review	engineering	cross testing	UAT/IAT	certification
158		Asset Manager	106519	requirements review	engineering	cross testing	UAT/IAT	certification
158		Asset Manager	106519	requirements review	engineering	cross testing	UAT/IAT	certification
144		Reflection Desktop	106504	requirements review	engineering	cross testing	UAT/IAT	certification
143		Reflection Desktop	106504	requirements review	engineering	cross testing	UAT/IAT	certification
135		Asset Manager	106495	requirements review	engineering	cross testing	UAT/IAT	certification



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HAP Leveraging OpenAI for Business Analytics

HAP is a leading not-for-profit health insurance provider headquartered in Detroit, Michigan. Since 1956, HAP has been enhancing the well-being of the communities they serve by offering quality healthcare plans and innovating to meet the ever-evolving needs of their customer base.

In the rapidly changing digital landscape, HAP recognizes the power of artificial intelligence (AI), especially through OpenAI's advancements. Utilizing AI, HAP strives to improve their website's user experience, make information more accessible, refine health plan choices, and gain deeper insights into customer interactions.

Our Leveraging OpenAI for Business Analytics tool is a web application composed of three unique tools to address these goals.

Our chatbot tool enhances the user experience on HAP.org by quickly answering users' questions clearly and efficiently. It provides real-time data based on HAP.org content, making it easier for users to find the information they seek without the need to navigate through multiple web pages.

Next, the plan selector tool provides a personalized approach to the health plan selection process. By analyzing responses from a customer-completed survey, the selector tool matches users to the health plan that most closely aligns with their individual needs.

Lastly, the call summarization tool takes detailed call transcripts, extracts key phrases, and determines a call's purpose. This enables HAP to quickly understand the reason behind calls, helping them continually adapt to meet customer needs.

The front end of the web application was created using the ReactJS framework along with HTML and CSS. The back end leverages DynamoDB and S3 for data storage, LangChain for information processing, and Python Flask, all of which interact with OpenAI. The application is containerized with Docker and hosted on Google Cloud.

Date	Call Subject	Keywords	Transcript File
2023-10-06	Coverage	Medication, Coverage, Migraines	transcript31.txt
2023-10-13	Provider	Mental health, Psychologist, In-network	transcript35.txt
2023-10-10	Billing	Billing, Coverage, Lab tests	transcript22.txt
2023-10-10	Medical bill	Surgery, Billed services, Elective procedures	transcript77.txt
2023-10-23	Billing	Colonoscopy, Billing, Payment options	transcript47.txt
2023-10-04	Medication	Cost increase, Prescription drug, Medication	transcript48.txt
2023-10-12	Billing	Medical bill, Charges, Payment options	transcript36.txt
2023-			

Call Subject Trends for October

Your Virtual Assistant

choose your healthcare providers. With a PPO, you have the flexibility to see any doctor or specialist without a referral, both in-network and out-of-network. However, you will typically pay less out-of-pocket if you choose a healthcare provider within the PPO network. PPOs also offer coverage for prescription drugs and may have additional benefits such as dental and vision coverage.

What plans does HAP offer?

HAP offers a wide range of plans including individual and family plans, group plans for small and large businesses, self-funded plans, Medicare solutions for those 65 and older, and Medicaid plans for those with a limited income or who live with a disability.

Q1: What is your current age?
A: 65 or older

Q2: Are you currently enrolled in Original Medicare (Part A and Part B)?
A: No

Q3: Do you have any specific healthcare needs or chronic conditions?
A: Not right now

Q4: Are you currently taking any prescription medications? If so, what are they?
A: No medications

Q5: What is your preferred maximum monthly premium for a Medicare plan?
A: \$50 - \$100



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Kellanova Global Business Services Process Intelligence

With iconic, world-class brands, Kellanova is a leading company in global snacking, international cereal and noodles, plant-based foods and North American frozen breakfast. Launched in late 2023, Kellanova is building on the strong brand equity and legacy created over the previous 117 years as the Kellogg Company.

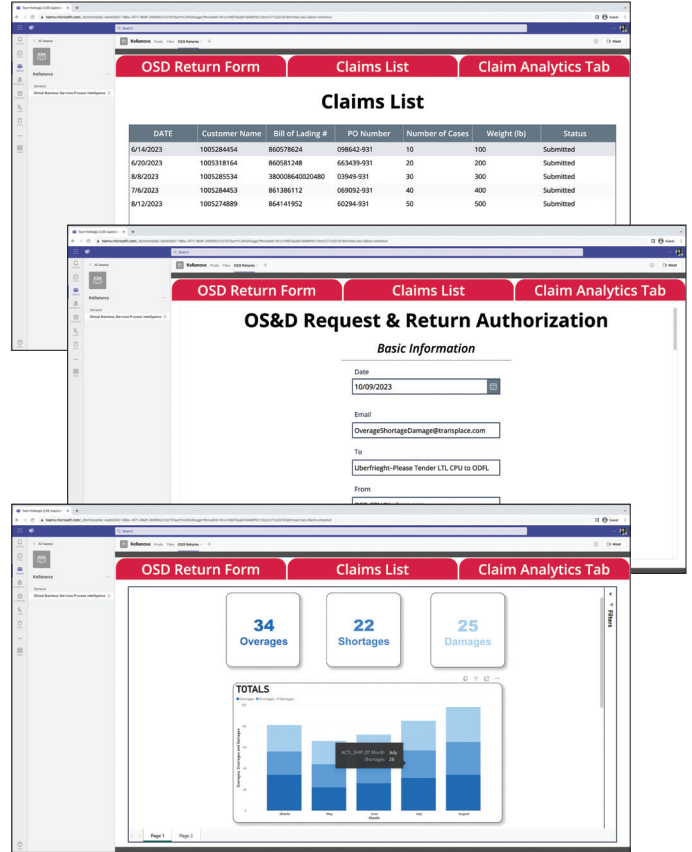
Kellanova's Global Business Services plays a pivotal role in the company's operations, streamlining processes through automation and improving overall performance. Their current process relies on manual data entry via Excel for handling customer returns, overages, shortages and damages (OSD). Kellanova recognizes the need to modernize these operations to enhance the customer experience and internal efficiency.

Our Global Business Services Process Intelligence application provides a comprehensive solution to address the existing challenges in customer returns processing at Kellanova.

Our application is an innovative tool that empowers internal Kellanova employees and claims processors to report and track OSD incidents effectively, ensuring swift resolution and improved supply chain efficiency. Processors can submit OSD claim forms, view all submitted claims in an organized fashion and interact with a dashboard to view statistics and visualizations of claim data, all in one central location.

Our software ensures the delivery of the highest quality products and service to Kellanova's customers while providing an environment where employees are equipped with the tools they need to succeed.

The front end of the OSD claim process uses Microsoft Teams as an integrated application developed through Microsoft Power Apps. The Power App connects to Amazon's Relational Database Service which hosts our SQL tables that contain the claims data.



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The Capstone Experience

Kohl's Infinity Gauntlet

With over 1,100 brick and mortar stores and locations in every US state save for Hawaii, Kohl's stands as a leader in retail. In addition to their physical locations, Kohl's has invested heavily into the online world, where they are highly vertically integrated, running much of their development in house.

Kohl's developers are constantly creating new applications for the company, both consumer-facing products such as apps or promotions and business-oriented tools for other teams within Kohl's.

As Kohl's has expanded their digital capabilities, their usage of cloud service providers to host their online offerings has increased. With the plethora of hosting options available such as Google Cloud Platform or Amazon Web Services, learning the ins and outs of each can be a challenge.

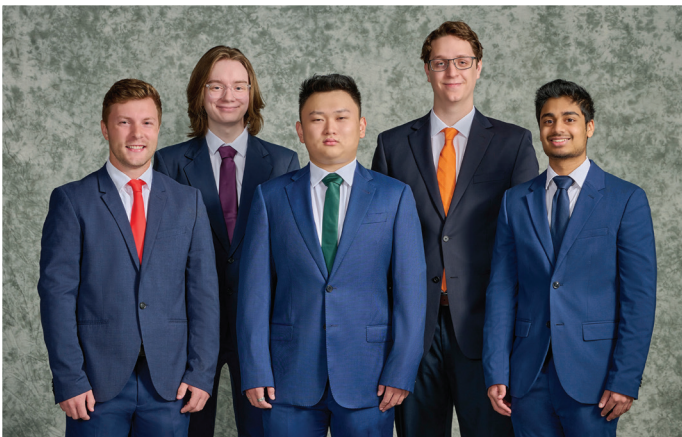
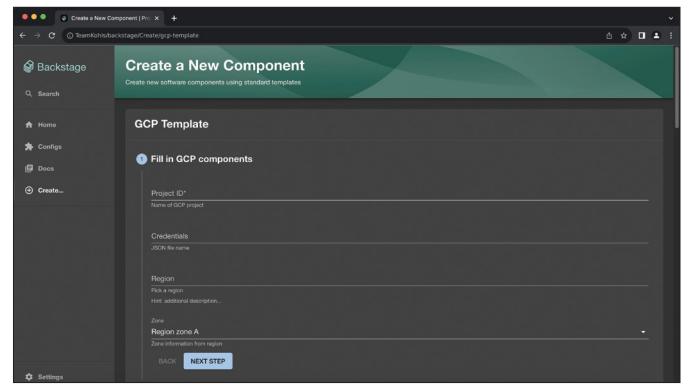
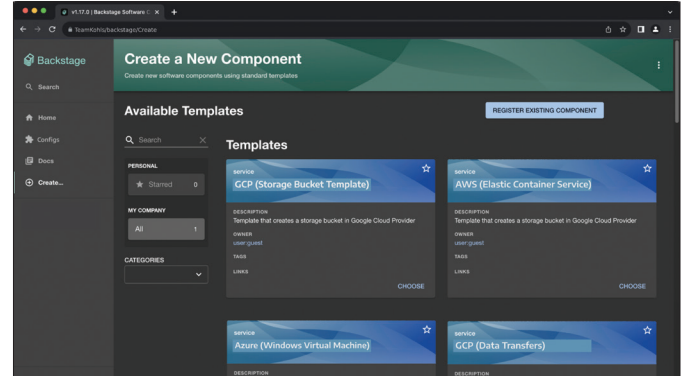
If a developer needs to switch providers due to a unique feature or getting better rates on a competing provider, it can take considerable time to learn how to use the new system.

Our Infinity Gauntlet simplifies the process of creating a project with a new cloud service provider. Just as Thanos' Infinity Gauntlet united the Infinity Stones, our Infinity Gauntlet unites all the cloud service providers onto one platform.

Instead of having to learn the intricacies of each cloud service platform, Kohl's developers use our website to create and host servers on any platform from one convenient location. Our software is designed to be as simple as possible with the most common setting pre-configured to enable faster and easier development.

Our project speeds up the challenging process of setting up cloud platforms, saving time and resources for Kohl's engineers.

The front-end website and forms are created with Backstage, which then calls upon Terraform to create and manage the cloud service providers.



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Lockheed Martin Space SmartSat™ Heterogenous Computing in Space

Lockheed Martin Space, a division of Lockheed Martin, is one of the largest companies in the aerospace, military support, security, and technologies industry. They work with government and commercial customers to create breakthrough technologies to discover more of space and defend the U.S. and its allies.

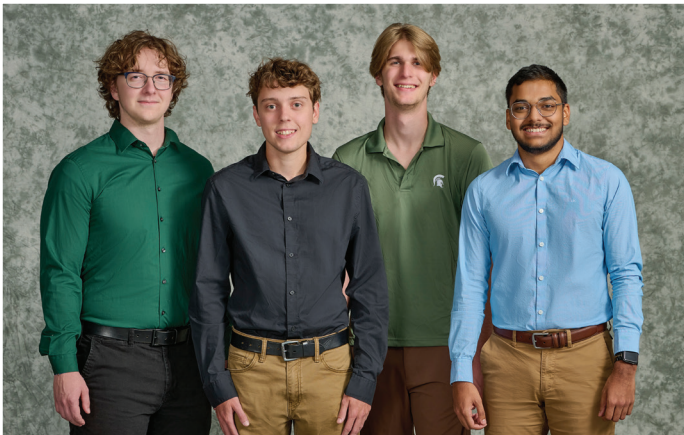
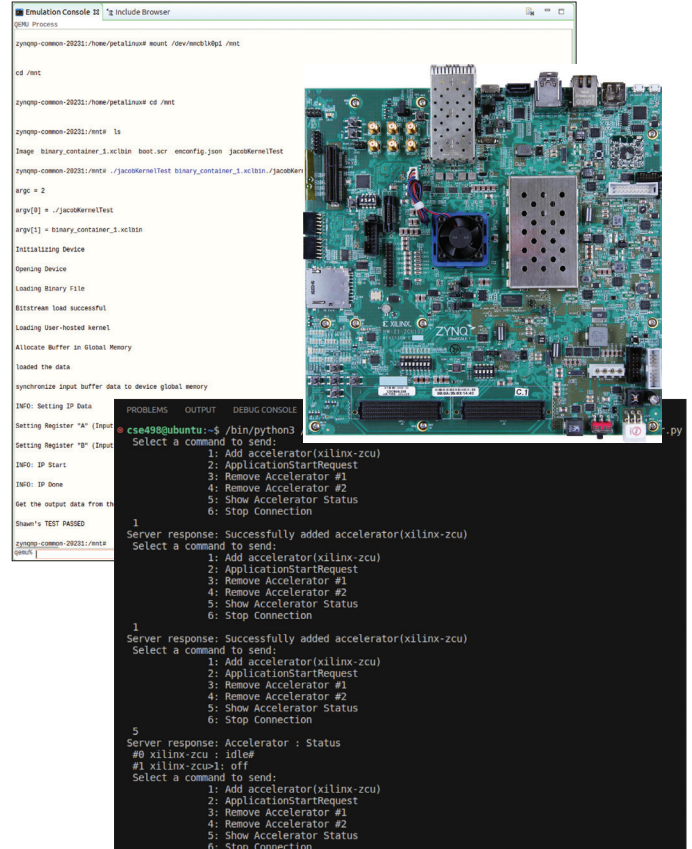
Lockheed Martin satellites continuously collect data during space missions. Historically, satellites have offloaded all major data processing functions to ground resources due to computing limitations of in-flight hardware.

With the recent advancements in radiation resistant processing devices, satellites now offer additional processing power in orbit. Lockheed Martin developed the SmartSat™ software infrastructure to facilitate development of satellite flight software and leverage new capabilities in satellite hardware. SmartSat satellites have an open system architecture with significant in-orbit re-programmability, meaning they can be used for a variety of diverse missions.

Our SmartSat Heterogeneous Computing in Space system makes it easier for mission applications to utilize the full power of diverse processing devices in flight. Our system enables faster data processing by enabling algorithms to be run on many types of processing devices to ensure optimal execution. Our software makes real-time decisions on how to best distribute many unique applications across the computing systems available on the satellite.

Our Heterogeneous Computing in Space platform enables efficient computation onboard satellites, consequently improving the efficiency, and reduces the cost for Lockheed Martin.

Our back-end system is built using Lockheed Martin's SmartSat SDK. The application uses AMD Vitis and SYCL to run accelerators on available hardware. The software is built and tested on the Xilinx ZCU102 multiprocessor system on a chip (MPSoC).



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Magna International Composable 3D Model for a Manufacturing Plant

Magna, founded in 1957 as a small tool and die shop, has evolved into a global automotive technology and manufacturing powerhouse. They are a key player in the automotive industry, supplying components and systems to major vehicle manufacturers worldwide, and shaping the future of mobility solutions.

In the fast-paced world of manufacturing, gaining real-time insights into the intricate operations of a factory has long been a formidable challenge for floor managers. Understanding the status of machines, monitoring inventory levels, and optimizing plant layouts can be a daunting task.

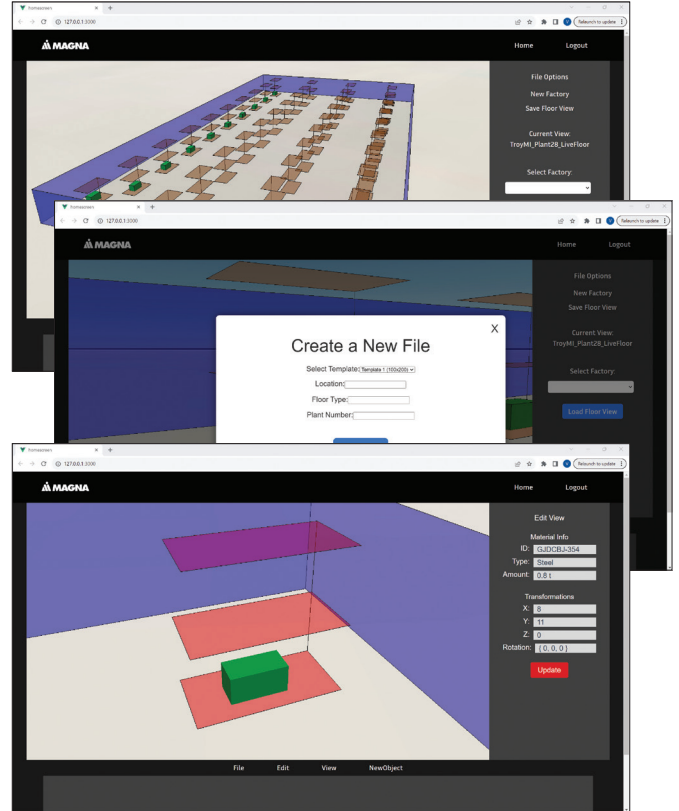
Our Composable 3D Model for a Manufacturing Plant system solves this problem for Magna, using an innovative web interface that models Magna's manufacturing plants in an intuitive 3D representation, shown on the right. Our tool transforms how floor managers oversee their manufacturing facilities, prioritizing convenience and efficiency.

Our platform provides a precise 3D representation of the entire manufacturing plant, with every machine and storage unit accurately placed, each tagged with the real-time status of the asset.

Floor managers access real-time insights throughout the factory to monitor efficiency and productivity remotely. By selecting any machine or storage unit, users instantly retrieve critical data such as operational status and storage capacity.

Our tool allows Magna's floor managers to easily customize the layout of their plant, view the operation's status, and quickly identify issues and weaknesses.

Our system utilizes CesiumJS, which enables factories to be displayed, updated, and traversed by users. Factories and all of their assets are encoded in GeoJSON. Saving and loading factory layouts are done using Node.js API calls to a MongoDB database.



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Meijer Enhanced Shopping Experience Using AI

Meijer is one of the country's largest supercenter chains, providing high-quality groceries and merchandise to over 265 locations throughout six midwestern states. Meijer is dedicated to elevating the customer experience in all of its stores. One of the ways that Meijer connects to its customers is through its expanding mPerks rewards program.

Serving as a grocer to many of its customers, Meijer would like to provide mPerks users with a tool to provide new and interesting meal ideas for customers to improve their shopping and dining experience.

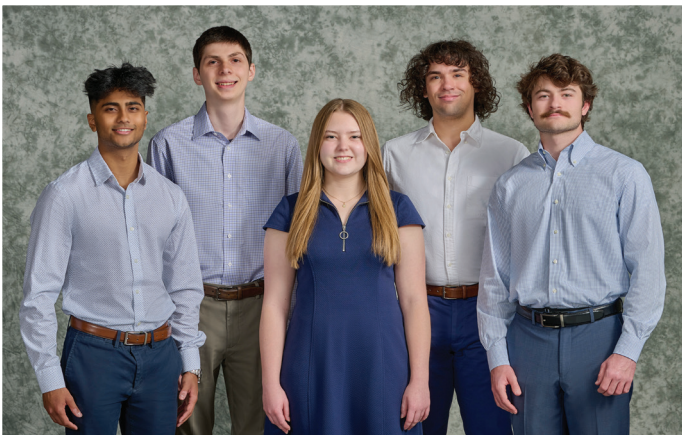
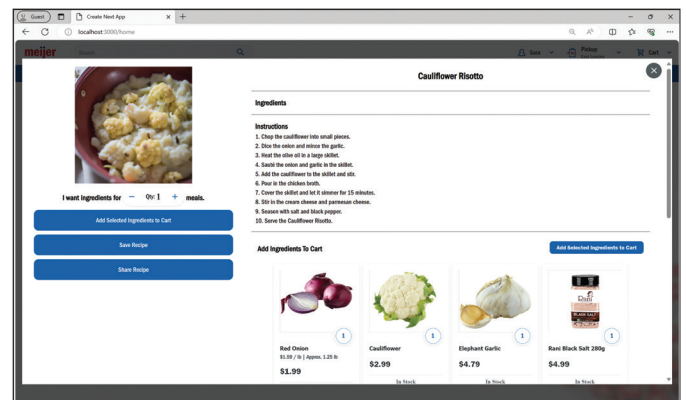
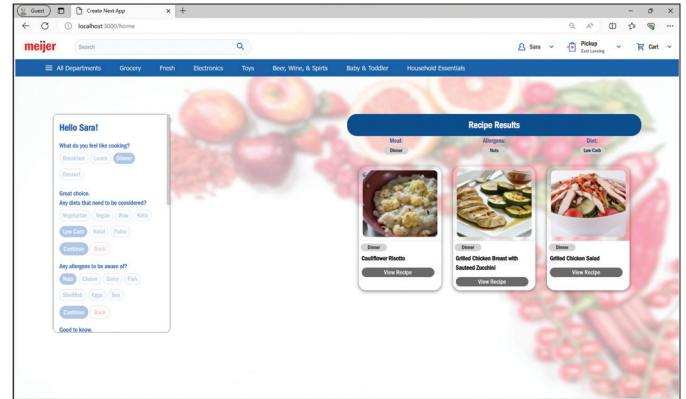
Our Enhanced Shopping Experience Using AI system tackles this problem and provides users with suggested recipes, all while considering their various dietary restrictions and preferences.

As customers plan their next meal, they use their mPerks account to inform our system of their dietary restrictions and allergies. Our web app is expansive to be as inclusive as possible for a wide variety of shoppers. Customers also provide their meal preferences, such as breakfast, lunch, dinner or dessert.

Unique recipes are then generated using advanced artificial intelligence (AI), taking into consideration information such as a customer's shopping history, their dietary restrictions, and many other factors. Each recipe is presented to the user, who then decides to add the necessary ingredients to their shopping list or ask for a new recipe idea.

Our system improves the shopping experience for Meijer customers and enables shoppers to explore new foods and ideas.

Delivering a user-friendly and seamless experience is made possible through Next.js as our front-end technology. Our front end is able to swiftly and securely communicate with our Azure SQL database. All recipe generation is done utilizing GPT-4 from OpenAI.



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Michigan State University clUML: A Browser-Based UML Editor

The Department of Computer Science and Engineering at Michigan State University provides world-renowned courses for over 2,000 students in computer science-related fields. These courses utilize several custom-made software applications developed in-house to facilitate student learning.

One of the skills that all computer science students must learn is the creation and usage of UML diagrams. Such models aid in the visualization of the connectivity between individual components in software systems. Students can make a more informed plan when developing the software structure and easily communicate that structure to other programmers using UML diagrams.

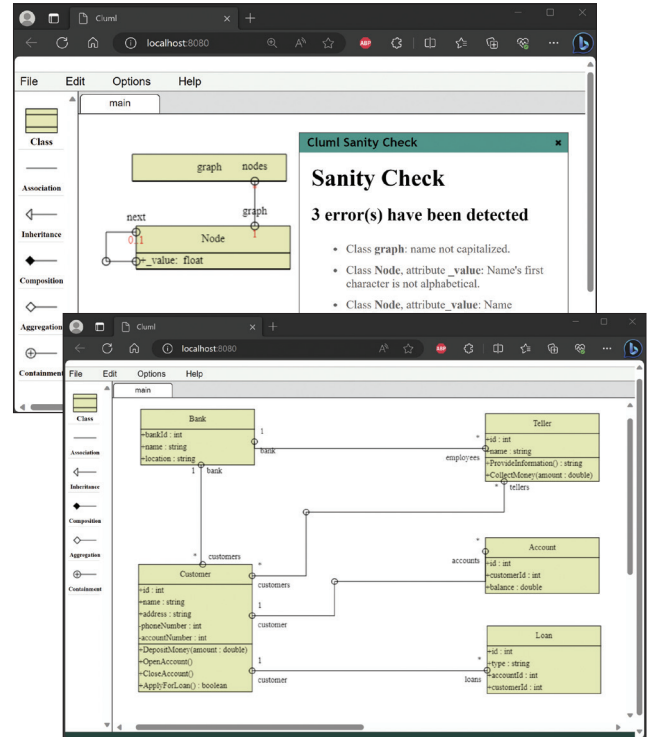
Students currently utilize a third-party program, Visual Paradigm, to create UML diagrams in their classes. Our clUML: Browser-Based UML Editor removes the department's dependency on third-party software.

Based on Cirsim, a university-developed circuit diagramming tool, our system provides students an approach to creating UML diagrams in a familiar format.

Our software features a palette of tools for adding UML components to a central diagram, as shown on the right. Components can be edited and moved directly on the diagram using a mouse or a touchscreen. Connections between classes are easily drawn and edited for placement and multiplicity.

Several quality of life features, such as saved states and diagram sanity checking, enable students to quickly and easily design UML diagrams, saving time and resources for students and instructors alike.

Our software runs on all modern internet browsers, utilizing Node.js/JavaScript, HTML, and Sass/CSS. Our software employs many JavaScript packages, such as DOMPurify for sanitizing user input and Jasmine and Karma for testing.



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Moi.AI

Small Object Detection Using CCTV Cameras

Moi.AI is a multinational MSU-born startup founded in 2019 in Troy, Michigan and Chennai, India. Moi.AI leverages state-of-the-art artificial intelligence technologies to provide actionable analytics and enhance security through real-time video feed analysis.

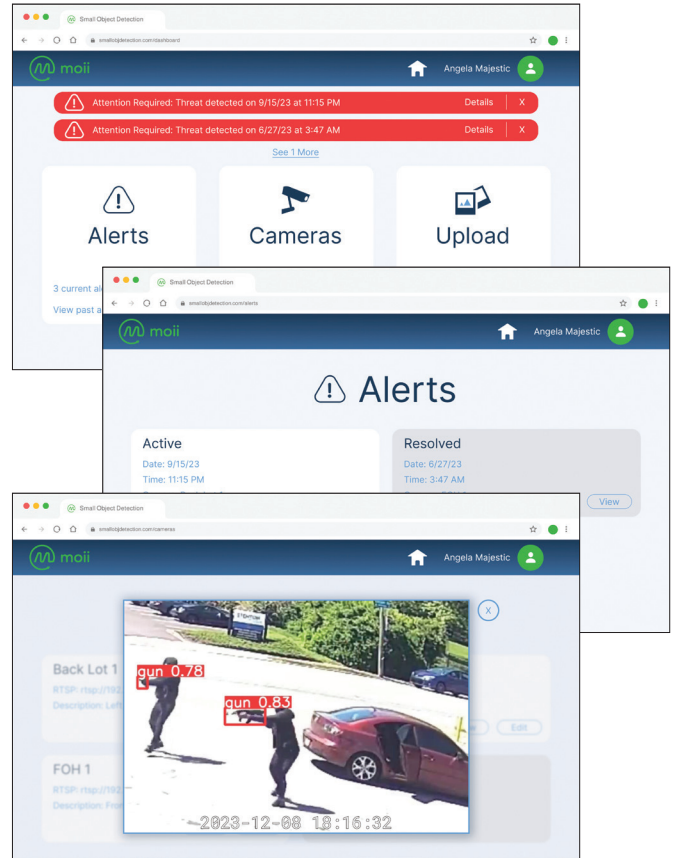
Current CCTV systems require camera feeds to be constantly monitored for small objects, introducing a constant need for labor and the possibility of human error. Due to this, Moi.AI is advancing its capabilities to detect small objects, particularly firearms, to better serve client security needs and support unsupervised surveillance.

Our Small Object Detection Using CCTV Cameras system provides users with a method to detect weapons automatically through a web application and a small object detector created with machine learning. To access the detector's capabilities, clients input their CCTV camera details on the web application.

The weapons detector continuously scans live incoming camera footage for potential threats. When a firearm is detected, the system generates a marked video snippet, highlighting the weapon with a bounding box, and triggers an alert. Our solution prioritizes safety and security by promptly alerting clients through SMS or email, enabling timely interventions.

The web application centralizes the management of CCTV cameras and provides clients with a platform to monitor and manage threats. Additionally, the web application includes a testing feature that lets clients upload images or videos containing firearms, providing an easy method for them to explore the capabilities of the small object detector without facing an actual threat.

The system features a ReactJS-based web application deployed on Firebase. The small object detection model, which handles the gun detection, is trained with PyTorch and SAHI method and is hosted on Google Cloud Platform. A FastAPI interfaces with this model and coordinates with Firebase to relay predictions.



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MSU Federal Credit Union Digital Banking Car App

Established in 1937, Michigan State University Federal Credit Union (MSUFCU) is an esteemed American credit union. Its ascension to prominence can be attributed to the cultivation of robust affiliations, an unwavering commitment to fostering financial literacy, and active community engagement. As a result, MSUFCU has emerged as the preferred choice for university students, faculty members, and esteemed alumni.

MSUFCU offers members a seamless and secure means to undertake a multitude of financial transactions, ranging from checking transactions to transferring funds to other members, through their internal Member2Member system, all accessible at the touch of a finger.

Due to legislative changes enacted by Michigan in 2023, the physical use of mobile electronic devices while operating a vehicle is illegal. Our Digital Banking Car App is an innovative extension of MSUFCU's current mobile application.

Our application runs on a vehicle's infotainment system, enabling members to safely, intuitively, and quickly perform banking actions while operating a vehicle.

The application gives users the ability to perform actions within their banking application safely. Through voice-controlled technology, members talk to the system through digital assistants to transfer funds, view recent transactions, find nearby loyalties, and locate nearby MSUFCU branch locations.

The software enhances the member experience by delivering a seamlessly secure digital banking interface that caters to their dynamic and on-the-go lifestyles.

The front end of our Android application is written in Kotlin using Java to communicate with the back end. The back end uses a PHP framework that communicates with a SQL database that is hosted on an MSU CSE server.



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Roosevelt Innovations Predictive Claims Scoring

Roosevelt Innovations, LLC is a software company and subsidiary of Delta Dental, the nation's leading dental insurance provider. Roosevelt Innovations offers end-to-end solutions with industry-leading claims processing capabilities that have saved \$972 million in treatment costs for over 23 million members.

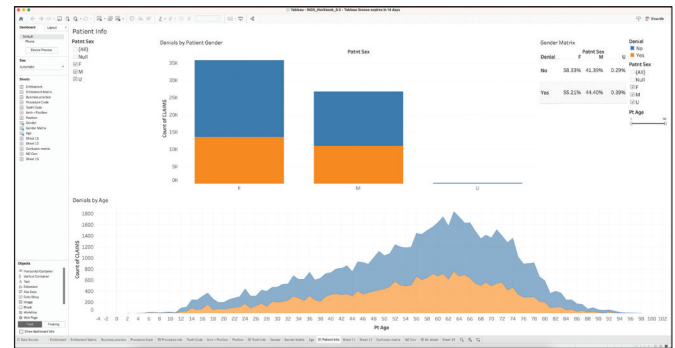
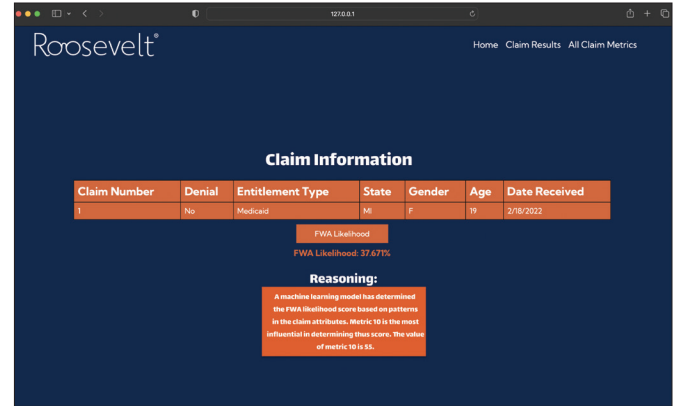
Reviewing insurance claims for signs of fraud, waste, and abuse (FWA) is a tedious and time-consuming process. To enhance the claims assessment process and optimize resource allocation, our Predictive Claims Scoring system uses machine learning techniques to provide business and data analysts a preliminary score representing the likelihood of a claim containing FWA.

Business analysts reviewing claims leverage our system to search for specific claim identification numbers. Users are directed to a webpage displaying the specific claim's FWA likelihood score and the attributes of the claim that were most influential to the score. For a broader search, a full history of claims and their scores are listed underneath the search bar, providing quick and easy access to valuable information.

Our software provides data analysts with intuitive graphs that show patterns and trends in insurance claim scoring, seen on the right. Charts and graphs update as new claims with scores are entered into the system. Analysts track claim denials over time and between attribute groups, enabling them to make connections and inferences quickly and efficiently.

Identifying patterns in denied claims enhances the business analysts' workflow and improves the overall effectiveness of the claims assessment process.

Our system's website is written in HTML/CSS and uses FastAPI to interact with the Snowflake database. Dashboards within our software are built in Tableau. Our machine learning model uses the scikit-learn library in Python.



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Roosevelt Innovations Universal Guided Web Editor

Roosevelt Innovations, headquartered in Okemos, Michigan, is a software solutions company owned by Delta Dental. With over 50 years of experience and innovative automated claims processing capabilities, Roosevelt has achieved an industry-leading 96% auto-adjunction rate and enabled a total treatment cost savings of \$972 million. Altogether, Roosevelt has over 23 million users across its platforms and offers their services to insurance companies across the country.

At Roosevelt Innovations, insurance experts need to create and edit business rules that govern the automated claims processing system. However, development can be time-consuming for users without a technical background, often requiring additional training and resources.

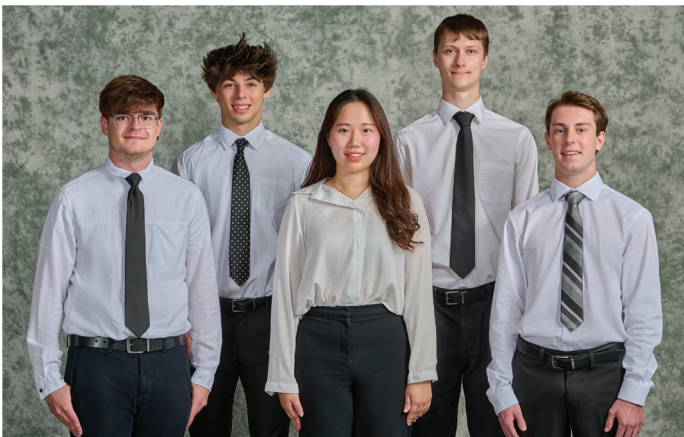
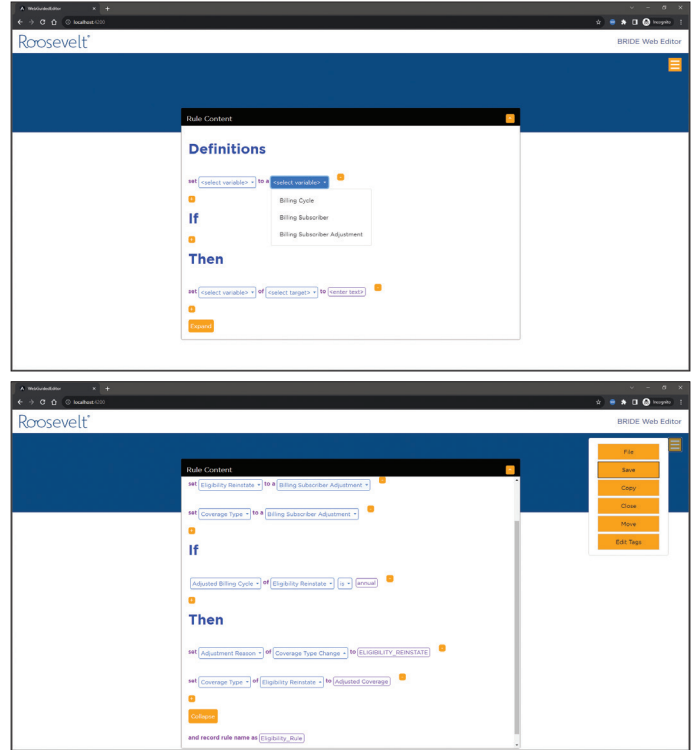
Our Universal Guided Web Editor assists anyone working on claims in creating business rules in a streamlined and easy-to-use process.

Users first select a particular rule-framework. The complicated and technically confusing framework is then interpreted into an intuitive layout in the web editor (shown on the right) for users to input their rule specifications and variables in plain English.

This self-guided tool empowers businesses to create rules without the involvement of technical team members. Dropdowns and other selectable options improve the speed and ease of rule creation.

Our software improves quality and reduces errors in the work environment, increasing productivity.

Our application's front end is constructed with Angular, a web application framework and Bootstrap 4. The interpretation of the rule framework is done by ANTLR 4, a powerful parser generator that produces parsers for processing structured text, using a visitor approach to traverse the generated abstract syntax tree.



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RPM AI-Based Chat Service

RPM is an international logistics and supply chain solutions company based in Royal Oak, Michigan. RPM specializes in freight transportation and vehicle logistics across North America and Europe. RPM services 30 countries and transports over 60,000 vehicles per month.

Serving as an end-to-end transportation provider, RPM requires a considerable amount of effort to manage drivers' and customers' inquiries. To address the needs of the drivers and customers, RPM requires 24/7 on-call representatives. This leads to high operational costs and potential gaps in customer service quality. Therefore, RPM wants to maximize the utility of carrier representatives while reducing costs and improving drivers' satisfaction.

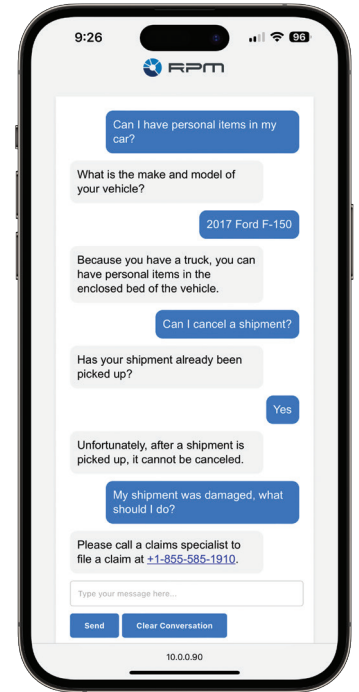
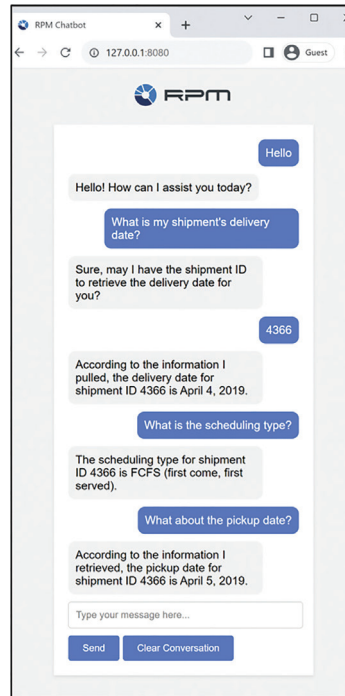
Our AI-based Chat Service mimics a customer service representative by instantly answering carrier inquiries. The AI chat service has access to a multitude of frequently asked questions as well as instant access to all of RPM's shipment data.

The chat maintains a natural human language interaction, such that the driver feels as if they are talking to a real human. The AI chat service is knowledgeable and able to assist in most situations.

If the chat reaches a point that a carrier representative is needed, it seamlessly transfers a user to an on-call representative. Transferring the user's chat transcript to the representative improves the speed and quality of the customer service experience.

Our software intelligently serves customers, reducing the need for dedicated customer service workers, saving time and money.

Our AI-based chat is a back-end service that can be integrated into any platform. Our service utilizes Python Flask as well as OpenAI, Turvo and Microsoft .NET. The chat service is hosted entirely on Python Flask. OpenAI's API is used for natural language processing while Turvo's API is used to pull data from RPM's .NET database.



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Stryker Electronic Data Interchange (EDI) Dashboard

Stryker is a Fortune 500 company that provides world class medical equipment to hospitals worldwide. From surgical equipment to neurotechnology, Stryker operates in over 75 countries and impacts more than 130 million patients annually.

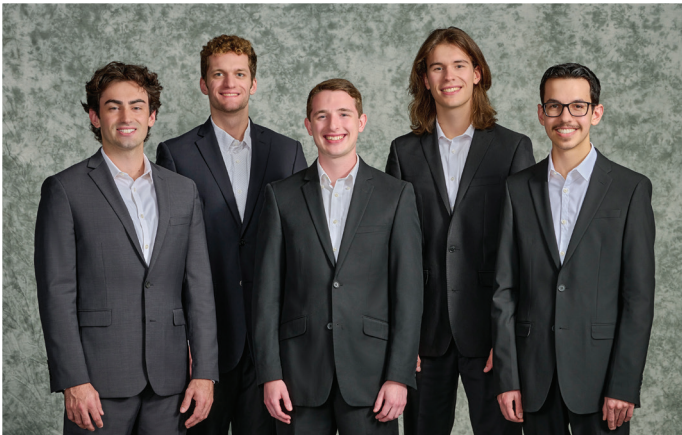
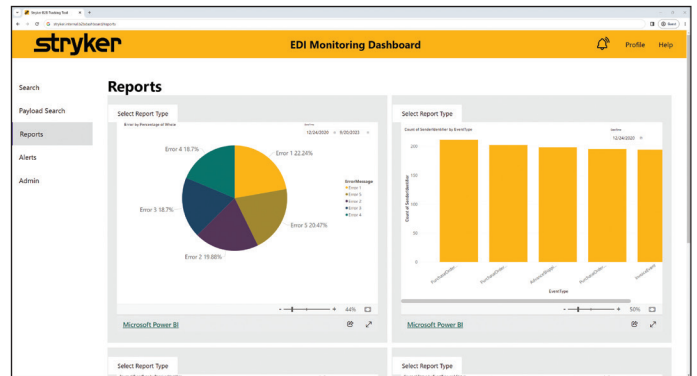
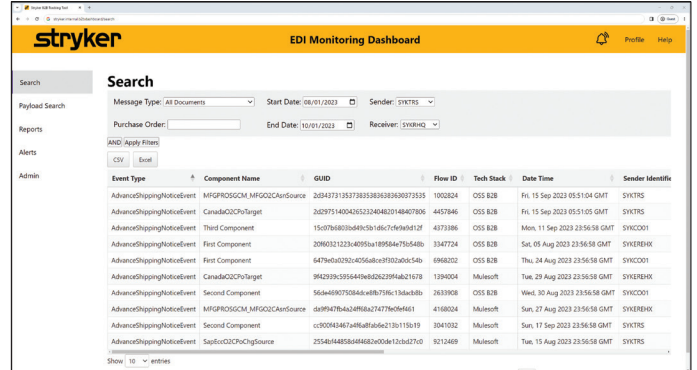
Due to its size, Stryker faces the intricate challenge of overseeing a vast supply chain. As a serial acquisition company, Stryker frequently integrates software systems from acquired companies, known as Enterprise Resource Planning (ERP) systems. These new ERP systems are used to manage the products, purchase orders, and employees of the acquired company. To facilitate the many different systems, Stryker requires a centralized software platform that helps display and analyze the ERP transactions.

Our Electronic Data Interchange (EDI) Dashboard provides a web application to monitor the various ERP transactions inherited by Stryker's acquisitions.

Upon launching our web application, users are provided a comprehensive table containing an overview of all ERP transaction records. Employees use our advanced sorting, searching, filtering, and exporting capabilities to quickly and efficiently analyze ERP transaction data. Anomalies or transactions of interest are quickly identified using our system.

Our system provides holistic analyses of all transactions, highlighting key trends and metrics, improving the efficiency and accuracy of Stryker's integration efforts. The system also provides scheduled email alerts to help users receive data that needs to be monitored at regular intervals.

The app's back end uses Flask, hosted on Azure App Service. Data for each transaction is stored in Azure SQL Server. We utilize jQuery's DataTables to display tabular information and Power BI to display dynamic graphs.



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TechSmith Automated Content Editor (ACE)

TechSmith is a global leader in media recording and editing software, driven by a mission to empower their 73 million worldwide users to share knowledge and information visually. TechSmith's flagship products, Camtasia and Snagit, provide unmatched solutions for creating videos quickly and precisely.

TechSmith continuously innovates and paves the way for users to seamlessly share knowledge and create compelling content. While videos have become the quintessential medium for knowledge transfer, the intricacy and steep learning curve behind video creation often poses a barrier for content creators to translate their vision into a great video.

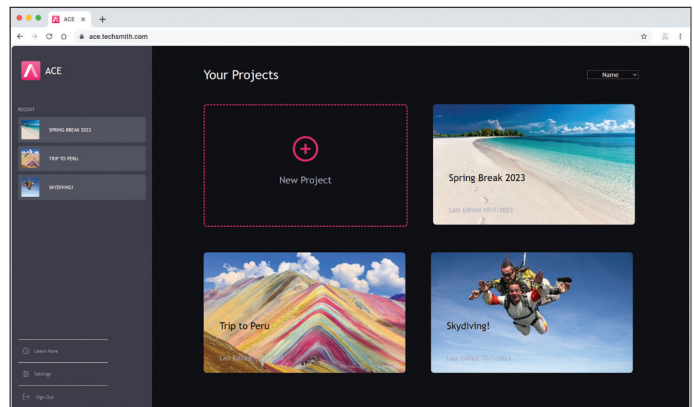
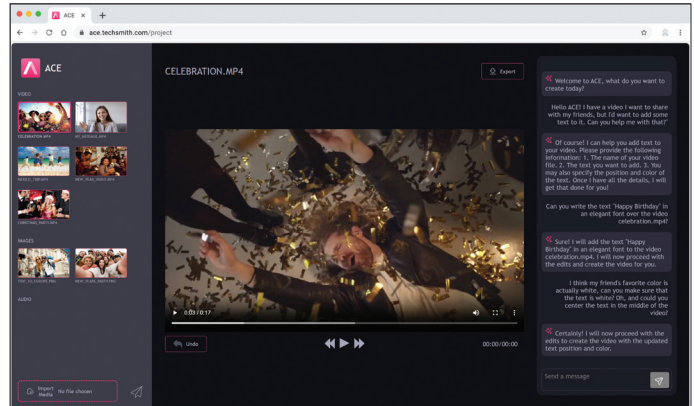
Our Automated Content Editor (ACE) simplifies video editing by enabling users to edit videos using everyday language. This is achieved via a web application built around an artificial intelligence (AI) driven editing approach.

Unlike traditional video editors, ACE features a chat panel, shown on the right, through which all editing tasks are delegated. Users simply express their desired editing needs to the AI-powered conversational assistant which interprets their intent, automatically executes the corresponding editing actions, and continues to chat with the user to achieve their desired outcomes.

Users only need to be able to describe the video they want to create, and our software does all of the heavy lifting for them, reducing the barrier to entry for beginning video editors.

By eliminating the inherent complexities and challenges of video editing, ACE enables users to center their attention on the creative and innovative expression of content and information delivery.

Our web application, hosted on Microsoft Azure, leverages React for front-end development and Flask for back-end operations. OpenAI's large language model GPT-3.5 interprets the user intent while directing FFmpeg to implement the exact media edits.



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Union Pacific Railroad Switch Alignment Training

Union Pacific has been building America for more than 160 years. Founded July 1, 1862, they are one of the largest railroad companies in the United States. With over 32,500 miles of track in 23 western states, Union Pacific boasts an impressive lineup of over 8,000 locomotives and a team of over 30,000 employees.

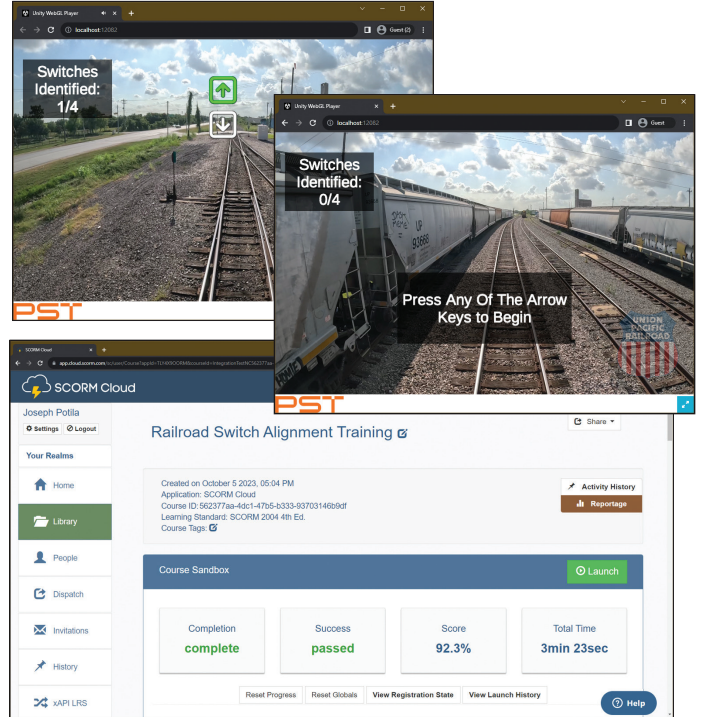
Switches are a core component of railroads that direct the movement of a train. Correctly identifying switch alignment is crucial to ensuring the transportation of resources the country relies on. A misaligned switch — if not identified and corrected — can lead to delays and damages and can pose a danger to personnel.

Our Railroad Switch Alignment Training software consists of courses that train employees to identify the alignment of railroad switches quickly and accurately. Employees get the necessary experience and training in a safe environment.

During a course, a prerecorded video taken from the front of a locomotive plays. As a switch approaches, the user interface displays inputs corresponding to switch identification. The user indicates the alignment of the switch, and the software gives audio-visual feedback to indicate whether the response was correct.

The training software teaches personnel to better identify rail switches in a real-world setting. Each course of the training is its own program, giving management more control over exactly what content employees should complete. Upon completion of a course, feedback is given and a score is reported to Union Pacific's learning management system. The software is also highly configurable, supporting custom course creation without having to write a line of code.

Our software is developed in Unity 3D and programmed with C#. It follows the SCORM standard for eLearning courses. The software is configured using JSON files and pulls videos from a database to generate a course in real time.



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United Airlines Audit Automation Tool

United Airlines is one of America's foremost airlines, headquartered in Chicago, Illinois, serving over 100 million passengers annually. Utilizing a substantial fleet of more than 850 aircraft, United Airlines strives to hold themselves to the highest standards of safety and reliability for their passengers.

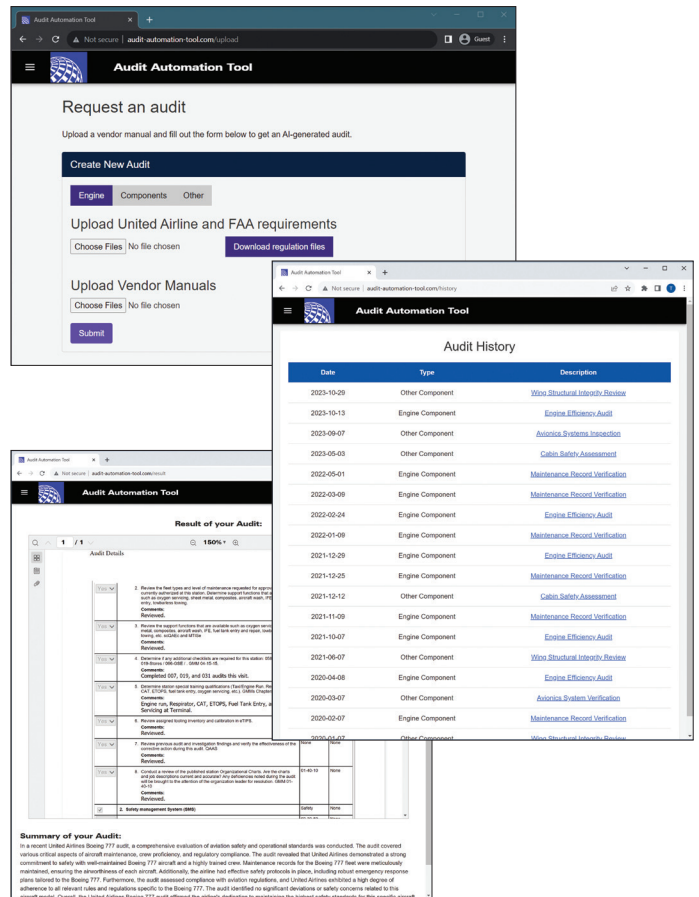
To maintain their remarkable fleet, ongoing maintenance is essential, and United Airlines has established a network of vendors dedicated to preserving the fitness of its planes. These suppliers perform repairs and part replacements while undergoing regular inspections by auditors from United Airlines, ensuring strict adherence to industry best practices. The current auditing process demands a substantial amount of labor hours, incurring significant financial expenditures for the company.

Our Audit Automation Tool streamlines this process for auditors by diminishing the disparities in auditing practices through the utilization of artificial intelligence (AI).

Our software automatically scans uploaded vendor manuals that auditors use to complete an audit. Through the application, auditors have the ability to upload vendor manuals and industry regulations. The system then compares the documents to ensure that the vendor manuals are in compliance with the provided regulations.

United Airlines auditors use our tool to quickly parse and analyze vendor manuals and regulations documents that can be hundreds of pages each. Our system automates large portions of the auditing process, increasing efficiency and saving time.

The application's user interface is constructed using React and interacts with the back-end model developed in Python. This communication occurs via a Flask API while the historical data is stored on a DynamoDB database. The front end and back end, along with the database, are all hosted on Amazon Web Services.



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The Capstone Experience

Urban Science Synthetic Media

Founded in 1977 and headquartered in Detroit, Urban Science is a leading global data-driven consulting firm that specializes in providing insights and solutions for the automotive industry. With a track record of serving major automakers worldwide, they utilize data and business science to address market challenges and drive success for their clients.

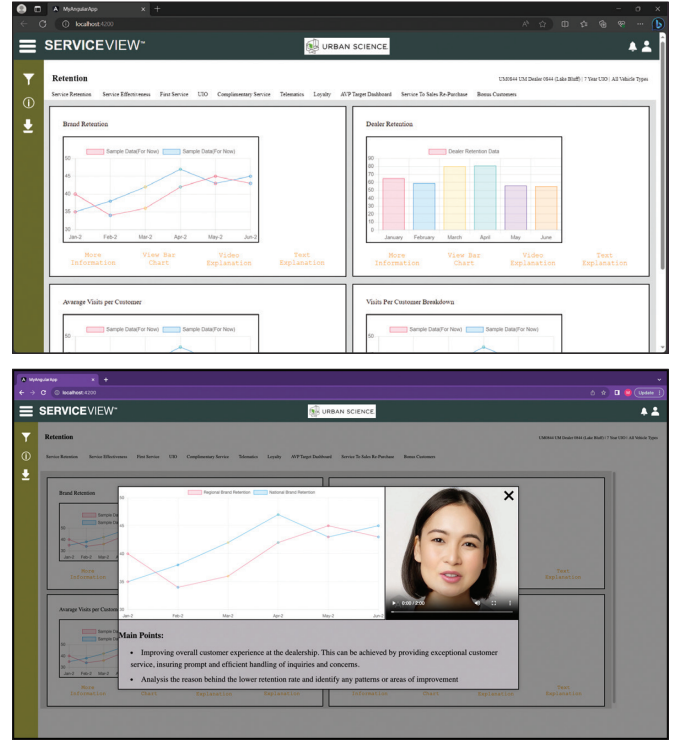
Due to the increasing intricacy of data in modern industries, clients and field staff are encountering the challenge of drawing meaningful conclusions from wide ranges of statistics. In the past, Urban Science hired firms to generate informative content to educate clients of the results of data analytics. This, however, came at a high cost. Recent advancements in artificial intelligence (AI) create a new avenue for Urban Science to inform clients of analytic results with minimal cost.

Our Synthetic Media web extension mitigates the challenge of complex data analysis by generating a virtual avatar that clearly explains the analysis in an easy to understand and friendly way.

Our web extension displays a wide array of charts and graphs to visually illustrate data trends and changes. Each chart comes equipped with an AI-generated explanation, which is easily accessible with just the click of a button. The generated explanation is given in a text format or via our virtual avatar, which explains the chart with auditory and visual elements for any user that prefers a more human element in their learning experience.

Utilizing our generated explanations, clients can extract meanings and trends that may have been invisible before. The Synthetic Media web extension makes data driven decision-making easier and faster than ever before.

The front end of our user dashboard is written in HTML, CSS, Chart.js, and Angular. The back end is built with FastAPI and Firebase Firestore database in Python.



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UWM Change Insights Datamart and Risk Assessment

Headquartered in Pontiac, Michigan, United Wholesale Mortgage provides mortgage products and services to mortgage brokers all over the country and is currently the top wholesale and mortgage lender in the United States.

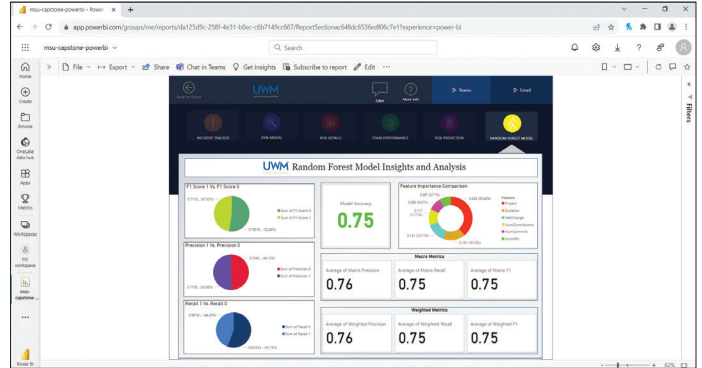
In a large IT organization such as UWM, there are thousands of software changes and custom software solutions built every year. These changes produce valuable data about how certain software changes can affect the overall development cycle and other production risks. However, the data associated with these changes is spread across multiple different systems and is ineffective in this state.

Our Change Insights Datamart and Risk Assessment tool assists team leaders at UWM to proactively mitigate any potential production risks throughout the development cycle and monitor their team's performance.

In our tool, data related to software changes is aggregated from various sources into one cohesive IT Datamart. This creates a single view of all IT operations within UWM, making it easier than ever to analyze data at a glance.

Our predictive model leverages data from the IT Datamart to collect crucial insights which may correlate to deployment risks such as net changes to a file, associated incident reports, and which team is contributing the corresponding changes. Following collection and analyzation, the model determines the level of risk associated with each software change.

Our IT Datamart includes data from Bitbucket, Jira, Harness, Octopus, and ServiceNow. Python scripts are utilized for cleaning the CSV files. The model is implemented in Azure Machine Learning Studio. Azure Blob Storage is used to import data into Power BI from the model for front-end representation.



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The Capstone Experience

Vectra AI Malware Command and Control Channel Simulator

Vectra AI is a leader in the cybersecurity field, harnessing the power of artificial intelligence (AI) to provide clients with state-of-the-art threat detection and real-time response across all domains of enterprise systems. With over a decade of experience, Vectra AI provides security for enterprises in 113 countries. Along with winning Security Customer Champion at the 2023 Microsoft Excellence Awards, Vectra AI can be found on the Forbes AI 50 List and the CRN Security 100.

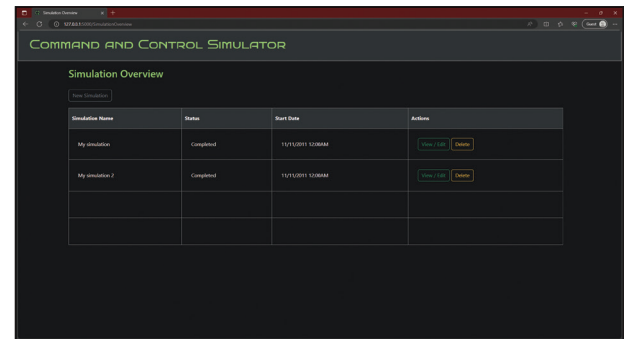
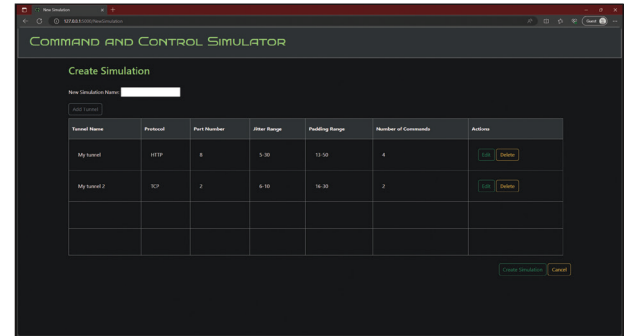
Ransomware attacks cost companies \$20 billion in 2021, a figure that is expected to rise to \$256 billion by 2031. This makes Vectra AI's service increasingly crucial and the effectiveness of their AI models of the utmost importance. A common technique utilized by attackers is to take control of a victim's computer and command it remotely, known as a command and control channel (C2).

Our Malware Command and Control Channel Simulator generates configurable C2 channels through an application set. Users configure the channel in a web interface where they select different features to customize the channel behavior. This enables Vectra AI to generate network activity, simulating real-world behaviors that would be present in the event of a command and control attack.

Hackers use a variety of methods to disguise their presence, making the customization of the channels an important aspect to mimic diverse behavior.

The simulation data our application generates is used to train AI threat detection models used in the software that Vectra AI sells to its clients, increasing the effectiveness of Vectra AI's security service.

Our server is hosted on Amazon Web Services in an EC2 instance, and our entire application set is written in Python. Our server communication with the client is achieved over multiple protocols (TCP, UDP, HTTP, HTTPS).



VECTRA®



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Volkswagen Group of America Volkswagen Shopping App with Augmented Reality

Volkswagen Group of America is the North American subsidiary of the Volkswagen Group, a global leader in automobile manufacturing. Delivering over 570,000 full-electric vehicles in 2022, VW is also at the forefront of sustainable transportation.

Currently, the car-buying process is time-consuming and sometimes inconvenient, requiring customers to physically visit dealerships to view any vehicles they might purchase.

Our Volkswagen Shopping App with Augmented Reality offers a unique solution to this process. It empowers customers to explore and personalize Volkswagen vehicles from the comfort of their homes and on the go.

Within the application, users select a vehicle from a catalog of Volkswagen's latest models and customize the vehicle with an array of exterior body paints and accessories. These customizations can be saved to be viewed and edited later.

Our software detects and highlights surfaces where the user's vehicle can be placed. Once a location is selected, our application displays a high-quality 3D model. It is life-sized, making it easy to envision owning the vehicle.

Users can also view the car's virtual interior. While imagining themselves behind the wheel, they can tap to honk the horn or look around to get a feel for the interior.

Our innovative approach to window shopping streamlines the car-buying process by providing an immersive user experience. This informs VW customers and aids in decision-making as they search for their newest Volkswagen vehicle.

Our Volkswagen Shopping App with Augmented Reality is available exclusively on iOS devices. It is developed in Swift using Xcode and leverages ARKit, RealityKit and SceneKit for AR. Our system uses API calls to AWS for database communication.



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Whirlpool Corporation

DeepOven: Volume and Quantity Estimation in Cooking

Whirlpool Corporation, a fortune 500 company headquartered in Benton Harbor, Michigan, is the world's leading home appliance company with over 50 manufacturing and research centers. Whirlpool is in constant pursuit of improving life at home through their reliable appliances.

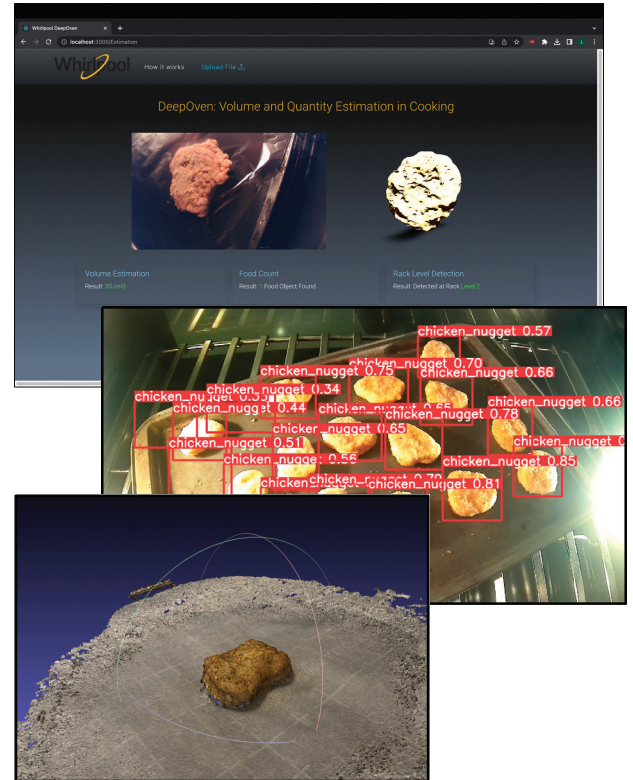
In this spirit, Whirlpool is working to make cooking more accessible to all through the development of a smart oven. An oven of this nature provides users with insight and instruction to improve the result of the dish.

Our DeepOven system contributes to the larger Whirlpool smart oven goal by estimating volume and quantity of food inside a Whirlpool smart oven. Through a camera inside their oven, users see a livestream of their food cooking and leverage the camera and our tool to improve their cooking experience.

Connecting to the oven brings the user to the livestream view from inside the oven. Using either a frame from the livestream or a pre-captured image, the user initiates our system, which uses advanced machine learning to automatically determine the oven's rack level, the food quantity, and the total estimated volume of the food in the oven.

Our system produces a 3D reconstruction of the food in the oven, accompanied with the original image and any statistics and data determined by our software. Whirlpool uses this data to improve the performance of their smart ovens, enabling them to better estimate the cooking time required in many scenarios.

The web application is built with React as the front end and utilizes Flask and Python for the back end. Food quantity detection is achieved with a custom trained YOLOv8 instance segmentation model. A convolutional neural network (CNN) model determines the rack level, and a differentiable volumetric rendering model calculates the volume and creates the 3D image of the food.



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WK Kellogg Co Global Business Services Process Intelligence

WK Kellogg Co, home of the world’s most memorable cereal brands, is one of the largest food manufacturing companies in the nation. Located in Battle Creek, Michigan, WK Kellogg Co was created recently as a spinoff of Kellogg’s.

Supply chain manufacturing is the backbone of WK Kellogg Co’s iconic brand. After spinning off as the leading manufacturer of ready-to-eat cereal, WK Kellogg Co is charted to achieve aggressive margin improvements by improving their internal software to meet the demands of their new enterprise.

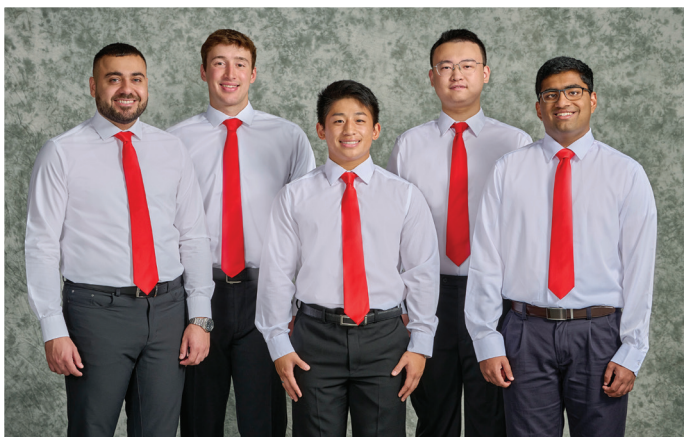
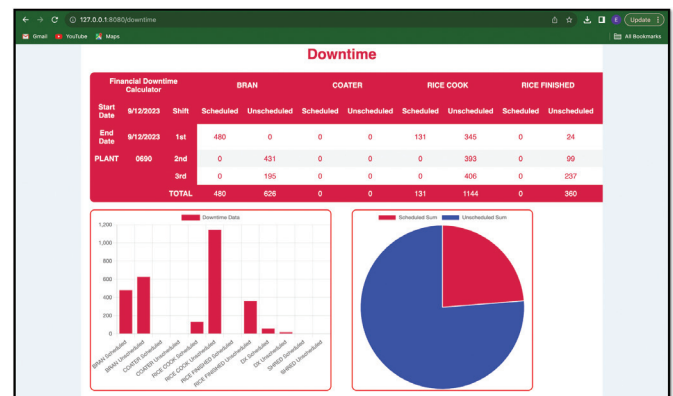
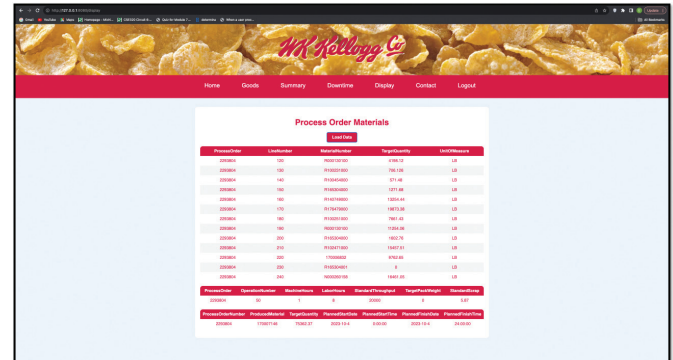
Our Global Business Services Process Intelligence website is accessible to plant employees and supports them in performing their day-to-day tasks.

A major concern of WK Kellogg Co leadership is the discontinuation of the data integration software they currently use. Our website replaces this system and connects multiple data centers together, offering a smooth flow of data. Using our website, employees can compare live data and customize it according to their needs.

Our website offers the option of charting data by simply clicking on the specified row in the table, providing a wider array of options to study and analyze the data. These features support WK Kellogg Co’s mission of creating greater strategic focus and operational flexibility.

Our Global Business Services Process Intelligence website is supporting WK Kellogg Co in this transition period by not only replacing the current tool, but improving upon it.

Our Global Business Services Process Intelligence website is developed using HTML CSS and JavaScript for a modern, friendly, and easy-to-use user interface. The data is stored in an SQL Database and Flask used in Python connects the front end and back end smoothly.



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The Capstone Experience

The Capstone Experience

At the end of each semester, the College of Engineering sponsors Design Day, at which student teams from across 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.



As the Executive Director of Design Day, Professor Dyksen gives the opening remarks at the College of Engineering Design Day Awards Ceremony.



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 Shareholder Engagement Chatbot

Ally Financial, headquartered in Detroit, Michigan, is a leading entity in the U.S. financial services industry, known for its extensive list of offerings including banking, investing, and auto financing. With a strong customer base that includes over 2 million depositors and 4.5 million individuals utilizing its financing and leasing options, Ally is at the forefront of revolutionizing financial interactions through technology.

In today's financial landscape, investors are faced with the daunting task of sifting through vast amounts of information to make well-informed decisions. As a result, investors sometimes struggle to obtain the specific information they need about Ally promptly and effectively. There is a need for straightforward access to financial insights without the constraints of traditional research methods.

Our Shareholder Engagement Chatbot is an artificial intelligence-powered solution that enhances investor relations and addresses the obstacles associated with obtaining financial information. It enables investors to navigate the complexities of dense financial reports in a quick and conversational manner, while staying on topic and protecting any private information.

Available to the public and equipped with the most up-to-date information, the chatbot provides real-time responses to financial queries. Source citations are provided that include document links for transparency, along with example questions to guide investors who may need a starting point for their inquiries.

Our system quickly and effectively answers shareholders' questions, improving relations and transparency.

Our software is written in Python and JavaScript, leveraging multiple Amazon Web Services for authentication, data storage, and deployment. Its generative capabilities derive from interfacing LangChain with Amazon Bedrock's foundation models.



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Amazon Employee Badge Image Validation Tool

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

As Amazon continues to grow, ensuring a quality employee onboarding process is paramount to supporting Amazon's vision. An efficient onboarding process enables new employees to focus on transitioning without unnecessary delays or disruptions.

Currently, when Amazon hires a new employee, the employee uploads a photo to the employee badge verification system. This photo is manually checked against photo requirements by the Amazon verification team. This process can take days, slowing down the rate in which employees can join Amazon teams.

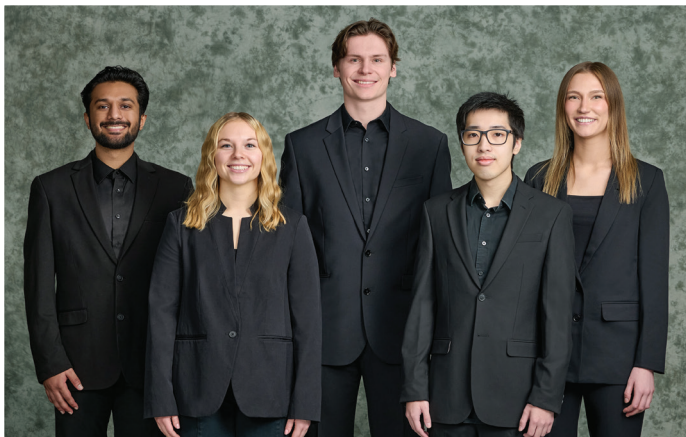
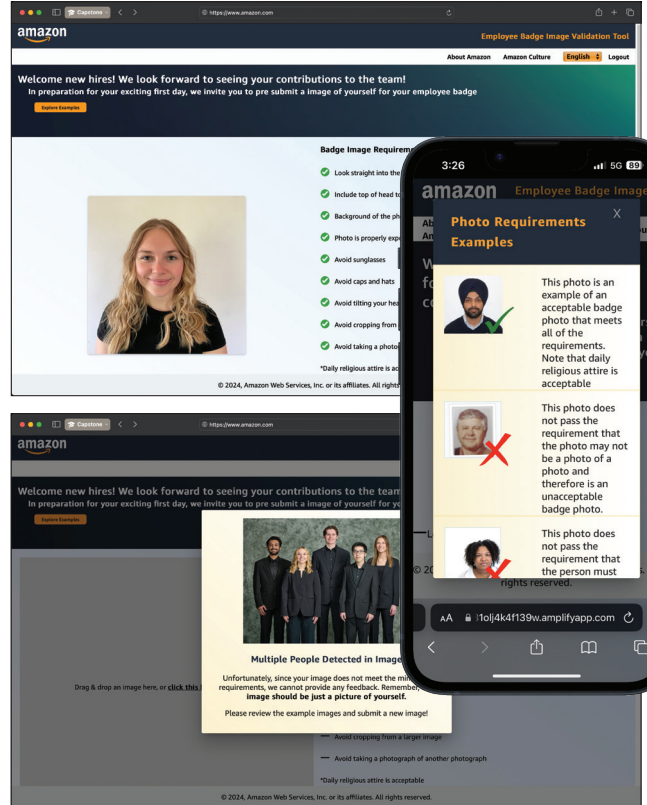
Our Employee Badge Image Validation Tool streamlines the new employee onboarding process by providing instant feedback on new employee badge photos.

Users simply need to upload their photo to the Employee Badge Image Validation Tool website in order to get feedback on their photo. When a photo is uploaded, our system uses machine learning models to test the validity of the new uploaded photo against standardized badge requirements.

The website displays feedback on photos and gives instructions on how they can improve their photo for the next upload.

Our tool not only saves time for new hires, enabling them to start faster and transition more smoothly into their roles, but also enables Amazon to dedicate more resources to delivering quality services to their customers.

Our 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 handled by API Gateway, Lambda, Rekognition, and S3.



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Anthropocene Institute Vessel Classifier for Marine Monitor (M2)

The Anthropocene Institute is an organization based in Palo Alto, California, focusing on exploring solutions to tackle climate change. With a goal of solving the climate problem by 2030, the Anthropocene Institute connects investors, entrepreneurs and policymakers with research groups and experts, while assessing research claims and viability.

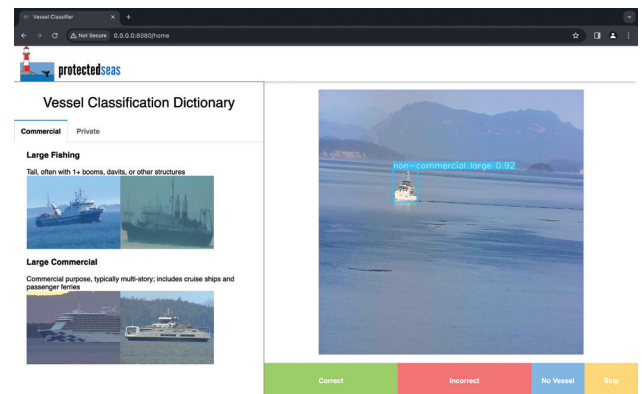
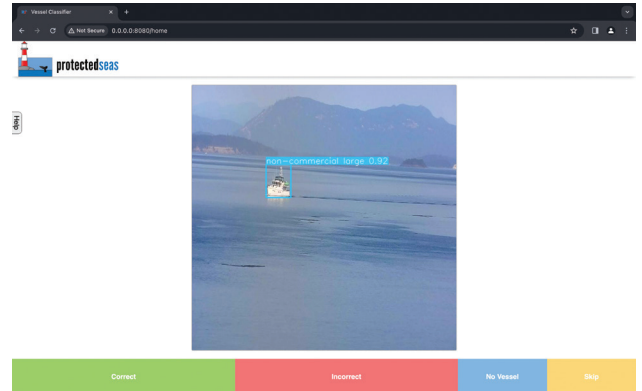
Marine conservation is a key part of maintaining and healing entire ecosystems and populations that depend on the ocean. Focusing on enforcing and monitoring marine conservation and no-fishing zones, ProtectedSeas, a partner of the Anthropocene Institute, utilizes cameras on their land-based radar systems to capture images of vessels near protected zones to ensure compliance. Using these images, ProtectedSeas is creating ship-identifying AI models and must perform the time-consuming task of hand-labeling thousands of images for model training.

Our Vessel Classifier for Marine Monitor (M2) takes input images and identifies whether a ship is present using machine learning, automating the labeling process, saving time and effort.

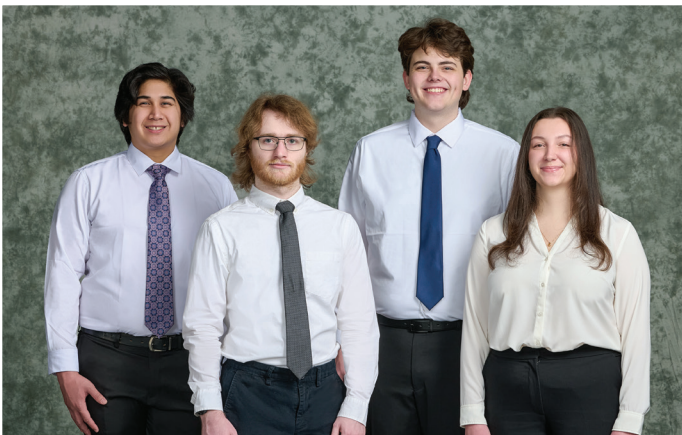
The system runs on a website that takes in user images and automatically labels them using a model trained periodically on the vessel dataset. If the model is not at least 90 percent confident with its label, the user is prompted to manually classify said image. The user can also access all the images from that session to override their automated labels. The images and their labels are added to ProtectedSeas' database to train their ship-identifying models as well as the system itself periodically.

Using our system, training AI is more efficient than ever before, giving ProtectedSeas more time to keep the ocean protected.

Our Vessel Classifier for Marine Monitor (M2) runs on a Flask website containerized in Docker for ease of migration and uses a PyTorch computer vision model for image classification.



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Auto-Owners Insurance Policyholder's Interactive Guide (PIG)

Founded in 1916, Auto-Owners Insurance is a Fortune 500 company employing more than 4,700 associates, and providing nearly 5.6 million insurance policies across 26 states. Auto-Owners has been headquartered in Lansing, Michigan for over 100 years.

Auto-Owners offers a wide range of vehicle coverage. Navigating through the intricacies of the various vehicle insurance policies can be overwhelming. To help mitigate this, Auto-Owners is looking to create comprehensive ways for policyholders to learn more about loss prevention and insurance for vehicle parts.

Our Policyholder's Interactive Guide (PIG) is an augmented reality application that enables users to interact with vehicle parts and associated insurance coverage information in real time using the Microsoft HoloLens 2.

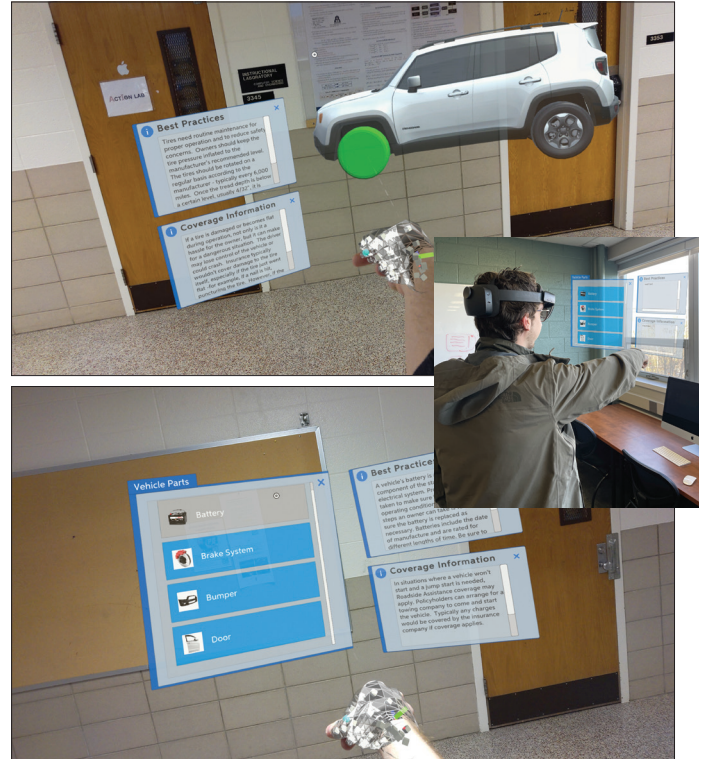
Once wearing the HoloLens 2, users select from three distinct modes: panel, full virtual object, and object detection. In panel mode, users are presented with a list of vehicle components in which they choose a component from a simple two-dimensional menu to learn more about.

In full virtual object mode, users select a fully virtual vehicle model. Once selected, the three-dimensional vehicle model appears and the user can view different vehicle components on the model to reveal in-depth insurance information about that object.

Lastly, in object detection mode, the user can approach various components on real-world vehicles and the system provides the user with coverage information.

Using our system, Auto-Owners' policyholders save time and money, and are provided the best possible customer service experience.

The PIG: Policyholder's Interactive Guide is built in Unity using the Mixed Reality Toolkit and is written in C#. Object detection uses Azure Custom Vision to detect real-world objects.



Auto-Owners
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DRIVEN-4 DRIVEN-4 Connect Application, Server and Backend

For over 30 years, DRIVEN-4, based in St. Joseph, Michigan, has focused on and specialized in the areas of product lifecycle management (PLM), connected product development (IoT), connected operations (IIoT) and cybersecurity. Today, DRIVEN-4 strives to create innovative software solutions for its clients.

The DRIVEN-4 Connect Module is a programmable logic controller (PLC) that, through on-board sensors and network connectivity, is customizable to fit end-user needs. Managing user modules, providing connectivity to modules, and analyzing data collected from modules requires an equally customizable solution.

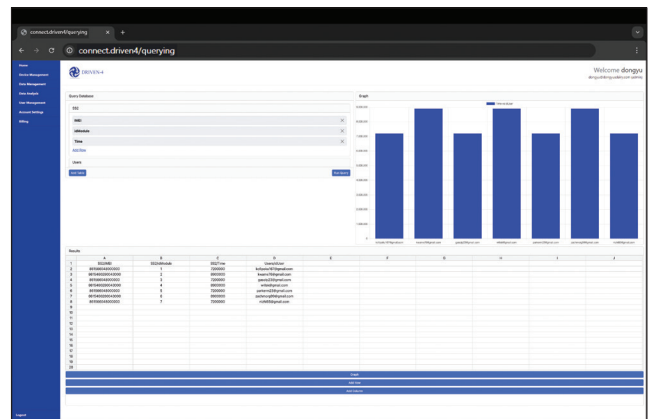
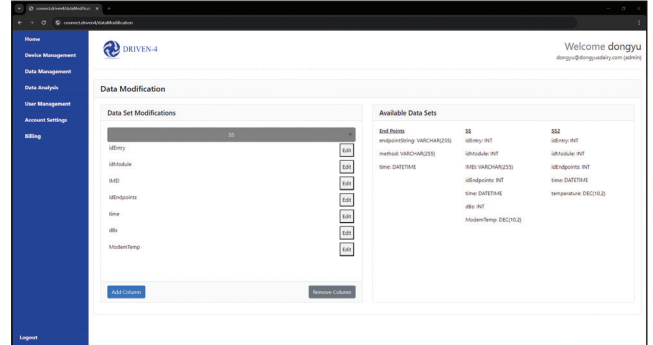
Our DRIVEN-4 Connect Application provides a customizable and streamlined solution for end-users to interact with DRIVEN-4 Connect Modules. Through the Connect system, users can view provisioned modules, update module firmware, and analyze data collected and uploaded from modules.

A provisioned module is set up by the end-user and specifies the schema of collected data. Once set up, the Connect system generates a unique endpoint to facilitate the connection to the Connect Module. Through the generated endpoint, the Connect Module sends collected data for storage.

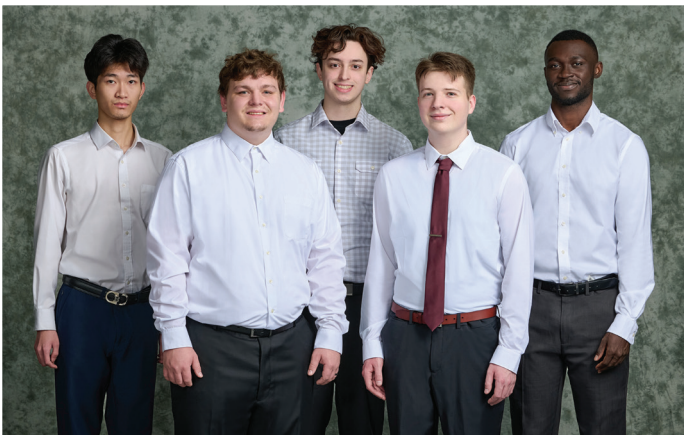
Collected data can be queried, analyzed, and visualized through a spreadsheet that enables for mathematical functions and visualizations through graphing.

Additionally, users can create custom dashboard widgets to display the most relevant data in a convenient location. A learning center is available for users to view tutorials, to view code snippets, and to download code libraries.

The DRIVEN-4 Connect web application front end uses HTML, CSS, and JavaScript. The back end is implemented using the Flask framework, MySQL databases, and SQLAlchemy to interact with databases.



DRIVEN-4



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Elektrobit

Automotive Software Integration In Virtual 3D

Founded in 1988, Elektrobit is a global automotive software company, headquartered in Erlangen-Tennenlohe, Germany with locations across multiple continents. Elektrobit is an industry-leading supplier of automotive software products and services, with their products powering over five billion devices in over 600 million vehicles.

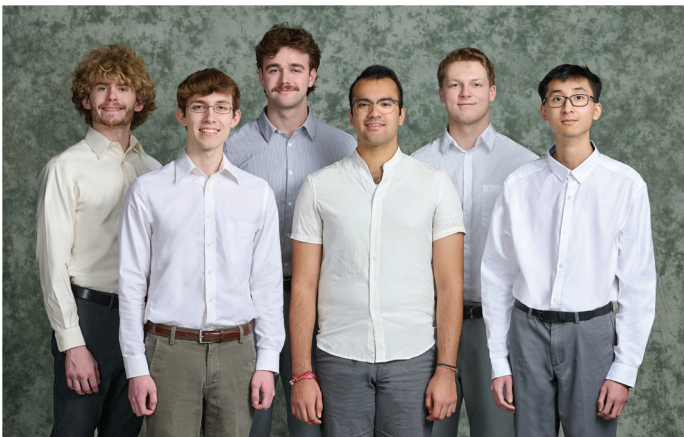
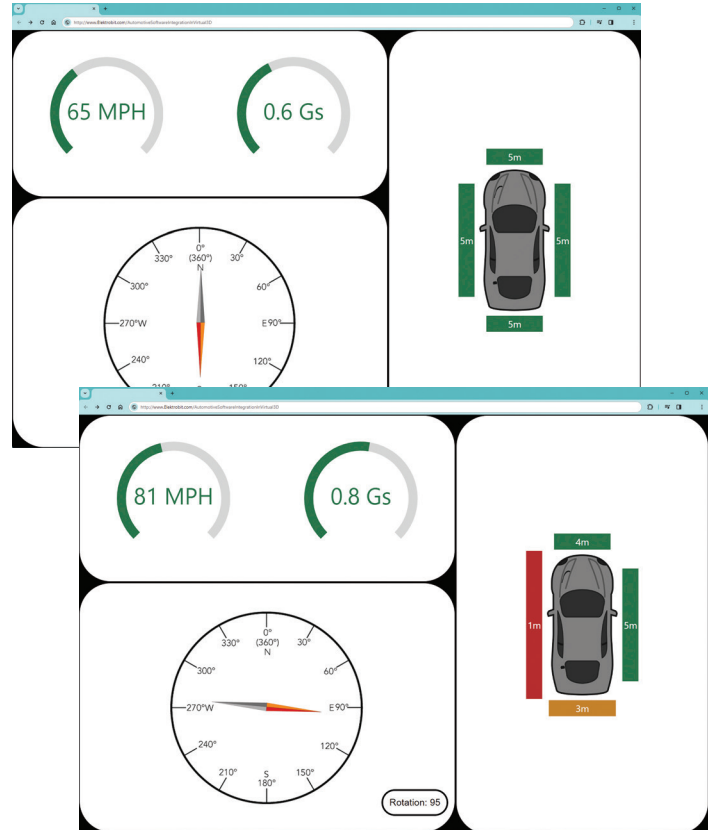
To ensure safe driving, new vehicular innovations are constantly being researched. However, it is very costly to test these innovations in the field. Recently, Elektrobit released Corbos, a software suite that developers utilize in creating programs to be run on automobiles. These programs can include anything from infotainment displays to autonomous driving features. Elektrobit seeks a means to demonstrate the powerful and dynamic capabilities of their new Corbos product to customers.

Our Automotive Software Integration In Virtual 3D system demonstrates the capabilities of Corbos by responsively displaying important metrics from simulated vehicles to automotive engineers and testers through a dashboard-like interface.

The website displays several important features: A top-down view of the vehicle displays the distance and direction of nearby obstacles, a compass is used to dynamically show the direction of a simulated vehicle, and speed and RPM dials are displayed to illustrate these metrics as they would in a real vehicle.

Through our system, Elektrobit is able to display how Corbos is able to help the development of future vehicular innovations.

CARLA simulator, an open-source automobile simulator, is used to generate sensor data that is sent through a Python API to a Docker container. The data is processed and sent to a second Docker container, where a React user interface fetches data from a C++ application running alongside it. Communication between the containers is facilitated by the HPC Dev-Kit from Elektrobit.



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Evolutio Evo Project Reporting Tool

Evolutio is a software consulting company that specializes in delivering innovative solutions to complex technological challenges, empowering businesses to thrive within the tech industry. With approximately 33 employees, the company operates two offices, one in Chicago, and one in Manchester, UK.

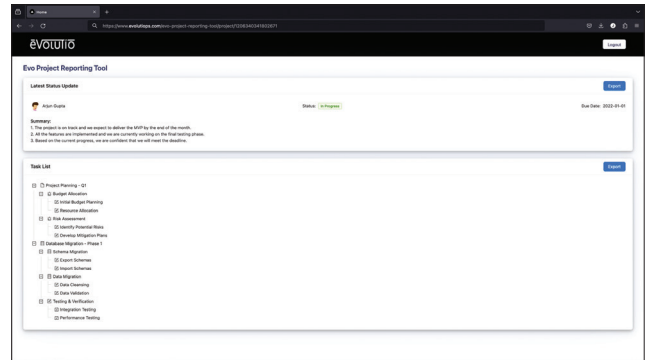
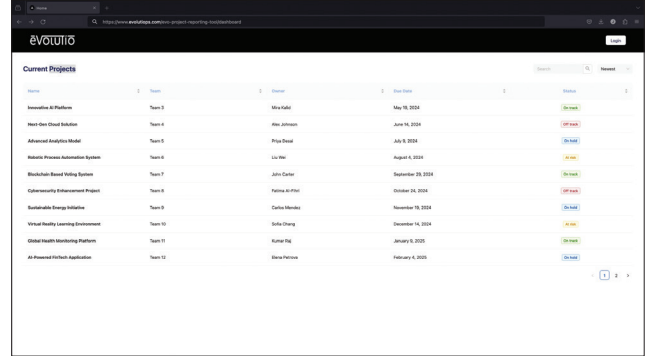
Evolutio has many important clients who need data on their projects presented attractively in reports. However, exporting the relevant data from their internal tools and formatting it in a visually appealing and professional manner is a time-consuming process for the consultants and architects working on projects. Much of this work is repetitive and is the same from week to week.

Our Evo Project Reporting Tool makes report generation easy with a web-based report generation tool that integrates with Evolutio's existing project management tools. Our tool pulls the necessary data for a project and produces high quality PDF reports alongside other exportation formats such as JSON and CSV, that can be provided to stakeholders at all stages of an engagement.

Utilizing the Asana API for real-time data extraction, our software ensures information is consistently updated, providing users with the most current project insights. Our software meticulously processes this data, facilitating its smooth presentation for an intuitive user experience.

Through our tool, Evolutio generates attractive reports with ease, allowing them to focus on making technological strides.

The technological backbone of the Evo Project Reporting Tool includes Next.js and ReactJS for a responsive front-end interface, complemented by a Node.js and Express framework back end. This setup is optimized for efficient data management and seamless user interaction. Okta's authentication system enhances security, while Asana's API integration ensures real-time project updates, maintaining operational efficiency and data accuracy.



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Ford Motor Company Dealer Experience Dashboard

Ford Motor Company is an international automotive manufacturer headquartered in Dearborn, Michigan. With nearly 175,000 employees and producing about 6.4 million vehicles globally, Ford stands as one of the top ten automakers worldwide.

Dealerships are facing stiff competition in the market. Tracking performance across dealerships is pivotal in our modern information age. Ford dealers need to be constantly innovating and improving to ensure success in the automotive industry.

Our Dealer Experience Dashboard streamlines and modernizes the access and analysis of critical information to drive future sales for Ford dealers.

Dealers interact with our dashboard to generate reports of the key data metrics they are interested in analyzing, for example, sales, repair orders, vehicle deliveries, etc.

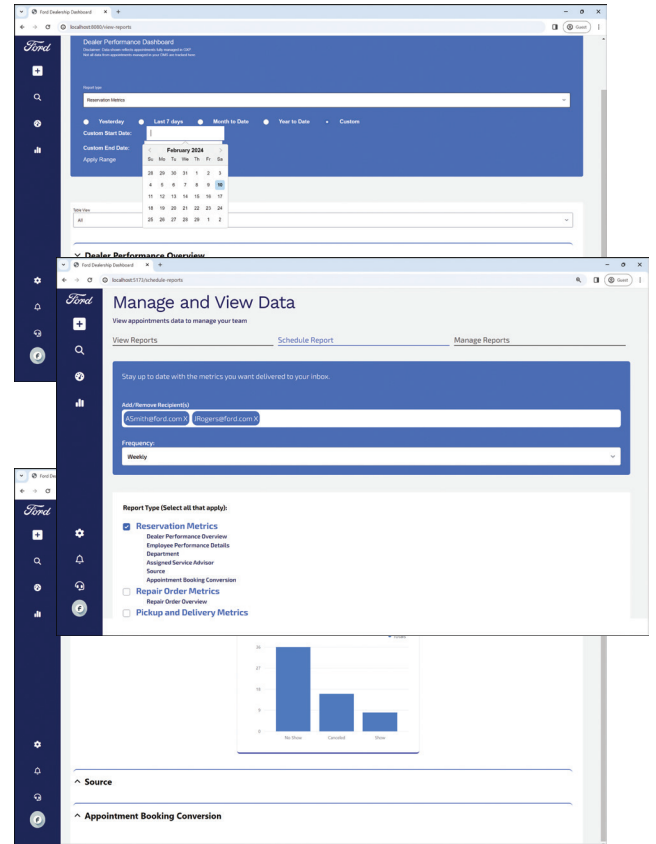
We offer significant customization options so that each dealer can focus on what matters to them. Our dashboard also boasts extensive data visualization tools, enabling users to quickly and effortlessly comprehend complex data through charts and graphs.

After a dealer finishes their data analysis, our dashboard generates a report of the data, visualizations, and overall analysis. This report is then shared with any relevant entities to help improve the overall dealer performance.

Our system automates real-time updates, keeping dealers informed of any changes or trends in dealership performance.

Our software shows sales trends and identifies key areas of growth in dealerships, improving sales and increasing revenue. All the information analysts need to see is now condensed in a few easy-to-use web pages along with easy ways to share these reports.

Our UI is primarily written in JavaScript and developed using React for the front end, Express to talk to the server, and Google's BigQuery to handle the data.



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General Motors Recovery of Lost and Stolen IT Assets

General Motors (GM) is a multinational automotive company based in Detroit, Michigan. GM produces and sells some of the top performing vehicles including Buick, Chevrolet, GMC and Cadillac totaling 2.6 million vehicles sold worldwide.

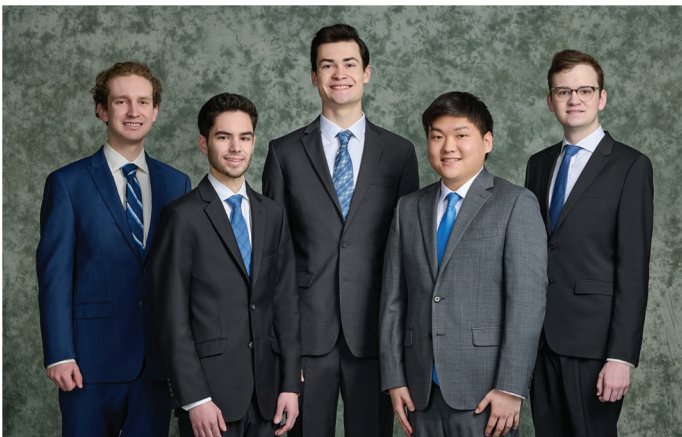
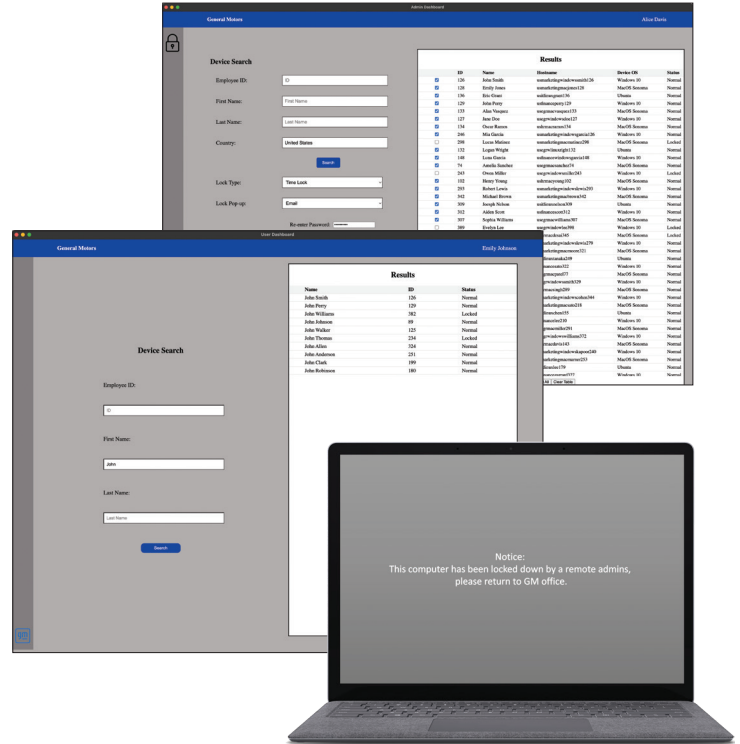
With over 165,000 employees internationally, GM provides a variety of devices to their employees to assist with their work. With all these devices it is inevitable that some are lost or stolen, exposing vulnerabilities to proprietary data and applications. To mitigate this vulnerability GM must go into the device and perform a manual shutdown to revoke access.

Our Recovery of Lost and Stolen IT Assets system streamlines the process of remotely shutting down lost or stolen devices. Our software makes it easy to detect when a device has been misplaced, at which point the device is then automatically locked until it is returned or an administrator logs in.

Once an IT administrator marks a device's location as unknown, a signal is sent out to the device through network communications. On receipt, the lockdown initiation begins by disabling all other users except the administrator account, which is reset with a new password. After lockdown, a confirmation email is sent back confirming the device's status. Upon relocating the device, the IT administrator can log in and recover data held on the devices. This prevents the use of the device and incentivizes its return to GM.

Our software automates the remote lockdown process of GM devices and gives employees the ability to check the status of a device as well. This increases the security of the proprietary data and applications.

Our front end is built with JavaScript, HTML and CSS. The back end is built on a Dockerized Flask application running PowerShell scripts and Python. Finally, our database utilizes PostgreSQL.



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Google Android Vulnerability Database

Google, founded by Larry Page and Sergey Brin in 1998, is the world's largest search engine with its 92% market share. Google offers more than 50 services such as Gmail, Chrome, and the Google Cloud Platform.

One of Google's many services is Android, an operating system designed for mobile devices. Every year, hundreds of security vulnerabilities are remediated on over three billion Android devices. Google's Android Security Bulletin communicates information on vulnerabilities to Google's partners and is matched to reports in the National Vulnerability Database (NVD). These data sets are critical to security experts, but additional effort is required to collect and combine the data from both sources.

Our Android Vulnerability Database consolidates information from the bulletins and data from the NVD in one place and enables users to access that information via the web.

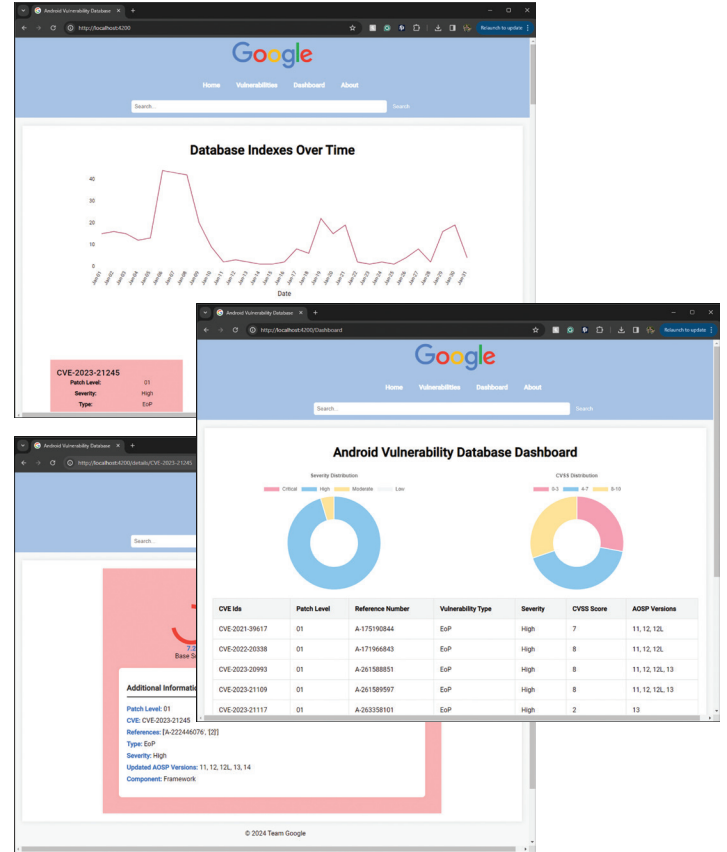
Our tool illustrates metrics that are found in the databases in an attractive, easy-to-use format so experts can survey vulnerabilities with ease.

The most important metric is the base score which indicates the overall severity of the vulnerability and helps security experts to prioritize certain vulnerabilities as they develop fixes.

Security experts can access the consolidated data set via the web-facing application. They can retrieve information with prepared requests or tailor their requests to suit their specific needs.

The app also visualizes the data for users, helping them to analyze the information in an intuitive way, enabling Google employees to solve Android vulnerabilities easier than ever before.

Our tool is open source, hosted on Google Cloud Platform, and utilizes ETL methodology to manage the data. API calls are then used to retrieve data from cloud SQL databases.



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HAP Artificial Intelligence (AI) Training Course

HAP is a Detroit-based healthcare insurer that covers customers of all sizes whether they're a corporation or an individual. With a workforce of roughly 1,100 employees, HAP provides for over 430,000 members.

With such a large number of customers, HAP is looking for ways to increase the productivity of its employees, and artificial intelligence (AI) is a new option. HAP is looking for a way to teach its managerial staff the basics of AI, such as popular large language models (LLMs), and different ways of using them.

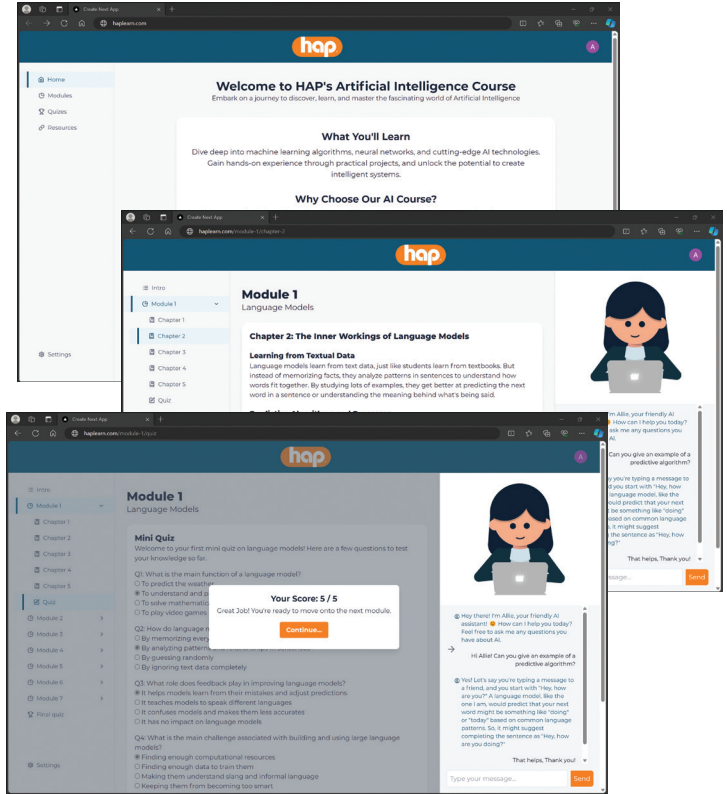
Our Artificial Intelligence (AI) Training Course is an education platform with multiple modules that HAP employees can complete to gain an understanding of AI basics.

Since this covers the basics exclusively, the entire course takes only 15-30 minutes to complete. Content is presented in both text and audio/video format. The audio/video content is exhibited by an AI powered avatar, or "professor." Additionally, the "professor" supports interaction with the user through a chat feature where the user can type or speak questions to receive specific and instant feedback.

Employees take the course module by module and test their retention of the content with mini quizzes. With the completion of this course, employees can leverage AI in their daily lives.

Training a work force to be proficient in the use of AI will enable HAP employees to be more efficient and more productive in the course of their work.

The front end of our application is powered by Next.js, TypeScript, and shadcn/ui for a professional user interface and experience. The back end of our application is powered by Python and FastAPI with MongoDB as the database for the course content. OpenAI powers the avatar's interactivity and Docker containerizes both the front end and back end to be deployed to GCP.



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Lockheed Martin Space SmartSat™ AI Acceleration in Space

Lockheed Martin Space, a division of Lockheed Martin, is headquartered in Littleton, Colorado. Employing over 20,000 people, Lockheed Martin Space is one of the largest aerospace companies in the nation. The advancements of satellite technology in recent years has assisted Lockheed Martin Space in developing the SmartSat™ software development kit. SmartSat™ enables for the rapid development and deployment of satellite software.

Cameras are a crucial component of satellite systems, and the images they capture can be utilized to run image recognition software. However, these operations can be expensive and time-consuming if not properly optimized, which is quite difficult due to the delicate and complex satellite hardware and software systems.

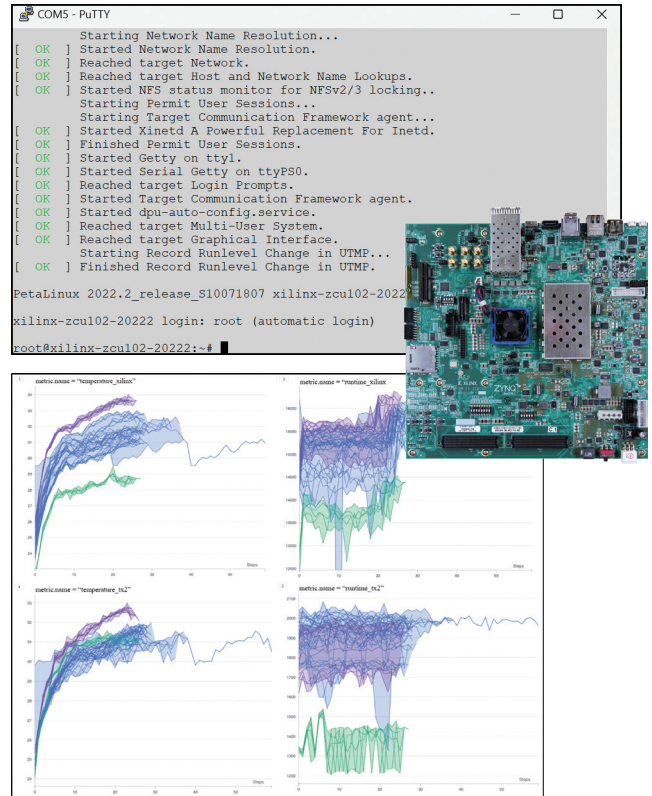
Our SmartSat™ AI Acceleration in Space system deploys various image recognition software onto SmartSat™ hardware to find the optimal hardware for each model.

Our software targets specific hardware components on a given satellite using hardware accelerators. It enables the resources needed in running models on a satellite to be tracked and minimized. Examples of tracked metrics include, but are not limited to, runtime, throughput, and temperature.

The resulting metrics are visualized in an easy-to-use dashboard so Lockheed Martin engineers can easily view optimal components.

Our software enables efficient deployment of image recognition models onto various satellite hardware components. Through our tool, Lockheed Martin Space can easily cut down on the cost of expensive satellite resources, ensuring they are able to keep making exciting advancements in satellite innovation.

Our AI models are compiled by Vitis AI and ONNX Runtime and deployed onto the Xilinx ZCU102 and NVIDIA Jetson TX2. Benchmarking results are displayed using an AimStack dashboard.



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Ludus Digital Playbill Builder

Based out of Holland, Michigan, Ludus is a software-as-a-service (SaaS) company providing various services to 2000+ performing arts organizations of all sizes across the United States. Initially just a ticketing platform, Ludus has since expanded to include marketing, fundraising and streaming.

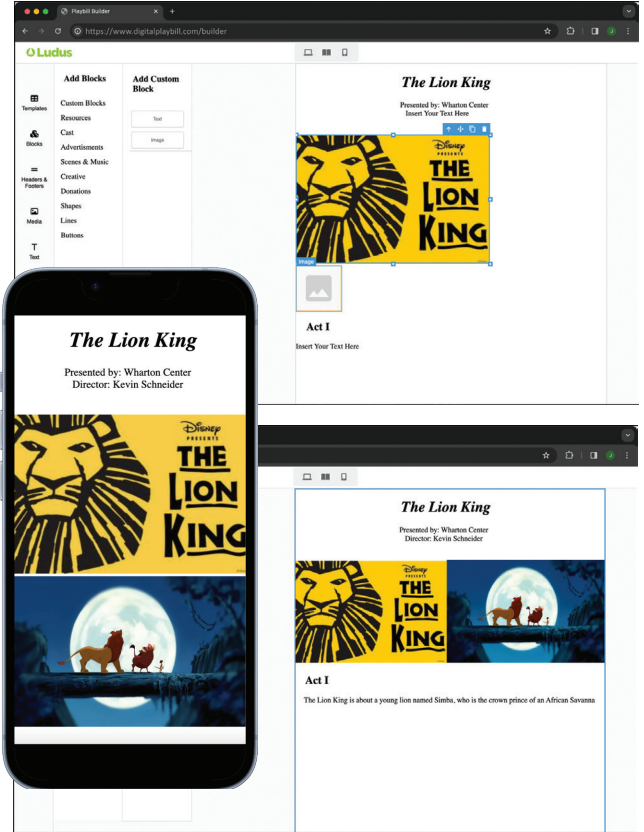
Many performing arts organizations now utilize digital platforms when selling and distributing tickets. However, paper is still the standard for playbills, which can be costly to develop and print. Ludus' latest initiative is to transition from the use of traditional paper playbills into a digital system.

Our Digital Playbill Builder is a web application that consolidates the creation and the distribution of playbills all in one easy-to-use tool. Organizations create custom playbills in a drag-and-drop document builder from a selection of premade elements such as images and textboxes. The user also has the option to upload custom media, designs, and advertisements.

Users can fully customize their digital playbills to be accessible on all devices. Once the design is ready to be viewed by the public, users publish their playbill with the click of a button and easily share a public URL or printable QR code where the playbill can be accessed by the audience.

Our playbill builder creates a unique way for theaters to distribute playbills, provides patrons with a new and exciting interactive experience, and eliminates the costs associated with standard paper playbills.

The Digital Playbill Builder is developed as a PHP application backed by the Laravel framework and standard web development languages, including JavaScript, HTML and CSS. The rendering engine for the interactive elements and playbill editor is powered by GrapesJS. All stored data for this tool lives within a secure and managed MySQL 8 database.



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Magna

3D Model for Factory Digital Twin Using WebGPU

Founded in 1957, Magna has established itself as a pioneering force in the global automotive industry. With over six decades of experience, it is more than just a supplier; it is a visionary leader, driving the evolution of the automotive industry.

Managing an entire factory is difficult. With moving machinery, containers, and various supplies, keeping track of everything means walking through the factory and locating objects as needed, which can be very time-consuming. While some of the necessary information is digitalized, Magna currently has no centralized resource for all its factory data.

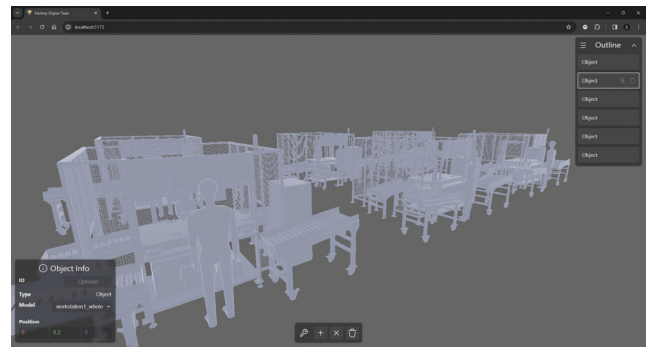
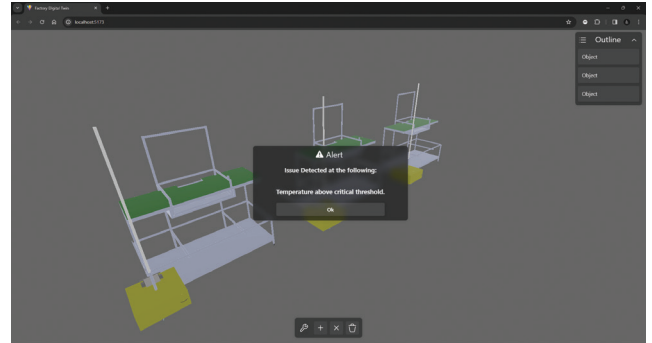
Our 3D digital factory twin web app using WebGPU fixes this problem by creating a way for managers to view a digital model of their factory. The system enhances the efficiency and convenience with which floor managers can supervise their facilities.

Our system enables employees to create digital models of their factory by importing files to portray all the various parts and objects. Objects are then translated and rotated to be placed in their correct spot on the factory floor.

Once the model is built, an outline list on the screen displays all relevant objects within the digital factory twin. If more information on an object is desired, clicking the object in the list brings up a menu showing its position, name, object ID, and other relevant data.

Live data updates and alert statuses are visually represented. For a given object, if a sensor identifies readings above a set threshold, such as a high temperature, the alert system is triggered. The user is then notified with the object details and the object is highlighted within the digital twin so it can be monitored.

The front end is built with Vue for the UI and WebGPU via Orillusion for 3D Rendering. The back end is built in Docker with MongoDB for file storage and EMQX MQTT Broker for handling real-time data transmission.



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Meijer Supply Chain Induction Visibility Using Witron

Meijer is the premier retailer of the Midwest, carrying over 220,000 different products at more than 270 supercenters. Offering such a robust collection of items for purchase, Meijer has and continues to make many innovations in the field of supply chain management, one such innovation being Meijer’s automated warehouses.

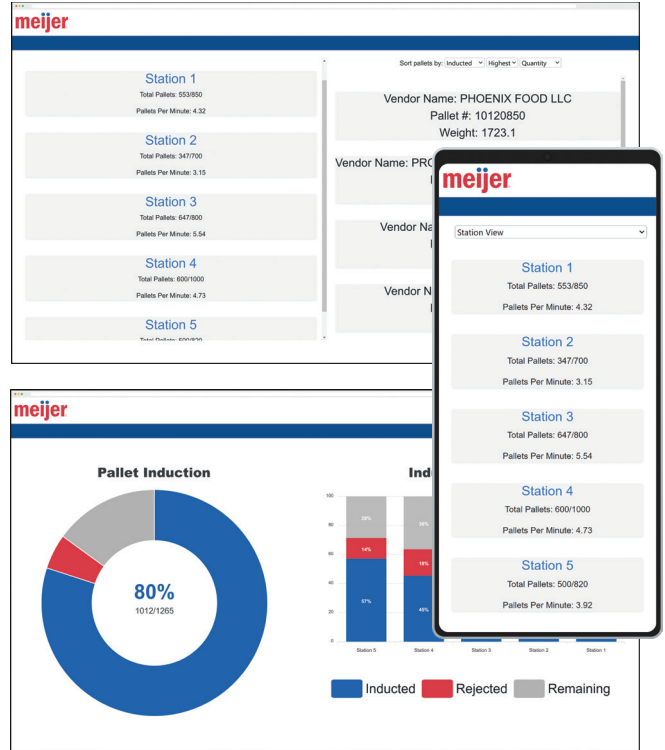
Through their partnership with the German engineering company Witron, Meijer has revolutionized the storage and management of dry groceries, ensuring operational efficiency. One challenge that Meijer faces is the lack of transparency and visibility that a hyper-efficient system creates. This lack of transparency can lead to difficulties pinpointing inefficiencies and disruptions in the supply chain.

Our Supply Chain Induction Visibility Using Witron dashboard improves transparency by visualizing real-time induction station data and displaying it to employees on the warehouse floor using wall-mounted monitors.

Our dashboard integrates data from both Witron and Meijer, streamlining it onto a singular and concise user interface. The data displayed offers detailed insights into pallet induction, including the number of pallets inducted, rejected, and remaining, ensuring a comprehensive view of each station’s operations.

Additionally, the web version of our application enables users with the proper credentials to access an administration page that is configured for both desktop and mobile web browsers. This webpage provides more in-depth statistics for each station and shows efficiency across the entire warehouse, equipping administrators with the information needed to optimize operations.

Our web application is written in C# using .NET Core 8. It is connected to our front end using Microsoft Blazor and is updated on a MySQL database hosted on Microsoft Azure.



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Michigan State University clUML: A Browser-Based UML Editor

Michigan State University's Department of Computer Science and Engineering (CSE) delivers acclaimed courses to over 2,000 students every semester in various computer science-related disciplines. Some of these courses use a system of in-house software called CourseLib to build custom websites.

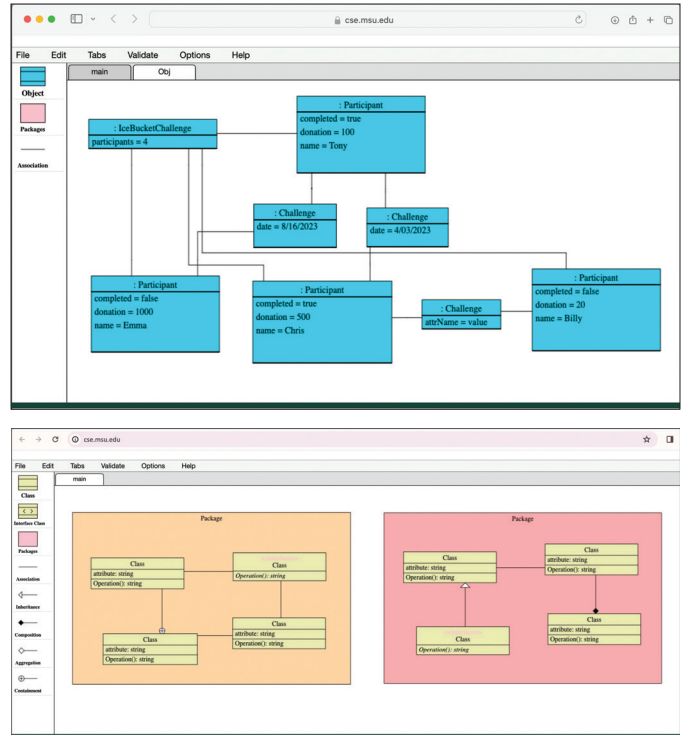
Students taking the department's software design course use Unified Modeling Language (UML) diagrams to visualize the structure of their software, which is a crucial step in the design process. Until now, CSE has relied on a third-party desktop application called Visual Paradigm to create UML diagrams.

clUML is a browser-based UML editor. This eliminates the department's dependency on Visual Paradigm and provides a practical way for students and instructors to create and edit UML diagrams directly on the course website, using any modern web browser.

Students can check their diagrams for redundancy, improve their solutions based on instant feedback, and submit diagrams to be graded. Instructors can embed UML diagrams in assignment pages and quizzes, enabling more efficient grading and reducing the workload for course staff.

clUML supports editing multiple diagrams simultaneously in separate tabs. When creating a new tab, the user specifies whether it should hold a class or object diagram. This determines which components are available.

The front-end interface is implemented in JavaScript, HTML and Sass and works in all modern web browsers. The back end is a PHP package that the owner of a CourseLib website can install using Composer. We use DOMPurify to sanitize user input, Jasmine for JavaScript unit testing, and Karma to facilitate testing the user interface across multiple browsers.



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Michigan State University Envioweather Mobile

Envioweather is a free online resource that provides Michigan farmers and agricultural stakeholders with weather-based tools to help them make pest, disease, plant-production and natural resource management decisions. Envioweather provides more than 60 different weather, pest, disease and crop predictors.

These prediction models provide Michigan agriculturalists with essential data that they can utilize to make informed decisions regarding farm management.

Approximately half of Envioweather’s users access their website via a mobile phone while in the field. However, the current website is not optimized for mobile devices, which leads to difficulties loading and accessing data.

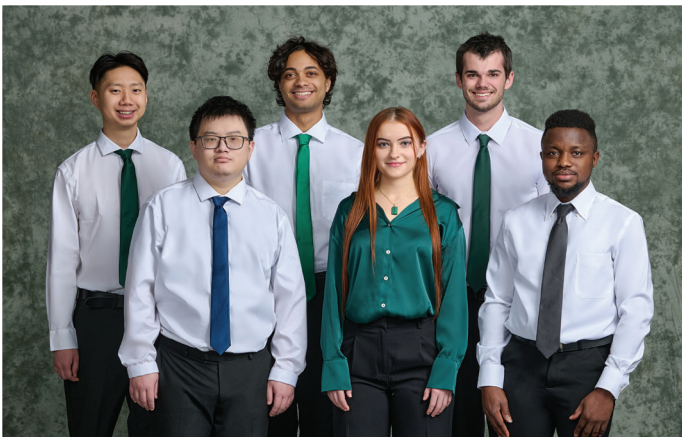
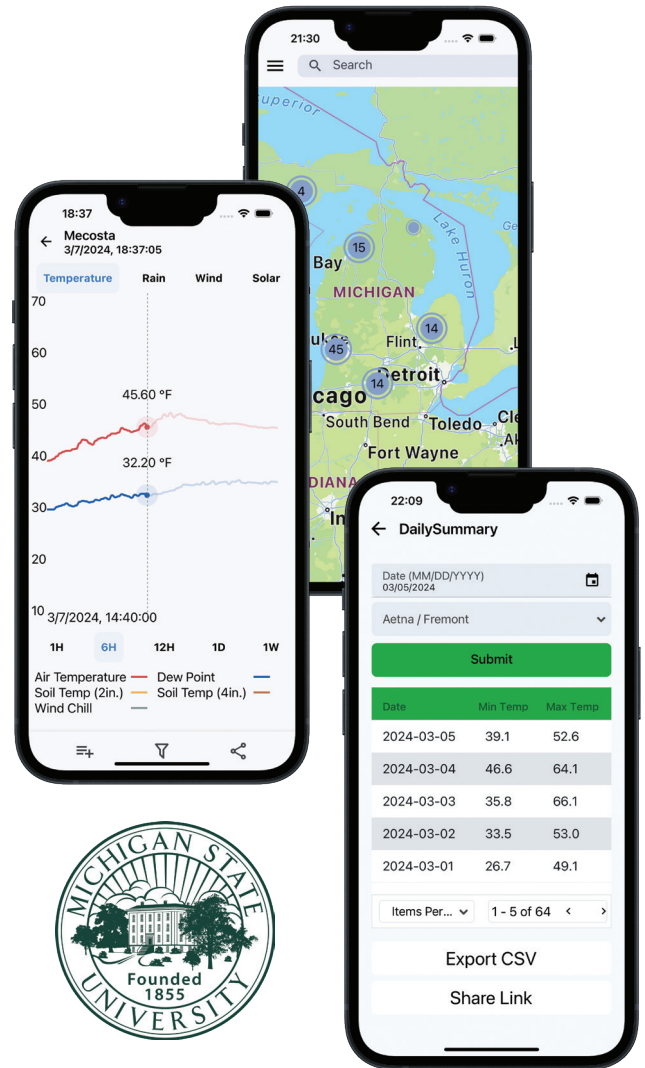
Our Envioweather Mobile application solves this problem by providing users a way to access Envioweather’s models through an app that is designed and optimized for mobile use. The app is downloaded onto mobile devices and enables users to view all of Envioweather’s helpful metrics in a seamless and easy-to-use way.

Our mobile app contains all of the models that are found on the Envioweather website. One example is a model that displays information about current and forecasted weather conditions such as temperature and precipitation.

Envioweather Mobile also contains new and unique models that provide more specific information to agriculturalists to assist in crop management. These models include insights on leaf wetness, soil moisture, and crop pests and diseases.

Having these models in an easy-to-use mobile app enables agriculturalists to make informed decisions about crops, animals, plant diseases, and more.

The front end of our app uses React Native, JavaScript, and CSS. The back end is composed of Envioweather’s API and the National Weather Service’s API.



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MillerKnoll Product Lifecycle Tracing System

MillerKnoll, formerly known as Herman Miller, is renowned for its contemporary interior design and ergonomic furniture. Headquartered in Zeeland, Michigan, they are a leading producer of home and office goods and inventors of the office cubicle.

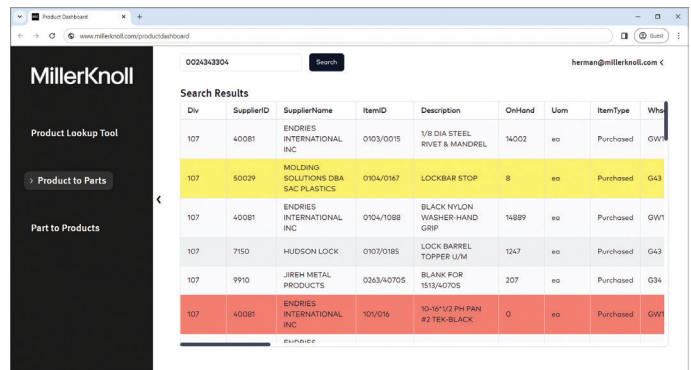
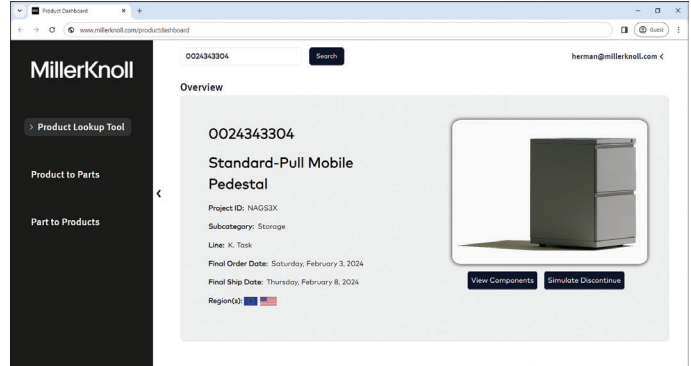
Businesses frequently require specialized furniture for their office space. MillerKnoll services this need with their made-to-order business model. Its level of customizability generates vast amounts of unique data about products and their corresponding components. Manually navigating this information requires a deep understanding of their current inventory and legacy data management systems.

Our Product Lifecycle Tracing System is a web application that provides a centralized, user-friendly way to find product information. Users search for a component and receive basic information about the item, such as its current stock, manufacturing location, and latest order and ship dates.

When searching for a product, users are provided with a summary of its metadata. They can simulate the product's discontinuation and view the impacts on each of its associated components. The software displays components that can be safely removed from the supply chain, while flagging those that other products depend on.

Our system establishes relationships between parts and products. It determines how integral specific components are to the product lineup. It gives insight into how resources can be better allocated, supporting supply and product managers in making informed decisions regarding production volumes.

Our front-end software is built using Next.js, ensuring responsiveness when processing large quantities of data. The back-end software is built with Express.js, which queries a Snowflake database to serve information to the front end.



MillerKnoll



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MSU Federal Credit Union Personalized Augmented Reality Experience

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, 361,000 members, and managing nearly \$7.71 billion in assets, MSUFCU strives to help its local communities thrive and achieve financial freedom.

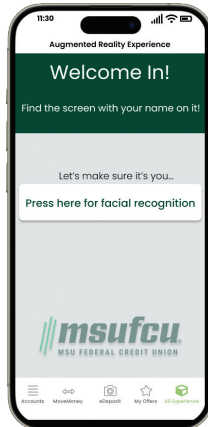
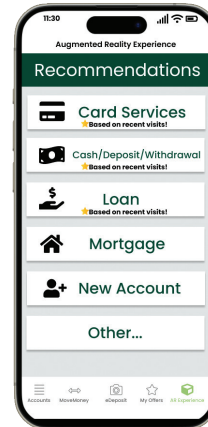
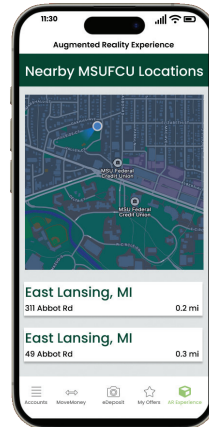
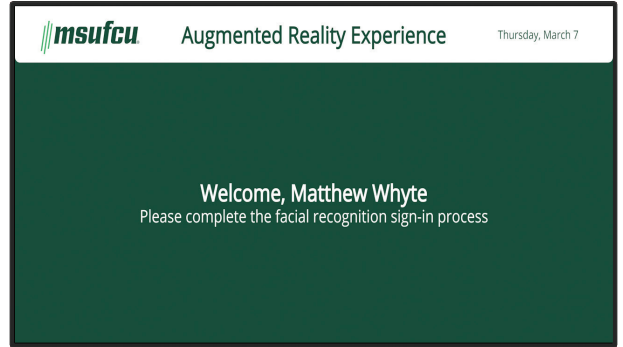
When visiting a branch, MSUFCU currently provides a standard check-in process that requires a member to input their name and wait for an attendant to assist them. As modern technology continues to advance, MSUFCU is looking to introduce a streamlined and personalized on-site experience.

Our Personalized Augmented Reality Experience is a mobile application and web application that provides customers visiting a branch with a digital, yet personalized, experience by offering recommendations for their visit based on a customer's predicted purpose for visiting the branch.

The user begins the experience by using our iOS app to find a nearby MSUFCU branch. The app uses geolocation to recognize when a user approaches a branch. The user then authenticates their account with facial recognition and accesses the Personalized Augmented Reality Experience tool on an on-site screen.

The user is then presented with a list of services on their phone that they can perform at the branch. These include the ability to make deposits or withdrawals, request a loan, or any other common bank activity. The list of services provided by the application is tailored towards the specific user based on their banking history.

The web application displayed by the on-site screen is developed using Python Flask for the back end and HTML, CSS, and Vue.js for the front end. The database that is utilized by the web application is an Amazon Relational Database MySQL server. The iOS mobile application is developed with SwiftUI.



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Roosevelt Innovations Microsoft Excel Data Extractor/Modeler

Roosevelt Innovations provides simple, seamless, and smart software solutions for calculating group rate coverage for dental insurance. Headquartered in Okemos, Michigan, Roosevelt Innovations serves over 23 million customers with 50+ years of claims experience.

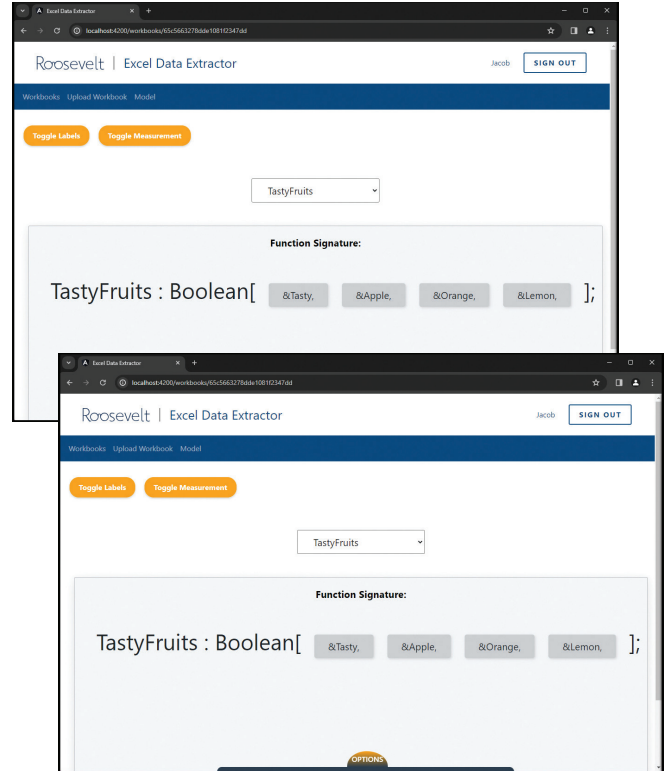
Insurance rates depend on a wide range of factors. Companies seeking to purchase group insurance deal with a large amount of information to calculate the cost for each employee. Microsoft Excel workbooks are a powerful tool for storing and calculating this information. However, rate calculation may become increasingly complex, thus Excel struggles to scale to match corporate demand.

Our Microsoft Excel Data Extractor/Modeler converts information from an Excel workbook to a company domain-specific language, known as GRACE. Users view the workbook in our system, then select groups of related cells, assigning a label to each group. The user also defines custom measurements of interest. Our system automatically converts this measurement information into a calculation using the labels defined in our system.

Diagrams are displayed that show all the labels and measurements defined within a workbook. These diagrams display how different items relate to one another in a graphical format. This deepens the user's understanding of the relationships between elements and the importance of certain factors on an insurance rate calculation. The user can also see redundant relations within the data and optimize their formulas.

Our software simplifies the data ingestion and viewing process, saving time and money.

Our web application is built with an Angular framework written in Typescript, HTML5 and Sass. The web app utilizes a MongoDB connection by communicating with a Quarkus API endpoint written in Java.



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RPM Voice Transcription System

RPM is an international logistics and supply chain solutions company based in Royal Oak, Michigan. RPM specializes in freight transportation and vehicle logistics across North America, including Mexico and Canada.

As a non-asset logistics company, RPM invests heavily in supporting customers and carriers. RPM has 24/7 on-call representatives which aid carriers but increase operational cost. RPM wants to increase the efficiency of helping carriers and customers alike while reducing costs.

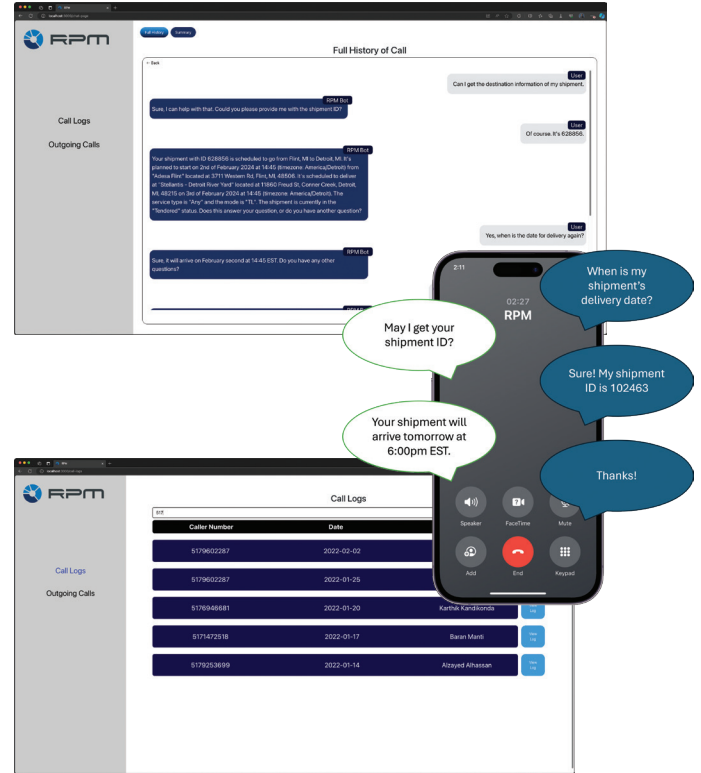
Our Voice Transcription System provides customer service by answering any inquiries the clients have over the phone. The system seamlessly addresses a diverse number of inquiries from carriers and customers without the need of a representative.

Furthering the goal of seamless customer service, our system boasts advanced caller recognition technology that identifies users by their voice. This eliminates the need for users to provide additional information, ensuring swift and hassle-free assistance.

Our system fosters natural interactions and supports Spanish conversations for non-English speakers. System administrators can view callers' data on the web portal. Our system also takes initiative while assisting callers to update crucial information from carriers and clients, again improving efficiency with little effort.

Our system provides high-quality assistance to carriers, reducing costs and increasing customer satisfaction.

The Voice Transcription API is a back-end service that is integrated with phone calls and an admin portal. The service utilizes Python Flask as well as OpenAI, Azure AI, Turvo, Twilio, and React. The Voice Transcription API is hosted on Python Flask. OpenAI's API provides natural language processing, Azure AI translates speech in real-time, Twilio's API manages incoming and outgoing calls, while Turvo's API pulls data from RPM's database.



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Stryker

Dynamic Visualization of Architecture Diagrams

Stryker is a Fortune 500 company that provides world class medical equipment to hospitals worldwide. From surgical equipment to neurotechnology, Stryker is active in over 100 countries and impacts more than 130 million patients annually.

The need to synchronize data across multiple applications, databases, and platforms is strategically imperative for Stryker to stay agile and competitive. With over 200 systems and thousands of integrations between them, Stryker employees need a visual way to display these relationships. The current modeling process relies on manual work done by an engineer, consuming valuable time and increasing the risk of errors.

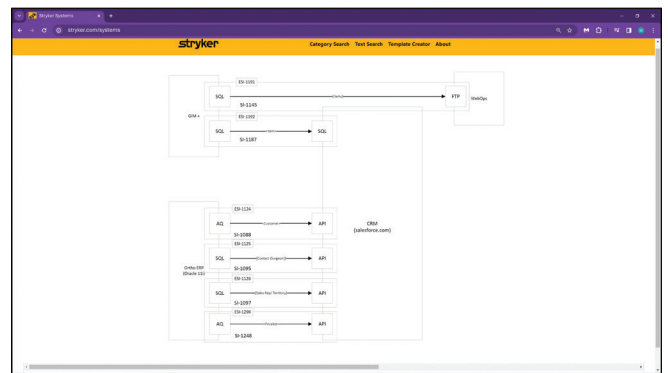
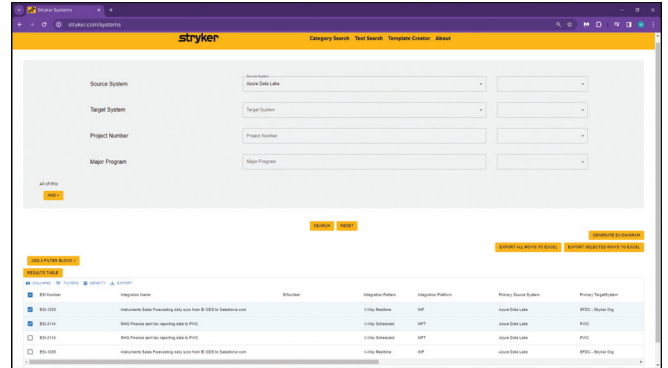
Our Dynamic Visualization of Architecture Diagrams is a web application that improves this modeling process by generating accurate and precise diagrams that represent Stryker's systems and the relationships between them.

Once navigated to the website, the user is presented with options for systems that they can filter to select only the elements they need in their diagram. The software then automatically creates a diagram showing the selected systems and what integrations are present between them. The resulting diagram is then displayed on the web page for viewing. Template diagrams can also be generated with generic information for users to edit.

Diagrams made by the web app can be exported to a Microsoft Visio diagram for further changes. The data can also be exported to a Microsoft Excel file.

Our system saves Stryker engineers time and minimizes opportunity for error by generating accurate architecture diagrams instead of having to do them manually.

The application's back end uses Flask. The front end uses React, hosted on Azure Web App Service. Data for the architecture diagrams is stored in Stryker's Azure SQL Server.



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TechSmith Enhanced Video Assistant (EVA)

Founded in 1987, TechSmith is the global leader in screen recording and screen capture technologies. TechSmith creates software that empowers people to produce extraordinary videos and images. One of TechSmith's key software products, Camtasia, currently has over 39 million users.

As video editing can be time-consuming and difficult to learn, many people are unfamiliar with the process. Additionally, most video editing applications have a large learning curve requiring hours of practice. This creates a problem as many people find themselves unable to enhance or improve a video with ease.

To combat this issue, our Enhanced Video Assistant (EVA) web application enables users to upload videos to be edited by our AI systems. Our software receives a given video and, with a click of a button, seamlessly transforms it into a well-polished product, saving users' time and energy.

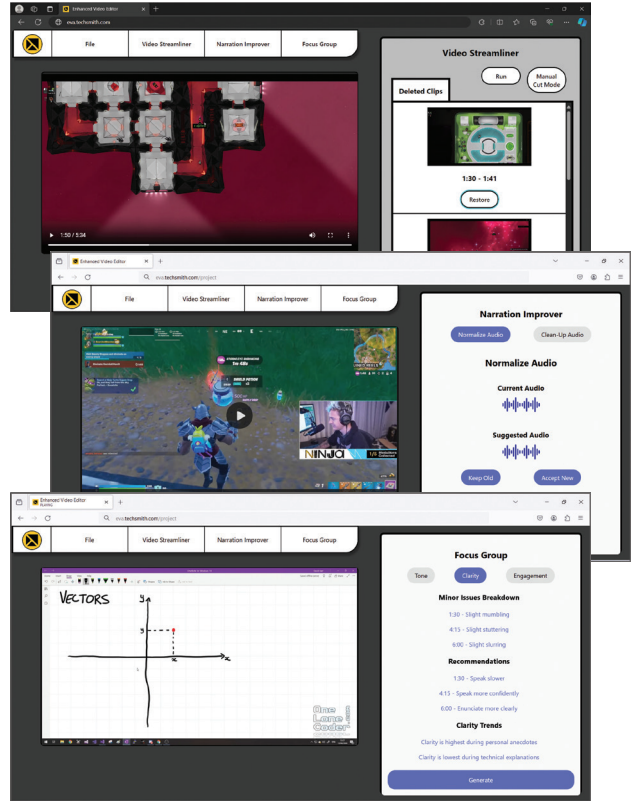
To do this, our system analyzes which segments of a video are most important by using voice recognition and computer vision. EVA removes the unnecessary clips from the video, while retaining the key segments, ensuring that only the best parts remain.

In addition to condensing the video, our software normalizes and balances the video's audio content by filtering out stuttering and background noises.

Finally, our platform contains an AI audience which provides an in-depth rating of the clarity, engagement, and tone of the video content, informing the user about the quality of their video.

Using our tool, video editing is seamless, enabling anyone to make an expertly crafted video regardless of experience.

The back end of our Enhanced Video Assistant is built using FastAPI, while the front end uses ReactJS. The web application is hosted on Microsoft Azure. EVA uses OpenAI Whisper and Azure AI Video Indexer to analyze the videos.



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Union Pacific Rules Test Practice Tool

Union Pacific, headquartered in Omaha, Nebraska, is a leading railroad franchise in the United States, playing a pivotal role in the global supply chain. With an extensive network of railroads spanning 32,200 miles across 23 states, Union Pacific is a united team of over 30,000 employees committed to safe locomotive transport.

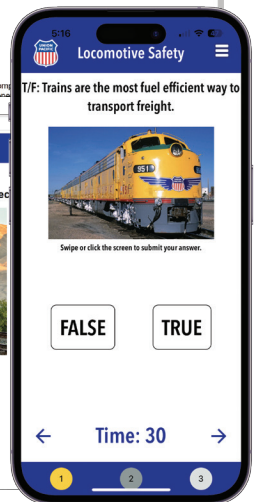
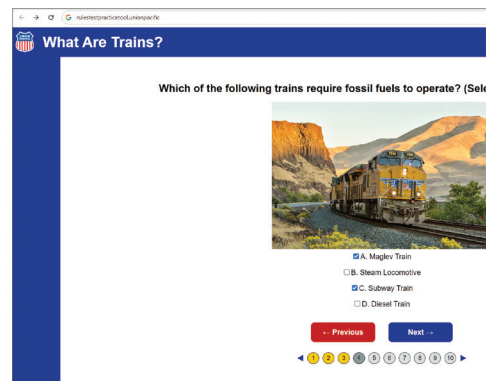
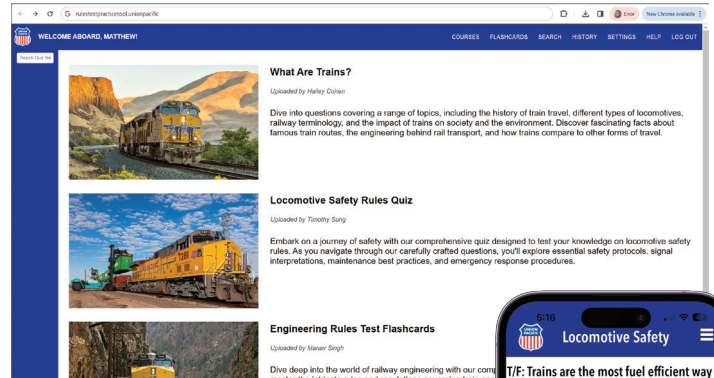
Every three years, Union Pacific requires their employees to review for an online license renewal exam that covers over 3,000 rules for railroad and locomotive operation. Studying for these exams is crucial to both success and operational safety.

Our Rules Test Practice Tool modernizes the training process for Union Pacific employees. Our software addresses the need for an accessible learning platform with an engaging user interface and flexible exam formats. By replacing old testing applications with a versatile web and mobile app, the tool's stimulating learning environment improves study habits and exam preparation.

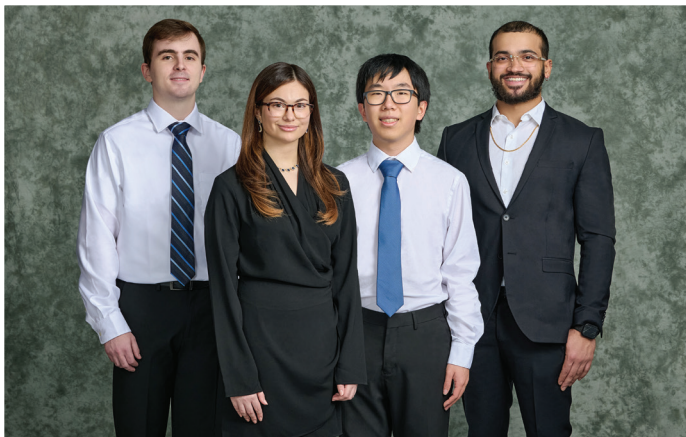
Our tool features multiple testing options and an interface which simplifies navigation and makes learning more intuitive. The platform supports many question formats, including multiple-choice, true/false, and multi-select, as well as multimedia elements. Our software functions across desktop and mobile devices, providing users with access to study materials anytime, anywhere.

Our software consolidates the wealth of educational material Union Pacific holds, better preparing employees for their exams and increasing safety within the company.

The Rules Test Practice Tool is built using ReactJS and React Native for the front end and Firebase as the back end. With SCORM compatibility, the tool easily integrates into existing learning management systems. Our software draws JSON and CSV files from Firebase and uses a standardized format to generate and distribute exams.



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United Airlines Airworthiness Release Management System

United Airlines is one of the world's top commercial airlines. With a fleet of over 900 aircraft, they rank as the world's third largest airline. United Airlines deploys this fleet to conduct 4,500 flights a day that reach over 300 cities.

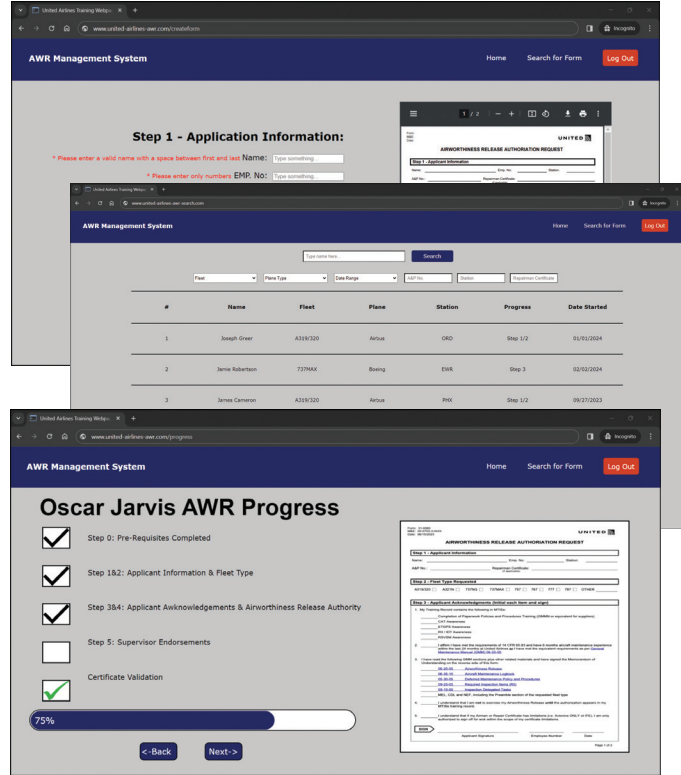
United Airlines employs many technicians who work on both the aircraft, as well as the systems in place necessary for successful flights. To work on aircrafts, technicians must be certified airworthy. The process of becoming airworthy involves the technician completing certain trainings and tracking their completion. Once those steps are complete, a supervisor signs off an authorization request to finalize the certification.

This process consumes time and is tracked with paper records. Our Airworthiness Release Management System digitizes the entire airworthiness process, including tracking completion.

Our system manages the creation, signing, and storage of the airworthiness release authorization requests. An employee can easily create the initial form by filling out their basic information. Then, both the technician and supervisor can sign and complete the newly-created form. Incomplete and complete forms are stored online and can be easily searched for using our system. During the form completion process, reminders are sent out to employees if a form requires an action from them. The entire process now requires no paper forms or signatures.

Our system streamlines the airworthiness release process, increasing efficiency and reducing user error.

The user interface for our Airworthiness Release Management System is developed using HTML, CSS, and JavaScript. The back end is developed using Flask, MySQL, REST APIs, and Python algorithms. Completed forms are stored in SharePoint, technician training records are stored in MTISE, and our web application is containerized and deployed using Docker.



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Urban Science AuditBuddy

Urban Science is a leading global consulting firm headquartered in Detroit, Michigan that has provided tailored insights and solutions for the automotive industry worldwide since 1977. They leverage data and business science to help clients increase market share, improve profitability, and enhance customer satisfaction.

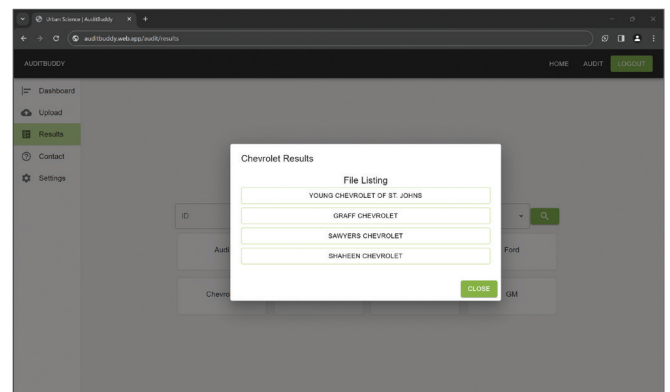
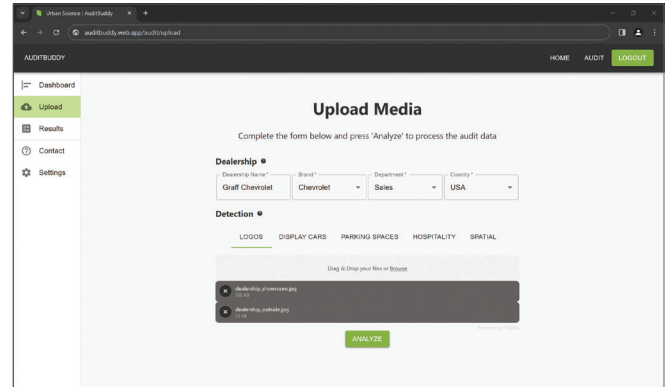
Automotive companies rely on car dealerships to make a strong first impression on potential customers. They recruit Urban Science to audit their dealerships for compliance with brand standards. The traditional audit process requires auditors to conduct an in-person inspection of a dealership, evaluate the premises on various metrics, and build a report manually. While thorough and effective, the process is time-consuming and resource-intensive.

Our AuditBuddy web application significantly reduces the total audit time by utilizing artificial intelligence to analyze and evaluate footage from dealership premises.

The AuditBuddy web application interface provides a separate media file upload space for each evaluation factor. Users capture videos and photos and upload each media item to the corresponding media file. Subsequently, the footage is analyzed using our AI model and the dealership is evaluated based on the standards set by the brand.

The application produces a comprehensive report on dealership performance based on factors such as the quality of display, customer hospitality, employee satisfaction, and parking availability. Along with generating new reports, auditors can access historical reports and compare statistics across various dealerships over different time periods.

Our web application is built using ReactJS for the front end, Firebase for data storage, and Python Flask for the back end. It utilizes YOLOv3 and the Google Cloud Vision API to perform advanced computer vision tasks.



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UWM IT Datamart Microservice for BitBucket

Headquartered in Pontiac, Michigan, UWM provides mortgage products and services to mortgage brokers all over the country and is currently the top wholesale and mortgage lender in the United States.

To support their daily operations, UWM's technical production is massive and in a constant state of change. With thousands of lines of code changing every day, production and deployment issues arise. Finding these bugs can be difficult, time-consuming, and may slow down progress.

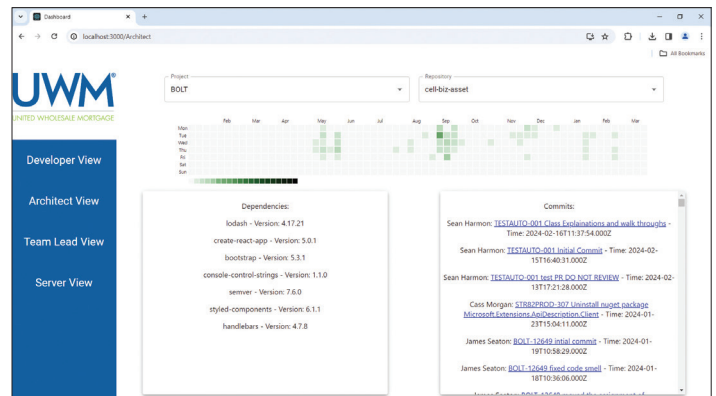
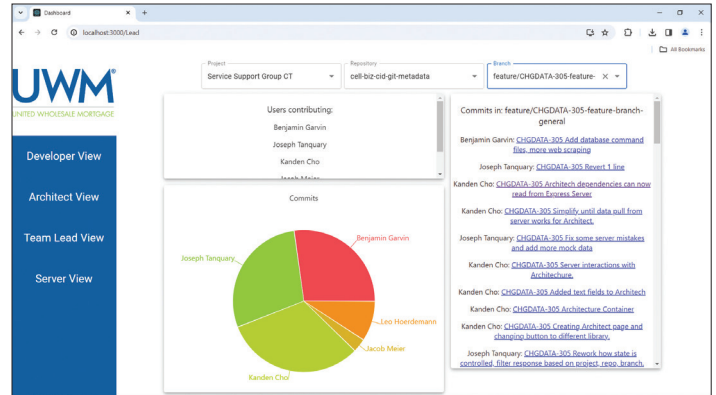
Our IT Datamart Microservice for BitBucket tool solves this problem by providing a way for managers to identify potential issues and predict where future problems may occur.

As software engineers make changes to UWM's BitBucket code repositories, our tool collects data about the changes. The data collected includes the number of commits to a branch or repository per day, the IDs of developers who contributed to a given branch, how much was contributed, when it was contributed, dependencies of the project, and more.

Once gathered, the data is then displayed on our web dashboard. The dashboard presents various diagrams for UWM employees to view. This enables managers to view information regarding thousands of code changes across the company at a glance.

Managers can then use this data to identify potential issues and predict where future problems may occur. This aids in improving code quality and preventing future bugs.

Our business logic is a microservice which is written in C#. It is hosted on a Docker container within UWM's larger server systems. In a separate container is our website written in ReactJS, which, along with the C# logic, communicates with Microsoft SQL Server to update UI elements and provide current and useful information.



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Whirlpool Corporation Personalizing the Culinary Experience

Whirlpool Corporation, headquartered in Benton Harbor, Michigan, is a global home appliance manufacturer with approximately \$20 billion in annual sales, 54 manufacturing and research centers, and 61,000 employees. Whirlpool's mission is to improve satisfaction and engagement with their home appliances.

As smart appliances become more common, personalization and adaptability to users' preferences are crucial for product differentiation and user satisfaction.

While most smart appliances offer a generic approach to user profiles and recommendations, Whirlpool is at the forefront of creating personalized user experiences, setting a new standard for appliance functionality.

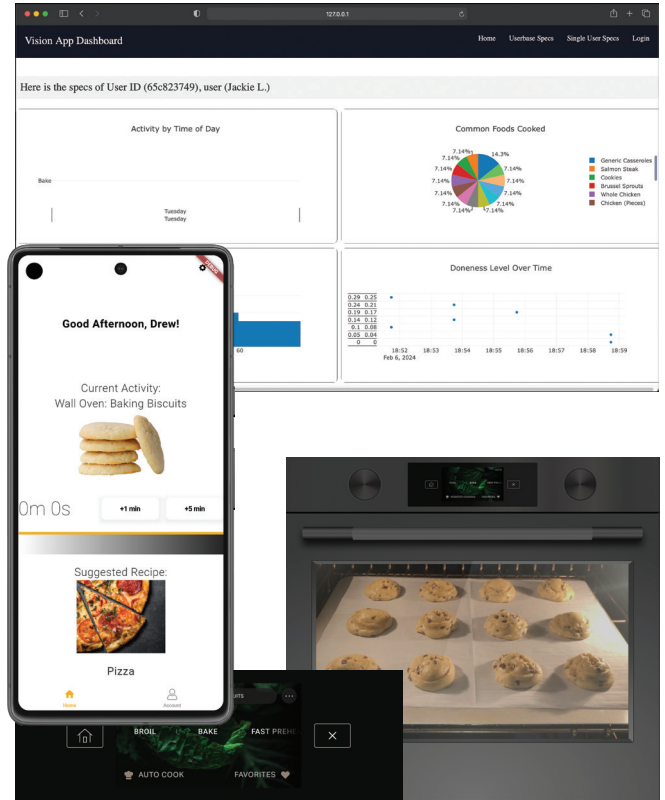
Our Personalizing the Culinary Experience application enables Whirlpool ovens to learn users' cooking habits and personalize their experience.

Our machine learning model responds to user interactions by identifying patterns in cooking settings, recipe details, and other preferences, ultimately refining user profiles over time.

This information is then used to generate tailored recipe recommendations and suggest cooking settings for the user.

Aggregated user analytics are accessible on our web dashboard, enabling Whirlpool's food scientists to enhance their services. These applications help advance Whirlpool's mission in improving user engagement by incorporating machine learning to provide customized recipe recommendations.

Our mobile and smart oven applications are built with Dart, and the dashboard is developed using JavaScript and Plotly. These applications are supported by a MongoDB server, with API calls facilitated by FastAPI. Recommendations are generated by BERT, a transformer model from Hugging Face, which we fine-tuned for our application.



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WK Kellogg Co Next Gen Smart Factory

WK Kellogg Co, home of the world’s most memorable cereal brands, is one of the largest food manufacturing companies in the nation. Located in Battle Creek, Michigan, WK Kellogg Co was created as a spinoff of Kellogg’s, owning the North American cereal division.

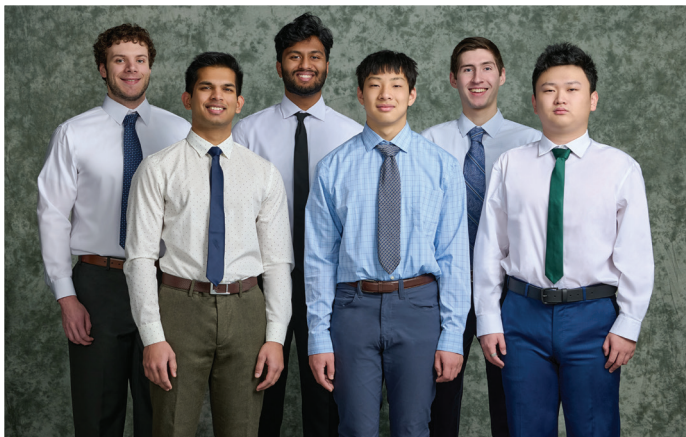
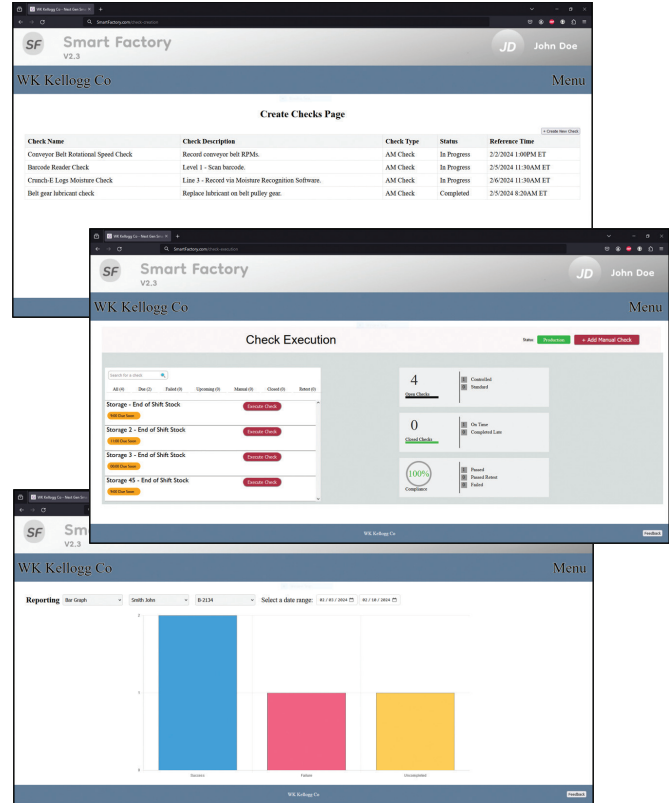
Proper factory operations are integral to cereal production. To manage factory operations, WK Kellogg Co uses a web application called Smart Factory to track factory logistics. Smart Factory keeps track of maintenance tasks for factory operators and enables management to create tasks and view visualizations of historical factory data.

However, the software that Smart Factory was created with is being retired and is not part of the new WKKC landscape. Moreover, some users of the existing software have expressed a desire for a more intuitive design for Smart Factory’s next iteration.

Our Next Gen Smart Factory platform replaces the existing Smart Factory software to provide seamless and intuitive operations for administrators and factory operators alike. Moreover, Next Gen Smart Factory preserves the integral components of the previous iteration of Smart Factory while improving the user experience for administrators and operators.

Our tool enables administrators to create customizable checks for operators, track task progress, and visualize historical factory data. Operators complete checks assigned by administrators and report this via our tool. These checks are easily logged and parsed to extract relevant data for administrator review, ensuring that WKKC factories are able to continue making their famous cereals.

Next Gen Smart Factory is developed using HTML, CSS, and JavaScript for a modern, friendly, and intuitive user interface. The historical factory data is stored in a SQL Database, and Python’s Flask framework to connect the front end and back end seamlessly.



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Fall 2023



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Team Anthropocene Institute



MSU Federal Credit Union Praxis Award
Team Vectra AI



TechSmith Screencast Award
Team TechSmith



Urban Science Sigma Award
Team Moii.AI

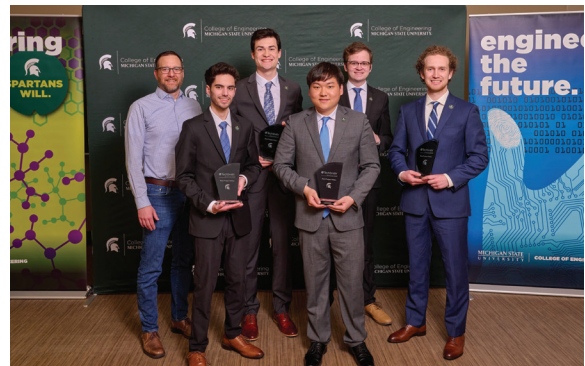
Spring 2024



Auto-Owners Exposition Award
Team TechSmith



MSU Federal Credit Union Praxis Award
Team MillerKnoll



TechSmith Screencast Award
Team GM



Amazon Sigma Award
Team Vectra AI

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