# The Capstone Experience

From Students...to Professionals

COMPUTER SCIENCE AND ENGINEERING 2018-2019

MICHIGAN STATE
UNIVERSITY

Auto-Owners
INSURANCE
LIFE · HOME · CAR · BUSINESS

The Capstone Experience

Department of Computer Science and Engineering

**CSE498, Collaborative Design**

Dr. Wayne Dyksen
Professor of Computer Science
and Engineering

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 Amazon, Aptiv, Auto-Owners Insurance, Consumers Energy, Dow Chemical, Evolutio, Ford Motor Company, General Motors, Google, Herman Miller, Humana, Meijer, Michigan State University, Microsoft, Mozilla, MSU Federal Credit Union, Principal, Proofpoint, Quicken Loans, Spectrum Health, Technology Services Group, TechSmith, Union Pacific Railroad, United Airlines, Urban Science, Volkswagen and Whirlpool.

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

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

THANKS TO AUTO-OWNERS INSURANCE

Auto-Owners
INSURANCE
LIFE • HOME • CAR • BUSINESS

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).

Project Sponsors

Jeff Lemmer

Vice President and
Chief Information Officer

*Ford
Dearborn, Michigan*

"Ford IT teams up with The Capstone Experience to provide opportunities that innovate IT solutions and technology. MSU students' core skills and emerging ideas bring a diverse academic excellence to our teams, influencing the future of mobility. The Ford IT College Graduate program has been an entry point for nearly 100 MSU alumni over the years."

April Clobes

President and
Chief Executive Officer

*MSU Federal Credit Union
East Lansing, Michigan*

"As a Design Day judge, I have evaluated Capstone projects from many of the project sponsors. The software systems produced by the MSU students rival that of professional developers. Our latest Capstone project, AutoBudget Chatbot, provides MSUFCU members with a voice-enabled chatbot that gives personalized budget suggestions based on a member's income and spending patterns."

Elizabeth Klee

Chief Information Officer

*Urban Science
Detroit, Michigan*

"Our mission at Urban Science can only be accomplished with the best and brightest problem solvers, innovators and analytical thinkers, which is why we partner with The Capstone Experience at Michigan State University. We've sponsored twenty-one projects in the past ten years and have hired thirty-nine MSU graduates."

Jim Schumacher

Senior Vice President,
Information Systems
and Technology

*Auto-Owners Insurance
Lansing, Michigan*
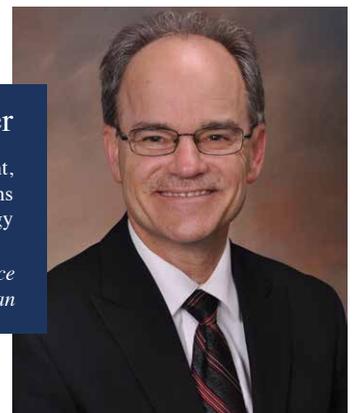
"Auto-Owners Insurance is proud to be a long-term capstone project sponsor. The business-like environment of the capstone experience provides a unique opportunity for students to develop into professionals. Our strategic partnership has enabled us to identify and recruit many outstanding Michigan State University graduates."

Capstone Alumni

Mairin Chesney

Software Engineer

Google
Mountain View, California

"Like no other class at MSU, the Capstone Experience taught us what it is really like to work in industry as a software engineer. Now as a Tech Lead on the Google Maps team, I particularly recall the importance of learning how to work with stakeholders to find the optimal solution from the technical, product, and user perspective."

Hometown: Brighton, Michigan

Adam Schoonmaker

iOS Software Engineer

Airbnb
San Francisco, California

"The Capstone Experience at MSU is the bridge between theoretical coursework and industry software engineering. My capstone project offered me a chance to solidify my skills while working with a company as a client. Our project operated like a startup environment, and the lessons I learned in project management, cross-functional collaboration, and engineering with a deadline serve me to this day. I've found Capstone to be the most career-relevant class I took at MSU."

Hometown: Haslett, Michigan

Max Goovaerts

Software Engineer

Facebook
Menlo Park, California

"Software development in the business world differs from class. You're developing a solution to solve a business need; the requirements aren't always clear and change throughout the development cycle. The Capstone Experience allows students to learn this first-hand in order to prepare them for the real world and set them up for success."

Hometown: Ann Arbor, Michigan

TJ Kelly

Software Engineer

TechSmith
Okemos, Michigan

"The MSU Capstone experience provided me with the essential skills required to be successful in a corporate engineering environment. I enjoyed working on real-world problems with my team and learning how to professionally communicate with a client. I learned important skills such as preparing, presenting, and defending technical presentations, which are crucial to becoming an effective team member in a full-time engineering position. I apply the skills which I acquired from this course every day as a Cloud Engineer at TechSmith Corporation."

Hometown: Jackson, Michigan

Capstone Project Sponsors Fall 2018

amazon

Seattle, Washington & Detroit, Michigan

Auto-Owners
INSURANCE

Lansing, Michigan

Ford

Dearborn, Michigan

meijer

Grand Rapids, Michigan

Microsoft

Redmond, Washington

MSU MICHIGAN STATE UNIVERSITY
FEDERAL CREDIT UNION

East Lansing, Michigan

Quicken Loans
Engineered to Amaze

Detroit, Michigan

TechSmith

Okemos, Michigan

UNITED

Chicago, Illinois

VW

Auburn Hills, Michigan

APTIV

Troy, Michigan

DOW

Midland, Michigan

HermanMiller

Zeeland, Michigan

MICHIGAN STATE UNIVERSITY Founded 1855

East Lansing, Michigan

Firefox

Mountain View, California

proofpoint

Sunnyvale, California

SPECTRUM HEALTH

Grand Rapids, Michigan

UNION PACIFIC

Omaha, Nebraska & Okemos, Michigan

URBAN SCIENCE

Detroit, Michigan

Whirlpool
CORPORATION

Benton Harbor, Michigan

Amazon
AVAST: Amazon Video And Shopping Technology

Founded in 1994 as an online bookstore, Amazon is the largest online retailer in the world. In addition to retail, Amazon offers services in cloud infrastructure through Amazon Web Services, and audio and video streaming through Amazon Music and Prime Video.

According to a recent study, 80% of internet usage will be people watching online videos by the year 2020. This presents a significant opportunity for all online retailers.

Our AVAST (Amazon Video And Shopping Technology) platform leverages the growth in online video streaming by providing users with an easy way to purchase products of interest that they see in the videos they are watching.

Using AVAST, an Amazon customer can stream videos from content providers such as YouTube and their favorite TV networks.

While a user is watching a video, AVAST analyzes it to find items of potential interest to the viewer. As the video plays, related Amazon products are displayed alongside the video as illustrated in the examples at the right.

For each item, AVAST displays a product description, pictures and ratings. A viewer can easily purchase any product simply by clicking on the conveniently provided link to Amazon.

The frontend of AVAST (Amazon Video And Shopping Technology) is built using Angular 6, while the backend is implemented using PHP Laravel. In addition, several Amazon Web Services are used including Rekognition to analyze videos, and EC2 to host the AVAST website.
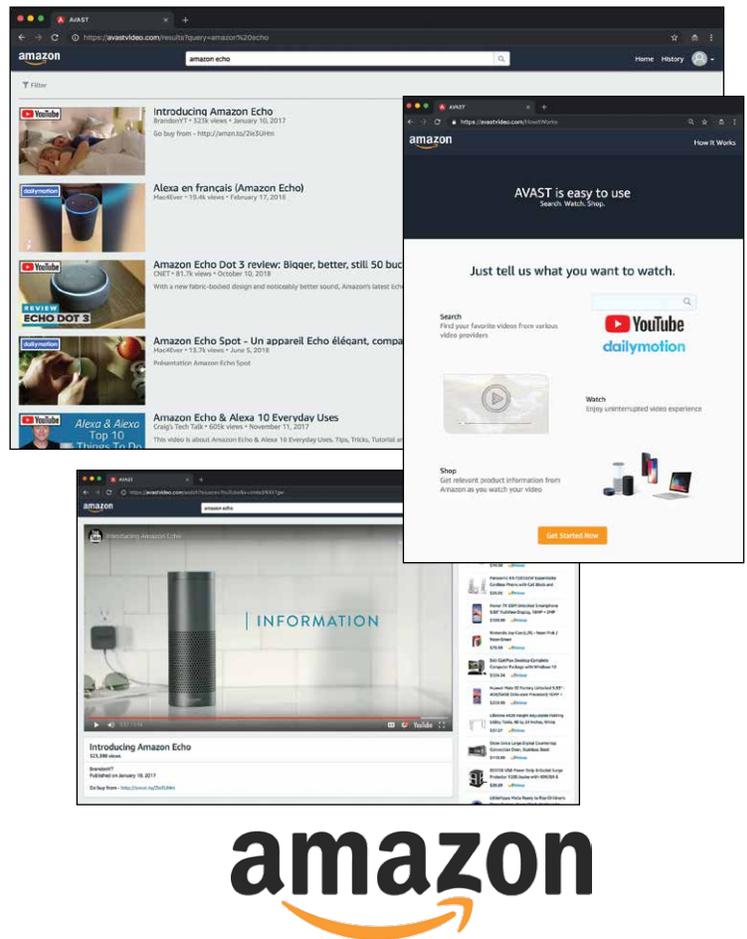
Michigan State University
Team Members (left to right)

Linshawn Fang
Wenzhou, Zhejiang, China

Ben Nwachukwu
Oak Park, Michigan

Patrick McCormick
Northville, Michigan

Ian McGregor
Clarkston, Michigan

Han Wang
Novi, Michigan

Amazon
Project Sponsors

Garret Gaw
Detroit, Michigan

Derek Gebhard
Detroit, Michigan

Kyle Koss
Detroit, Michigan

Pete Pfeiffer
Detroit, Michigan

Aptiv
Autonomous Vehicle Fleet Connectivity App

Aptiv is a global technology company that is transforming mobility with its portfolio of safe, green, and connected solutions for its customers.

As a leader in autonomous vehicle development, Aptiv maintains an extensive test fleet of autonomous vehicles, which must be managed and monitored.

Our Autonomous Vehicle Fleet Connectivity App provides connectivity to Aptiv's autonomous test fleet, which operates across the US, Europe and Asia, and includes various vehicles with software for every level of autonomy.

Among other features, our system provides scheduling of test vehicles. After logging in, Aptiv engineers see a calendar view of the entire fleet from which they can select a particular day to obtain a list of available vehicles.

Once a vehicle is selected, our app displays a complete set of information about it including its past usage, reservations and diagnostic information.

In addition to checking availability of vehicles based on dates, our app provides for advanced search to narrow the scope based on things like type of vehicle, location of vehicle and level of autonomy.

The "My Reservations" tab shows a user's upcoming vehicle reservations as well as enabling them to make and cancel reservations.

Our Autonomous Vehicle Fleet Connectivity App is written using the Angular web framework, obtaining information from Aptiv's native servers. Communications are implemented using Microsoft Azure Services.
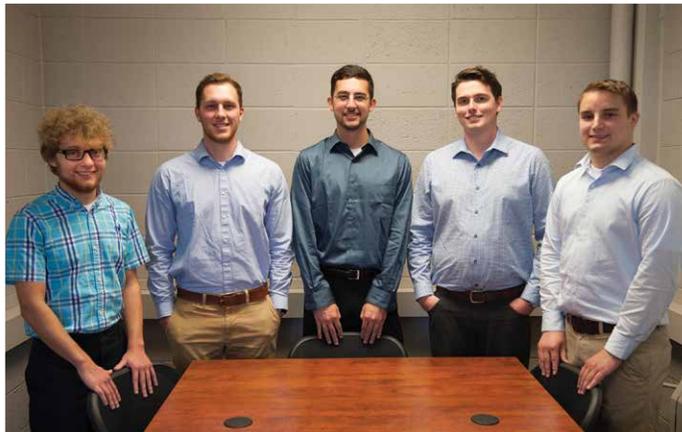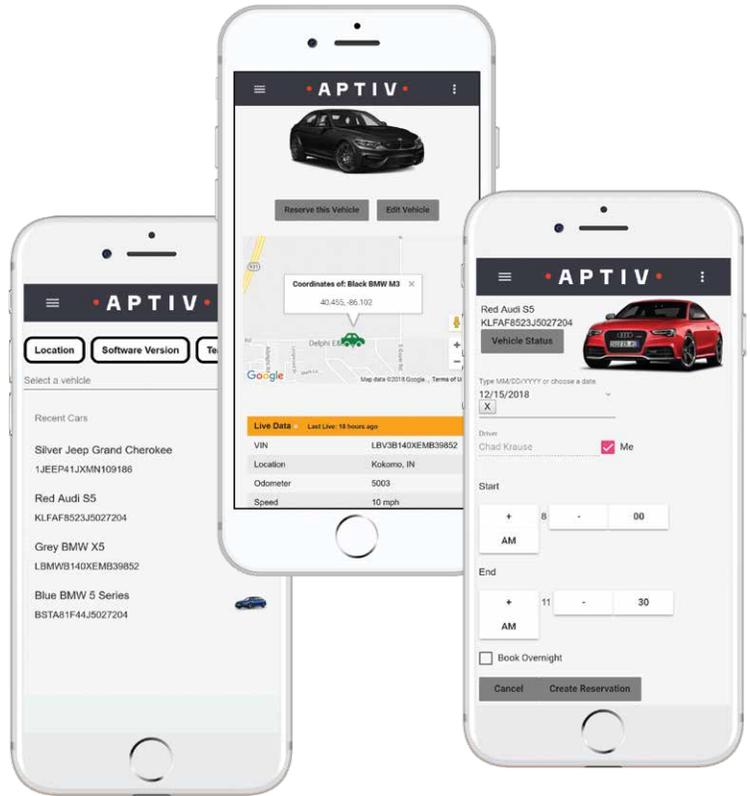
Michigan State University
Team Members (left to right)

Alex Patton
Howell, Michigan

Drew Glapa
Dexter, Michigan

Emilio Castillo
Lansing, Michigan

Klint Kaercher
Lansing, Michigan

Chad Krause
Novi, Michigan

Aptiv
Project Sponsors

Chris Lussenhop
Troy, Michigan

Joe Lyon
Troy, Michigan

Ross Maguire
Troy, Michigan

Jim Quesenberry
Troy, Michigan

Auto-Owners Insurance
Jeffrey: Virtual Insurance Claim Advisor

Auto-Owners Insurance is a Fortune 500 company that provides automotive, home, life and commercial insurance. Headquartered in Lansing, Michigan, Auto-Owners is represented by over 44,000 licensed insurance agents across 26 states, and provides insurance to nearly 3 million policyholders.

Every day, hundreds of insurance claims are filed with Auto-Owners through its independent agents. This process can be tedious for both policyholders and agents.

Our Jeffrey Virtual Insurance Claim Advisor system is a virtual claim assistant that automates the entire claim reporting process. Our mobile app, shown at the right, enables both agents and policyholders to file a claim easily and efficiently.

Jeffrey engages in a dialogue with policyholders and agents to gather information required to file their claim through natural conversation. If necessary, Jeffrey prompts users to take photos, record videos or attach documents relevant to a claim.

After completing a dialogue with a user, Jeffrey automatically gathers the appropriate claim information and submits it to Auto-Owners.

Our companion web app enables agents and Auto-Owners associates to find and review claim information that is submitted through the mobile application.

Our Jeffrey Virtual Insurance Claim Advisor system features natural language processing, which is implemented using Google's Dialogflow. A custom REST API, written in Kotlin, handles interactions between the applications and our MySQL database. Our web application is built using the React JavaScript framework.
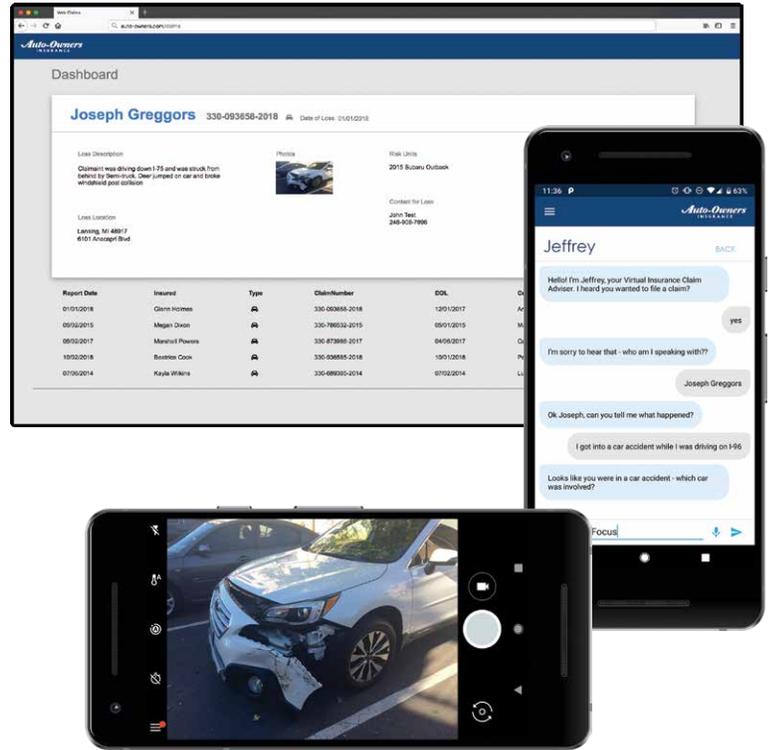
Auto-Owners
INSURANCE
LIFE · HOME · CAR · BUSINESS

Michigan State University
Team Members (left to right)

Alex Klingel
Marshall, Michigan

Connor Stabnick
Rochester, Michigan

Nabiha Biviji
Novi, Michigan

Michael Dickmann
Novi, Michigan

Auto-Owners
Project Sponsors

Ross Hacker
Lansing, Michigan

Scott Lake
Lansing, Michigan

Jim Schumacher
Lansing, Michigan

Dow Chemical Company
IT Assistant

With over a century of experience, Dow Chemical Company is changing the world through innovation by providing advancements like more drinkable water, more clean and affordable energy, and increasing food production.

Dow employs over 70,000 people worldwide, including some 30,000 of which are contractors. For many of them, information technology (IT) is central to their work. Providing IT support is crucial, but to do so for so many people in so many locations is a challenge.

Our IT Assistant is a chatbot that brings all of Dow's IT knowledge to one place, providing a one-stop shop for resolving IT issues.

Our chatbot leverages natural language processing to engage with a Dow employee in a natural and intuitive way, handling both text and voice input.

When a user describes their IT problem, IT Assistant either provides a solution by searching Dow's vast knowledge base of issues and solutions or it asks the user for more information.

IT Assistant is a responsive web app so it can be used with any web browser on a desktop or on any mobile device. And, since it's web-based, it provides IT support at any time, from anywhere.

Our IT Assistant uses a variety of Microsoft Azure Cloud Services including LUIS and Voice Services. Our chatbot leverages Dow's extensive IT knowledge base of issues and solutions. Hosted on Azure, IT Assistant is implemented using React.js and C#.
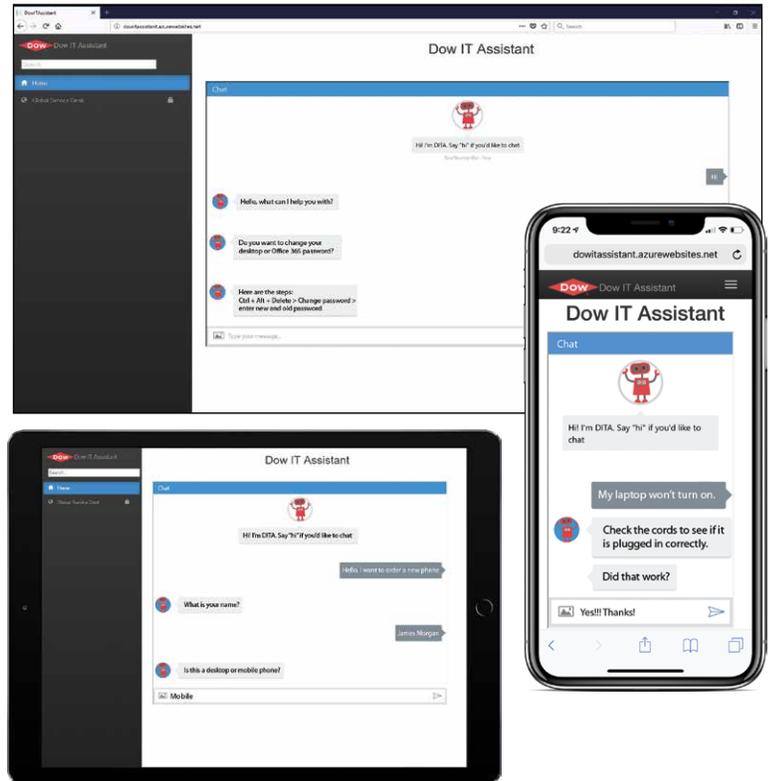
Michigan State University
Team Members (left to right)

Brandon Brooks
Clinton Township, Michigan

Keaton Coffman
Jackson, Michigan

Cassie Thompson
Kalamazoo, Michigan

Charlie Benson
Lansing, Michigan

Dow
Project Sponsors

Kyle Alexander
Midland, Michigan

Marc Habermann
Midland, Michigan

Fareed Mohammed
Midland, Michigan

Matt Olmsted
Midland, Michigan

Ford Motor Company
Ford Customer App Review Dashboard

Founded in 1903, Ford Motor Company is the second-largest automaker in the U.S. and fifth-largest in the world, employing 202,000 people worldwide and selling 6.6 million vehicles in 2017.

Currently, Ford offers several mobile apps for connected vehicles, allowing users to take advantage of features such as remote start, parking search, media streaming and more.

With their passion for customer satisfaction, Ford associates continually monitor user feedback for their apps to ensure that they meet the needs of their customers.

Our Customer App Review Dashboard streamlines this process by providing a convenient and automated system to analyze, summarize and display data from many app reviews all at a single glance.

Reviews are gathered from multiple app stores and analyzed using Natural Language Processing (NLP) to determine whether the sentiment of each review is positive, negative or neutral. Our web app visualizes the results of this analysis, enabling Ford associates to see the distribution of positive versus negative reviews at a glance.

Updates to our review analysis are sent through the Slack messaging service, which gives a real-time feed of user feedback. Ford associates use our companion web app to adjust dashboard settings.

Our Customer App Review Dashboard's frontend is written in Angular 6. Our RESTful API is written in Java using Spring Cloud Function. Our NLP is implemented using Amazon Comprehend. The backend processing is serverless, performed using AWS Lambda.
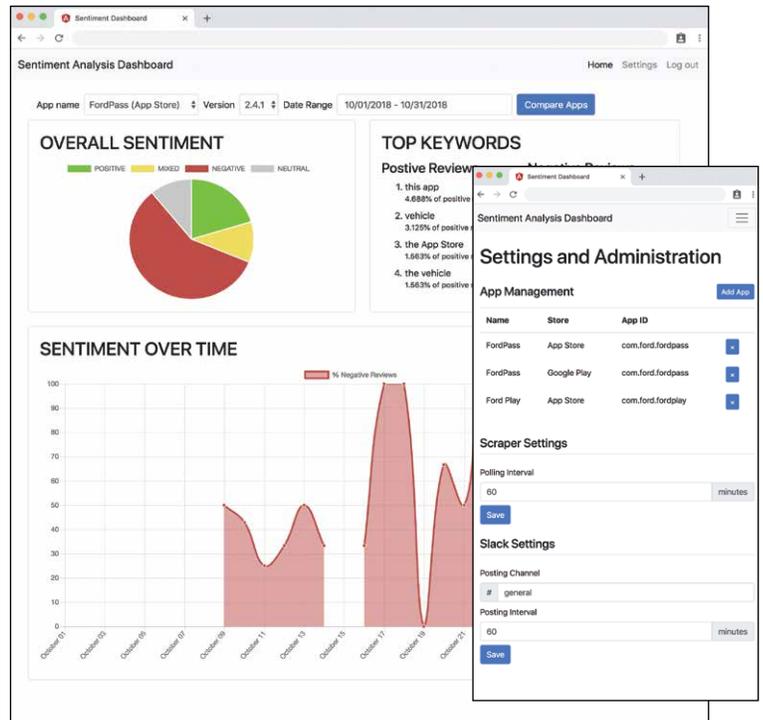
Michigan State University
Team Members (left to right)

Mingkai Yang
Shanghai, Shanghai, China

Noah Keppers
Findlay, Ohio

Paul Friesen
Marquette, Michigan

Drew Morgan
Yale, Michigan

Jordan Schroeder
Macomb Township, Michigan

Ford
Project Sponsors

Jeff Bourgoin
Dearborn, Michigan

Adam Haas
Dearborn, Michigan

Jacob Prickett
Dearborn, Michigan

Michael Volk
Dearborn, Michigan

Herman Miller
FIBRE: Fabric Identification Based Recommendation Engine

Herman Miller, a 100-year-old-plus company, is an industry leader in office and home furniture, which are sold and used in countries all over the world. Herman Miller furniture is highly customizable, with thousands of combinations for each piece including choices for the color and pattern of the fabric. In addition, customers can not only choose from a catalog of Herman Miller fabrics, they can also request a fabric of their own, making an order even more complex.

When a custom fabric is requested, the process of manually searching for a similar fabric in Herman Miller's existing catalog of fabrics is tedious, error prone and very time-consuming.

Our Fabric Identification Based Recommendation Engine, FIBRE, leverages computer vision and machine learning to classify fabrics, automatically detecting color and pattern.

FIBRE is first applied to Herman Miller's existing extensive catalog of fabrics, to tag images with standard, quantifiable measures of both color and pattern.

When a request for a custom fabric is submitted, our system analyzes it, generates its measures of color and pattern, searches the extensive Herman Miller catalog of fabrics, and finds fabrics that most closely match. The four most similar fabrics are displayed for review by a Herman Miller associate or customer, thereby reducing the number of fabrics to consider from thousands to just four.

Our FIBRE utilizes scikit-learn for color detection, and SageMaker and TensorFlow for pattern detection. Flask provides the client side interface to the backend, which is hosted on Amazon Web Services.
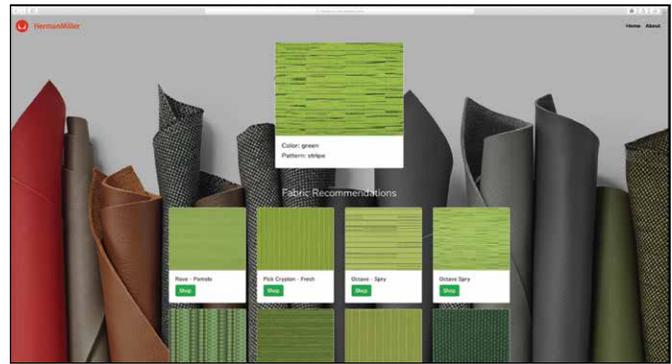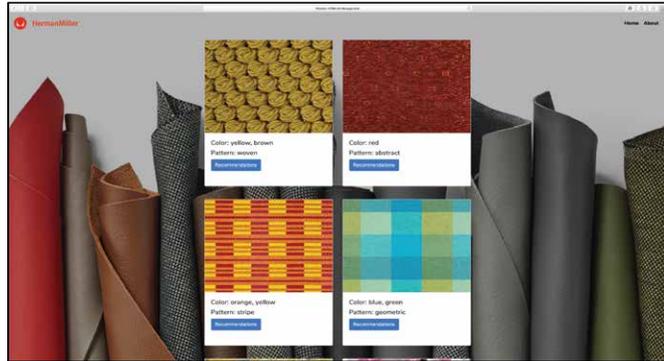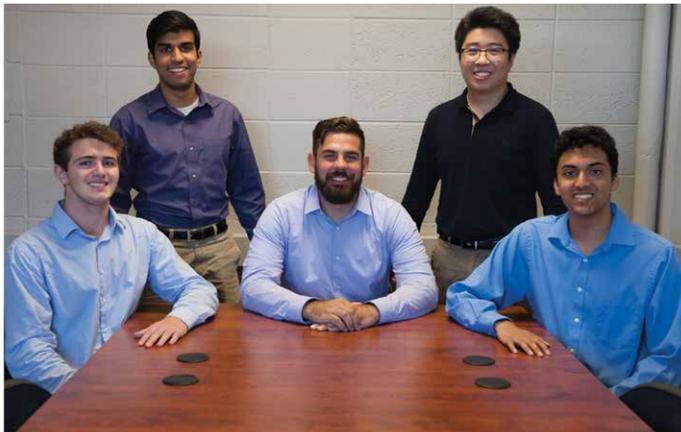
Michigan State University
Team Members (left to right)

Ted Stacy
Birmingham, Michigan

Ritwik Biswas
Okemos, Michigan

Joe Smith
Hastings, Michigan

David Xuan
Beijing, Beijing, China

Josh Bhattarai
Novi, Michigan

Herman Miller
Project Sponsors

Mark Buikema
Zeeland, Michigan

Andrea Haggerty
Zeeland, Michigan

Tom Holcomb
Zeeland, Michigan

Jeff Kurburski
Zeeland, Michigan

Meijer
Shrink Reduction Using Blockchain

Founded in 1934, Meijer is the pioneer of the modern supercenter with 242 stores located throughout the Midwest.

As a large retailer, Meijer ships and tracks thousands of products from supplier to store shelf. Timely and safe arrival of products is key for customer satisfaction and business efficiency.

All retailers experience product loss, often from theft or from product expiration for things like produce and dairy products. This product loss is known as "shrink."

Our Shrink Reduction Using Blockchain system reduces shrink resulting from product expiration by tracking products along the entire supply chain from supplier to store.

Meijer team members use our web app to record a product's expiration date when it is received from a supplier. Team members update product information by scanning QR codes each time a product arrives at a new location, which is updated in our blockchain database.

Meijer team members use our shrink reduction alerts to decide which products should be put on the shelf based on their expiration dates. As a result, more products are sold before their expiration dates, thereby reducing shrink.

Our companion web app shows loss statistics on specific products such as product location and estimated cost, which is used to prevent future loss.

Our Shrink Reduction Using Blockchain system uses the Microsoft Azure Framework with Ethereum Private blockchain technology. Our iOS app is built using XCode. Our web app uses HTML, CSS, JavaScript and ASP.NET.
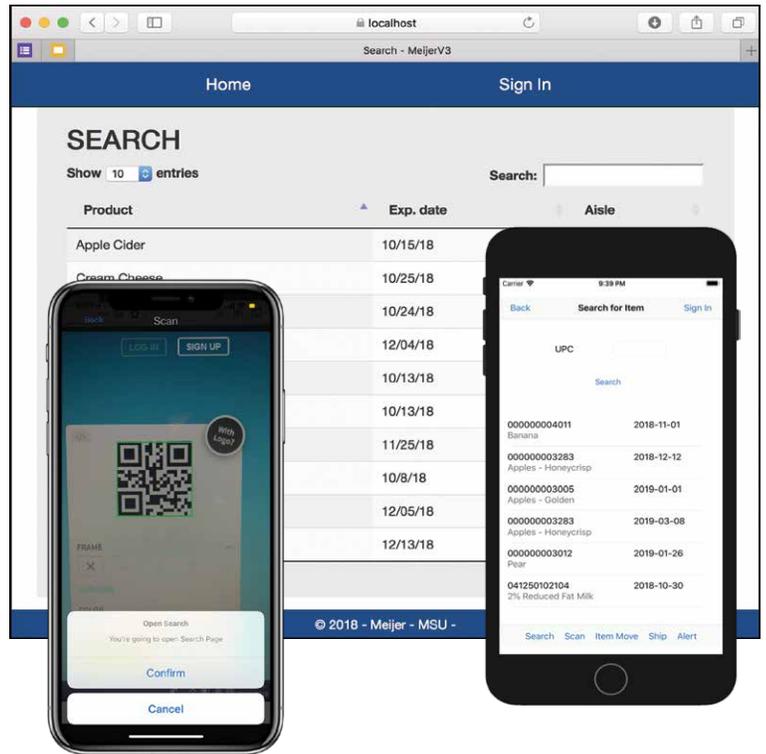
Michigan State University
Team Members (left to right)

Lucas Banks
Okemos, Michigan

Moritz Greiss
Oakland, Michigan

Mohammad Yousafzai
Lahore, Punjab, Pakistan

Phillip Litchfield
Memphis, Michigan

Matt Wilimberg
Avenel, New Jersey

Meijer
Project Sponsors

Jim Becher
Grand Rapids, Michigan

Kristin Lake
Grand Rapids, Michigan

Chris Laske
Grand Rapids, Michigan

Terry Ledbetter
Grand Rapids, Michigan

Murali Rajagopalan
Grand Rapids, Michigan

Michigan State University
Navigating MSU's Campus Using Augmented Reality

Founded in 1855, Michigan State University is the nation's pioneer land-grant university. Today, MSU is one of the largest universities in the US with over 50,000 students and holds many distinctions, including being one of the top 70 universities in the world.

Each year, thousands of people come to MSU for the first time, including some 8,000 freshmen. MSU's campus is comprised of hundreds of buildings spread across its large 5,200-acre sprawling campus. Navigating this large campus is a challenge for all newcomers who often rely on paper maps and hard-to-find signs.

Our Navigating MSU's Campus Using Augmented Reality app leverages augmented reality (AR) to guide people around MSU's large campus with ease.

Our app, shown at the right, identifies and labels buildings and landmarks simply by using the camera of any supported mobile device. Some landmarks, such as the Spartan Statue and the Rock, have clickable names where a user can learn fun facts about them.

A user can easily navigate MSU's campus with a 3D AR experience called wayfinding, which gives directions to any destination on campus.

After selecting a destination, directional arrows, as seen at the right, are overlaid on a user's mobile device showing the way to go. Users simply follow the arrows to find their way to their chosen destination.

Our Navigating MSU's Campus Using Augmented Reality app supports both Google Android and Apple iOS, which use ARCore and ARKit SDKs respectively. Our app obtains building information and wayfinding directions from MSU's ArcGIS API.

Michigan State University
Team Members (left to right)

Shaye Beadling
East Lansing, Michigan

Yongqi Han
Qingdao, Shandong, China

Paul Rosemurgy
Hancock, Michigan

Minseo Baik
Seoul, South Korea

Austin Pfeil
Kalamazoo, Michigan

Michigan State University
Project Sponsors

E.J. Dyksen
East Lansing, Michigan

Rob McCurdy
East Lansing, Michigan

Spencer Ottarson
East Lansing, Michigan

Microsoft
ITPro Company Portal

Microsoft is a long-time leader in the technology industry, providing enterprises with a comprehensive suite of software solutions created to drive productivity.

More and more, people are using their personal mobile devices to do company work, both inside and outside of the office. This enhances work flexibility and productivity, and also lowers company hardware costs.

However, this new work paradigm presents significant security and reliability risks since personal devices are now connecting to corporate networks and often storing confidential corporate data.

Our ITPro Company Portal is a system that enables information technology (IT) administrators to ensure that all company employees' personal mobile devices are both secure and reliable.

Before using their personal mobile device for work, an employee installs a simple app, which allows an IT professional to check that it is indeed secure and reliable. ITPro does so with very limited access, which maintains an employee's personal privacy and complete control over their device's non-work information.

With ITPro, IT administrators can be confident that all mobile devices company-wide are compliant with corporate security and reliability policies. And, since ITPro itself is a mobile cross-platform app that supports Google Android, Apple iOS and Microsoft Windows devices, administrators can do so using any device, from anywhere in the world, at any time.

Our ITPro Company Portal app is written in C# using the Xamarin framework within Microsoft Visual Studio. It communicates with Intune via the Microsoft Graph API.
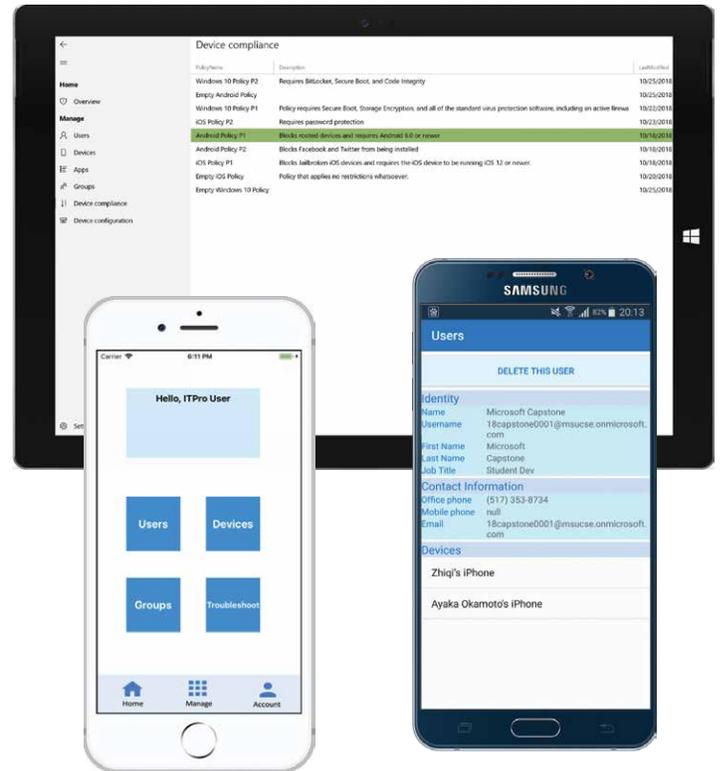
Michigan State University
Team Members (left to right)

Zhanming Bai
Chengdu, Sichuan, China

Zoe Fu
Shenyang, Liaoning, China

Jason Brownell
Luna Pier, Michigan

Ayaka Okamoto
Ann Arbor, Michigan

Microsoft
Project Sponsors

Katie Gilligan
Cambridge, Massachusetts

Scott Sawyer
Cambridge, Massachusetts

Kurt Seippel
Cambridge, Massachusetts

Mozilla Corporation
Asynchronize All the (Localization) Things!

Since its establishment in 1998, Mozilla's mission has been to build a better, more open and accessible internet. As a part of this mission, Mozilla's Firefox web browser supports 99 languages worldwide.

Currently, non-English users must download a separate version of Firefox or perform a series of complex configuration steps and then restart the browser to use their preferred language. Such customization of software is referred to as "localization."

Mozilla's new framework, called Fluent, addresses these issues and improves the localization experience for users, translators and developers. Fluent allows users to change their locale on the fly, and helps localizers and developers by simplifying the work required to convert phrases from English to other languages.

Firefox contains many pages, which enable users to localize Firefox for things like menus and error messages. For each page, the English phrases are now consolidated into new Fluent files, and the Firefox frontend code is updated. These phrases take several forms, from static content to dynamic expressions where the phrasing varies depending on language and context.

To save work for volunteer localizers, our new Python scripts are used to migrate phrases from old files to new Fluent files in every language that is currently supported.

After thoroughly testing our system, our localization patches are now integrated into the Firefox codebase for distribution to hundreds of millions of users worldwide.

Our Asynchronize All the (Localization) Things project is implemented using Fluent, JavaScript, Python, XHTML, XML and XUL.
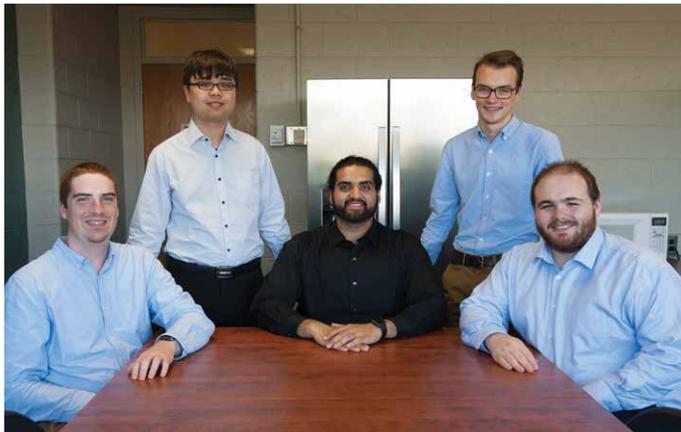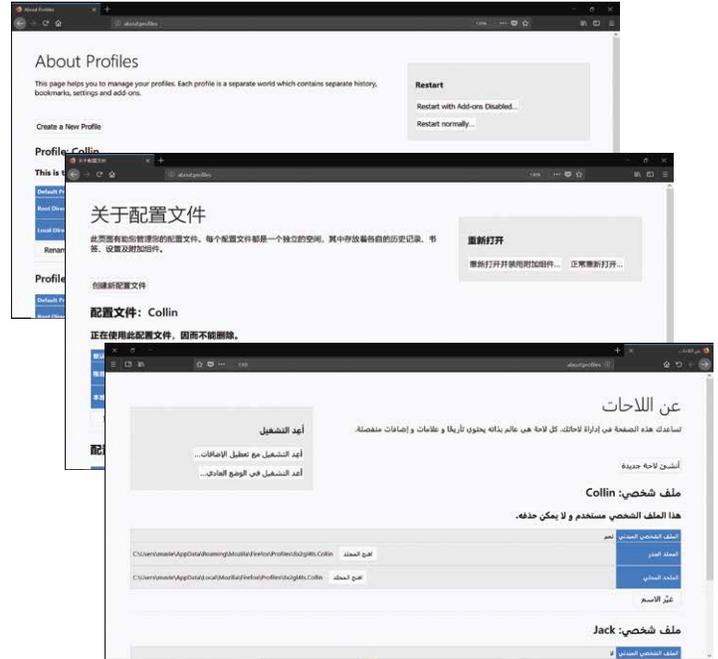
Michigan State University
Team Members (left to right)

Jim Lennon
Lansing, Michigan

Jack Song
Beijing, Beijing, China

Raza Haider
East Lansing, Michigan

Jack Smith
Traverse City, Michigan

Collin Wing
Laingsburg, Michigan

Mozilla
Project Sponsors

Zibi Braniecki
San Francisco, California

Gijs Kruitbosch
Hinckley, England

Jared Wein
Royal Oak, Michigan

MSU Federal Credit Union
Transaction Anomaly Detection

Founded in 1937, Michigan State University Federal Credit Union offers financial services to students, faculty and staff of Michigan State University. With over $4.1 billion in assets and 265,000 members, MSUFCU is the largest university-based credit union in the world.

In the past year, U.S. consumers experienced over $8 billion in losses due to payment card fraud. MSUFCU protects its members from fraud by monitoring almost 40 million transactions of its members annually.

Our Transaction Anomaly Detection system leverages the MSUFCU's existing software platforms to notify its members of unusual account activity.

When anomalous transactions are detected, our system sends push notifications to MSUFCU members and flags the transactions on our companion web app used by MSUFCU associates.

Our system identifies irregularities ranging in severity from a peculiar increase in a monthly cable bill to a suspected account takeover.

In addition to detecting suspicious account activity, our system harnesses a member's transaction data to provide them with insights into their spending habits.

Within the MSUFCU member web portal, transactions flagged as suspicious can be expanded for more information. Spending habits are summarized by personally tailored reports, which categorize purchases and visualize patterns.

Our Transaction Anomaly Detection iOS, Android and web apps connect to a Django server via a RESTful API. Anomalies are detected using a machine learning TensorFlow module and other scientific Python packages.
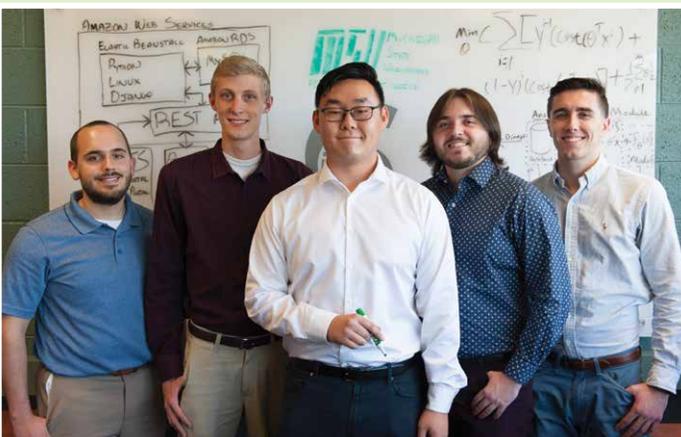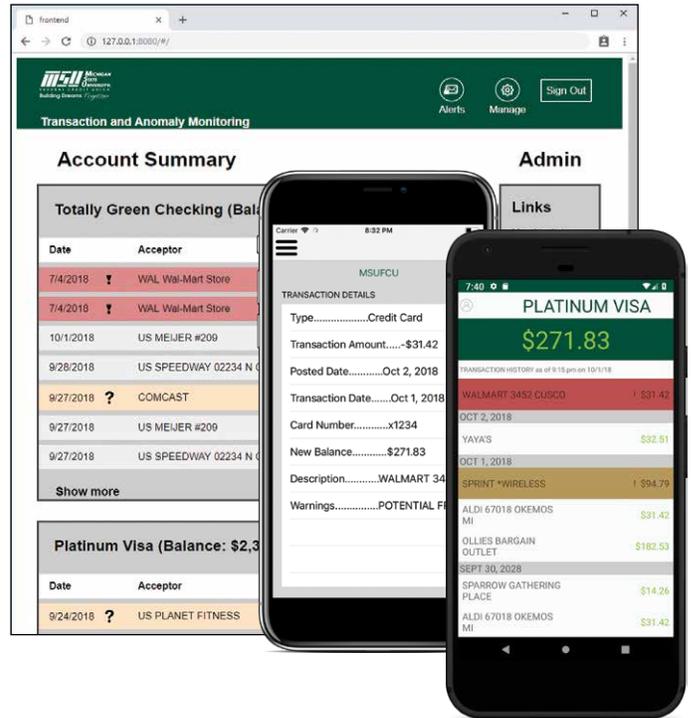
Michigan State University
Team Members (left to right)

Caleb Sherman
Mount Morris, Michigan

Andrew Schmidt
St. Louis, Missouri

Jim Xu
Beijing, Beijing, China

Austin Roberts
South Lyon, Michigan

Paul Soma
Traverse City, Michigan

MSUFCU
Project Sponsors

Samantha Amburgey
East Lansing, Michigan

April Clobes
East Lansing, Michigan

Emily Fesler
East Lansing, Michigan

Pete Lenhard
East Lansing, Michigan

Ben Maxim
East Lansing, Michigan

Jim Solce
East Lansing, Michigan

Andrew Wardell
East Lansing, Michigan

Proofpoint
Improved Detonation of Evasive Malware

Headquartered in Sunnyvale, California, Proofpoint provides cybersecurity to many organizations, including Fortune 100 companies and educational institutions such as Michigan State University.

Analyzing malware is challenging. Viruses, spyware, ransomware and other malicious programs come in many complex forms. To protect its customers, Proofpoint uses tools called sandboxes, which are restricted computing environments where potentially harmful malware can be tested and analyzed safely.

Unfortunately, a new class of malware called "evasive malware" is rapidly emerging, thereby presenting a new, more dangerous class of cybersecurity threats.

Evasive malware has the ability to detect the presence of the sandbox environment. After doing so, it changes what it does, thereby evading analysis.

Our Improved Detonation of Evasive Malware system modifies evasive malware to block its ability to detect the sandbox environment, which causes it to execute. When the evasive malware does execute, its behavior is analyzed to determine precisely what it does so that Proofpoint can design countermeasures to protect against it.

Our web app, shown at the right, displays the results of processed malware. Users can check the status of the malware samples being tested as well as see the top evasive techniques being used. Both harmless and harmful evasive results are presented.

Our Improved Detonation of Evasive Malware system is implemented in Python, using the Cuckoo sandboxing framework and Suricata network monitor. Our web app is implemented using Python and Flask with the interface framed in Bootstrap and jQuery.
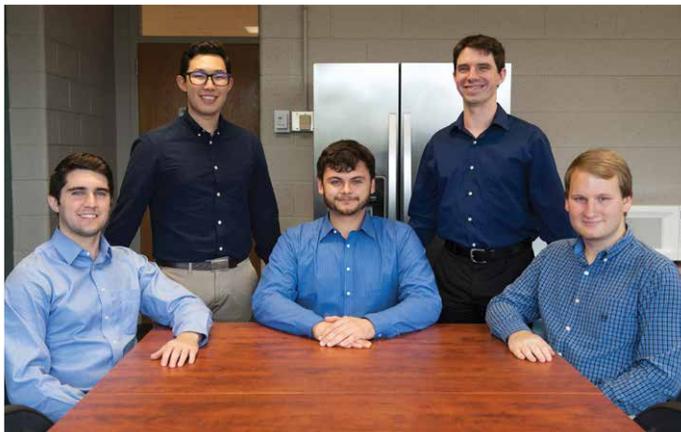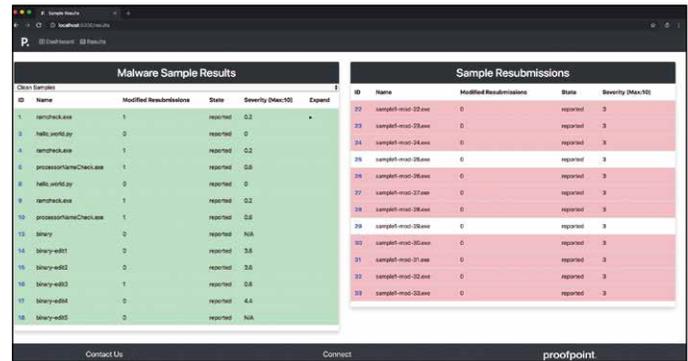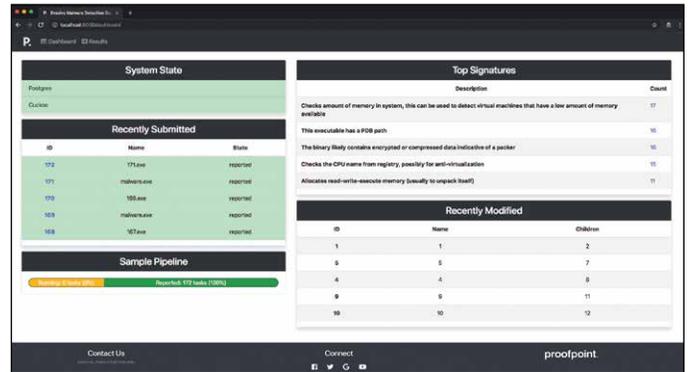
Michigan State University
Team Members (left to right)

Jack Mansueti
Beverly Hills, Michigan

Tae Park
Canton, Michigan

Sean Joseph
Grand Ledge, Michigan

Ryan Gallant
Midland, Michigan

Ian Murray
Midland, Michigan

Proofpoint
Project Sponsors

Leilani Alejo
Sunnyvale, California

Kristi Gee
Sunnyvale, California

Brad Woodberg
Troy, Michigan

Quicken Loans
Walter, You Gotta Go

Quicken Loans is the largest online mortgage lender in the US, the nation's largest FHA lender, and the premier Veteran Affairs lender. Legacy software systems can be tedious and inefficient to use, sometimes requiring employees to spend valuable time manually inputting data from documents. Unfortunately, replacing legacy software systems with modern ones is complex and costly.

Our Walter, You Gotta Go system provides a modern software system that accomplishes the same task as the legacy system without replacing it.

Our system leverages Robotic Process Automation (RPA) to create a specialized program called a "virtual worker," which watches how a user processes documents in the legacy software and then learns how to replicate it.

Having learned the process, the virtual worker then automates the data-entry process by extracting information from documents and submitting the data to the legacy system directly, saving time and reducing errors.

In addition to our virtual worker, our system includes a web app used to view and edit previously entered data. This web app provides all of the functionality of the legacy system as well as some additional features, all with a modern user experience.

In the spirit of Quicken Loans, each part of our system is anthropomorphized with its own persona. Walter is the tired legacy system that is replaced by Lindsey who is the new cutting-edge princess of the mortgage world.

Our virtual worker is implemented with an RPA tool using UiPath to extract data. Our web app is written with the Angular 6 framework and Quicken Loans' Spark Design Systems. Our backend is powered with a GraphQL API connected to a Microsoft SQL Server database.
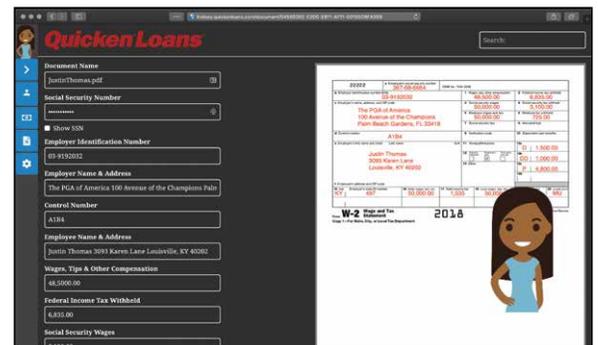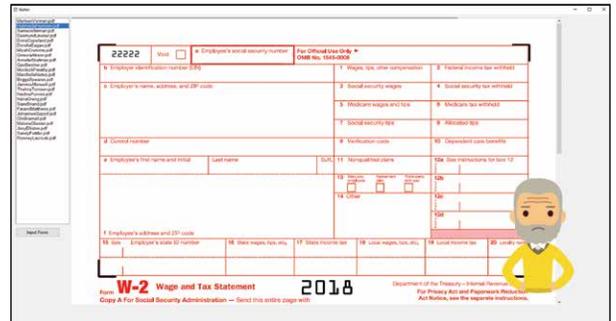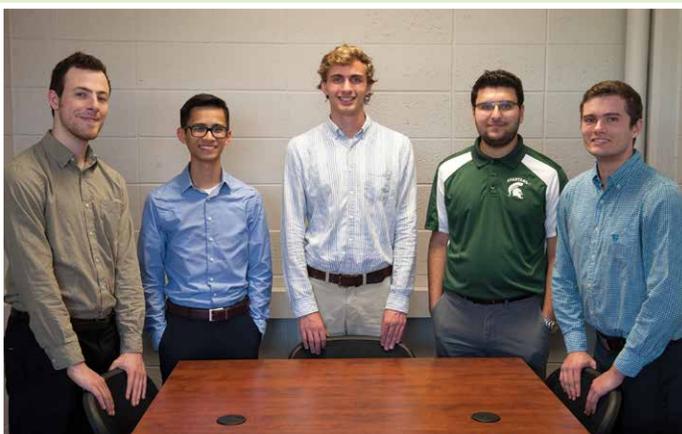
Michigan State University
Team Members (left to right)

Gabe Martino
Plymouth, Michigan

James Nguyen
Lansing, Michigan

Austin Robbins
Washington, Michigan

David Flores
Novi, Michigan

Dustin Eastway
McBain, Michigan

Quicken Loans
Project Sponsors

Alyssa Boucher
Detroit, Michigan

Keith Elder
Hattiesburg, Mississippi

Pat Hartford
Detroit, Michigan

Linglong He
Detroit, Michigan

Jordan LaFramboise
Detroit, Michigan

Jim Livingston
Detroit, Michigan

Jim Ross
Detroit, Michigan

Gina Wildauer
Detroit, Michigan

Teresa Wynn
Detroit, Michigan

Spectrum Health
Spectrum Health Virtual Reality Experience

Based in Grand Rapids, Michigan, Spectrum Health is a not-for-profit integrated health-care system including 12 hospitals, 8 urgent care facilities and 48 lab centers, making them the largest employer in West Michigan.

For patients and their families, a trip to a hospital or other medical facility is often confusing and stressful. Strange devices, some rather large and others rather intimidating, seem to be everywhere.

Our Spectrum Health Virtual Reality Experience app gives patients and their families the ability to explore Spectrum Health's many facilities virtually, from the convenience and comfort of home.

Patients enjoy an interactive experience with a full 360° view. As they look around, items in the room are identified and explained. From operating rooms to treatment rooms to patient rooms, users learn what's what before ever entering a Spectrum Health facility, thereby reducing confusion and stress.

Our Spectrum Health Virtual Reality Experience app runs within any desktop or mobile web browser. In addition, our app supports various virtual reality devices such as an Oculus Rift or a Google Cardboard to provide a completely immersive experience.

Spectrum Health employees use our companion administrative web portal to add new rooms, which includes uploading 360° images and annotating points of interest within a room.

Our Virtual Reality Experience app is written in HTML and JavaScript. A-Frame is used for 360° image browser support. ASP.NET Core and MSSQL provide server integration.
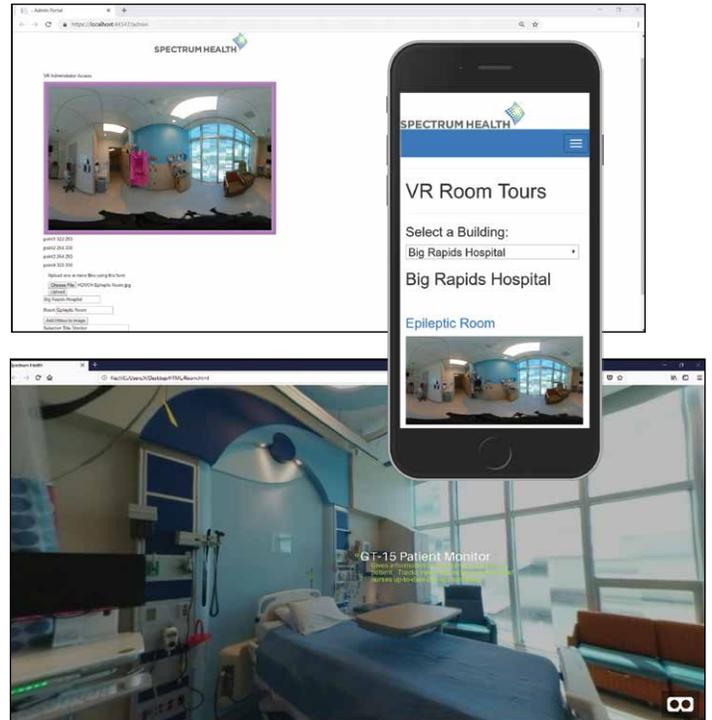
Michigan State University
Team Members (left to right)

Jordan Hill
Grand Rapids, Michigan

Jeremy Du
Shenyang, Liaoning, China

Stefani Taskas
Novi, Michigan

Anthony Flattery
Saginaw, Michigan

Spectrum Health
Project Sponsors

Adam Bakker
Grand Rapids, Michigan

Ron Bussa
Grand Rapids, Michigan

Jason Joseph
Grand Rapids, Michigan

Markus Neuhoff
Grand Rapids, Michigan

Vincenzo Pavano
Grand Rapids, Michigan

Apoorv Singh
Grand Rapids, Michigan

Mark Welscott
Grand Rapids, Michigan

TechSmith
TechSmith Video Review and Slack Integration

TechSmith provides software that empowers people to communicate more effectively by easily creating visual content such as images and video. Their flagship products, Snagit and Camtasia, are used by more than 30 million people worldwide.

TechSmith Video Review is a web-based system that enables video authors to obtain feedback on their videos before publishing them.

Our TechSmith Video Review and Slack Integration project extends the functionality of Video Review by connecting video authors with video reviews using team messaging systems.

In particular, our system integrates the popular messaging system Slack into Video Review. Users post and review videos, all from within their desired Slack channel. Reviewers post reviews of their own and comment on other users' reviews. Video authors read reviews and respond to reviewers interactively using Slack.

Reviews can be created from directly within Slack or synchronized from a preexisting review created from within TechSmith's Video Review.

Once a review is posted on Slack, all reviews and replies are updated both within Slack and within Video Review. This enables users to create and modify reviews on the platform of their choice while having consistent information.

Our TechSmith Video Review and Slack Integration system is implemented using two proxy servers, one for Slack's API and one serving a REST API that communicates with Video Review. Both servers are written in *C#*, contained in Docker, and documented using Swagger.
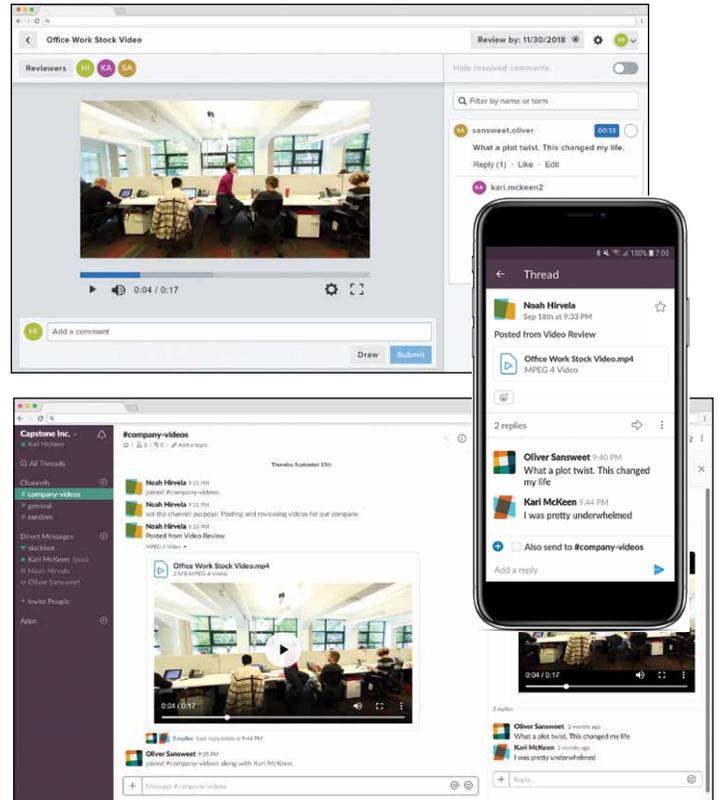
Michigan State University
Team Members (left to right)

Noah Hirvela
Plymouth, Michigan

Nick Gilreath
Southfield, Michigan

Conner Bean
Milford, Michigan

Tommie Henderson
Detroit, Michigan

Neil Xu
Hangzhou, Zhejiang, China

TechSmith
Project Sponsors

Mike Bell
Okemos, Michigan

Paul Donahue
Okemos, Michigan

Ryan Eash
Okemos, Michigan

Wendy Hamilton
Okemos, Michigan

Tony Lambert
Okemos, Michigan

Dave McCollom
Okemos, Michigan

Dave Norris
Okemos, Michigan

Dave Wegscheid
Okemos, Michigan

Union Pacific
Augmented Reality Mechanic Training

Headquartered in Omaha, Nebraska, Union Pacific is a leading railroad company with some 42,000 employees, 8,600 locomotives and 64,000 freight cars riding on 32,000 miles of track covering the western two-thirds of the U.S. To maintain this massive infrastructure, Union Pacific must train teams of mechanics to repair and operate complex machinery. This equipment is often large, unwieldy and expensive, making it challenging to provide training that is both safe and cost-effective.

Our Augmented Reality Mechanic Training systems provide an immersive and intuitive virtual training experience using the Microsoft HoloLens and Android. Our system is separated into two educational modules: Learn About Machinery and Build a Train.

Learn About Machinery displays holographic images of equipment for mechanics to study as a replacement for actual, physical machinery. As shown in the lower example at the right, trainees can rotate and interact with these holograms, accessing detailed maintenance information.

Build a Train provides real-time instructions on how to assemble a train, verifying that each step is completed correctly along the way. Labels projected above each train car provide guidance to the trainee as seen at the right.

Our Learn About Machinery and Build a Train systems demonstrate proof that augmented reality environments such as ours provide safe and cost-effective training.

Our Augmented Reality Mechanic Training systems are written in C# using the Unity game engine. They use Vuforia for object recognition and the PiXYZ plugin to process CAD models.
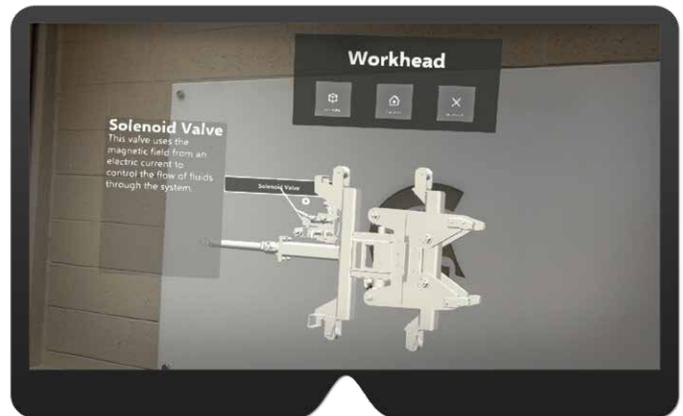
Michigan State University
Team Members (left to right)

Luke Sperling
Birmingham, Michigan

Nick MacDonald
Grand Rapids, Michigan

Justin Barber
Clarkston, Michigan

Colleen Little
Saint Louis, Michigan

Jake Cousineau
Iron Mountain, Michigan

Union Pacific
Project Sponsors

Weston Baxter
Okemos, Michigan

Seenu Chundru
Louisville, Colorado

Scott Coleman
Omaha, Nebraska

Chris Cornish
Okemos, Michigan

Jeff Girbach
Okemos, Michigan

Justin Snyder
Omaha, Nebraska

United Airlines
Toolkit Content Verification System

United Airlines is one of the world's largest airlines, serving over 148 million customers a year to 357 destinations in 48 countries with 4,600 daily departures.

For any airline, aircraft grounded due to mechanical issues may cause cancelled flights, loss of revenue, and dissatisfied customers. United operates the third largest fleet in the world with some 757 planes.

In order to maintain their fleet, United uses over 200,000 tools stored at various airports. Many of these tools are bundled into kits designed for very specific tasks like changing out the engine on a Boeing 787.

When a toolkit arrives at a United destination, it is crucial that the kit be complete so that technicians can address the issue and return the aircraft to service safely.

Our Toolkit Content Verification System ensures that toolkits are complete before they are checked out for use and before they are checked back in for storage. The system also logs every transaction for each toolkit.

To verify the completeness of a toolkit, a United technician simply uses their Apple iPhone or iPad to capture a photo of an opened kit as shown at the right.

Once a photo is captured and sent to our server, computer vision algorithms determine which tools are present and which are missing. On screen, our app then informs the technician whether or not the kit is complete.

Senior technicians use our companion web app to add new toolkits to the system and to track histories of kits.

Our Tooling Kit Content Verification System iOS app is written in Swift, with computer vision processing using the OpenCV library. Our web app uses the Django framework.
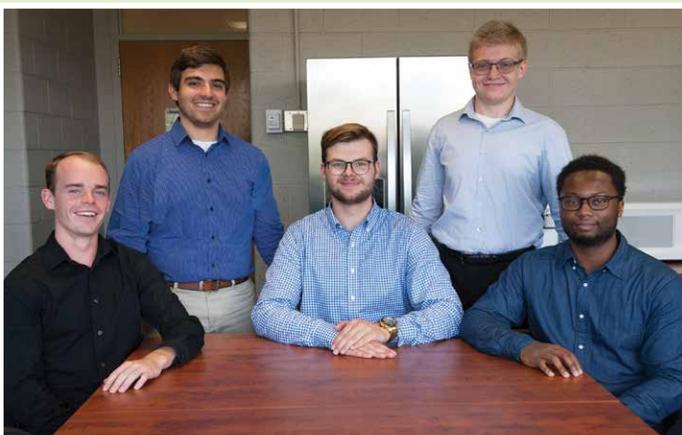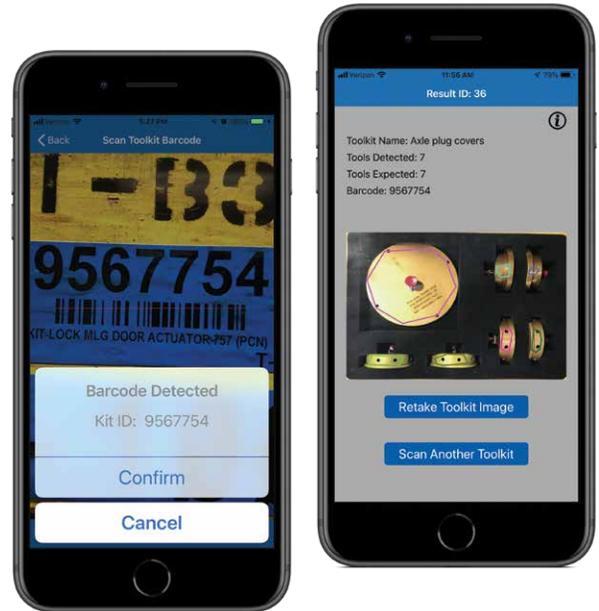
Michigan State University
Team Members (left to right)

Evan Childs
Plymouth, Michigan

Scott Campbell
Troy, Michigan

Bill Geshwender
Chicago, Illinois

Andy Ashton
East Lansing, Michigan

Vladimir Jojo Otchere
Ann Arbor, Michigan

United Airlines
Project Sponsors

Amadou Anne
Chicago, Illinois

Rick Brown
Chicago, Illinois

John Kleberg
Chicago, Illinois

Cathy Stout
Chicago, Illinois

Urban Science
VIN-Verse

Headquartered in Detroit, Urban Science is internationally renowned for providing data-driven, science-based solutions to problems in the automotive, health and retail industries.

The history of a vehicle is important to owners, sellers and buyers alike. Keeping an accurate and accessible record of a vehicle is a challenge, which often results in a disorganized group of documents stored in a vehicle's built-in filing cabinet, its glove box.

Based on a vehicle's unique Vehicle Identification Number (VIN), our VIN-Verse system leverages Urban Science's existing data to provide a comprehensive history of a vehicle, including maintenance, both past and upcoming, repairs, recalls, and accidents.

VIN-Verse enables a vehicle's owner to manage who can view their vehicle's history. Repair facilities give better service when they are able to review a vehicle's complete history. Potential buyers are more likely to purchase if they know the complete facts about a vehicle.

To augment Urban Science's existing vehicle data, VIN-Verse includes a verified self-reporting system with which vehicle owners can enter their own repairs, thereby making the history complete.

For vehicle manufacturers, VIN-Verse provides a dashboard that visualizes trends in the service history of the vehicles that they make and sell.

As a responsive web app, VIN-Verse is accessible using any web browser on desktops or mobile devices.

The frontend of our VIN-Verse system is built with ASP.NET/C# and Angular 6. The backend is implemented using Microsoft SQL Server 2016.
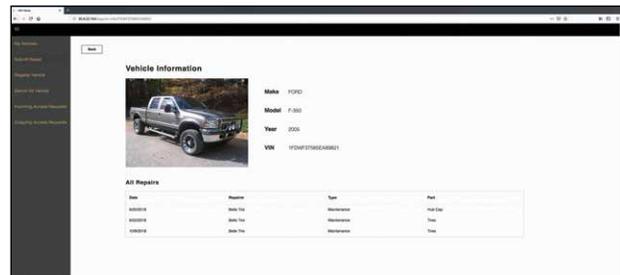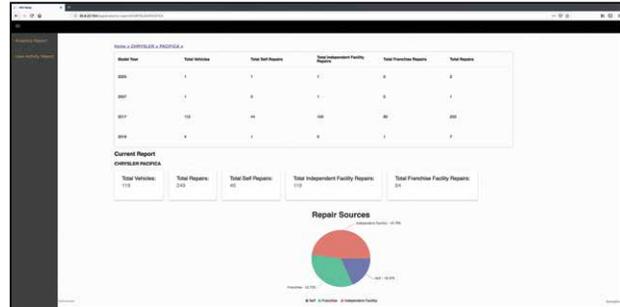
Michigan State University
Team Members (left to right)

Jacob Lawler
Goodrich, Michigan

Rachel Grunder
Midland, Michigan

Gabe Heikes
Carthage, Missouri

Aakash Bhargava
Okemos, Michigan

Urban Science
Project Sponsors

Mike DeRiso
Detroit, Michigan

Jeff Drake
Detroit, Michigan

Elizabeth Klee
Detroit, Michigan

Andrea Michaud
Detroit, Michigan

Majd Nashwati
Detroit, Michigan

Piermichele Robazza
Detroit, Michigan

Nik Steel
Detroit, Michigan

Ben Tiefenbach
Detroit, Michigan

Volkswagen Group of America
VW Car-Net® Demo App

Volkswagen Group of America is the North American operation headquarters and subsidiary of the Volkswagen Group. Volkswagen sold 10.5 million vehicles globally in 2017, the most of any manufacturer.

In 2013, Volkswagen introduced VW Car-Net, a Connected and Mobility Services system that offers convenience and ease of access to Volkswagen owners through a variety of features and tools. With technology evolving quickly, VW is preparing to launch an updated version of VW Car-Net with new features and technologies starting with model year 2020 vehicles. As a result, it is important that dealers and customers be made aware of the benefits of this new version of VW Car-Net.

Our VW Car-Net Demo App provides a platform where users are introduced to and familiarized with VW Car-Net while at the dealership. Our app guides users through several tutorial modules. Each module explains the functionality of a VW Car-Net feature, acquainting users with the advantages of their connected car services while simultaneously engaging with the VW brand.

Our app consists of five tutorial modules that explore VW Car-Net features including Registration, Remote Services, Vehicle Health Reports, Navigation and Guardian Services.

To encourage the greatest number of potential VW customers to learn about VW Car-Net, our app supports both Google Android and Apple iOS mobile devices.

Our VW Car-Net Demo App is written in Kotlin for Android and Swift for iOS. Firebase Analytics is integrated into each app to gather usage statistics.
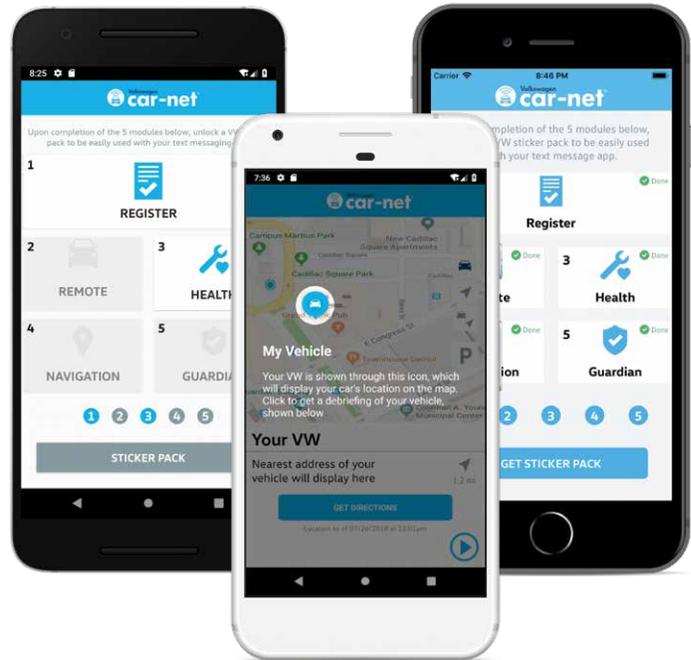
Michigan State University
Team Members (left to right)

Zebin Liang
Quanzhou, Fujian, China

Tim Guertin
Ellicott City, Maryland

Emily Brent
Bloomfield Hills, Michigan

Cyprian Blunt
Leslie, Michigan

Kira Chan
Ann Arbor, Michigan

Volkswagen
Project Sponsors

Shelly Desmet
Auburn Hills, Michigan

Andrew Kehrig
Auburn Hills, Michigan

Frank Weith
Auburn Hills, Michigan

Whirlpool
IRAV: Image Recognition, Annotation and Validation

Whirlpool Corporation, headquartered in Benton Harbor, Michigan, is the world's leading major home appliance company with approximately $21 billion in annual sales and 92,000 employees.

Whirlpool is reducing the daily challenge of getting meals on the table by providing their customers with a seamless kitchen experience. To this end, they recently acquired Yummly, the premier digital food platform.

Yummly gives personalized recipe recommendations based in part on the ingredients that a user already has on hand. Yummly determines these ingredients by applying computer vision to images captured with mobile devices.

In order to recognize ingredients accurately, Yummly compares captured images to a large set of existing images in which ingredients are already annotated with labels and validated for accuracy.

Our Image Recognition, Annotation and Validation (IRAV) mobile application leverages crowdsourcing of Whirlpool employees, utilizing users' captured images and validating them, effectively contributing to the many comparison images required by Yummly.

IRAV users take pictures of ingredient items, annotate them, and submit them. However, before Yummly accepts an image, the annotations must be validated by other users.

An image is considered to be acceptable only after it is validated by enough IRAV users. Only then is it added to Yummly's set of comparison images.

Our Image Recognition, Annotation and Validation application is written in Swift using Xcode for iOS, and Java using Android Studio for Android. Google Firebase is used for the backend.
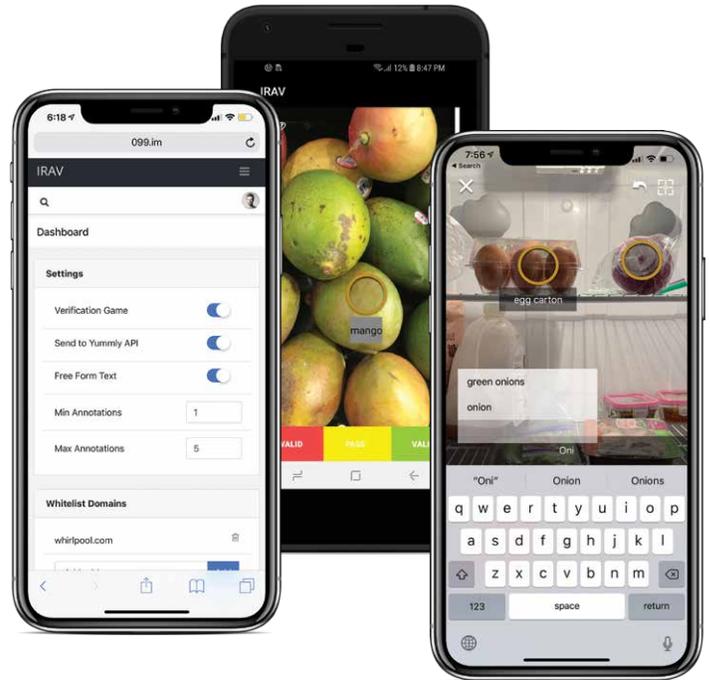
Michigan State University
Team Members (left to right)

Jessica Clappison
Farmington Hills, Michigan

Jack Turak
St. Joseph, Michigan

Shruti Avutapalli
Troy, Michigan

Jackie Li
Harbin, Heilongjiang, China

Savanna Pinkoski
Sault Sainte Marie, Michigan

Whirlpool
Project Sponsors

Miguel Becerra
Benton Harbor, Michigan

Greg Boothroyd
Benton Harbor, Michigan

Jeff Stoller
Benton Harbor, Michigan

The Capstone Class, Fall 2018
COMPUTER SCIENCE & ENGINEERING
MICHIGAN STATE UNIVERSITY

Project Sponsors

Wendy Hamilton

Chief Executive Officer

TechSmith
Okemos, Michigan

"TechSmith is a global technology company located just five miles away from MSU in Okemos. Our Capstone projects give students real-world experience with some of the latest trends including multimedia technologies, cloud computing and mobile applications, all of which add to their marketability. We also recruit the majority of our software engineers from MSU, so the capstone experience gives us a meaningful connection to many prospective employees."

Terry Ledbetter

Senior Vice President,
Chief Information Officer

Meijer
Grand Rapids, Michigan

"Meijer is proud to have sponsored MSU computer science capstone projects over the past ten years. We have been impressed with both the capabilities of the students and the quality of the solutions they have developed. The latest project, aislePerks: Location-Based Personalized Shopping, augments the mPerks experience by notifying Meijer customers of deals and specials that may interest them while they are shopping in the store."

Jeff Kurburski

Chief Technology Officer

Herman Miller
Zeeland, Michigan

"Working with MSU has allowed Herman Miller to leverage new skills and talents, while at the same time providing the capstone students with real-world technical challenges that companies like Herman Miller face on a regular basis. The problem-solving creativity of the student teams is impressive. Their recent award-winning capstone project Fabric Identification Based Recommendation Engine, FIBRE, leverages computer vision and machine learning to classify fabrics, which enables users to search through Herman Miller's extensive catalog of fabrics quickly, easily and accurately."

Rob McCurdy

Vice President and
Chief Information Officer

Michigan State University
East Lansing Michigan
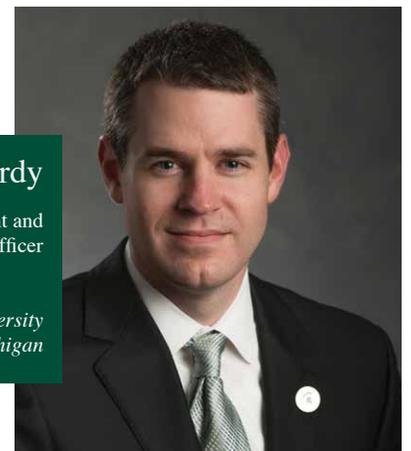
"MSU's Computer Science and Engineering students are some of the most talented in the nation. They have consistently proven to have the ability to translate business requirements into a technical solution, anticipate future needs before we even do, and solve complex problems. MSU sponsoring capstone projects has been even more valuable since they bring a student perspective to the solutions we are designing for the MSU community."

Capstone Alumni
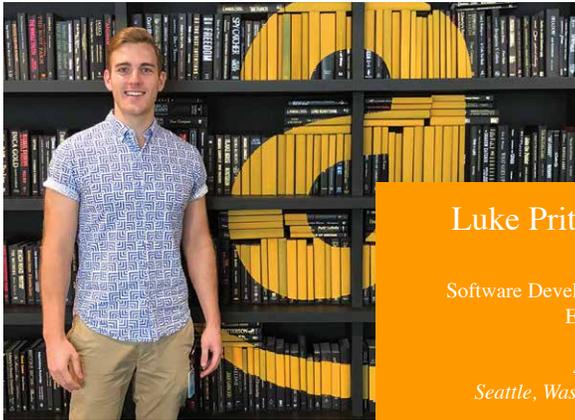
Luke Pritchett

Software Development Engineer

Amazon
Seattle, Washington

"The MSU Capstone Experience took the strong foundation I had gained as a computer science student of MSU and applied it to a real-world business problem. By being able to work on the entirety of the design and development process, and by focusing on issues such as scalability, modularity and reusability, I am much more prepared for my work at Amazon."

Hometown: Midland, Michigan

Cyndy Ishida

Compiler Engineer

Apple
Cupertino, California

"The MSU Capstone Experience enabled me to develop time management and delegation skills to create a production-ready, reliable service that leveraged the aspects I've learned about creating strong software from my coursework and previous internships. Being part of a time-critical project with many moving pieces and people, during my capstone experience, was influential for my full-time employment with Apple. At Apple, I contribute to the LLVM compiler infrastructure, that's used to develop languages like C++, Swift, Objective-C and Rust, to name a few."

Hometown: Canton, Michigan

Alex Klingel

Associate Software Developer

Auto-Owners Insurance
Lansing, Michigan

"The Capstone Experience was vital to my development as a young professional as it brought real world experiences into a classroom environment. Many of the challenges and obstacles we faced provided valuable lessons helping to prepare me for a seamless transition into my position at Auto-Owners Insurance."

Hometown: Marshall, Michigan

Dan Tinsman

Software Developer

Quicken Loans
Detroit, Michigan

"Being on a team that works toward a common goal provides an invaluable set of lessons for aspiring engineers. The most important skills to have entering the work place out of college are communication and time management. Both of these skills are perfected over time through The Capstone Experience lead by Dr. Dyksen. Capstone has made my transition to Quicken Loans exceptionally smooth."

Hometown: Novi, Michigan

The Capstone Experience

Capstone Project Sponsors Spring 2019

amazon
Seattle, Washington & Detroit, Michigan

Auto-Owners INSURANCE
LIFE · HOME · CAR · BUSINESS
Lansing, Michigan

DOW
Midland, Michigan

ēvolutio
Indianapolis, Indiana

Google
Mountain View, California & Kirkland, Washington

Humana
Louisville, Kentucky

Michigan State University HPCC
East Lansing, Michigan

Firefox
Mountain View, California

Principal
Des Moines, Iowa

SPECTRUM HEALTH
Grand Rapids, Michigan

technology services group
Chicago, Illinois

UNION PACIFIC
Omaha, Nebraska & Okemos, Michigan

URBAN SCIENCE
Detroit, Michigan

· A P T I V ·
Troy, Michigan

Consumers Energy
Count on Us®
Jackson, Michigan

DRIVEN-4
St. Joseph, Michigan

Ford
Dearborn, Michigan

HermanMiller
Zeeland, Michigan

meijer
Grand Rapids, Michigan

Michigan State University ITS
East Lansing, Michigan

MSU MICHIGAN STATE UNIVERSITY® FEDERAL CREDIT UNION
East Lansing, Michigan

proofpoint.
Sunnyvale, California

SURGE
Rochester Hills, Michigan

TechSmith®
Okemos, Michigan

UNITED
Chicago, Illinois

VW
Auburn Hills, Michigan

Amazon
Browser Sharing for Customer Support

Originally founded as an online bookstore, Amazon is now a leader in e-commerce and cloud computing, accounting for one in three online shopping transactions in North America.

When an Amazon customer needs help with a product, support staff must be ready immediately to ask him or her for more information in order to diagnose the problem, working hard to further avoid frustrating the customer.

Customer support organizations need better ways to understand the problems their customers are facing in order to help them more efficiently. Browser sharing, or co-browsing, provides support representatives with a visual way to guide customers to a quick and painless resolution.

With our Browser Sharing for Customer Support, the click of a button allows customers to share their browsers with Amazon representatives. The representative can offer quick and efficient assistance without having access to the customer's screen or computer. In most cases the customer gets immediate assistance, without any time-consuming installation needed.

Because the Amazon representative cannot view any other content on the customer's desktop, this is much safer than traditional remote control solutions.

Our browser sharing tool is written in JavaScript and hosted on Amazon Web Services (AWS) EC2 servers. It uses the W3C DOM API to capture the DOM events. The REST API is hosted on AWS and saves interactions in an AWS RDS Database for auditing purposes.
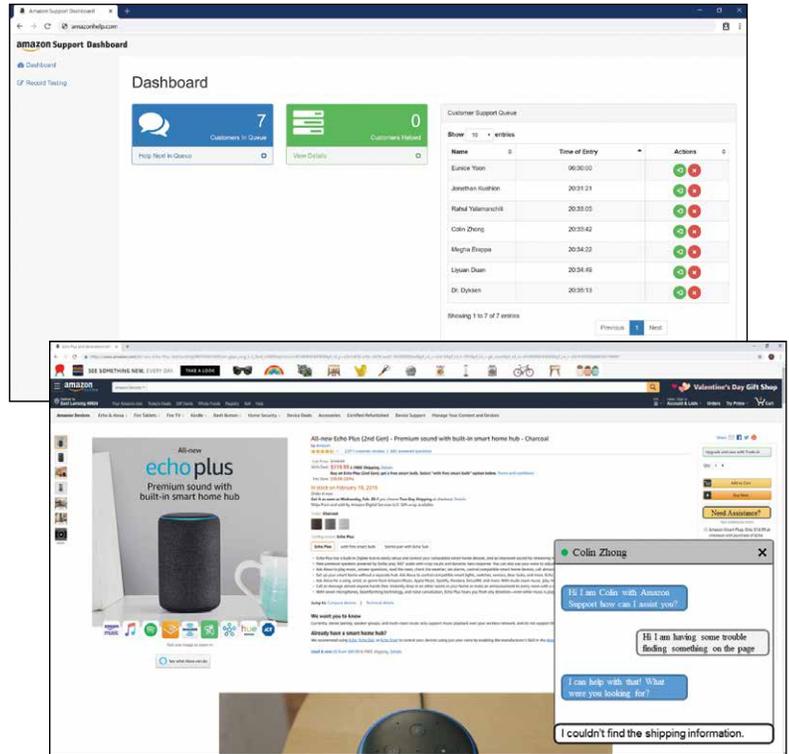
Michigan State University
Team Members (left to right)

Megha Erappa
East Lansing, Michigan

Rahul Yalamanchili
Farmington Hills, Michigan

Colin Zhong
Troy, Michigan

Liyuan Duan
Chongqing, Chongqing, China

Jonathan Kushion
Hemlock, Michigan

Eunice Yoon
Farmington Hills, Michigan

Amazon
Project Sponsors

Christin Burek
Seattle, Washington

Mitchell Cohen
Detroit, Michigan

Garret Gaw
Detroit, Michigan

Derek Gebhard
Detroit, Michigan

Aptiv
Analysis of Autonomous Vehicle Testing Video

Headquartered in Dublin, Ireland, and with more than 147,000 employees in 45 countries, Aptiv is a global technology company focused on helping create the next generation of active safety, autonomous vehicles, and smart cities.

With the ultimate goal of improving the safety of autonomous vehicles, Aptiv has a video database that presents a wide range of driving scenarios that a vehicle may encounter, including traffic signs, traffic lights, other vehicles, and pedestrians, all of which help to ensure vehicular safety for their customers.

Heightened highway and road safety concerns have introduced the need to expand the range of scenarios identified in their driving data.

Our Analysis of Autonomous Vehicle Testing Video model identifies and places boxes around salient features including overpasses, bridges, tunnels and tollbooths, and stores the labeled images in a database. The web app is connected to the database and visualizes entries from it. In order to navigate the web application, Aptiv users must first create an account and log in.

Our Analysis of Autonomous Vehicle Testing Video web app allows vehicle testing engineers access to enhanced driving scenarios that increase the safety of autonomous vehicles being manufactured by Aptiv and minimize loss of life and damage to property caused during vehicular crashes.

Our model is written in Python. Our web application is written using HTML, CSS, PHP, JavaScript and Bootstrap. The backend database is implemented with MySQL.
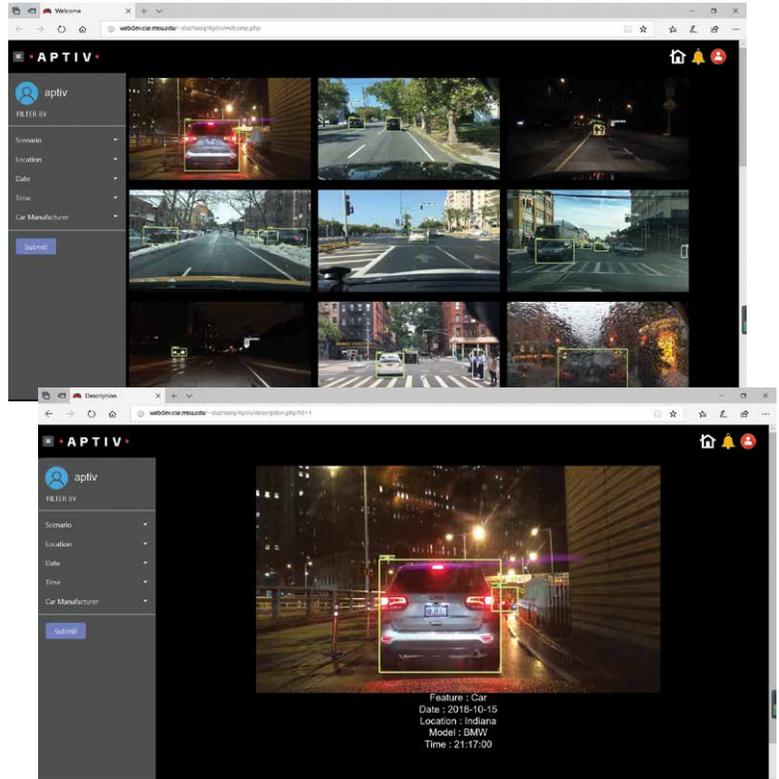
Michigan State University
Team Members (left to right)

Shivaani Annadurai
Troy, Michigan

Harshita Das
Okemos, Michigan

Rebecca Skladd
Wayne, Michigan

Patrick Thornton
Dewitt, Michigan

Diana Xia
Changzhou, Jiangsu, China

Aptiv
Project Sponsors

Aidong Chen
Troy, Michigan

Chris Lussenhop
Troy, Michigan

Ross Maguire
Troy, Michigan

Auto-Owners Insurance
Secretary of State (SoS) Software Robot

Founded in 1916, Auto-Owners Insurance is a Fortune 500 company that provides auto, home, life and commercial insurance to more than four million policyholders.

One of its products is workers' compensation insurance. Agents fill out applications for this insurance and submit them to be reviewed by an underwriter at Auto-Owners.

Frequently, the business name is entered differently than what the Secretary of State has on file. This can be caused by a slight variation in the business name or simply by a typo. Finding the official business name is time-consuming and not a productive use of an Auto-Owners associate's valuable time.

Our Secretary of State (SoS) Software Robot automates this process, using what's called robotic process automation, or RPA. With the click of a button, the software robot, or softbot, assumes the role of the insurance underwriter, searching first for the correct Secretary of State website, then searching for the proper name of the business.

Agents enter applications into the form provided on the website. Once submitted, underwriters can access applications for review from the web portal. After running the softbot, underwriters utilize the softbot's results to finish the application review process and approve the application. To monitor how well the softbot is performing, there is a reporting dashboard that allows managers to view statistics and metrics captured during processing.

Our website is implemented in PHP and hosted on a CentOS Linux server. The community edition of UiPath was used to create our software robot.
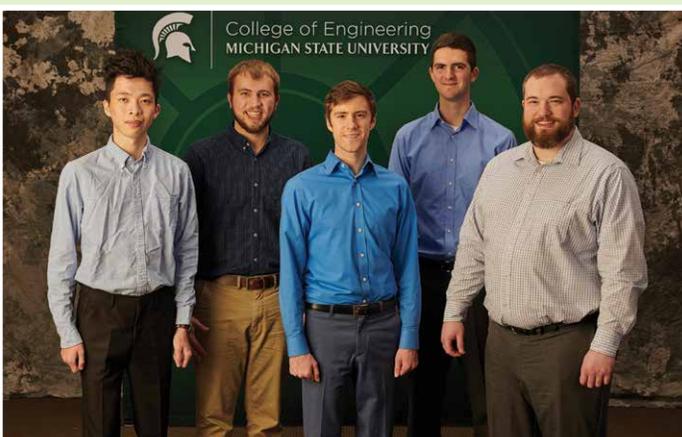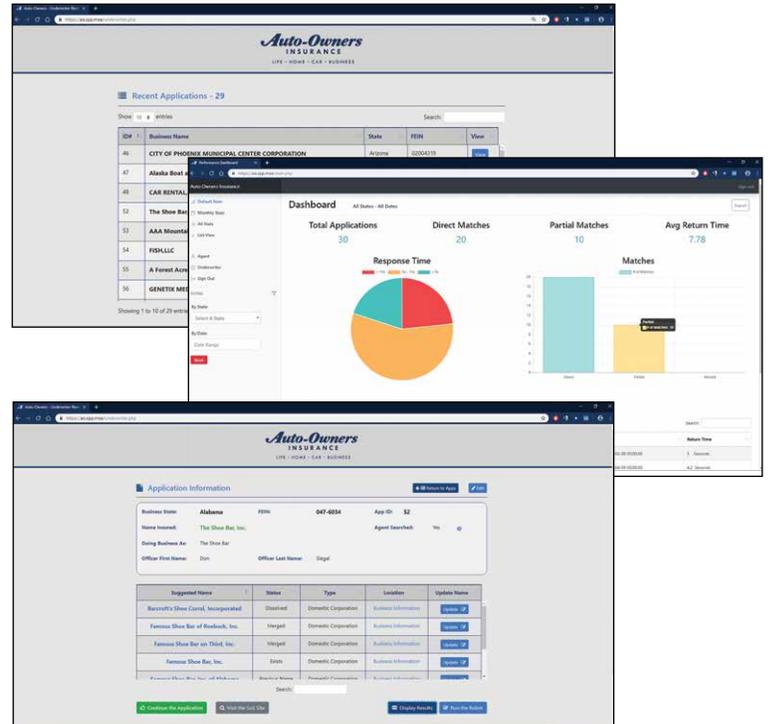
Michigan State University
Team Members (left to right)

Tiezheng Shao
ShaoXing, Zhejiang, China

Brian Jean
Traverse City, Michigan

Joey Baum
Grand Rapids, Michigan

Richard Hutchins
Chicago, Illinois

Adam Leyrer
Lansing, Michigan

Auto-Owners
Project Sponsors

Ross Hacker
Lansing, Michigan

Scott Lake
Lansing, Michigan

Jim Schumacher
Lansing, Michigan

Consumers Energy
New Customer Service Channel

Founded in 1886, Jackson, Michigan-based Consumers Energy provides natural gas and electricity to nearly 6.7 million residents using a large power-generating system portfolio.

At some point, nearly everyone has had to contact a company using its customer service telephone line. Navigating through a confusing automated system and call tree or waiting in long phone queues can be a troubling process that sometimes results in a negative perception of the company.

Our New Customer Service Channel web application improves this experience for Consumers Energy customers by offering an option that allows them to utilize self-service methods to handle inquiries and save valuable time.

When customers first call into the Consumers customer service line, they are given the option of receiving a text message containing a link to the web application. This process handles their inquiry much faster than if they had waited to speak to a representative.

If customers choose to load the web application, they can view the account and balance, set up payment options, pay bills, or create payment arrangements on their own with a simple and user-friendly layout.

Customers are automatically placed in a priority queue in case they elect to speak with a representative.

Our New Customer Service Channel uses the Angular framework for frontend development, consisting of HTML5, CSS3, JavaScript, Typescript, Node.js, and Bootstrap. The backend utilizes ASP.Net, Entity Framework, and C#, while the Twilio API maintains call functionality.
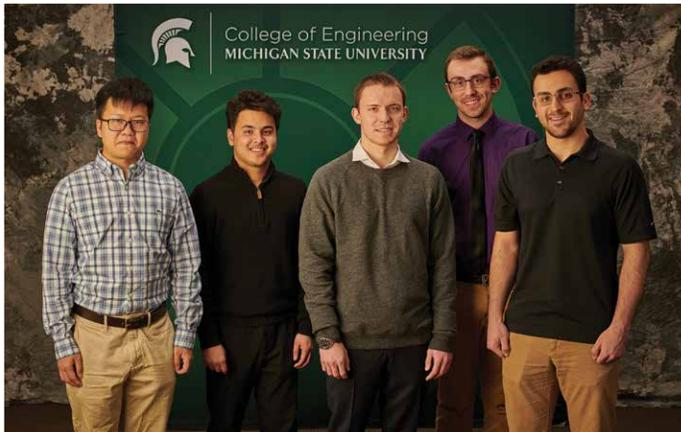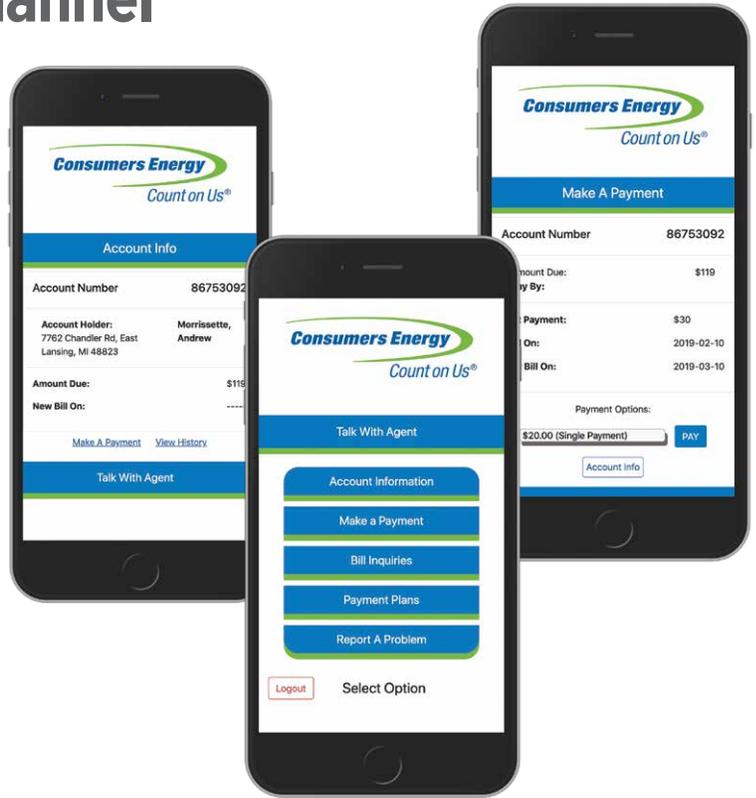
Michigan State University
Team Members (left to right)

Hang Zhao
Xiantao, Hubei, China

Muhammed Zahid
Lansing, Michigan

Ben Weinstock
Farmington Hills, Michigan

Andrew Morrissette
Saginaw, Michigan

Ibraheem Saleh
Grand Rapids, Michigan

Consumers Energy
Project Sponsors

Allison Cooper
Jackson, Michigan

Norman Corrion
Jackson, Michigan

Ben Frederick
Jackson, Michigan

Meg Martin
Jackson, Michigan

Josh Stamper
Jackson, Michigan

Rae Anne Tolonen
Jackson, Michigan

The Dow Chemical Company
AR Model Management Platform

With more than 100 years of success and industry-leading innovation, Michigan-based Dow is a global leader in specialty chemicals, advanced materials and plastics. From bottles to boxes, Dow provides a world-class portfolio of advanced, sustainable and leading-edge products.

In addition to face-to-face interactions with their customers, Dow sales professionals also visit dozens of trade shows and other events, showcasing their products using augmented reality (AR) via the representative's mobile phone. The problem the representatives often run into is this: when a new product is to be showcased, either a new application must be created or an old one manually updated before it can be shared with a potential customer.

Our AR Model Management Platform eliminates the need for separate applications. This iOS and Android mobile application functions company-wide. AR models update automatically. Any employee with permission can view, color, scale and download models.

Utilizing a mobile device's camera and screen, sales professionals exhibit product models as if they exist in the space around them. The user places the product on any surface, displaying real-world scale and structure to a potential customer. In addition, tapping the model highlights features and displays additional information.

Administrators add models to a central storage location and give model viewing capabilities to sales professionals.

Our platform is built with the Unity game engine, ARKit and ARCore. The models are saved on a SharePoint site, and access is handled through Azure Active Directory.
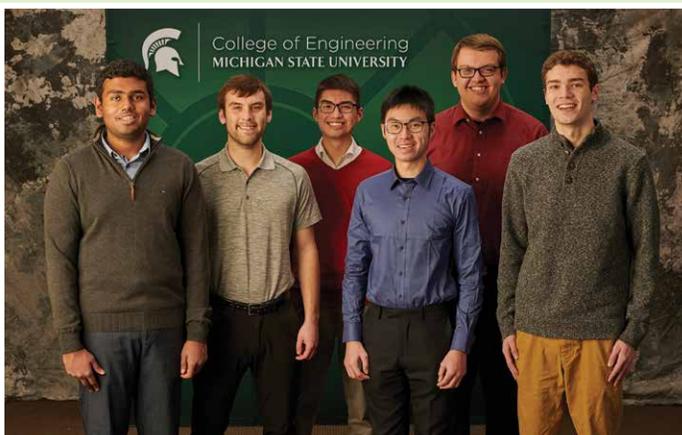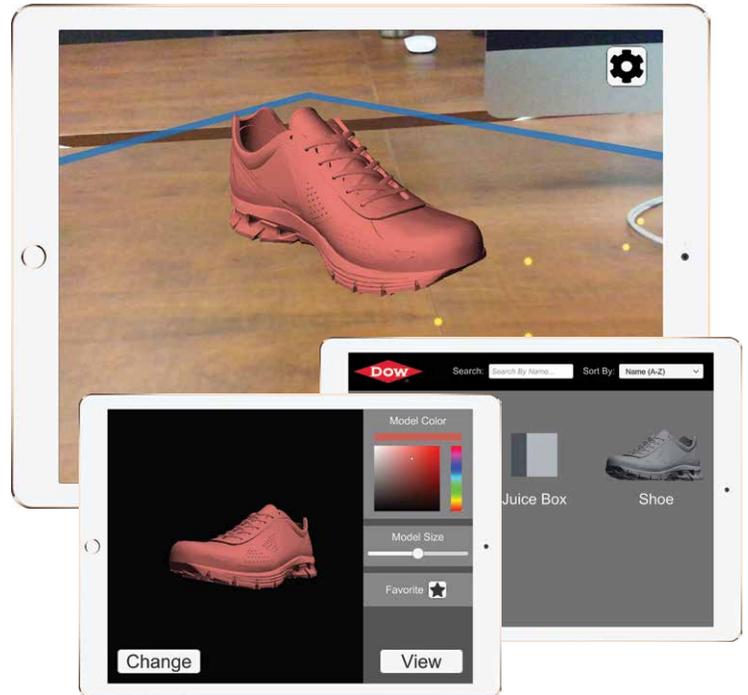
Michigan State University
Team Members (left to right)

Thomas Diaz
Novi, Michigan

Matt Dennis
Detroit, Michigan

David Slimak
Troy, Michigan

David Zhou
GuangZhou, GuangDong, China

Harrison Sanders
Charlotte, Michigan

Nate Kurt
South Lyon, Michigan

Dow
Project Sponsors

Chris Anderson
Chicago, Illinois

Gauthier Devolder
Chicago, Illinois

Marc Habermann
Houston, Texas

Fareed Mohammed
Midland, Michigan

DRIVEN-4
Product Development Portfolio and Planning

Based in Michigan, DRIVEN-4 offers its customers a competitive edge by providing them with innovative strategies, insights and proven implementations of integrated process and technology.

Original equipment manufacturers, or OEMs, are companies whose goods are used as components in the products of another company. In order to be competitive, OEMs must have plans in place that guide them to the most profitable results. These plans include budget information and hiring needs, as well as the storage of information that may be useful for future projects.

Our Product Development Portfolio and Planning software gives project managers the ability to forecast and track execution of annual product development budgets.

In addition, it provides them with the ability to insert the data required to build multiple forecasts and then generate graphs with just a click of a button. This enables them to visualize plans and choose the best possible one to build the product. It also gives them the ability to track the execution of an ongoing development and compare it with the forecast to ensure timely delivery of the product.

Our mobile app allows project managers to view updates or changes made to the project by other managers. It also allows employees to log the hours they have spent working on different projects throughout the week.

Our web app frontend uses Angular and the backend uses PTC ThingWorx, a platform to create business logic. Our mobile app is written in Xamarin and is available on both Android and iOS devices.

Michigan State University
Team Members (left to right)

Kevin Kye
Grand Rapids, Michigan

Athena Zhang
Nanjing, Jiangsu, China

Hassan Tarar
Lahore, Punjab, Pakistan

Kyle Forbes
Fremont, Michigan

Dan Tinsman
Commerce Township, Michigan

DRIVEN-4
Project Sponsors

Fred Bellio
Saint Joseph, Michigan

Carl Wendtland
Saint Joseph, Michigan

Evolutio
AppDynamics Platform Configuration Tool

Evolutio is a group of technology professionals convinced that business problems have significantly simpler solutions than the market is led to believe. Living and breathing big data, one tool they use to help meet their customers' goals is Cisco's AppDynamics platform, designed to learn application behavior as well as visualize critical health and performance data.

Dashboards are one of the best ways AppDynamics makes the data visible and understandable to the user. For example, it can let the company know if the site is getting too much traffic and unless more servers are put into use the site could slow considerably or even crash.

A company's applications are crucial to attracting new customers or retaining existing ones. AppDynamics reminds them how their complex apps directly affect their businesses.

Our AppDynamics Platform Configuration Tool is utilized by Evolutio to deploy efficiently dynamic template dashboards that allow for quick and easy exportation across applications. It significantly reduces the amount of work required to create custom dashboards by using specially created templates and a simple-to-use interface assisting in dashboard deployment.

There also is an Amazon Alexa feature that interfaces with AppDynamics. Customers simply use their favorite Alexa device to ask questions about the performance of and health information for a given application that AppDynamics is monitoring and receive easy-to-understand results.

Our AppDynamics Platform Configuration Tool is written in JavaScript and communicates via a Java RESTful API. The Alexa skill is run via an AWS Lambda function.
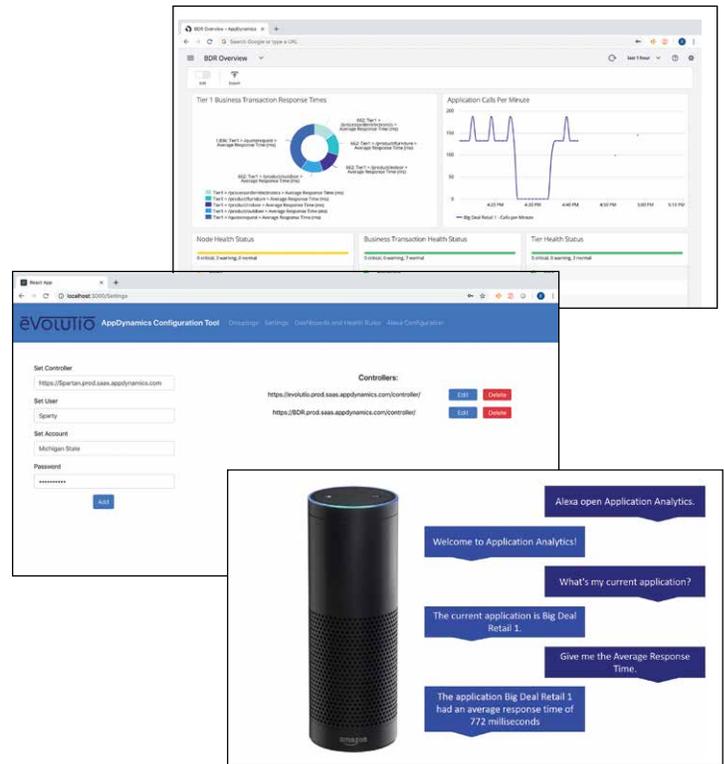
Michigan State University
Team Members (left to right)

Ben Haase
Knightstown, Indiana

Cameron Rasico
Auburn Hills, Michigan

KP Inuaeyen
Lagos, Nigeria

Jon Dressel
Williamston, Michigan

Ian Guswiler
Grand Rapids, Michigan

Evolutio
Project Sponsors

Bob Dyksen
St. Louis, Missouri

Drew Osborne
Indianapolis, Indiana

Adam Ties
Indianapolis, Indiana

Laura Vetter
Indianapolis, Indiana

Ford Motor Company
Greenfield Labs SHARED Locker System

Ford Motor Company is a multinational automotive manufacturer based in Dearborn, Michigan, employing 202,000 employees and producing a total of 6.6 million vehicles in 2017.

Ford's Greenfield Labs in Palo Alto, California is made up of a cross-functional team of researchers who often acquire cutting edge hardware. Upon completion of each research project, these devices often find their way to the back of a drawer or a storage rack within the lab.

Our "SHARED" system, or Shared High-value Asset Reallocation Enablement Device Locker System, showcases these devices in such a way to encourage more efficient use. Unlike most lockers, which hide objects stored within, our system enables the process of walk-up, checkout, and basic tracking of the assets inside.

When an employee checks out or in an item, it is done using our cross-platform app that requires authentication and unlocks the locker. Locker reservations save the requested item at a specific date and time that is set by the user. Administrators keep track of devices, as well as monitor what devices are used.

There are three colors of LED lights that indicate the current status of a locker. Green is for available, yellow is for reserved, and red is for unavailable.

Our system utilizes a Raspberry Pi device to control a cluster of lockers. The corresponding software is written with React and React Native to support web, Android, and iOS platforms. The status of all lockers is displayed within the applications as well as within the physical locker itself.

Michigan State University
Team Members (left to right)

Rob Sulaka
Sterling Heights, Michigan

Wei Dai
Shanghai, Shanghai, China

Seth Killian
Jackson, Michigan

Ning Han
Beijing, Beijing, China

Brett Dziedzic
Detroit, Michigan

Ford
Project Sponsors

Jeff Bourgoin
Dearborn, Michigan

Adam Haas
Dearborn, Michigan

Jake Prickett
Dearborn, Michigan

Michael Volk
Dearborn, Michigan

Matthew Whitaker
Palo Alto, California

Google
Kubernetes Cluster Inspection Tool

Google's mission is to organize the world's information and make it universally accessible and useful.

To this end, Google provides Kubernetes, which is open-source software that enables a customer's cloud application to scale based on current usage and other factors.

For example, if a website is experiencing a high volume of traffic that slows the application, Kubernetes increases the number of servers needed to keep the application healthy.

The information to assess the health of a Kubernetes cluster is in many different places. As a result, diagnosing problems is time-consuming and becomes more difficult as the cluster increases in size.

Our Kubernetes Cluster Inspection Tool organizes cluster information, making it available in a single web app. Our tool lowers the barrier to entry for new users, improves the functional experience for existing users, and allows users to spend less time diagnosing problems.

Users are presented with a visual overview of the cluster and click-on components to gather more information. When a component is clicked, a window appears with a list of data stored in logs, as well as a variety of metrics displayed on a series of graphs. Additionally, network communications between cluster components are shown in one view.

Our Kubernetes Cluster Inspection Tool utilizes the Stackdriver Monitoring and Logging APIs and the Kubernetes API to obtain data. The backend is built in Go, and the frontend uses Vue.js and D3.js.
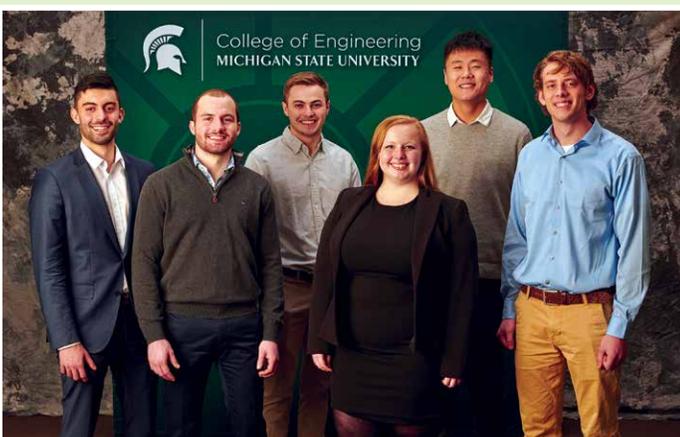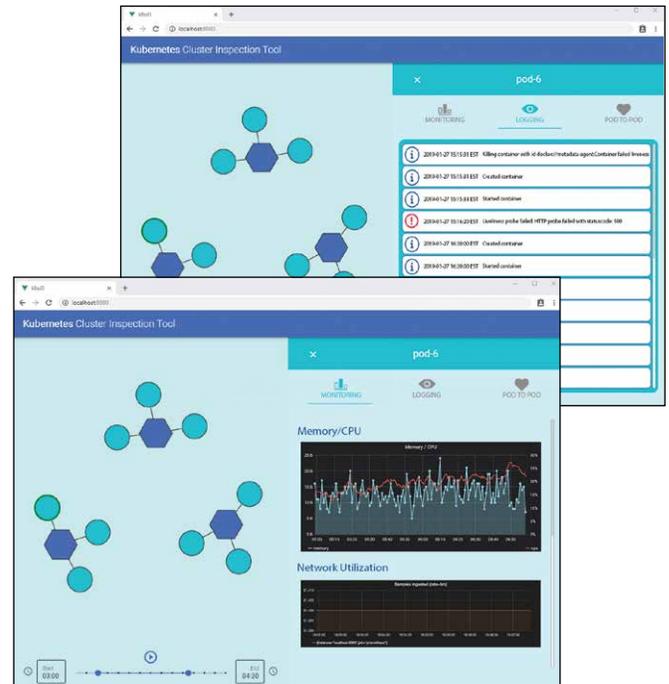
Michigan State University
Team Members (left to right)

Guillermo Jimenez
Rochester Hills, Michigan

Casey Schneider
East Lansing, Michigan

Ben Whitelaw
Birmingham, Michigan

Haylee Quarles
Williamsville, New York

Linghao Ji
Jinan, Shandong, China

Dave Ackley
Harrison Township, Michigan

Google
Project Sponsors

Pedro Marcolino
Kirkland, Washington

Ken Massada
Kirkland, Washington

Pradeep Nekkalapudi
Kirkland, Washington

Michael Taylor
Kirkland, Washington

Herman Miller
Office Navigation Using Augmented Reality

Headquartered in Zeeland, Michigan, Herman Miller is one of the world's largest producers of high-end office furnishings. Its products are used in modern workspaces around the globe.

When moving to a new location, workers can easily get lost trying to find their office, the breakroom or even the bathroom. Finding their way can also be challenging for visitors, including potential customers.

Our Office Navigation Using Augmented Reality app is an indoor AR navigation tool for clients and employees of Herman Miller.

Our app provides turn-by-turn instructions on how to maneuver through an unfamiliar building. It allows a building administrator to set up the environment by locating multiple destinations, as well as identifying the routes throughout the building. After selecting a destination, directional spheres, as shown on the right, will be displayed on the screen. Users then follow the spheres to lead them to their destination.

Our app uses computer vision via Apple's ARKit and machine learning to detect features and landmarks within an enclosed space. It uses AR to display turn-by-turn instructions. It also has the potential to be useful in a variety of other settings, including hospitals, shopping malls and parking structures.

Our Office Navigation Using Augmented Reality app is built using ARKit, Placenote, AWS Cognito, AWS SageMaker and Pods. They work together to create a coherent user experience.
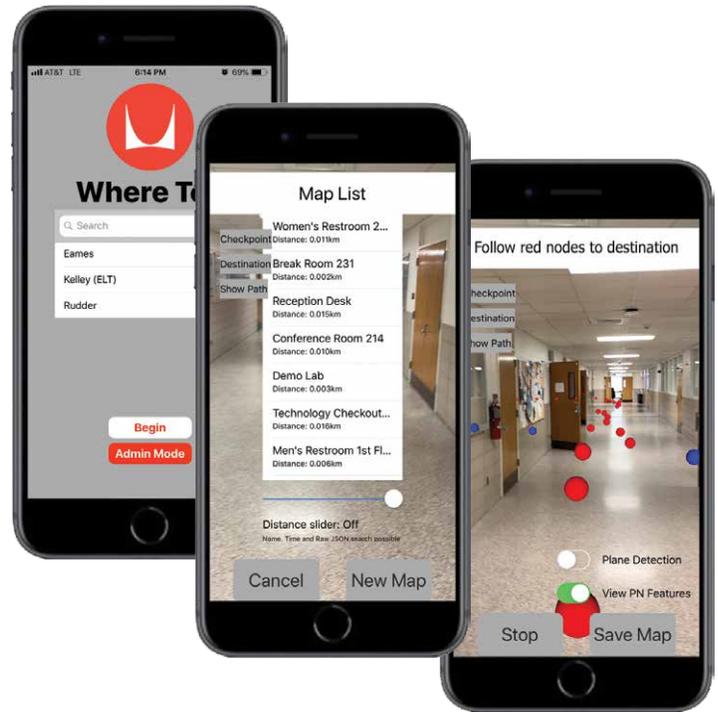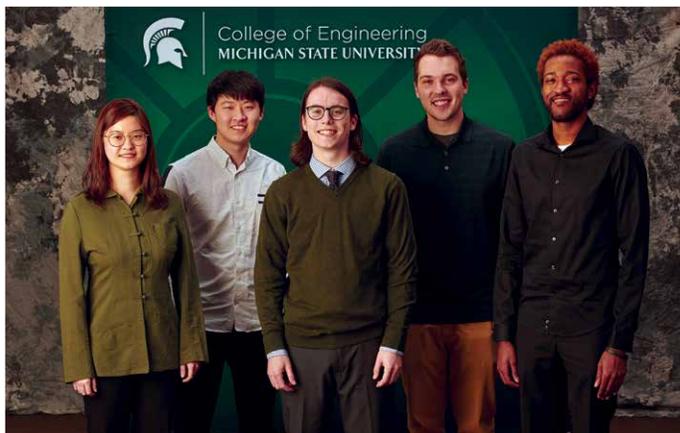
Michigan State University
Team Members (left to right)

Zhenru Wang
Beijing, Beijing, China

Stefan Zhang
ZhengZhou, Henan, China

Aaron Eshleman
Kalamazoo, Michigan

John Riley
Midland, Michigan

Matthew Rhodes
Detroit, Michigan

Herman Miller
Project Sponsors

Mark Buikema
Zeeland, Michigan

Tom Holcomb
Zeeland, Michigan

Humana
Technology Peripheral Inventory Predictor

Humana is a Fortune 100 health insurance company that provides products and services to more than 13 million U.S. customers. Humana seeks to empower its members, urging them to live healthy, active and rewarding lives.

Providing as many as 40,000 employees with the technology they need to more efficiently do their jobs presents a significant challenge for the company. Its goal for 2019 is to increase the accessibility of computer peripherals and to improve the process of procuring those items.

To this end, Humana uses our web app, Technology Peripheral Inventory Predictor, to predict the future demand of various peripherals based on past purchase history. With these tools, purchasers make well-informed decisions about which items are needed the most. Peripherals include any computer-related products, from keyboards to mice to external hard drives.

Our app closely monitors new purchases and then indicates how these purchases differ from past trends. This allows users to see how demand shifts over time. Users also can observe the purchase history by itself in order to make judgments based on both data and their own experiences. In this way, the application does not supersede the user, but instead enables him or her to make better decisions more quickly.

Additionally, users input large quantities of data all at once by uploading a .csv file. This way, new sources of data are incorporated into the system quickly and efficiently.

Django is used to host the backend of the web application. The data is stored using PostgreSQL.
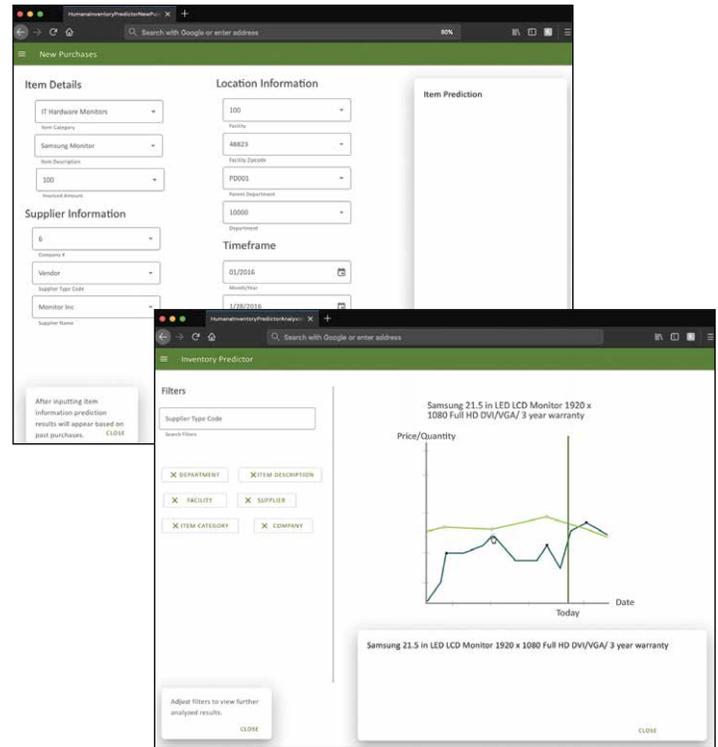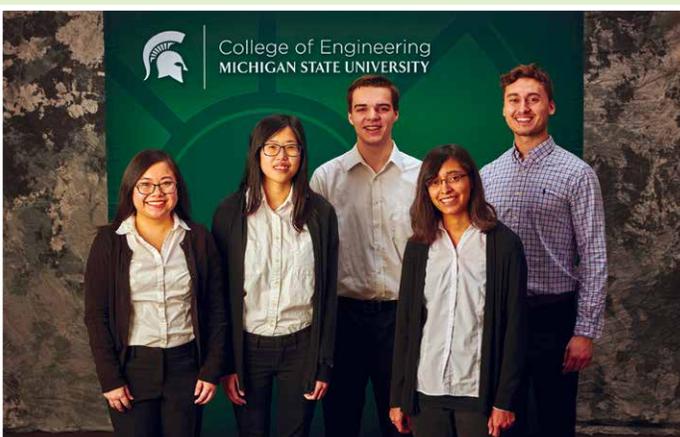
Michigan State University
Team Members (left to right)

Linda Duong
Grand Rapids, Michigan

Siru Chen
Shanghai, Shanghai, China

Brendan Vande Kieft
Livonia, Michigan

Katie Sydlik-Badgerow
Kalamazoo, Michigan

Gabe Apaza
Northville, Michigan

Humana
Project Sponsors

Ashlee DeLine
Louisville, Kentucky

Mick Horton
Louisville, Kentucky

Aaron Lawhead
Louisville, Kentucky

Owen McMahon
Louisville, Kentucky

Erin Wycoff
Louisville, Kentucky

Meijer
aislePerks: Location-Based Personalized Shopping

Meijer is a supercenter chain with roots firmly planted in Michigan. With 242 stores in six states, Grand Rapids-based Meijer is one of the biggest retailers in the nation.

Meijer is at the forefront of innovation with the early adoption of products such as shopping carts, automated checkout conveyor belts, and the mPerks digital-coupon program. mPerks enhances shoppers' experiences by helping them earn discounts without the hassle of paper coupons.

Our Location-Based Personalized Shopping system, or aislePerks, improves the mPerks experience by notifying customers of deals and specials that may interest them while they are shopping. Customers who have the mPerks app on their mobile device have the option to download aislePerks.

When customers enter the store, they can open the app to see any relevant deals or specials. As they walk through the store, deals are recommended based on their previous purchases and where they spend the most time in the store. Deals are selected by customers and saved to their "Saved Deals" page where they can view their deal history.

Our system includes a companion dashboard website that Meijer employees utilize to view aislePerks usage data. This data includes statistics about top-selling products, the number of customers using it, and its effectiveness.

aislePerks utilizes APIs of Mist wireless networks to determine a customer's exact location within a store. aislePerks is written in Java for Google Android devices and Swift for Apple iOS devices. Our backend system is hosted on Microsoft Azure. Our companion administrative dashboard is written in AngularJS.
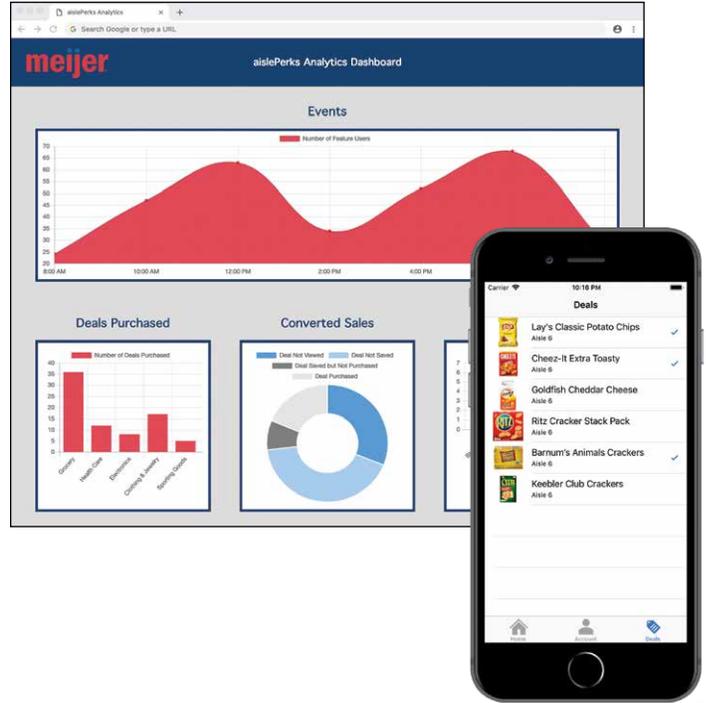
Michigan State University
Team Members (left to right)

Chris Le
Grand Rapids, Michigan

Jacob Kalt
Birmingham, Michigan

Sasha Morford
Livonia, Michigan

Jack Studzinski
Shelby Township, Michigan

Blaire Izbicki
Pepperell, Massachusetts

Meijer
Project Sponsors

Chirag Ghimire
Grand Rapids, Michigan

Phil Kane
Grand Rapids, Michigan

Sameer Kona
Grand Rapids, Michigan

Kristin Lake
Grand Rapids, Michigan

Chris Laske
Grand Rapids, Michigan

Terry Ledbetter
Grand Rapids, Michigan

Murali Rajagopalan
Grand Rapids, Michigan

Michigan State University HPCC
Simplifying High Performance Computing

The MSU High Performance Computing Center (HPCC) provides large-scale computing resources for university researchers as well as industry leaders trying to solve complex problems.

The HPCC is a cluster computer, which means many computers are brought together to form a single computer system. A cluster can do much more work than a single computer, which is why it is a great resource for research.

Using the HPCC can be challenging for people without a technical background. Users don't have a simple webpage on which to do their work and often must learn to write code for menial tasks.

To make high performance computing more accessible, our Simplifying High Performance Computing application creates a simple user interface for researchers to do their work. Users view helpful statistics and information about their work. Head researchers also view information on the work their employees are doing.

Computer code for certain tasks is automatically generated for users, which frees scientists to focus on the research that's important to them. It also has the potential to provide a "sandbox" environment not connected with the HPCC cluster, which allows researchers to test and evaluate their work.

Our Simplifying High Performance Computing app makes high-performance computing more accessible and abstract technical details more understandable. Our web app is built using Python, JavaScript, HTML, SQL Databases and SLURM.
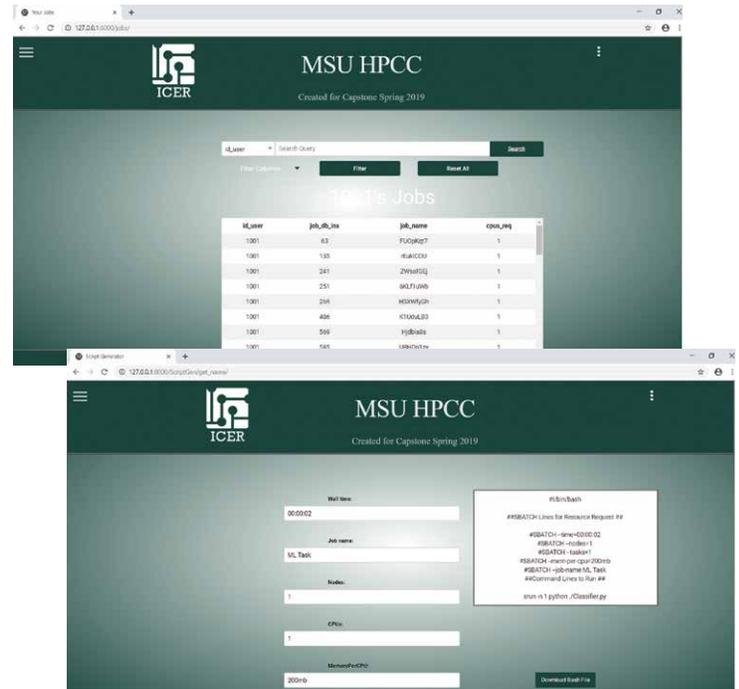
Michigan State University
Team Members (left to right)

Zach Roush
Novi, Michigan

Christian Luedtke
Lake Orion, Michigan

Matt Williams
Grand Rapids, Michigan

Zhihan Wang
Xinyang, Henan, China

Caleb Winner
Walker, Michigan

Michigan State University HPCC
Project Sponsors

Cameron Crisovan
East Lansing, Michigan

Andy Keen
East Lansing, Michigan

Bill Punch
East Lansing, Michigan

Michigan State University ITS
Group Project Organization and Scheduling

Michigan State University is a public research institution founded in 1855. The goal of its Information Technology Services unit is to deliver and maintain effective technology resources for students, faculty and staff.

All students frequently take part in group projects. This is frustrating because finding the best way to communicate, setting up meeting times, and managing resources used for the project is very difficult.

Our Group Project Organization and Scheduling app reduces the stress of these tasks in a quick and simple way by allowing a user to create a group, easily add members, and connect with any services they find useful for their project.

The user simply clicks to create the group, invitations are sent out, and the tools selected are automatically configured. A team portal is revealed, displaying scheduled meetings, linked tools, and suggested tools the group may find useful.

The main feature of our app is the ability to schedule meetings based on a user's linked calendar, whether it is Google Calendar or Outlook Calendar.

The scheduling algorithm finds available times from the individual calendars and proposes times which work for all or most members. After approval by a group member, the new meeting time is added to a list of scheduled meetings.

Our web app is built with the Serverless Framework and calls to Amazon API Gateway endpoints to invoke AWS Lambda functions written in Python. Our user interface is constructed with Vue.js and Bootstrap, served from a public Amazon S3 Bucket.
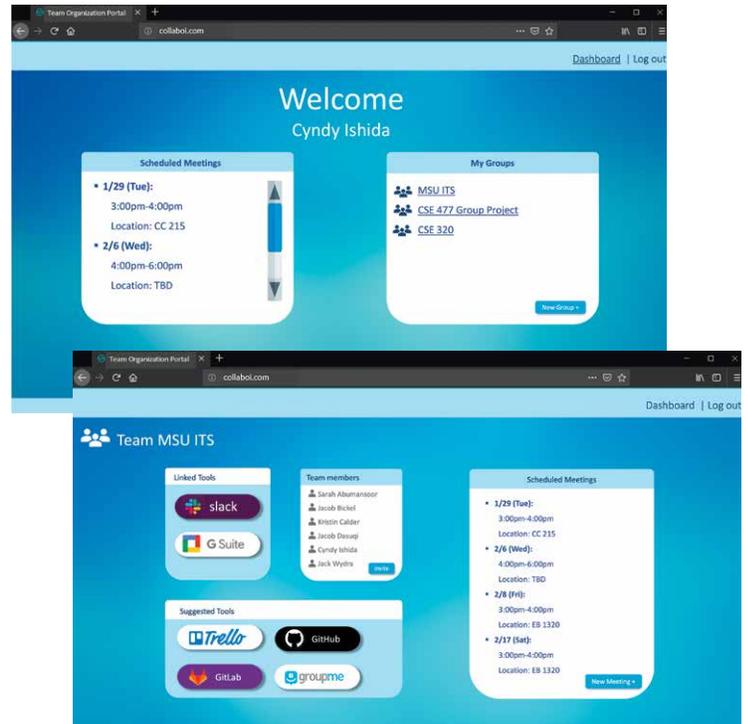
Michigan State University
Team Members (left to right)

Cyndy Ishida
Canton, Michigan

Jacob Bickel
Grand Rapids, Michigan

Kristin Calder
Saline, Michigan

Jack Wydra
Clarkston, Michigan

Sarah Abumansoor
Jeddah, Saudi Arabia

Jacob Dasuqi
Clarkston, Michigan

Michigan State University ITS
Project Sponsors

E.J. Dyksen
East Lansing, Michigan

Rob McCurdy
East Lansing, Michigan

Spencer Ottarson
East Lansing, Michigan

Nick Summers
East Lansing, Michigan

Mozilla Corporation
Optimizing Firefox Localization

Mozilla's mission is to ensure the Internet is a global public resource, open and accessible to all. Mozilla is most well-known for its browser Firefox, their main effort in making this vision a reality.

Firefox, with its more than 250 million active users, is available in 98 languages. However, only 40 percent of those users consider English their primary language. Previously, in order to change Firefox to a new language, users were required to select the new language and restart the browser.

To make changing languages easier, Mozilla created Fluent, a new technology that allows the Firefox interface to have more natural sounding and culturally appropriate translations. This type of translation is called localization.

Our Optimizing Firefox Localization tools enable Firefox developers to work more efficiently, spending less time catching small mistakes and more time integrating Fluent.

Our tools use a cutting-edge technology called WebAssembly, which is a new computing language designed specifically for modern web browsers like Firefox. WebAssembly speeds up the time to load Firefox in different languages. Translation to a new language is made with a simple setting change in the browser.

Optimization of the localization system is achieved by the integration of a Rust implemented parser through the use of WebAssembly, a version of JavaScript that achieves near native performance. These two factors decrease the time it takes to switch Firefox to a new language by one to two orders of magnitude.
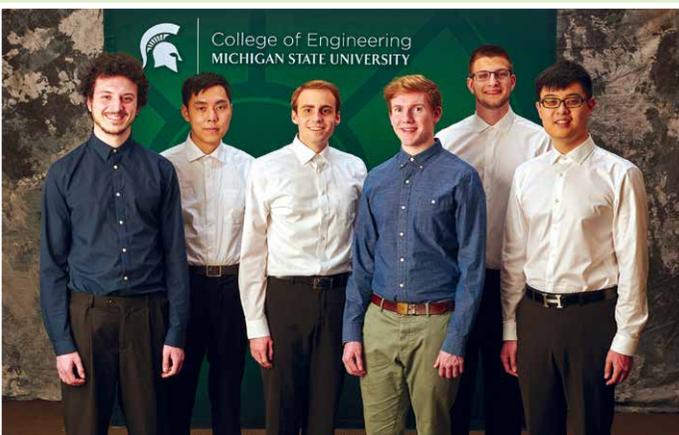
Michigan State University
Team Members (left to right)

Avery Berninger
Fraser, Michigan

Brian Chen
Lafayette, California

Nick Cowles
St. Clair Shores, Michigan

Ian Kirkpatrick
Chicago, Illinois

Chris Frey
Midland, Michigan

Yuan Cheng
Beijing, Beijing, China

Mozilla
Project Sponsors

Zibi Braniecki
Mountain View, California

Gijs Kruitbosch
Leicestershire, United Kingdom

Jared Wein
Burton, Michigan

MSU Federal Credit Union
AutoBudget Chatbot

Since 1937, Michigan State University Federal Credit Union (MSUFCU) has offered financial services to members of the MSU and Oakland University communities. MSUFCU is the largest university-based credit union in the world, with nearly 900 employees and more than 265,000 members.

With the evolution of financial tools comes a need for a tailored, more personalized user experience. MSUFCU currently offers robust home banking and mobile apps for members to connect with their accounts, check their balances, transfer funds, move money, and more.

However, these apps have not provided a personalized budgeting solution to assist members with their financial planning needs. MSUFCU has enhanced its services with our AutoBudget Chatbot, a voice-enabled tool that helps members get their financial worlds in order.

Our AutoBudget Chatbot provides members with a suggested budget based on their income and spending patterns. The chatbot also allows members to categorize their transactions and provides a graphical overview of the member's transactional trends. Members can set spending goals for any number of categories while the app helps them stay on track.

Our AutoBudget Chatbot is available on Alexa and Google Home devices, all web browsers, and mobile devices running iOS or Android.

The iOS app is built using Swift, the Android app is built with Java, and the website is primarily HTML, CSS and PHP. All applications call an API running Node.js.
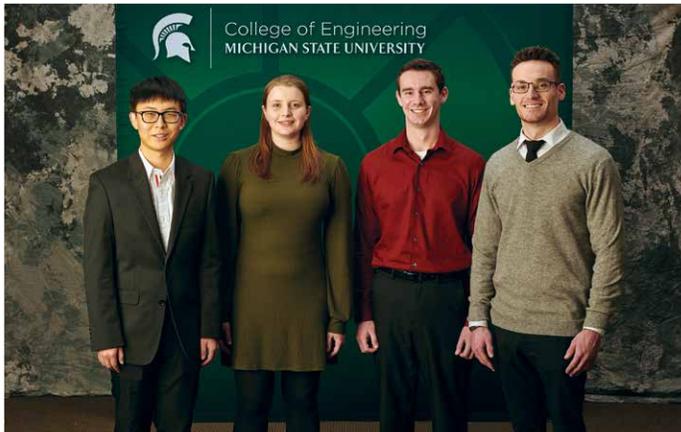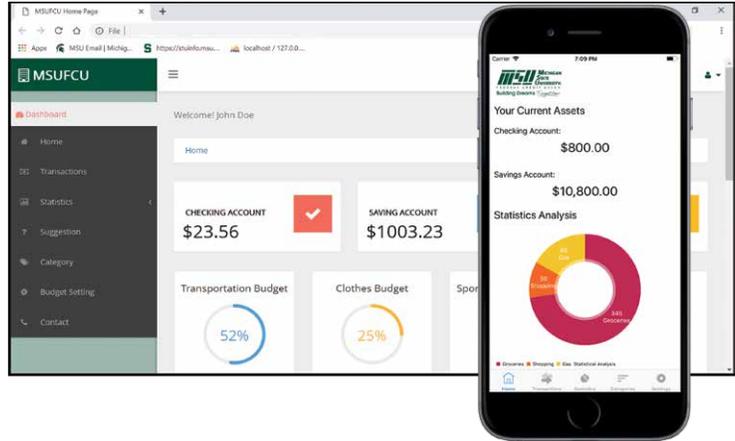
Michigan State University
Team Members (left to right)

Jiechen Song
Taiyuan, Shanxi, China

Ksenia Pestova
Dewitt, Michigan

David Evenson
Okemos, Michigan

Dillon Scott
New Hudson, Michigan

MSUFCU
Project Sponsors

Samantha Amburgey
East Lansing, Michigan

April Clobes
East Lansing, Michigan

Ben Maxim
East Lansing, Michigan

Liam Petraska
East Lansing, Michigan

Principal Financial Group
Integrated Analyst Ratings and Notes

The Principal Financial Group is an investment management and insurance company, with offices located in 19 countries. It welcomed 2019 with $626.8 billion in assets under management.

A major key to the company's success is the investment information generated by its financial analysts. Analysts generate reports on investment opportunities, thus ensuring that Principal is managing its assets in the most effective way possible.

Our Integrated Analyst Ratings and Notes system is a web app that aggregates Principal's divergent reporting systems into a single, comprehensive tool.

This allows analysts to more easily search through company and investment ratings and update the ratings if necessary. Analysts find they spend less time filling out forms and more time making data-driven decisions. The improved report viewing interface provides a central location for all report analyses, while also maintaining historical ratings.

Our app also improves collaboration between analysts, making access to imperative data widely available. Ratings and notes are easily accessible through the notification, feed and search functions.

In addition, analysts have the option to subscribe to investment portfolios, securities, user-generated tags or other Principal analysts to receive up-to-date information regarding the most vital investments.

Our app is built using PHP, Python, CSS, JavaScript and HTML, and is supported by a PostgreSQL database backend.
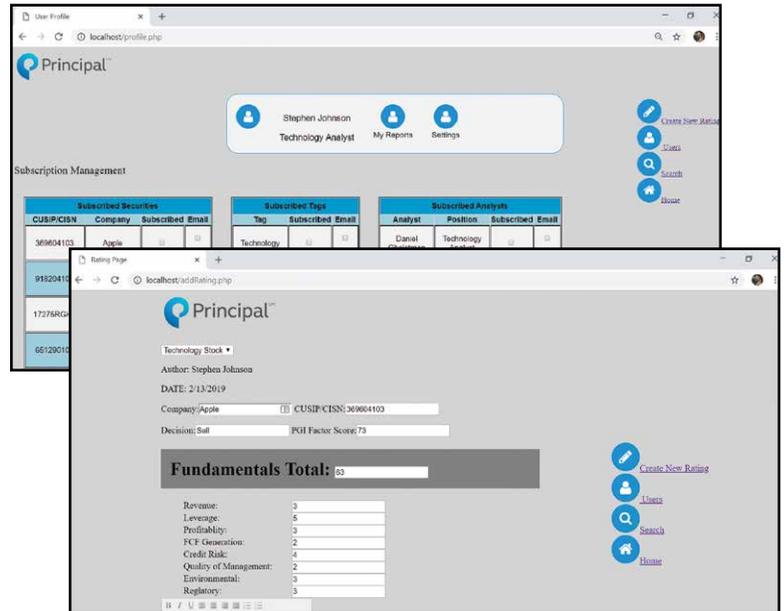
Michigan State University
Team Members (left to right)

Ryenn McAdory
Rochester Hills, Michigan

Ziyi Huang
Beijing, Beijing, China

Alexana Steck
Novi, Michigan

Carter Trpik
Chicago, Illinois

Jacob Rieck
Geneva, Illinois

Principal
Project Sponsors

Joe Byrum
Des Moines, Iowa

Steve Streetman
Des Moines, Iowa

Madeline Taylor
Des Moines, Iowa

Proofpoint
Defeating Malware Payload Obfuscation

Proofpoint is a leading cybersecurity firm which provides comprehensive, cloud-based security that protects organizations from malware threats.

Every day, Proofpoint stops billions of attacks on email, mobile apps and social media accounts. This massive volume of attacks requires an efficient method for detecting malware.

Our Defeating Malware Payload Obfuscation platform provides a faster and more efficient way to determine whether incoming files are benign or malicious. Our system utilizes a machine learning approach to detect and neutralize malware payloads.

Among other things, our platform detects so-called obfuscated malware, in which an attacker hides malware in a seemingly innocent document, such as a photo. Such a diagnostic process can be difficult and expensive. By handling different file types separately, our machine learning algorithm quickly and accurately classifies a wide range of malware files.

Our platform includes a companion web dashboard that displays basic system information, including a system health information page, and pages that examine details of the classification of an individual file and allow the user to submit files manually to be analyzed.

Our backend platform uses a Python controller to extract metadata from different file types and feeds that information into our machine learning algorithm running Keras, Tensorflow and scikit-learn to make a classification. Our web dashboard uses Flask for the backend, and Bootstrap, HTML and JavaScript for the frontend.
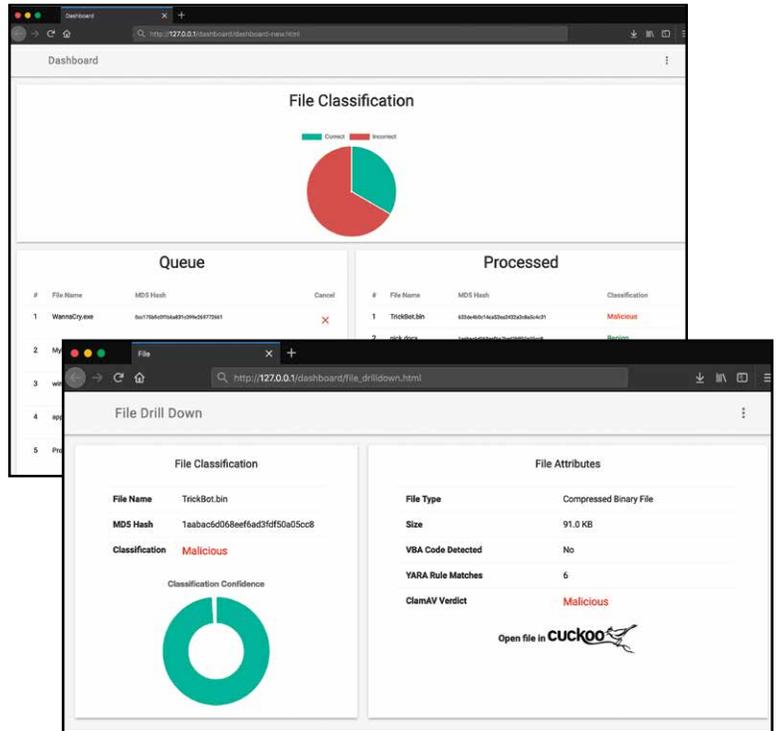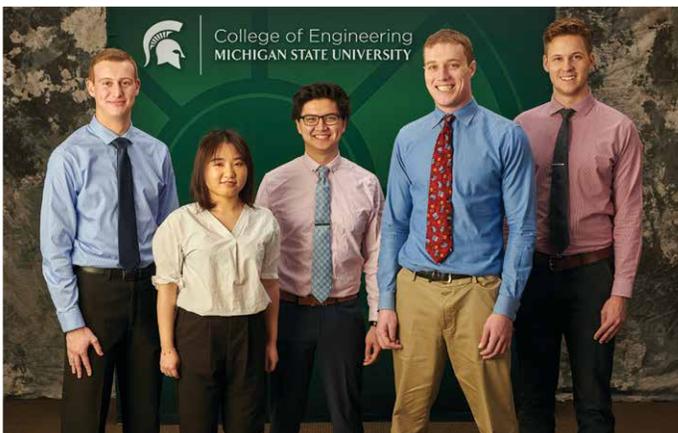
Michigan State University
Team Members (left to right)

Adam Johanknecht
Cranberry Township, Pennsylvania

Vivian Qian
Suzhou, Jiangsu, China

Derek Renusch
Lake Orion, Michigan

Dan Somary
Arlington Heights, Illinois

Nick Lojewski
Chesterfield, Michigan

Proofpoint
Project Sponsors

Leilani Alejo
Sunnyvale, California

Kristi Gee
Sunnyvale, California

Brad Woodberg
Plymouth, Michigan

Spectrum Health
Patient Training Tool

Spectrum Health is a not-for-profit health care provider based in Grand Rapids, Michigan, consisting of 12 hospitals and over 140 service sites throughout the state.

Among its offerings are urgent care and ER services, MedNow, for virtual doctor appointments, and eVisit, an online questionnaire in which a health care provider provides a diagnosis and treatment plan.

Many patients are not aware of these services and will instead head directly to the emergency room. These visits are usually unnecessary, can be overly expensive for both patient and provider, and could lead to longer wait times for all.

To combat this, our Patient Training Tool is a chatbot app that recommends the appropriate Spectrum service based on the symptoms the patient is experiencing.

After a patient speaks to the Google Home device, describing their symptoms, our Patient Training Tool searches through a database and identifies the condition that best matches those symptoms. It relays the matching condition to the patient in easy-to-understand terms and recommends the appropriate service.

The recommended service for a condition may change based on patient choices. Once recommended a service, the patient accepts or rejects the recommendation, informing the Google Home device of the service that will be utilized. If an alternative service is repeatedly chosen for a condition, the Patient Training Tool changes its recommendation to match for all future users.

Our Patient Training Tool, compatible with both Google Home and Amazon Alexa, is written in JavaScript using the Node.js framework to query an Azure SQL database. Dialogflow is utilized for natural language processing.
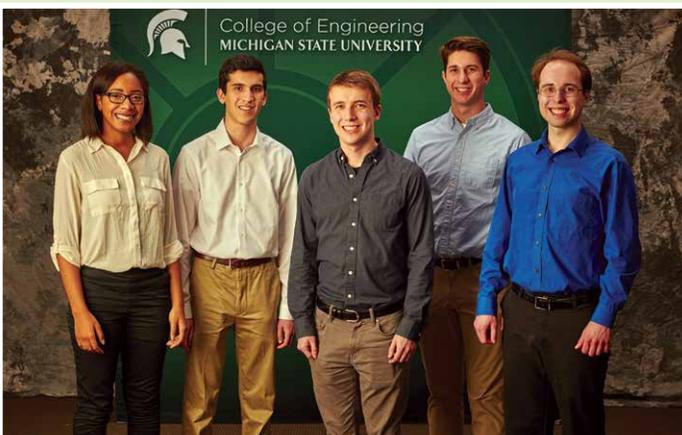
Michigan State University
Team Members (left to right)

Blake Williams
Cuyahoga Falls, Ohio

Mohammed Naji
East Lansing, Michigan

Grant Schonhoff
Oxford, Michigan

Matt Kelley
Novi, Michigan

Ryan Mathews
Jackson, Michigan

Spectrum Health
Project Sponsors

Adam Bakker
Grand Rapids, Michigan

Ron Bussa
Grand Rapids, Michigan

Jason Joseph
Grand Rapids, Michigan

Vincenzo Pavano
Grand Rapids, Michigan

Andrew Sheffer
Grand Rapids, Michigan

Apoorv Singh
Grand Rapids, Michigan

Mark Welscott
Grand Rapids, Michigan

Surge Solutions
xOS: Visualization of Automated Underwriting

Surge Solutions is a Michigan-based technology company whose goal is to provide custom software solutions for its clients. It utilizes cloud technology to create quick and creative results.

In the financial world, moneylending is challenging and complex. Lenders want their investments to be risk-free; borrowers want to make the right decisions. Efficiency, accuracy and speed are attained with the automation of the underwriting process.

To assist its clients in the lending industry, Surge is utilizing our xOS: Visualization of Automated Underwriting applications. Our product consists of two user-friendly web apps designed to streamline the underwriting of loan products, product recommendation and risk analysis.

Clients provide their financial information to the product-recommendation app, which searches for all products that match their needs. The best-fitting product is suggested, together with similar alternative products, with the ultimate goal of providing clients with the best loan option that meets their needs.

Loan officers also use our risk analysis app to visualize the change in risk and net benefit to the company as a result of changing loan guidelines. With the use of a tree structure, parameters are easily and quickly visualized and altered.

Our xOS: Visualization of Automated Underwriting application frontends are built using React and D3 in JavaScript. Our backend is accessed via a REST API and is hosted on Amazon Web Services.
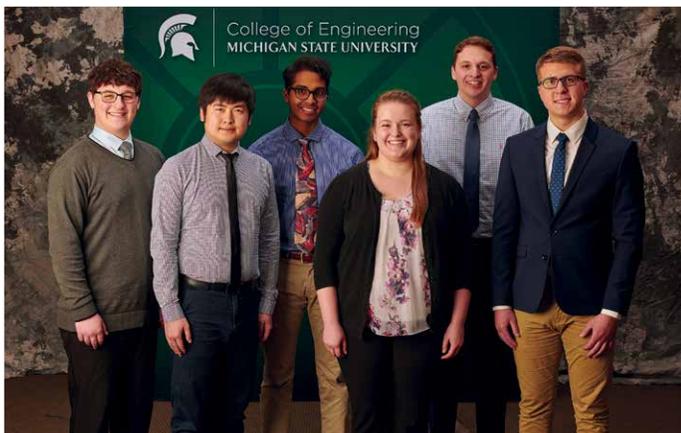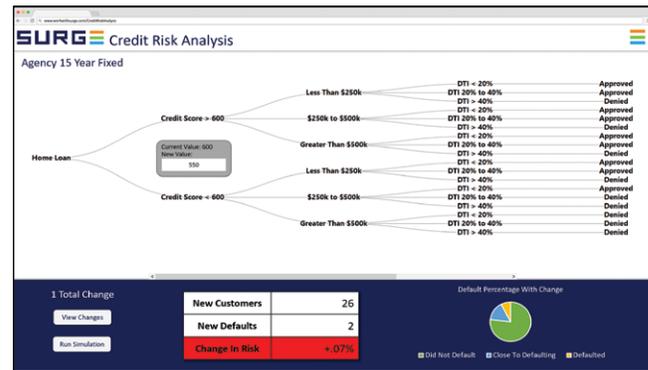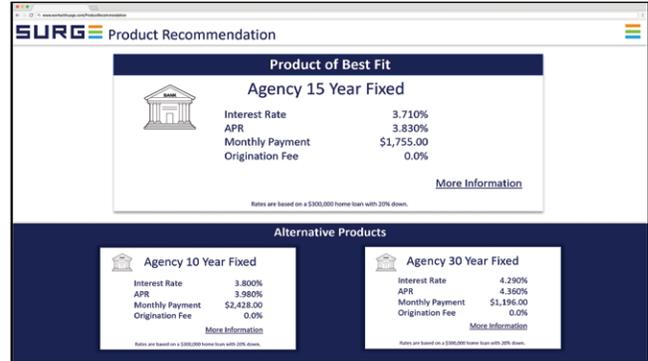
Michigan State University
Team Members (left to right)

Dakota Klatt
Menominee, Michigan

Sam Zhou
Beijing, Beijing, China

Prudhvi Kuchipudi
Ann Arbor, Michigan

Erika Lustig
Grand Blanc, Michigan

Drew Rutt
Lake Orion, Michigan

Pawel Babkowski
Grand Rapids, Michigan

Surge Solutions
Project Sponsors

Lindsay Eisen
Rochester Hills, Michigan

Matt Hawkins
Rochester Hills, Michigan

Travis Mottet
Rochester Hills, Michigan

Brandon Snider
Rochester Hills, Michigan

Justin Walker
Rochester Hills, Michigan

Technology Services Group
Multi-Video Case Management

Founded in 1996 in Chicago, Technology Services Group (TSG) focuses on helping companies manage their data and business processes. Today, TSG has many clients across a wide range of industries and is a leading provider of content management solutions.

Clients of TSG include insurance companies, whose claims agents must quickly deal with incidents that often contain large amounts of security video footage. These incidents can include anything from the theft of a bicycle to a multi-vehicle accident. Claims agents can spend large amounts of time searching for important pieces of security videos in order to sum up an incident.

Our Multi-Video Case Management tool helps clients more efficiently deal with cases containing multiple videos.

Our tool includes a feature known as Add Videos, which allows for the quick searching of security videos by prompting users for a location, time and date of an incident. It then retrieves security video files that match the criteria and displays each on an interactive map. Videos can be selected and added into the case folder by the user.

Multiple videos are then merged together into a single view, showing all angles of the incident using the Merge Videos feature. The merged video shows the most relevant video, based on annotations assigned by the user.

The Add Videos action is built with OpenContent Web Services (OC) and the Google Maps API provides the interactive map. The Merge Videos action is built with OC and uses FFmpeg as the video manipulation tool. The backend for both consists of DynamoDB, S3 and Solr.
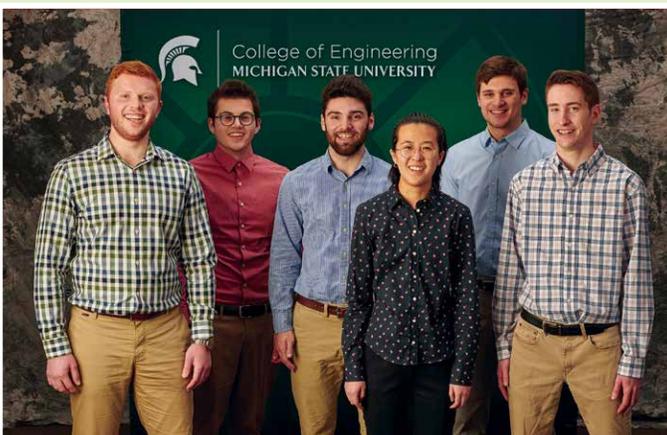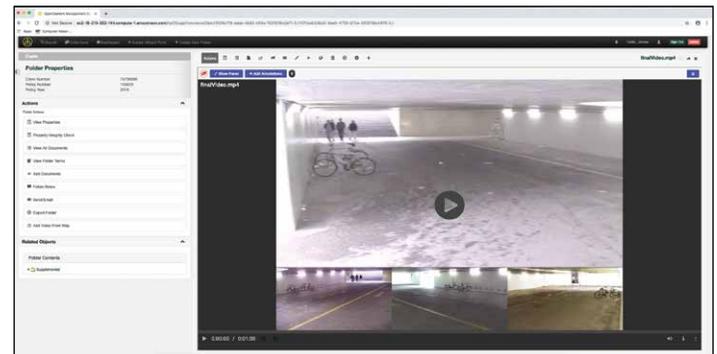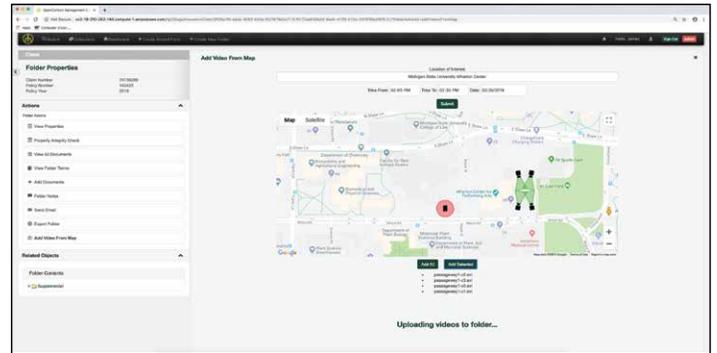
Michigan State University
Team Members (left to right)

Matt Wojno
Rochester Hills, Michigan

Jonathan Little
Alma, Michigan

Sam Belcher
Plymouth, Michigan

Yichen Zang
Beijing, Beijing, China

Adam Gnott
Edwardsburg, Michigan

Noah Engerer
Canton, Michigan

Technology Services Group
Project Sponsors

Marc Brouillette
Chicago, Illinois

Dave Giordano
Chicago, Illinois

TechSmith
Internal Telemetry for TechSmith Products

To help its customers communicate more effectively, TechSmith assists in the creation of images and videos. Its flagship products, Snagit and Camtasia, are used by more than 30 million customers.

While TechSmith prides itself on providing a superior product to its customers, like all companies, problems sometimes arise.

For example, when an app crashes, customers can submit a report so that TechSmith can investigate. Often these reports don't provide the best or enough information.

Our Internal Telemetry for TechSmith Products collects crash reports from multiple sources, gathering as much relevant information as possible. It then sends the combined crash report to a database, where an automatic notification is sent to the assigned TechSmith development team.

The tech team can then use an internal web portal to access the detailed crash report and associated information from each active product, together with access to a direct download of the report file. This, in turn, makes the diagnostic and repair process more streamlined, more efficient, and more to the customer's satisfaction, as well as resulting in long-range improvements to a product.

Our Internal Telemetry for TechSmith Products is written in C#/C++ and incorporated into Snagit and Camtasia as a dll file. The web portal uses ASP.NET Core and is hosted on Microsoft Azure. The crash report data is stored in an SQL database in Azure. Two prototype applications, modeled after Snagit and Camtasia, are used to demonstrate the working Internal Telemetry.
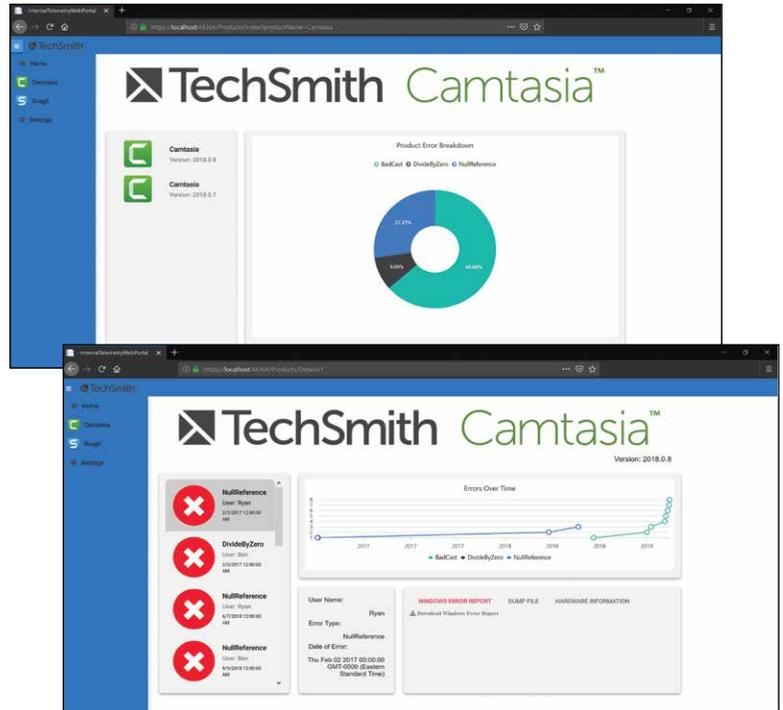
Michigan State University
Team Members (left to right)

Dakota Locklear
Lincoln Park, Michigan

Ben Hickmott
Hartford, Michigan

Zhuolun Xia
Changzhou, Jiangsu, China

Ryan Ciffin
Okemos, Michigan

Zack Schreur
Holland, Michigan

TechSmith
Project Sponsors

Ryan Eash
Okemos, Michigan

Wendy Hamilton
Okemos, Michigan

Bill Hoag
Okemos, Michigan

Tony Lambert
Okemos, Michigan

Dave McCollom
Okemos, Michigan

Dave Norris
Okemos, Michigan

Dave O'Rourke
Okemos, Michigan

Union Pacific
Railroad Arcade

U nion Pacific was founded in 1862. Today it is a leading transportation company, employing 43,000 people, utilizing more than 8,600 locomotives that run on 32,100 miles of track through 23 states.

Union Pacific uses interactive training simulations to help its employees learn how to properly operate its machinery, something known as gamification. Unfortunately, when a new training module is created, each component must be redeveloped, a slow, time-consuming process.

Our Railroad Arcade provides a framework for building training simulation systems. Our framework includes a variety of reusable components such as a main menu, a scoring system and a leaderboard.

Our Railroad Arcade significantly reduces the amount of time needed to develop a training simulation, as well as increases accessibility for a future one. It also allows simulations to be stored in a single location.

We provide both web and Windows applications so that simulations run in both environments. Developers configure our components to fit their needs.

Our framework, with its reusable components, enables Union Pacific developers to create new training simulations without having to reinvent the proverbial wheel. As examples to developers, our system includes three sample games.

The reusable components and sample games in Railroad Arcade are written using C# in Unity. The website is implemented with TypeScript and CSS based on Angular.
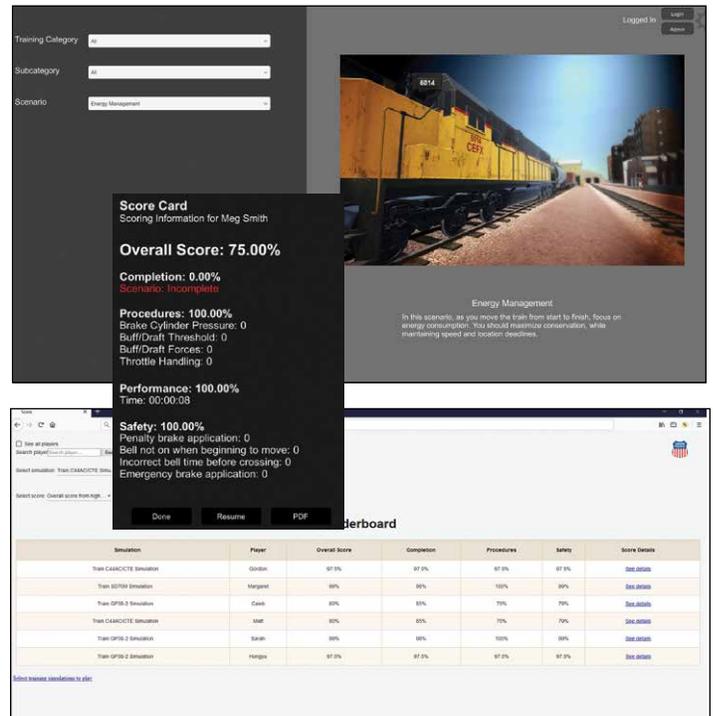
Michigan State University
Team Members (left to right)

Sarah Byrum
South Lyon, Michigan

Margaret Wootten
Huntington Woods, Michigan

Gordon Huang
Dalian, Liaoning, China

Caleb Howell
Holt, Michigan

Matthew Howard
Holland, Michigan

Hongyu Yan
Hefei, Anhui, China

Union Pacific
Project Sponsors

Jeff Girbach
Okemos, Michigan

Benjamin Hobbs
Okemos, Michigan

Royale Letourneau
Okemos, Michigan

Justin Snyder
Omaha, Nebraska

United Airlines
Training Scheduling and Optimization System

United Airlines is a major United States airline, operating 4,600 flights a day out of more than 350 airports. Having properly trained personnel to maintain its fleet of aircraft is vital to the successful operation of each flight.

In order to maintain a staff of trained personnel, United's Technical Operations division has 60 instructors that deliver some 700 courses to more than 7,000 employees a year.

Our Training Scheduling and Optimization System provides a web app and a mobile app that enable United's schedulers to schedule, instructors to teach, and students to take courses around the country.

When the scheduler wants to schedule a course, the system automatically displays the available locations and instructors that can be assigned to that course. It allows instructors to track attendance of their classes and generate a completion roster at the conclusion of the course.

Our system includes a schedule optimization system. Using a given set of classes and a timeframe, the optimizer recommends an optimal schedule. This reduces the amount of time it takes for the scheduler to plan courses.

Instructors also can request time off through the system and supervisors have the ability to approve or deny these requests, as well as track their instructors' time.

All of the functionality of our system is available using either our web app or our Apple iOS app with the exception of scheduling, which is exclusive to the web app.

Our Training Scheduling and Optimization System web app is built with ASP.NET Core, Angular 7 and a Microsoft SQL Server database. The Apple iOS app is written in Swift.
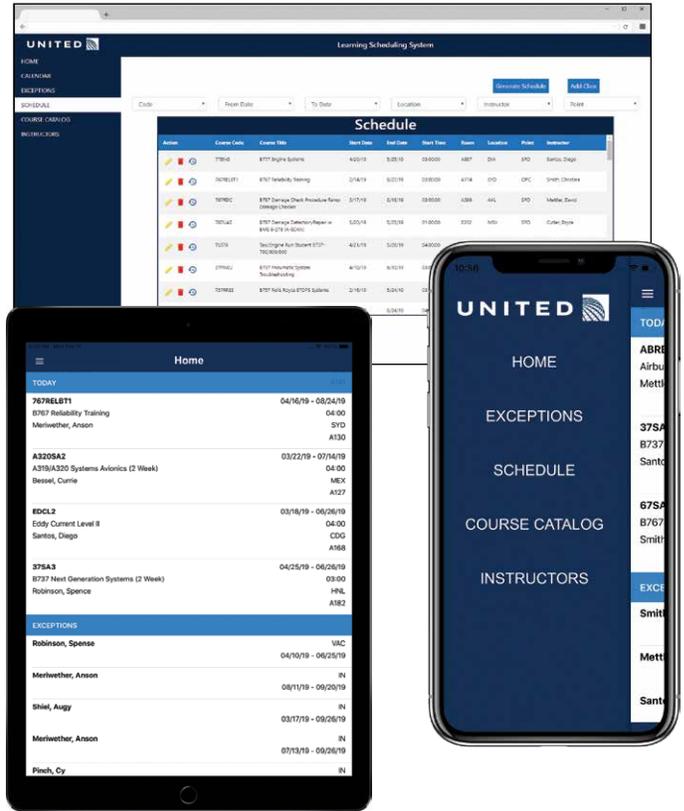
Michigan State University
Team Members (left to right)

Matthew Libiran
Okemos, Michigan

Hydra Xu
Shanghai, Shanghai, China

Kailash Saravanan
Canton, Michigan

Nathan Rizik
Birmingham, Michigan

Brian Lowen
Waterford, Michigan

United Airlines
Project Sponsors

Amadou Anne
Chicago, Illinois

Craig Bennett
Chicago, Illinois

Rick Brown
Chicago, Illinois

John Kleberg
Chicago, Illinois

Lynda McDaniel
Houston, Texas

Tom Wilson
Chicago, Illinois

Urban Science
Dealer4U

U rban Science is a Detroit-based company that uses scientific approaches to help solve the problems of modern business. Urban Science provides data-driven solutions to the retail, health and automotive industries.

In the world of car buying and selling, customers can identify what a certain dealership has to offer, but dealers cannot readily identify their customers' interests. This puts a burden on the customers and may overwhelm those who are more inexperienced, thereby decreasing the chances of a successful purchase.

Our Dealer4U system is an innovative method of connecting customers with car dealers. Using a mobile app, customers search through inventories of local car dealers, selecting brands and models that interest them. Once completed, it also allows potential buyers to view offers and incentives from dealers on cars that match their selections.

For the car dealer, our app enables them to see leads from customers in their area and create car-buying incentives based on those leads. Once a customer specifies their interests, dealers view them and create incentives designed to lure the customer into the showroom for a test drive and, hopefully, a successful sale.

Dealer4U simplifies and improves the experience of buying and selling cars for all involved.

Our Dealer4U system is accessible by customers through Android and iOS mobile apps, and by dealers through a web app. The mobile apps are written with Xamarin, and the web app is written with Angular. The backend uses ASP.NET Core, and the data is stored on a MongoDB database.
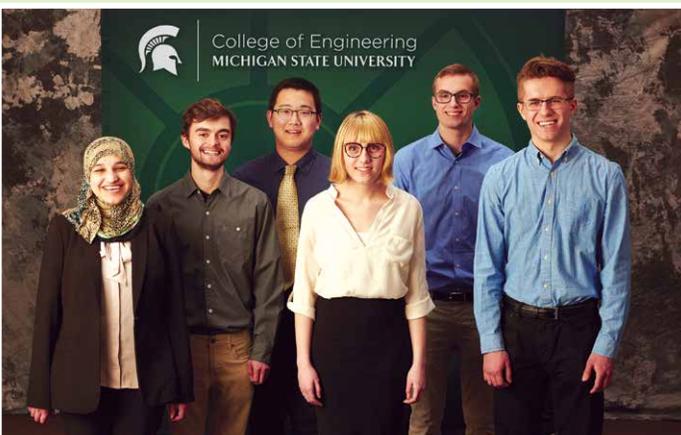
Michigan State University
Team Members (left to right)

Sara Alshaikhhussain
Qatif, Saudi Arabia

Blake Weidenfeller
Grand Rapids, Michigan

Tian Yan
Wuhan, Hubei, China

Riley Hoffman
Frankenmuth, Michigan

Hayden Cederstrom
Midland, Michigan

David Kinchen
Brighton, Michigan

Urban Science
Project Sponsors

Bill Bye
Detroit, Michigan

Joe Conrad
Detroit, Michigan

Mike DeRiso
Detroit, Michigan

Elizabeth Klee
Detroit, Michigan

Peter Koehler
Detroit, Michigan

Chris Morgan
Detroit, Michigan

Adam Serruys
Detroit, Michigan

Volkswagen Group of America
Cognitive Enterprise Software Robots

Volkswagen Group of America is the North American operation headquarters and subsidiary of the Volkswagen Group, which is comprised of 16 brands producing a variety of cars, motorcycles and commercial vehicles.

Volkswagen uses sophisticated robotic automation in direct manufacturing processes. By contrast, the indirect and administrative processes are yet to be automated on a large scale. With a workforce of over 600,000 employees, roughly 400,000 workers spend much of their day executing repetitive tasks.

Our Cognitive Enterprise Software Robots, referred to as softbots, take over manual work a human is performing on a computer and act as an intelligent co-worker.

For example, a Volkswagen Logistics Specialist spends several hours a day contacting suppliers to ensure all deliveries arrive on time. An employee must continuously look up shipments in a spreadsheet and compare the expected delivery date with the current date.

If the expected delivery date is five days or less away, the employee must send a reminder email to the supplier that the shipment has not arrived yet.

Using a technique called deep learning, our softbots learn a business process and execute it on the human's behalf. The employee is now able to focus on more complex tasks.

Our softbots use a recurrent neural network to predict future clicks in a clickstream. Utilizing natural language processing, the softbots read emails and then perform the appropriate actions.
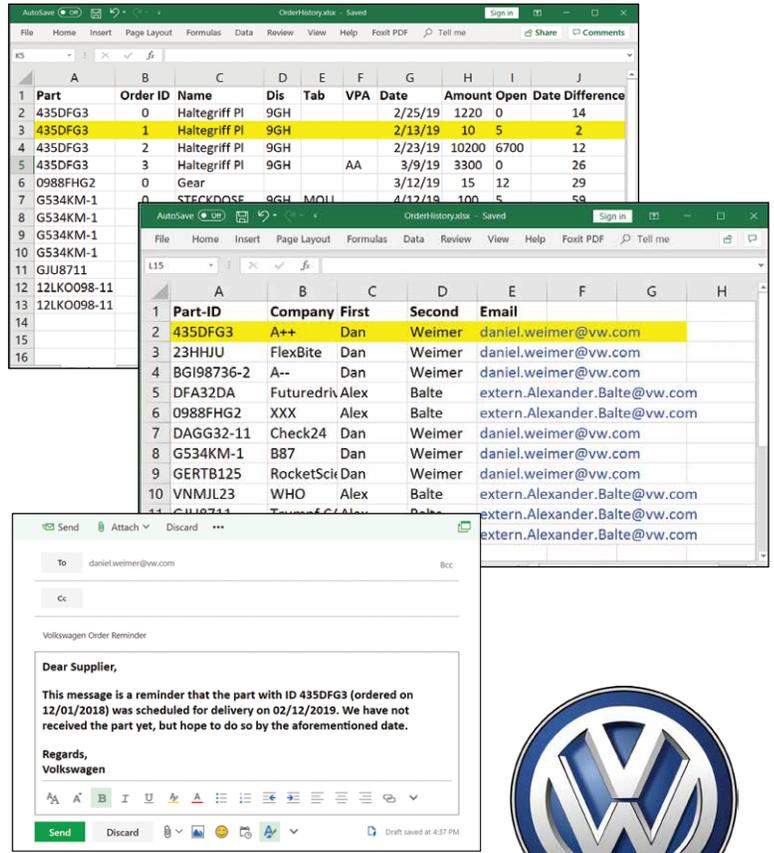
Michigan State University
Team Members (left to right)

Maryam Irannejadnajafabadi
Okemos, Michigan

Kevin Gu
Guangdong, Guangzhou, China

Amelia Wilson
Algonac, Michigan

Fynn Reckhorn
Osnabrück, Germany

**Zachary McCullough**
San Jose, California

Volkswagen
Project Sponsors

Ken Atilgan
Auburn Hills, Michigan

Shelly Desmet
Auburn Hills, Michigan

Daniel Weimer
Auburn Hills, Michigan

Frank Weith
Auburn Hills, Michigan

MICHIGAN STATE UNIVERSITY

The Capstone Experience, Spring 2019
COMPUTER SCIENCE & ENGINEERING
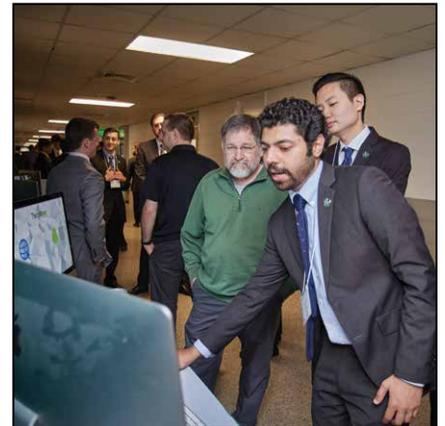
Design Day Award Winners

Fall 2018

Auto-Owners Exposition Award
Team Volkswagen

MSU Federal Credit Union Praxis Award
Team Proofpoint

TechSmith Screencast Award
Team Auto-Owners

Urban Science Sigma Award
Team Herman Miller

Spring 2019

Auto-Owners Exposition Award
Team Herman Miller

MSU Federal Credit Union Praxis Award
Team Ford

TechSmith Screencast Award
Team Humana

Urban Science Sigma Award
Team Michigan State University ITS

Auto-Owners Insurance is a proud sponsor of
THE DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
CAPSTONE EXPERIENCE

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

94% of our associates say their work atmosphere is great

Our IT division has **700+** associates in **45+** departments

We employ **470** Spartans companywide

Apply today at auto-owners.com!

For more information about
The Capstone Experience or
becoming a project sponsor, contact

Dr. Wayne Dyksen
Professor of Computer Science and Engineering
428 S. Shaw Lane, Room 3149
Engineering Building
Michigan State University
East Lansing, Michigan 48824
dyksen@msu.edu
(517) 353-5573
www.capstone.cse.msu.edu

MICHIGAN STATE
U N I V E R S I T Y