

# The Capstone Experience

*From Students...to Professionals*



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COMPUTER SCIENCE AND ENGINEERING 2015-2016



# The Capstone Experience



**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, Auto-Owners Insurance, Boeing, Bosch, Chrysler, Dow Chemical, Electronic Arts, Ford, GE, General Motors, Google, IBM, Meijer, Microsoft, Mozilla, MSU Federal Credit Union, Quicken Loans, Spectrum Health, Symantec, TechSmith, the Union Pacific Railroad, Urban Science, Whirlpool and Yello.

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.

We thank Auto-Owners Insurance of Lansing, Michigan for their continued support of Michigan State University and the Capstone Experience, including the printing of this Capstone Experience booklet.

Check out the Capstone Experience web site at [www.capstone.cse.msu.edu](http://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](mailto:dyksen@msu.edu)) or by phone (517-353-5573)

# The Capstone Experience, 2015-2016

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# Corporate Sponsors

Peter Faricy

Vice President  
Amazon Marketplace

Amazon  
Seattle, Washington



*“Capstone courses provide students with real-world experiences within the global online retail industry. Students get to apply what they’ve learned in the classroom to actual business problems. The most recent Amazon student Capstone team produced a software system that is designed to improve and optimize the experience of Amazon’s third-party sellers.”*

Marcy Klevorn

Vice President,  
Chief Information Officer

Ford Motor Company  
Dearborn, Michigan



*At a time when digital demand is greater than ever, Ford IT recognizes core skills and emerging ideas are needed to keep us one step ahead of the competition. Partnering with The Capstone Experience at Michigan State University helps Ford go further by bringing innovative thinking and academic excellence to our teams. In the past ten years, Ford IT has sponsored fifteen projects and hired more than 30 MSU alumni into our Ford College Graduate program. Then and now, people are our greatest asset.”*

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 corporate sponsors. The software systems produced by the MSU students rival that of professional developers. Our latest Capstone project, Money Smash Chronicle, will be deployed as part of MSUFCU’s suite of educational financial apps.”*

Terry Ledbetter

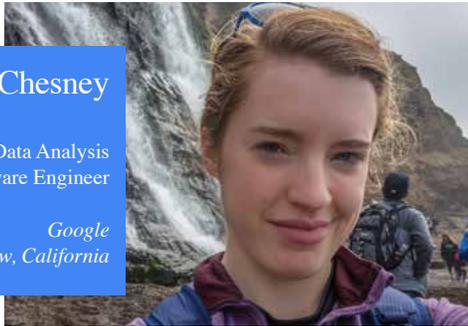
Senior Vice President,  
Chief Information Officer

Meijer  
Grand Rapids, Michigan



*“Meijer is proud to have sponsored MSU computer science Capstone projects over the past seven years. We have been impressed with both the capabilities of the students and the quality of the solutions they have developed. The latest project, In-Store Price Comparison, will improve our services to our customers.”*

# Capstone Alumni

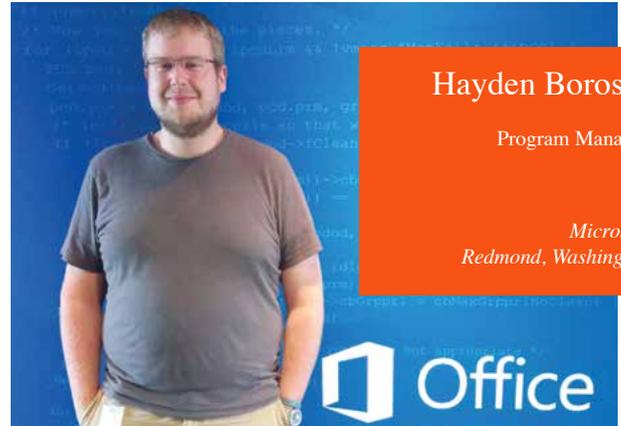


**Mairin Chesney**  
Data Analysis  
Software Engineer  
Google  
Mountain View, California



*“The Capstone Experience at MSU was invaluable on multiple fronts. From a technical perspective, we learned about the software design process from conception to completion. From an interpersonal perspective, we learned about the trials and joys of working on a team. On all fronts, this experience was phenomenal preparation for my job as a Google software engineer.”*

BS, CSE: May 2015  
Hometown: Brighton, Michigan



**Hayden Boroski**  
Program Manager  
Microsoft  
Redmond, Washington



*“Learning how to give and defend technical presentations is a key feature of the Capstone Experience, which I use often in my work at Microsoft.”*

BS, CSE: December 2013  
Hometown: Lansing, Michigan



**Austin Huynh**  
Associate Software  
Developer  
Auto-Owners Insurance  
Lansing, Michigan



*“The Capstone course provided me with real-world experience as a software developer while I worked on a team to deliver a finished software product within a set time constraint. The skills and experience that I gained prepared me for starting my career as a software developer at Auto-Owners.”*

BS, CSE: May 2015  
Hometown: Jackson, Michigan



**Jordyn Castor**  
Software Engineer  
Apple  
Cupertino, California



*“The Capstone Experience at Michigan State University gave me real-world experience creating a text recognition application and making it accessible to those who are visually impaired or blind. This prepared me for my job at Apple where I work on the Accessibility Design and Quality team, enhancing the accessibility of Apple products for those with disabilities.”*

BS, CSE: December 2015  
Hometown: Grand Rapids, Michigan

# The Capstone Experience

Fall 2015

## Project Sponsors

We thank the following companies for their generous support of the Computer Science Capstone Experience.

**Amazon**

Seattle, Washington & Detroit, Michigan



**Auto-Owners Insurance**

Lansing, Michigan



**Ford Motor Company**

Dearborn, Michigan



**General Motors**

Detroit, Michigan



**Meijer**

Grand Rapids, Michigan



**MSU Federal Credit Union**

East Lansing, Michigan



**Quicken Loans**

Detroit, Michigan



**Spectrum Health**

Grand Rapids, Michigan



**Symantec**

Mountain View, California



**TechSmith**

Okemos, Michigan



**Urban Science**

Detroit, Michigan



**Whirlpool Corporation**

Benton Harbor, Michigan



# Amazon Seller Forums Echo Companion

Amazon, one of the world's largest online retailers, sells hundreds of millions of different products. Of these online sales, many are fulfilled by third-party sellers.

Amazon's Seller Forums is a web resource for third-party sellers to post questions about selling on Amazon. Our *Seller Forums Echo Companion* provides these sellers with a hands-free way to interact with the Seller Forums.

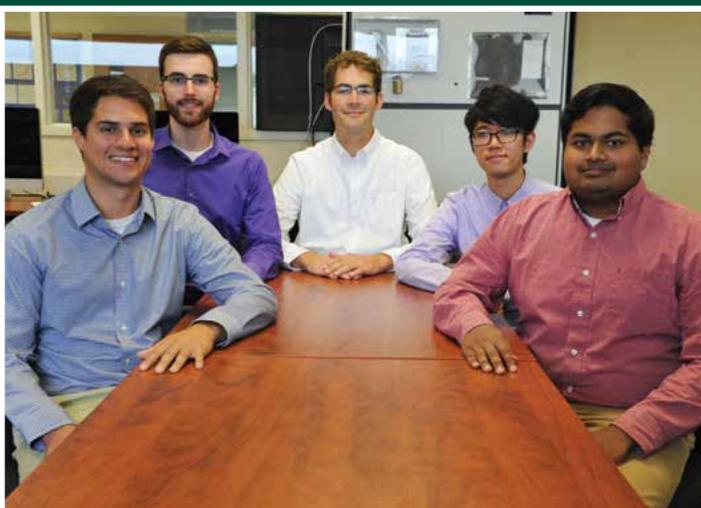
The Amazon Echo is a tower speaker providing voice assistance through the cloud-based Alexa intelligent assistant. Amazon sellers use our Echo Companion to ask Alexa about the questions and answers posted in the forums.

For example, a seller asks "Alexa, are there any replies to my question about shipping?" Alexa answers "There are three new replies to your question." The seller then responds "Read the most helpful reply to me."

Our Echo Companion is based on Alexa "skills," which are comprised of language constructs called intents for which Alexa listens and performs subsequent actions. Alexa uses its natural language processing in combination with the Seller Forums database to accomplish a seller's desired task.

Alexa's actions include many common Amazon Seller Forums tasks such as posting questions, reading questions, editing account settings and receiving notifications.

Our *Seller Forums Echo Companion* is coded in Java. AWS Lambda, an Amazon cloud service, stores and runs the Java. A MySQL database hosted by Amazon Web Services contains the content of the Seller Forums.



## Michigan State University

*Team Members* (left to right)

**Marc Habermann**  
Traverse City, Michigan

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**Jake Jensen**  
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**Archer Tang**  
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**Apoorv Singh**  
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## Amazon

*Project Sponsors*

**Peter Faricy**  
Seattle, Washington

**Garret Gaw**  
Detroit, Michigan

**John Marx**  
Detroit, Michigan

**Poornachandra Pesala**  
Detroit, Michigan

# Auto-Owners Insurance HR Recruiting System

**A**uto-Owners Insurance is a Fortune 500 company working with more than 6,200 independent agencies in 26 states. Founded in 1916, Auto-Owners continuously improves their products and services for their policyholders.

Auto-Owners is committed to recruiting and hiring the very best candidates to be associates at Auto-Owners. Our *HR Recruiting System* streamlines the entire process from recruiting to applying to hiring.

Applicants create accounts and complete job applications easily. They can upload their resumes and pull data from their LinkedIn profiles.

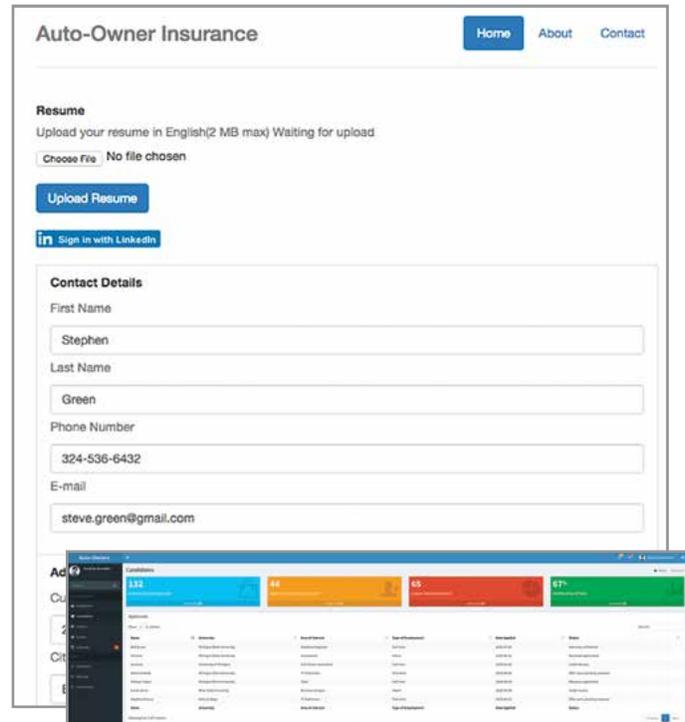
To measure the user-friendliness of the system, Google Analytics tracks the number of applicants who complete the entire application process.

Recruiters assign themselves to specific applicants, rank applicants based on interviews, and update the status of each application.

Recruiters can request video, phone, and in-person interviews. They can send acceptance, rejection, and hold letters.

Recruiters use our system to log recruiting events and record relevant information such as expenses, number of recruits in attendance, and contact information. Paper copies of resumes collected at events are scanned and stored in the system.

Our *HR Recruiting System* is written in HTML, CSS, AngularJS, and NodeJS. Our system is supported on the backend by a SQL database.



### Michigan State University Team Members (left to right)

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# Ford Motor Company Connected Vehicle Protocol Test Harness

Ford Motor Company designs and manufactures Ford and Lincoln vehicles across six continents and employs more than 220,000 employees in 90 plants worldwide.

Many Ford vehicles that roll off the assembly lines have complex infotainment systems. The performance demands on these systems varies with the customers' desires such as streaming audio and video directly to their car or truck.

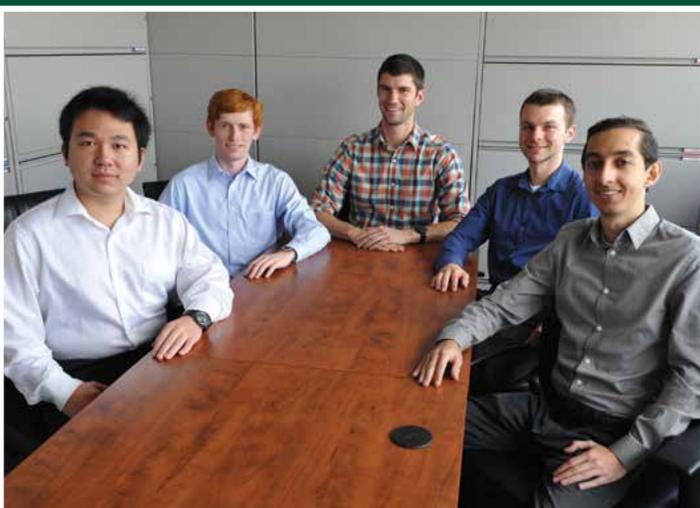
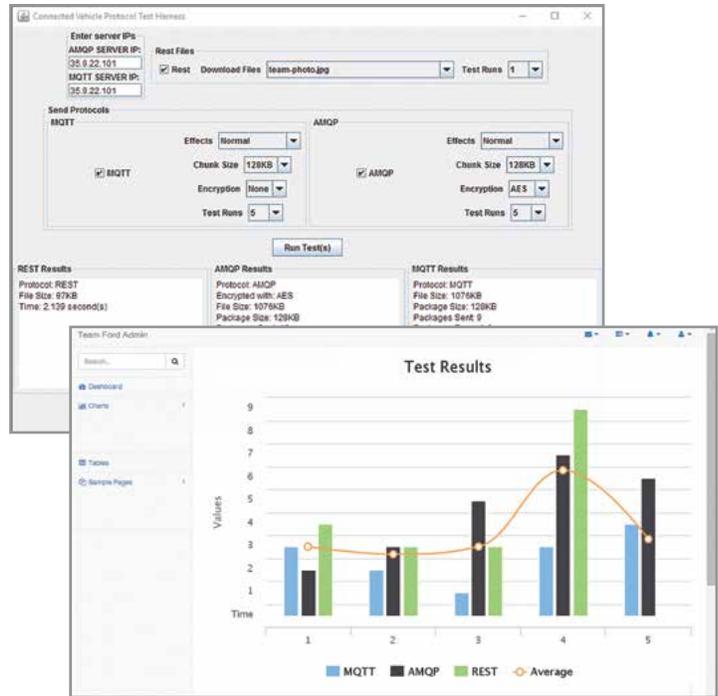
Infotainment systems send and receive a wide array of messages around the vehicle which include things like media files and system updates. As these messages are transmitted, they must arrive at their destination quickly and accurately.

Ford engineers use our *Connected Vehicle Protocol Test Harness* to evaluate the performance of a variety of messaging protocols. Engineers use the results of these evaluations to choose the best protocols for their designs.

Our test harness transmits various encrypted file types from the Ford Discovery Box, which simulates a vehicle, to a server. The test harness monitors and measures these transmissions, and collects data about a protocol's performance.

Ford engineers visualize the test results with graphs and tables using our companion web application, which enables them to compare and analyze various messaging protocols to determine the optimal performance.

Our *Connected Vehicle Protocol Test Harness* is written in Java and uses RabbitMQ as a message broker. The web app uses HTML/CSS and JavaScript with PHP and SQL to store data.



## Michigan State University

Team Members (left to right)

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Dearborn, Michigan

**Michael Volk**  
Dearborn, Michigan

**Matthew Whitaker**  
Dearborn, Michigan

# General Motors Global Service Desk Mobile App

General Motors is one of the world's foremost designers and manufacturers of cars and trucks sold in more than 120 countries. Headquartered in Detroit, Michigan, GM's 218,000-plus employees work in 396 facilities spanning six continents.

GM's Global Service Desk (GSD) helps GM employees solve their information technology (IT) problems. Our *Global Service Desk (GSD) Mobile App* provides GM employees with access to the GSD from anywhere at any time.

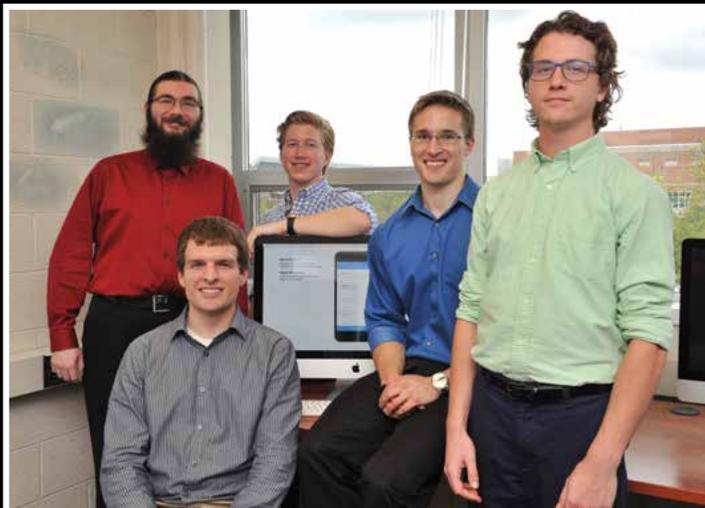
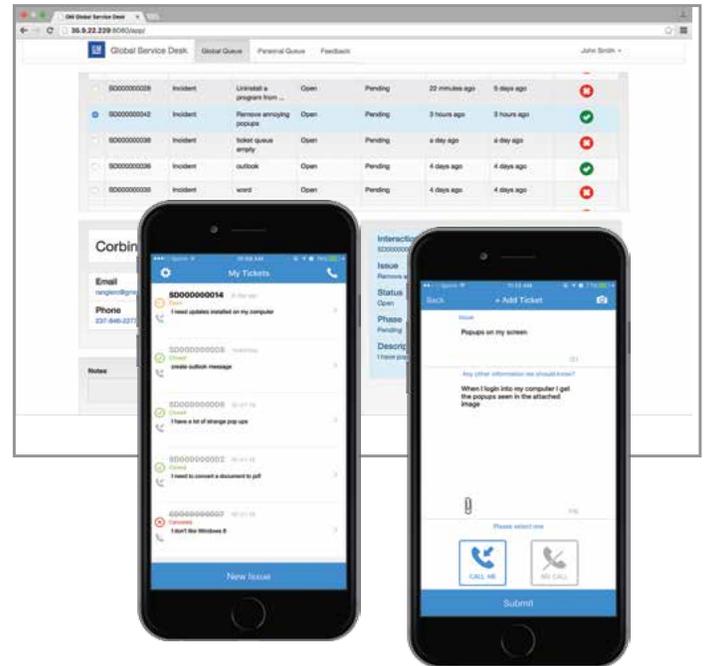
When needing IT assistance, GM employees use GSD Mobile. After describing their problem, users are presented with possible fixes so they can solve their problem immediately themselves, without calling the GSD. If not resolved, users submit a help ticket, which they can track easily.

A GSD agent determines the best time to call an employee needing IT help by looking at the employee's calendar, which our team integrated into GM's IT Service Manager system.

As an agent makes changes to a help ticket, push notifications are sent to the *GSD Mobile App* to keep the GM employee up to date. Agents may also send preset messages requesting more information about an employee's problem.

Using our system, GSD agents process help tickets faster and more efficiently, alleviating phone congestion for other GM employees with more serious IT issues.

Our *GSD Mobile App* and web front end are written in Swift 2 and JavaScript, respectively. Both interface with an Apache2 web server that synchronizes with a MySQL database via PHP.



### Michigan State University

*Team Members* (left to right)

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- Michael Palmer**  
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- Corbin Rangler**  
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- Evan Hlavaty**  
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- Trevor Lift**  
Warren, Michigan
- Shane McCutchen**  
Warren, Michigan
- Dan Rudman**  
Warren, Michigan
- Christian Stier**  
Warren, Michigan

# Meijer In-Store Price Compare

Meijer is one of the country's largest supercenter chains, providing high quality food and merchandise in six states across the Midwest. With their headquarters located in Grand Rapids, Michigan, Meijer has over 200 stores, 60,000 team members and serves millions of customers each year.

Our *In-Store Price Compare* mobile app gives Meijer customers an easy way to compare prices as well as giving Meijer insight into the marketplace.

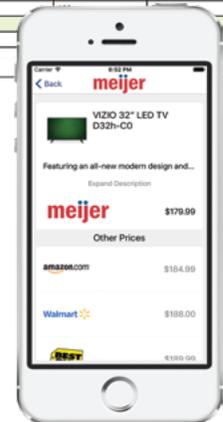
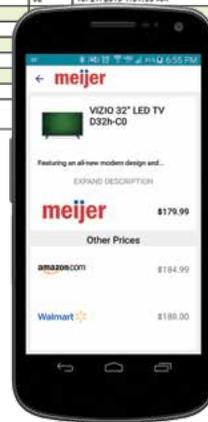
Customers scan an item's barcode using their iPhone, iPad or Android device. Our app shows the Meijer price along with the prices of Meijer's competitors. If the Meijer price is not the lowest, a special one-time coupon may be offered to encourage the customer to make the purchase at Meijer.

Every time a Meijer customer scans a product for pricing, relevant data about the product and prices are uploaded into a Meijer database. Our companion web app visualizes this data with charts and graphs.

Meijer sourcing managers use the web app to analyze the strengths and weaknesses of their in-store pricing as well as consumer buying patterns. As a result, Meijer customers get the best products at the lowest prices.

Our *In-Store Price Compare* iOS and Android apps are written in C# using cross platform interfaces created with Xamarin.Forms. The web platform runs on the ASP.NET framework and is written using HTML5, D3.js and Bootstrap. Both the SQL database and web platform are hosted on Microsoft Azure.

No	LUPC	Store	Datetime	AmazonPrice	WalmartPrice	BestBuyPrice
1	047532901795	49	10/20/2015 4:52:30 PM	77.99	78.57	0
2	047532901795	49	10/20/2015 4:52:47 PM	77.99	78.57	0
3	047532901795	49	10/20/2015 4:52:54 PM	77.99	78.57	0
4	848719037869	49	10/20/2015 4:57:28 PM	39.99	0	39.99
5	848719037869	49	10/20/2015 4:57:57 PM	39.99	0	39.99
6	047532901795	49	10/20/2015 5:02:25 PM	77.99	78.57	0
7	047532901795	0	10/20/2015 1:19:27 PM	0	78.57	0
8	047532901795	0	10/20/2015 5:21:13 PM	77.99	78.57	0
9	047532901795	0	10/20/2015 2:06:10 PM	0	78.57	0
10	047532901795	49	10/20/2015 10:35:23 PM	77.99	78.57	0
11	047532901795	52	10/21/2015 1:39:33 AM	77.99	78.57	0
12	047532901795	49	10/20/2015 10:35:23 PM	77.99	78.57	0
13	047532901795	49	10/20/2015 10:35:23 PM	77.99	78.57	0
14	845226012884	49	10/20/2015 10:35:23 PM	185.95	188.00	0
15	845226012884	49	10/20/2015 10:35:23 PM	185.95	188.00	0
16	712475393661	49	10/20/2015 10:35:23 PM	182.44	182.44	0
17	712475393661	49	10/20/2015 10:35:23 PM	182.44	182.44	0



## Michigan State University Team Members (left to right)

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Grand Rapids, Michigan

## The Capstone Experience

# MSU Federal Credit Union Online Dollar Dog Store

Michigan State University Federal Credit Union (MSUFCU) is the largest university-based credit union in the world, serving Michigan State University, Oakland University and their surrounding communities.

The MSUFCU Dollar Dog program encourages good banking habits in young MSUFCU members. When children ages 5-12 make deposits, they earn Dollar Dog coins, which they can exchange at a Dollar Dog Store for prizes such as backpacks, coloring books, bouncy balls, and stuffed animals.

Currently, there are Dollar Dog Stores in thirteen MSUFCU branches so it's difficult for kids who do not live near one of these branches to use Dollar Dog coins to buy prizes.

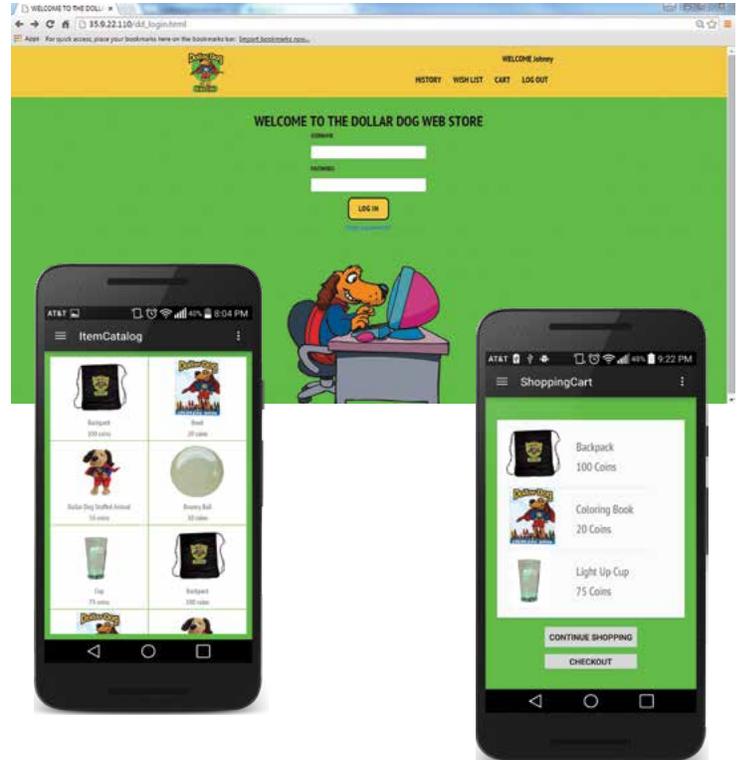
With our *Online Dollar Dog Store*, MSUFCU kids can shop online using Dollar Dog coins to buy prizes, which are shipped directly to their homes.

After logging in with their MSUFCU userid and password, kids can add prizes to a cart for purchase with Dollar Dog coins or they can add them to a wish list for a future purchase.

Our *Online Dollar Dog Store* works on desktop and mobile web browsers including iPhones, iPads and Android devices.

MSUFCU administrators use our companion web app to edit the store catalog and adjust user coin balances.

Our *Online Dollar Dog Store* native mobile apps are written in Java and Swift. The responsive web app uses CSS, HTML, JavaScript, and Bootstrap. All three platforms connect to a MySQL database via a PDO connection through an API running PHP.



### Michigan State University

*Team Members* (left to right)

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Midland, Michigan

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Midland, Michigan

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### MSUFCU

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**Ben Maxim**  
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# Quicken Loans Enterprise Roadmap Tool

Quicken Loans, based in Detroit, is the largest online mortgage lender in the US. With almost 30 years of experience, their customers include over 2 million families.

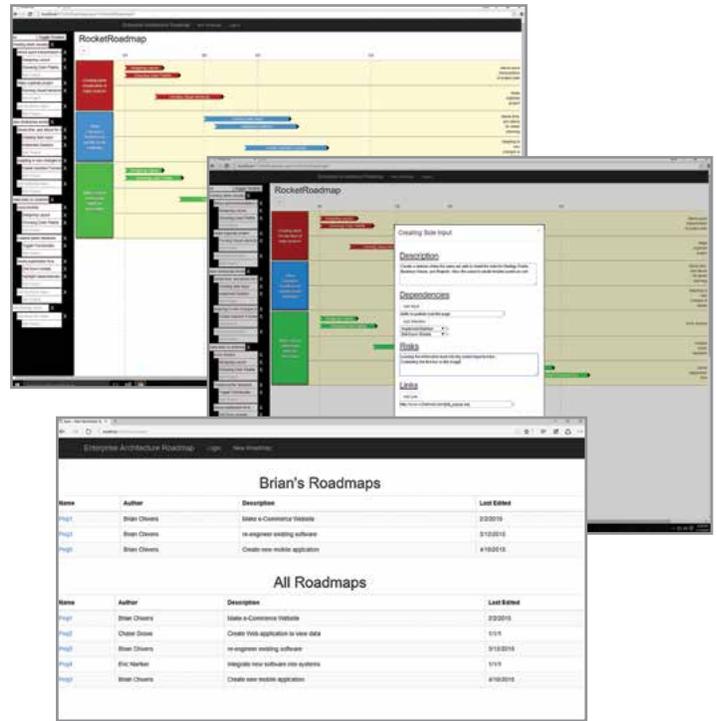
Quicken Loans designs and develops its own enterprise software systems, which often requires significant amounts of time and money. In order for senior level executives to make sound business decisions about investing in the development of these new systems, executives must understand what's being proposed and why.

Our *Enterprise Roadmap Tool* provides visualizations of Quicken Loans' enterprise software systems including projects being proposed and developed. Executives view an intuitive project roadmap rather than reading a complex document.

Enterprise architects use our system to build project roadmaps and their main components: the strategic purpose, the business value, and the tasks that need to be accomplished to achieve the purpose and business value.

A roadmap presents a high-level overall view of a project, color-coding tasks and business values to show dependencies. As executives drill down into the details, popups provide more information such as a task's description, its dependencies on other tasks, risks involved, and links to outside relevant information.

Our *Enterprise Roadmap Tool* is written in JavaScript and C# using the .NET framework. The database is implemented using Microsoft SQL Server 2012.



**Quicken Loans**  
Engineered to Amaze



**Michigan State University**  
*Team Members* (left to right)

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*Project Sponsors*

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**Linglong He**  
Detroit, Michigan

**Ted Williamson**  
Detroit, Michigan

# Spectrum Health Patient Service Delivery Planning

Spectrum Health, located in Grand Rapids, Michigan, provides high quality, high value healthcare through its seven hospitals, more than 140 service sites, and Priority Health, a health plan with nearly 500,000 members.

Our *Patient Service Delivery Planning* system increases customer satisfaction for patients while at the same time improving efficiency for Spectrum Health. It consists of two distinct parts, a mobile app and a web app, which share a common backend.

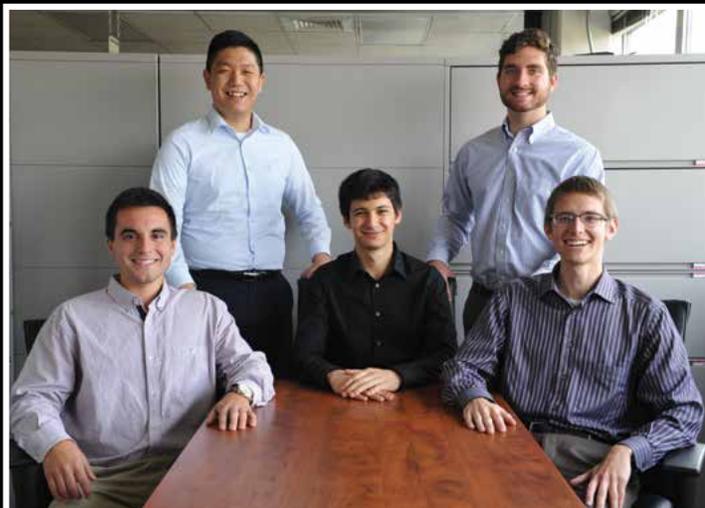
Our mobile app enhances the experience for patients by finding the nearest Spectrum Health urgent care center with the shortest wait time.

In addition, patients can see predicted future wait times so that they can plan for future visits on days and at times when wait times are normally shorter.

Our companion web app provides Spectrum Health with graphs and analytics of both past and predicted patient arrivals. Spectrum Health leverages this data to staff their facilities, optimize business hours, and predict average treatment time.

Both the mobile app and the web app use complex statistical software that predicts patient wait and treatment times. The design of this predictive model is completely modular so that it can be easily updated, enhanced, or even completely replaced.

Our *Patient Service Delivery Planning* system is written in C#, JavaScript, and R using AngularJS, D3.js, and MongoDB.



### Michigan State University Team Members (left to right)

**Jim Torres**  
Clawson, Michigan

**Justin Oh**  
Seoul, South Korea

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**Patrick O'Hare**  
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**Mike Ply**  
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**Mark Welscott**  
Grand Rapids, Michigan

## Symantec

### Integrated Silent Authentication via Symantec VIP

Based in Silicon Valley, Symantec Corporation is a security technology company that offers software products and services related to computer and information protection.

While passwords are the most common method to authenticate users, using passwords alone is not secure. Security is increased by adding a second factor such as a unique secret PIN generated dynamically on a user's mobile phone.

Symantec provides a two-factor authentication (2FA) product with their "Validation and ID Protection" or VIP service.

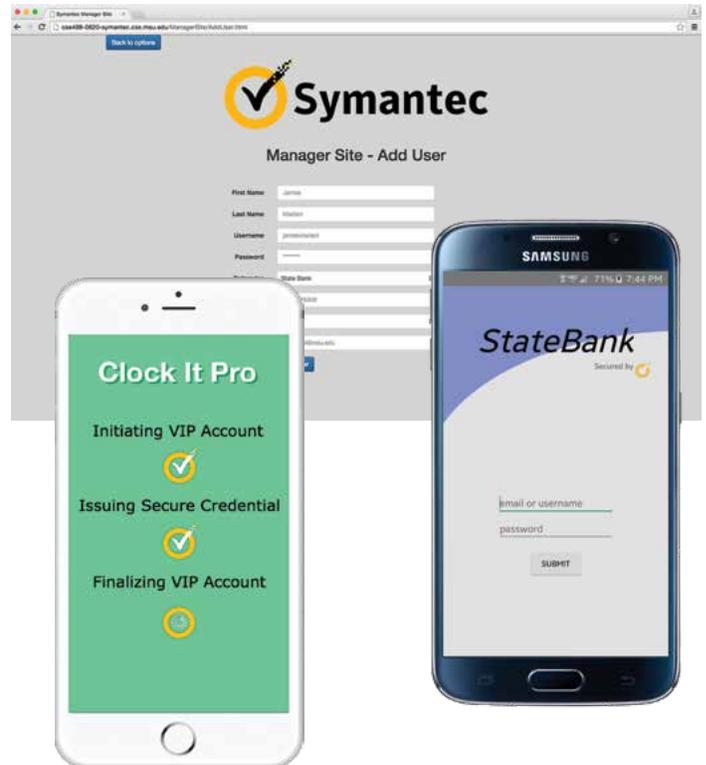
Typical 2FA on a mobile device is cumbersome. A user must enter a userid and password in one app, generate a secret PIN with a second app, copy the PIN from the second app, and finally paste the PIN into the original first app.

Our *Integrated Silent Authentication* via Symantec VIP architecture integrates the second authentication factor into an app so that it's done silently and automatically for the user.

Our system consists of multiple sample apps including "Clock It Pro" and "StateBank." Users need only enter their userid and password, which demonstrates the user friendliness of the VIP service by making 2FA transparent to the user.

Our sample apps with corresponding documentation are used by Symantec customers to design and develop their own apps.

Our Android and iPhone apps are written in Java and Swift, respectively. Communication with Symantec servers is accomplished through the Symantec VIP SDK as well as our own Java Enterprise Edition server. Our data is stored in a MySQL database.



#### Michigan State University

*Team Members* (left to right)

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# TechSmith Intelligent Real World Text Recognition

TechSmith is a leading developer of screen capture, video capture, and editing software including the very popular Snagit, Camtasia, TechSmith Relay and Morae, which are used by companies and educational institutions around the world.

Our *Intelligent Real-World Text Recognition* app uses a device's camera to find text in the real world, recognize what it is, and then perform a task depending on the format of the text.

For example, if our app recognizes text as a phone number, it offers to call it or save it. If it sees an email address, it can send an email. If our app recognizes a street address, it gives the address to Microsoft's Bing Maps.

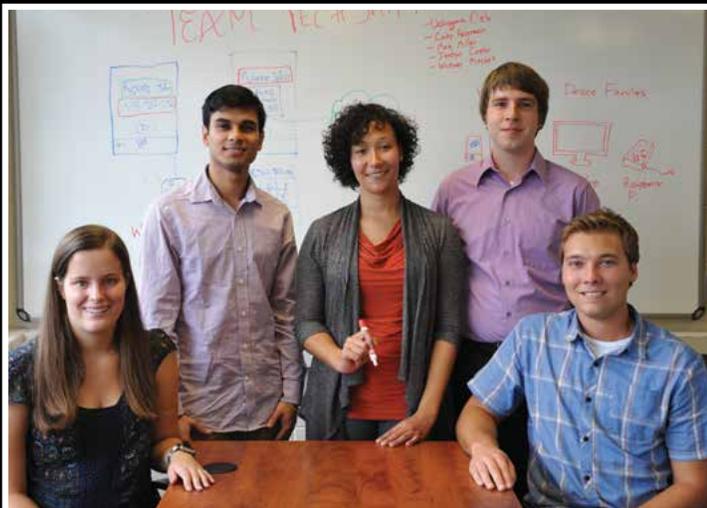
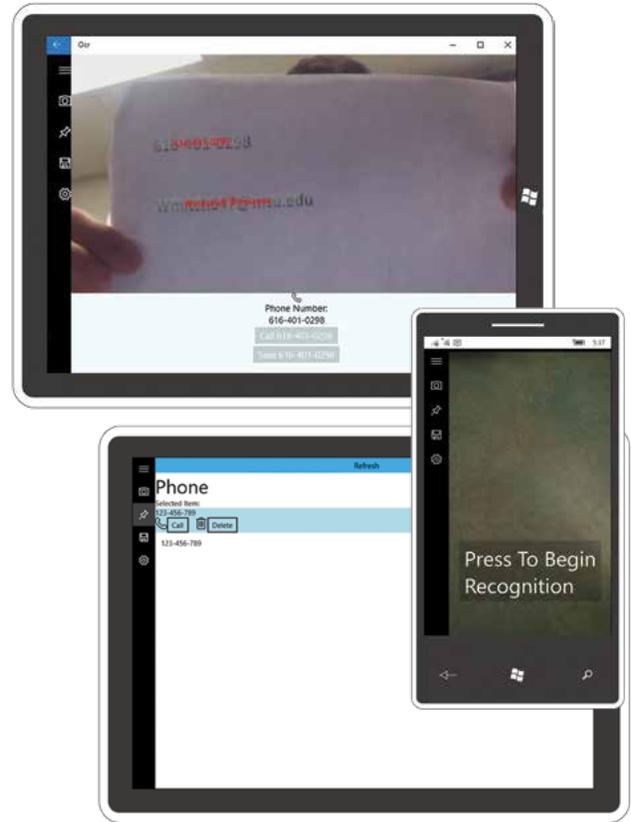
A useful feature of our app is its ability to read text out loud for the visually impaired or someone learning to read.

Our app is a Universal Windows 10 application, which means that it runs on any Windows 10 platform including phones, tablets, laptops and Raspberry Pi devices.

Users can save recognized text to the cloud and access it from any Windows 10 device.

Our app meets accessibility standards so that it is usable by those with disabilities. It enhances productivity for all users.

Our *Intelligent Real-World Text Recognition* app is written in C# and XAML. Microsoft Azure cloud services and an SQL database store the recognized text. Microsoft's Optical Character Recognition Engine converts camera frames to text, which is then recognized using regular expressions.



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# Urban Science

## Visualizing Brand Loyalty

Urban Science is a business-solutions company focused on supporting the sales and marketing needs of automotive companies. They leverage a scientific methodology to help their client partners sell more vehicles, improve profitability, and increase customer loyalty.

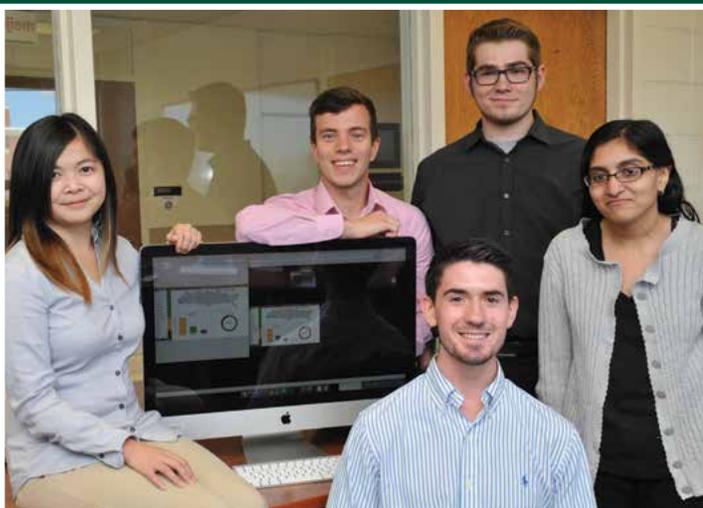
At each client partner, marketing managers track customer loyalty through a variety of metrics. By looking at “repurchase loyalty scores,” managers determine the amount of customers repurchasing the same vehicle brands. Low scores prompt consideration of new marketing schemes.

Our *Visualizing Brand Loyalty* app consolidates loyalty data in expressive visualizations that enable loyalty managers at client partners to quickly assess market performance.

Using a multi-diagram interface, loyalty managers select a market of interest for a specific manufacturer’s brand or model. Markets are colored red or green depending on the loyalty of customers, which allows loyalty managers to identify which markets are struggling and what former customers are buying instead of their vehicles.

Loyalty trends over time illustrate new customer (conquest) data and former customer (defection) data. Monthly push notifications alert loyalty managers of newly acquired market data.

*Visualizing Brand Loyalty* is an application written for Apple and Android tablets. It is built on the Ionic framework using AngularJS and the D3 visualization library. PHP connects the application to a Microsoft SQL Server database.



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## The Capstone Experience

# Whirlpool Corporation Whirlpool Indoor Maps

Headquartered in Benton Harbor, Michigan, Whirlpool is the world's leading global manufacturer of home appliances, employing over 100,000 people across 170 countries.

Whirlpool's facilities include many buildings with hundreds of conference rooms and thousands of cubicles. So, finding a specific conference room or cubicle in an unfamiliar building can be quite a challenge. In addition, determining room availability for meetings is often difficult and time-consuming.

Our *Whirlpool Indoor Maps* (WIM) app provides interactive maps of Whirlpool buildings. Using our simple and intuitive design, employees can access and explore maps of any building at any Whirlpool location with their mobile phone.

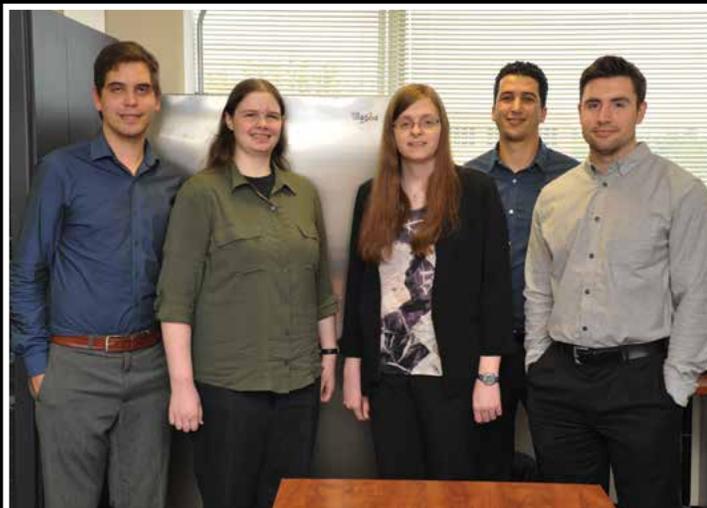
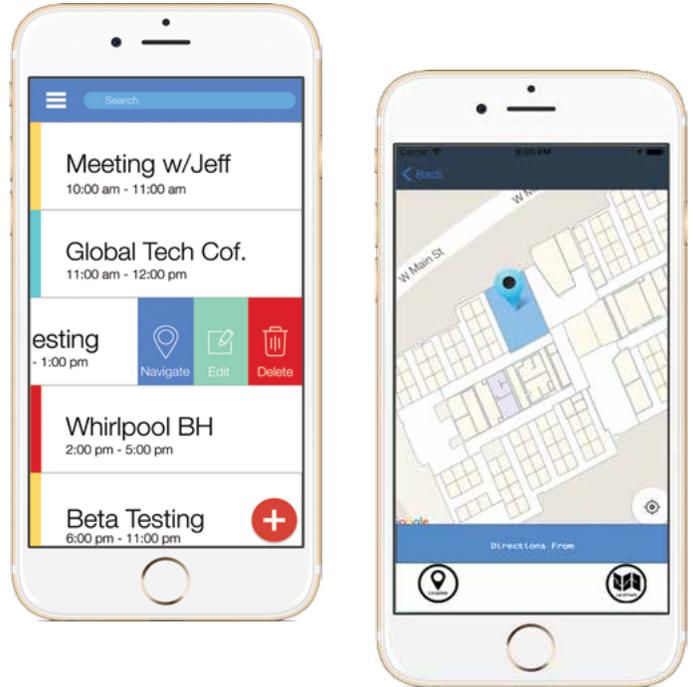
WIM enhances the everyday work life of Whirlpool employees in a unique way by displaying up-to-the-minute Google Calendar information.

Our app combines Google Calendar with maps to provide a streamlined service so employees can find and book available meeting rooms with visual map feedback.

To ensure simplicity, meetings for the day are readily available for viewing, editing and deleting.

Our mobile maps, combined with reservation and navigation functions, provide a comprehensive tool that increases the productivity of Whirlpool employees worldwide.

Our *Whirlpool Indoor Maps* app runs on both iPhones and Android phones. The iPhone app is written in Swift, while the Android app uses Java. Both utilize Google's API services.



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# Corporate Sponsors

Linglong He

Chief Information Officer

Quicken Loans  
Detroit, Michigan



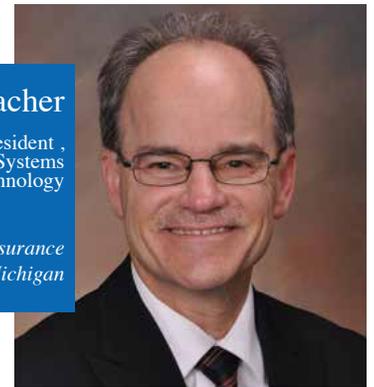
**Quicken Loans**  
Engineered to Amaze™

*“Michigan State’s Capstone project plays a vital role in ensuring our young, talented men and women receive the hands-on experience and contacts needed to lay the foundation for a great career in technology. We’ve hired several Capstone students that now work on critical projects at Quicken Loans and contribute to Detroit’s technology-driven resurgence.”*

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.”*

Randy Mott

Senior Vice President and  
Chief Information Officer

General Motors  
Detroit, Michigan



*“General Motors looks to Michigan State University to hire outstanding computer science graduates. Students in the Capstone course gain valuable experience with a wide diversity of state-of-the-art information technologies being used at GM. This is a tremendous chance for students to network with IT professionals and benefit from a powerful learning opportunity.”*

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.”*

# Capstone Alumni



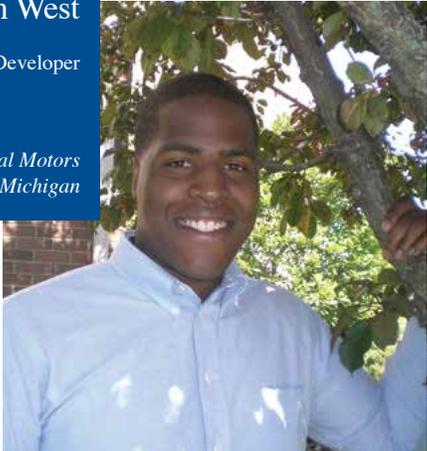
**Justin Fila**  
Software Engineer  
*TechSmith  
Okemos, Michigan*



*“As a Michigan native, I wanted to pursue my career within the state. I was thrilled to discover my company, TechSmith, near MSU in Okemos, Michigan. TechSmith is one of many Capstone course project sponsors located within Michigan. I am very grateful for the exposure I received and the experience I gained from it.”*

BS, CSE: December 2014  
Hometown: Norway, Michigan

**Jourdan West**  
Software Developer  
*General Motors  
Warren, Michigan*



*“I gained two essential skills from the Capstone Experience. First, I learned how to explain and defend technical decisions to teammates, peers and corporate clients. Second, I learned how to use my technical skills to convert my client’s needs to functional and intuitive software. In addition, I was able to connect with contacts from many large companies and jump-start my own career at GM.”*

BS, CSE: May 2015  
Hometown: Detroit, Michigan



**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.”*

BS, CSE: May 2015  
Hometown: Midland, Michigan



**Mike Quiroga**  
Software Engineer  
*Quicken Loans  
Detroit, Michigan*



*“In the Capstone course at Michigan State University, I worked on a four-person student team to design, develop and deliver a technically challenging software system for TechSmith. The experience gained and the lessons learned jumpstarted my career at Quicken Loans.”*

BS, CSE: Fall 2013  
Hometown: Mason, Michigan

## The Capstone Experience

Spring 2016

# Project Sponsors

We thank the following companies for their generous support of the Computer Science Capstone Experience.

### Amazon

Detroit, Michigan & Seattle, Washington



### Auto-Owners Insurance

Lansing, Michigan



### GE

Detroit, Michigan & Milwaukee, Wisconsin



### General Motors

Detroit, Michigan



### MSU Federal Credit Union

East Lansing, Michigan



### Quicken Loans

Detroit, Michigan



### Spectrum Health System

Grand Rapids, Michigan



### TechSmith

Okemos, Michigan



### Union Pacific Corporation

Okemos, Michigan & Omaha, Nebraska



### Urban Science

Detroit, Michigan



### Whirlpool Corporation

Benton Harbor, Michigan



### Yello

Chicago, Illinois



# Amazon

## Twitch.tv Comment Ranking & Smart Adverts

Twitch.tv is a website that provides a platform for entertainers to stream their activities live. Recently acquired by Amazon for nearly one billion dollars, Twitch is ranked above Facebook in peak Internet traffic websites in the United States.

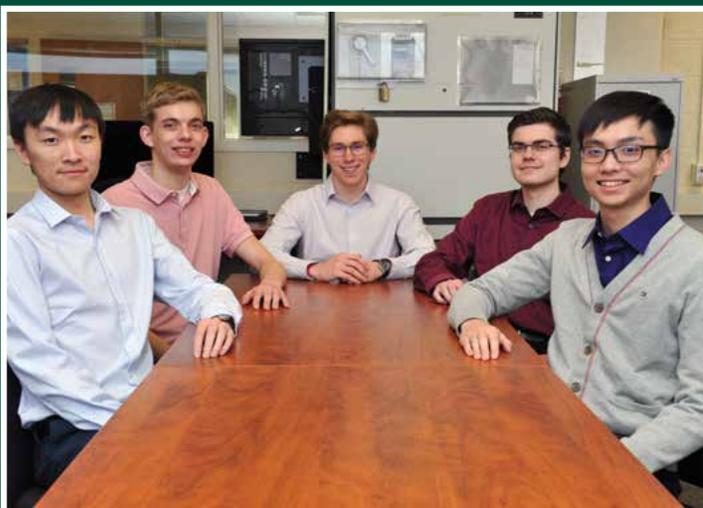
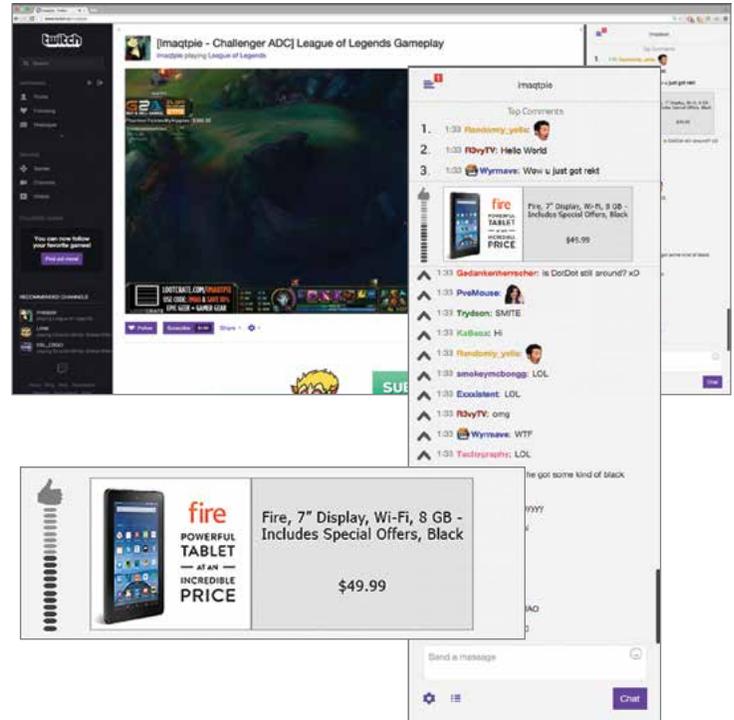
Similar to live television, Twitch grants viewers real-time access to a variety of channels. However, being web-based, Twitch also offers additional unique live features, such as chatrooms where viewers of an individual channel can chat among themselves and with the channel host.

Viewing and interacting with channel chat rooms is an important feature of the overall Twitch viewing experience. Our Comment Ranking system improves viewers' chat experience. Rather than scrolling through long lists of continuously scrolling comments, viewers are presented with a short list of the most popular ones for quick and easy viewing.

Our Smart Advertisements feature listens to both what's being discussed on the channel and what's being discussed in chatrooms to identify products being discussed. After identifying the most talked about products, it displays links to those products on Amazon's website.

Given our two new features, Twitch viewers are able to digest and interact with chat seamlessly while relevant advertisements receive a rise in traffic, which is a win-win for both Twitch viewers and advertisers.

Our *Twitch.tv Comment Ranking and Smart Advertisements* system is written in PHP and C++ and uses a MySQL database and Elastic Compute Cloud (EC2) Amazon Web Services.



### Michigan State University

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### Amazon

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**Garret Gaw**  
Detroit, Michigan

**Paul Krutty**  
Detroit, Michigan

**John Marx**  
Detroit, Michigan

**Paul Tunney**  
Detroit, Michigan

## Auto-Owners Insurance Catastrophic Claims Unit Mobilization

Auto-Owners Insurance is a Fortune 500 company working with more than 6,200 independent agencies in 26 states. Founded in 1916, Auto-Owners continuously improves their products and services for their policyholders.

Auto-Owners is committed to providing efficient, timely service to its policyholders affected by severe weather events that cause large amounts of damage. Our *Catastrophic Claims Unit Mobilization* system streamlines the entire process of handling large volumes of claims resulting from severe weather events.

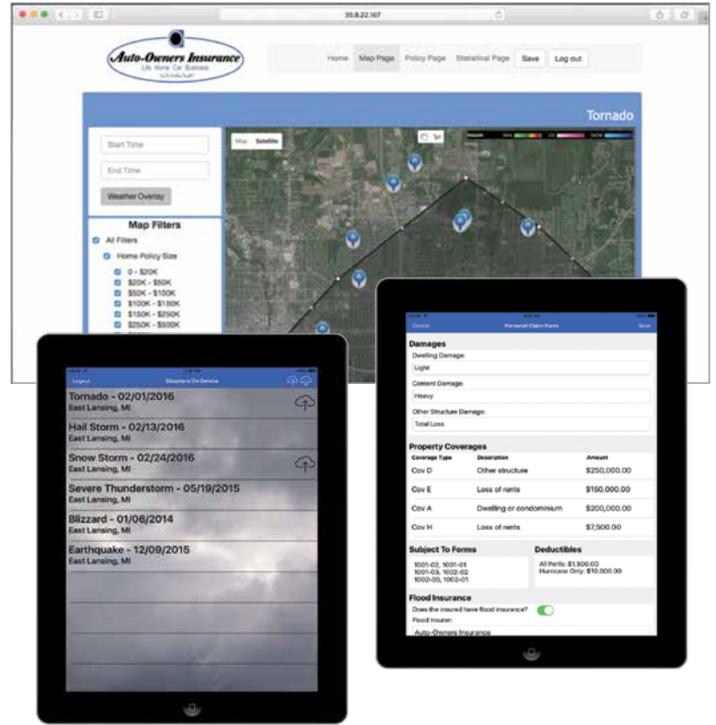
Our web app displays where policyholders' properties are located on a map. Auto-Owners claims adjusters utilize overlaid weather radar to locate its customers in high damage areas. Information about these customers is sent to our companion iPad app.

In addition, our web app determines the most centralized location within the high damage area to deploy the mobile claims unit vehicle so the claims adjusters are readily available to assist their policyholders.

Auto-Owners claims adjusters process claims using our companion iPad app. The adjusters file claims on-site, with or without an internet connection. Once connected to the internet, claims that are filed off-line are uploaded to Auto-Owners.

Auto-Owners management can view a statistical analysis of the claims as they are being filed and processed using our web app.

Our web app is written in HTML, CSS, JavaScript and PHP. Our iPad app is written in Swift. Both are supported by a MySQL database with JSON used to communicate between the two.



### Michigan State University Team Members (left to right)

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**Jim Schumacher**  
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# GE Cloud Management Portal

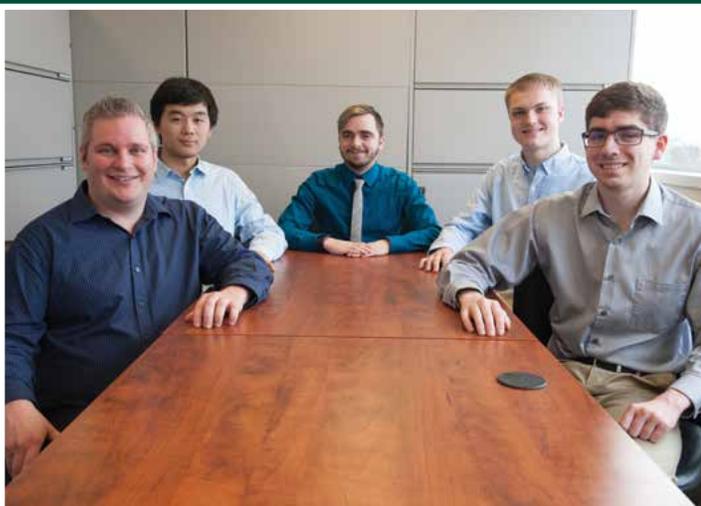
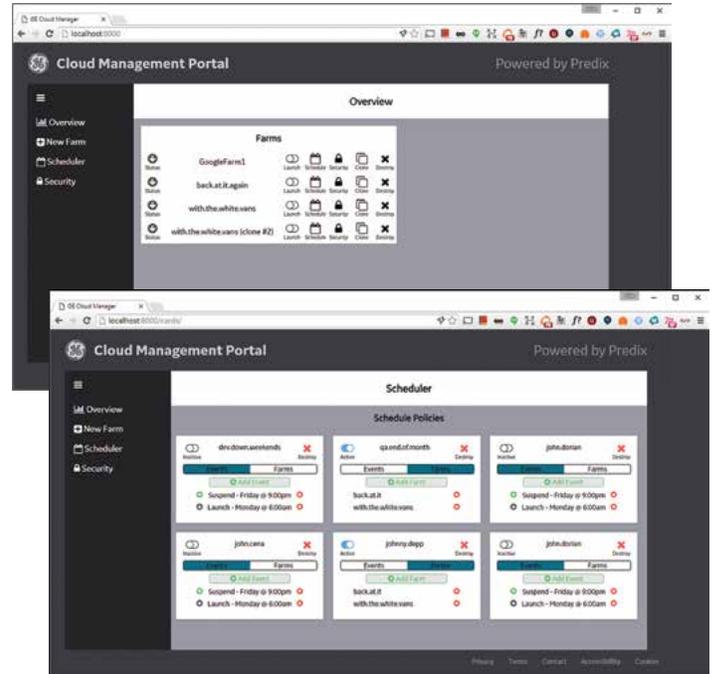
General Electric is the world's digital industrial company with global locations in more than 170 countries and a workforce of 305,000 employees. GE operates in many industries including appliances, power and water, oil and gas, energy management, aviation, healthcare, transportation and capital.

GE businesses rely on compute servers to handle large amounts of data. Servers are used for various applications such as storing files, hosting databases and handling email. Servers are also used to distribute information and run apps via the Internet. Today, computing services are often provided by an outside company at a remote location "in the cloud." GE relies on such cloud servers to manage their apps and deliver services quickly and efficiently.

Managing cloud services is important. Unfortunately, existing cloud management tools are often too complex for many users. Our *Cloud Management Portal* is a tool designed for use by non-technical users to manage and leverage a wide variety of cloud services. Users experience a simplified approach to cloud resource management with the flexibility of handling multiple cloud resource providers.

Our easy-to-use cloud portal makes cloud service management accessible to non-technical people, which increases the use of cloud resources, thereby enabling hospitals, manufacturers and other businesses to function faster and more efficiently.

Our *Cloud Management Portal* is written in CSS, HTML, JavaScript and Python, and utilizes the Scalr API, Amazon Web Services and the Django MVC framework.



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## The Capstone Experience

# General Motors IT Expert Live Help

**G**eneral Motors is a multinational automotive company that sells vehicles in over 120 countries worldwide. Headquartered in Detroit, Michigan, GM produces nearly ten million vehicles per year and employs over 210,000 people.

GM's Global Service Desk (GSD) provides information technology (IT) support to GM employees worldwide. With so many employees, GSD handles a large volume of trouble tickets every day, which sometimes results in long wait times and lost productivity.

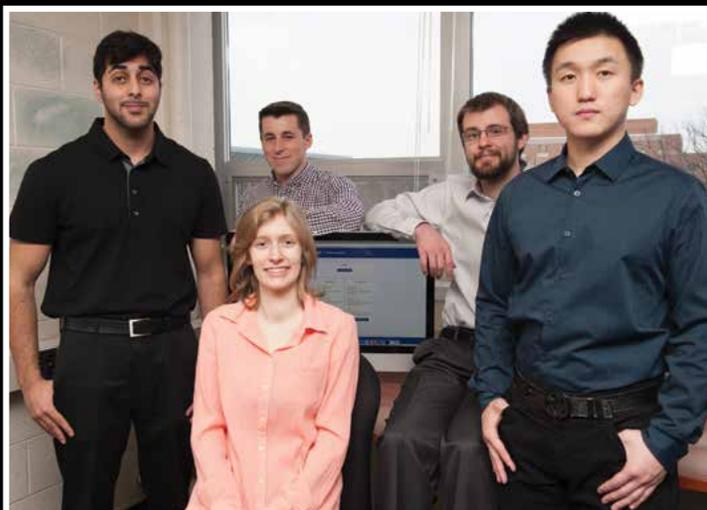
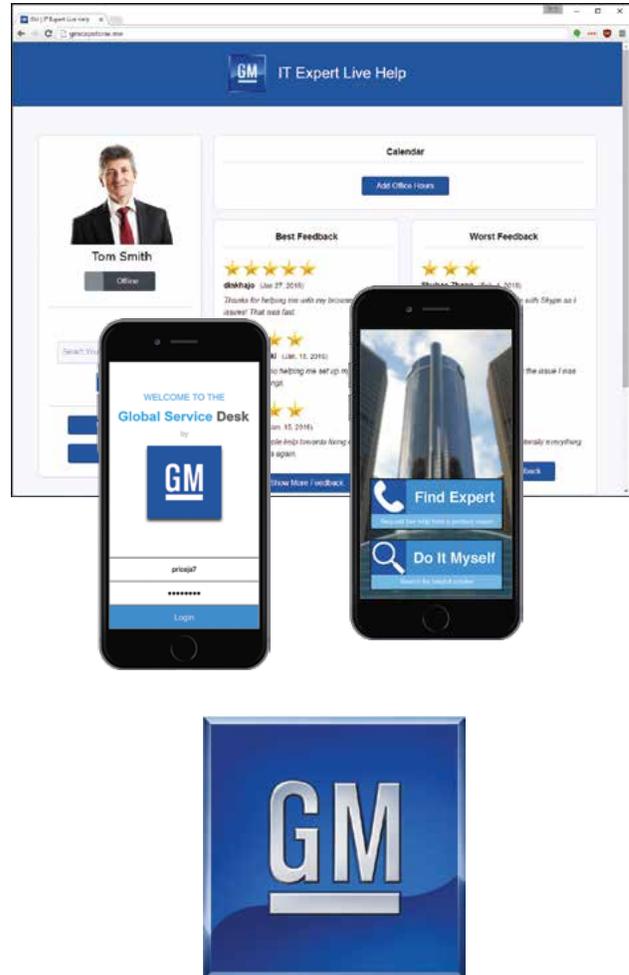
Our *IT Expert Live Help* system provides GM employees with an alternative to the current GSD system. When IT help is needed, a GM employee can use our app to search for a self-help article to fix the problem themselves or they can request immediate help from a volunteer IT expert.

When assistance from a volunteer expert is requested, our app locates an available expert and initiates a Skype call between the person requesting help and the IT expert.

Using Skype, participants can video chat, exchange texts and images such as screen shots. At the conclusion of the help call, users can rate their experience.

Volunteer IT experts manage their availability via our companion web app. They can edit their areas of expertise, their hours of availability and their current availability status.

Our *IT Expert Live Help* mobile and web apps are written in Swift and JavaScript, respectively, interfacing with a SQL database.



### Michigan State University

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**Jake Price**  
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## MSU Federal Credit Union Money Smash Chronicle

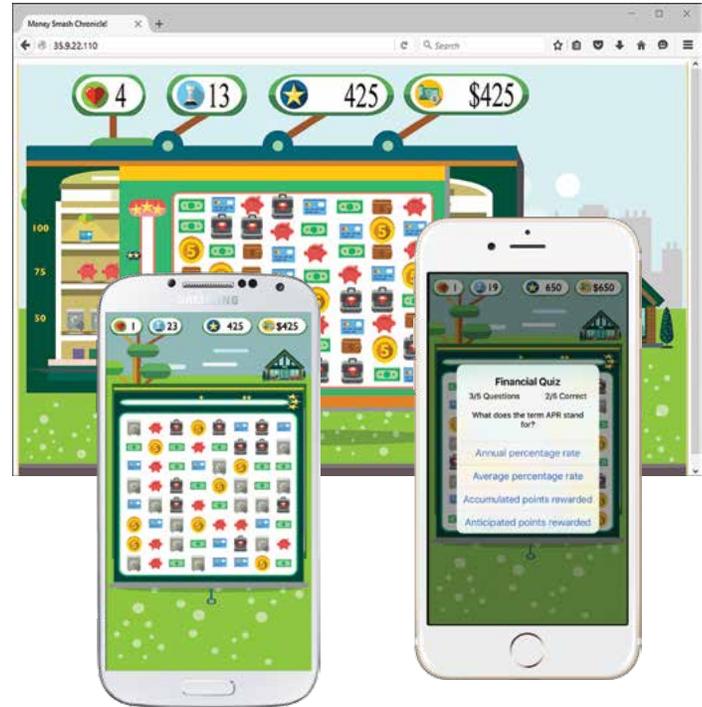
**M**ichigan State University Federal Credit Union (MSUFCU) is the world's largest university-based credit union, offering a full range of personal and business related financial services to Michigan State University, Oakland University and their surrounding communities.

As a university-based credit union, MSUFCU is committed to educating its customers about finances. To improve financial literacy among people of all ages, *Money Smash Chronicle* educates players while providing a simple yet fun and engaging gameplay experience.

*Money Smash Chronicle* is a tile-matching puzzle game similar to other popular games such as Candy Crush. Like other puzzle games, our app uses the gameplay design philosophy of being easy to learn yet difficult to master. However, in lieu of requiring payments for extra lives and power-ups, players earn these bonuses by taking quizzes covering topics ranging from financial terminology to financial responsibility.

In addition, gameplay obstacles and goals are modeled after real world situations like surprise expenses and bills with upcoming due dates. These obstacles keep gameplay exciting for all skill levels while giving players more "hands-on" financial knowledge.

*Money Smash Chronicle* can be played in any web browser, as well as iPhone, iPad, Android phones and Android tablets. Our web app is written in JavaScript and WebGL. The mobile versions are native apps written in Swift for iOS and Java for Android.



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## Quicken Loans Game of Loans

Quicken Loans, headquartered in downtown Detroit, Michigan, is the largest online retail mortgage lender in the US. With over 30 years of experience, their customers include over 2 million American families.

Our web-based game, *Game of Loans*, educates Quicken Loans team members on the loan process by taking players through a mock mortgage process.

The objective of the game is to close as many loans as possible in a set number of turns. A player's ability to acquire and close a loan is influenced by three in-game statistics: income, assets and credit. A player's statistics are raised or lowered through in-game chance events, such as getting a pay raise or losing a job.

As a player progresses through the loan process, sub-goals appear and indicate passing steps in the actual mortgage process, such as getting conditionally approved.

At the end of a game session, a player is given a score that is based on a combination of the number of loans closed, the difficulty associated with closing each of those loans, and the player's statistics.

A player's score is ranked against other players' scores on a leaderboard, which is managed by a Quicken Loans system administrator.

*Game of Loans* is written in C# using the Unity game engine, which utilizes WebGL as a platform. A SQL database stores players' scores.



**Quicken Loans®**  
Engineered to Amaze®



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**Linglong He**  
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## Spectrum Health Mobile Rounding App

Spectrum Health, located in Grand Rapids, Michigan, provides high quality, high value healthcare through its twelve hospitals, more than 180 ambulatory and service sites, and Priority Health, a health plan with over 700,000 members.

Our *Mobile Rounding App* is designed to improve the patient experience during their hospital stay after surgery. Our system consists of two distinct parts, a mobile app and a web app.

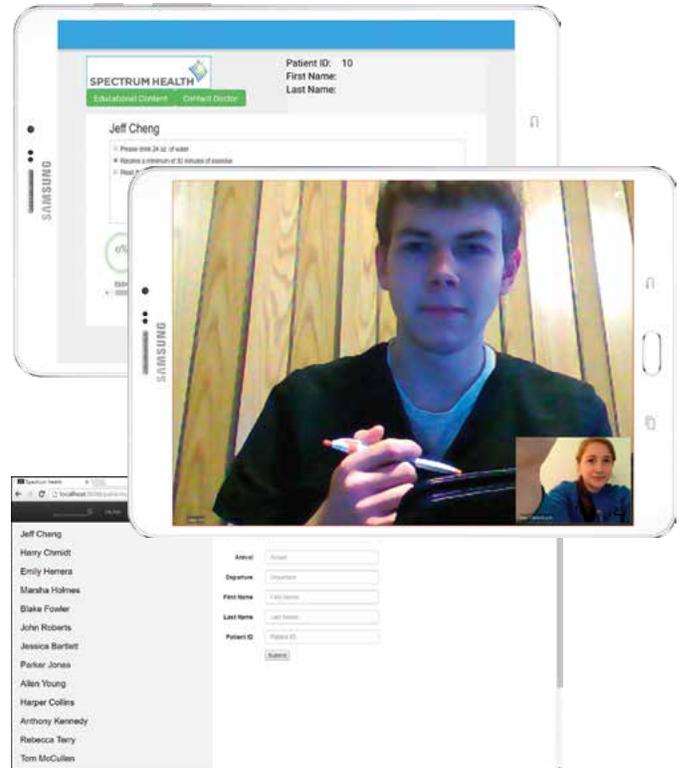
Our mobile app enables patients to contact their surgeon with concerns and questions. Patients can do this through a video call or a text message within our app. Each patient is provided with a personalized tablet to be used during their hospital stay.

In addition to contacting their surgeon, patients can view educational materials that pertain to their surgical procedure. They are also provided with a daily checklist of tasks they are expected to complete each day while they are recovering.

Surgeons like Drs. Jason Slaikeu and Peter Beaulieu, vascular surgeons at Spectrum Health and our project collaborators, use the *Mobile Rounding App* on their tablets to answer video calls from their patients and exchange text messages with them.

Spectrum Health configures tablets and mobile apps for patients using our companion web app. Patient information is entered along with the checklist of tasks to be completed during recovery from surgery.

Our *Mobile Rounding App* is written in Java and C. The web app runs on the ASP.NET Web API and is written using JavaScript with the AngularJS framework, HTML and C#. Our platforms are supported on the backend by a MySQL database.



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**Vincenzo Pavano**  
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**Mike Ply**  
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**Jason Slaikeu**  
Grand Rapids, Michigan

# TechSmith Cloud Based Video Face Tracking

TechSmith provides countries all around the world with screen capture and recording software for individual and professional use. Their products make it easy to create compelling, polished content that's ready to be shared with anyone.

When sharing videos in a public or legal setting, the need to blur faces often arises. A typical process of blurring faces in a video requires frame-by-frame editing, which is extremely tedious and very time consuming.

With our Cloud Based Video Face Tracking software, face blurring is done automatically, quickly and with ease.

For example, suppose a user needs to produce a video containing the faces of protected witnesses for a court hearing. A user begins by logging onto our website and uploading their video into their video library.

Once selected, the video is displayed with all faces automatically tracked. On a face-by-face case, the user then chooses to blur the face, highlight it or leave it as is.

Manual editing is available in case a face is lost or tracked incorrectly.

When finished, the blurs and highlights are rendered into the video. The user can either save it for further editing or export it.

Our Cloud Based Video Face Tracking software is an ASP.Net MVC 5 web app written in C#. The app along with the underlying SQL database is hosted on Microsoft Azure. Face tracking and video encoding, decoding and editing is supported by the OpenCV API via EMGU.



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**Dave McCollom**  
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**Anthony Tesija**  
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## Union Pacific Oculus Rift Inspection and Training Tool

Union Pacific Railroad is the principle operating company of Union Pacific Corporation. Connecting 23 states in the western half of the country with over 32,000 miles of track, it is one of America's leading transportation companies.

Working with large machinery such as locomotives is dangerous, especially for new employees. To minimize the risk of job-related injury, Union Pacific uses sophisticated training simulators to help trainees familiarize themselves with the operation of railroad equipment.

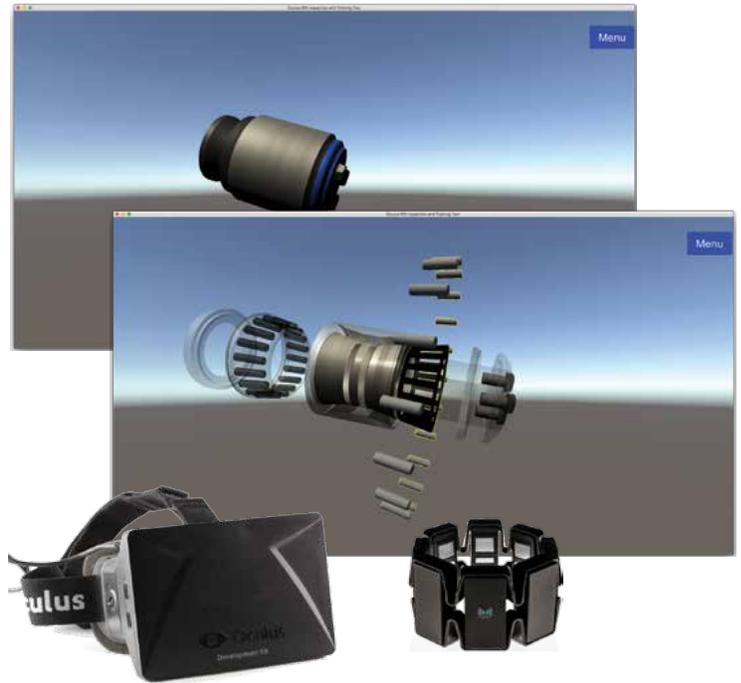
Our *Oculus Rift Inspection and Training Tool* is the latest in virtual reality training software, providing an immersive experience for Union Pacific employees without the risk of working with dangerous equipment.

Our system features two modes: Free View and Guided Lessons.

In Free View, trainees explore the structure of locomotives and other railroad equipment. They interact with these models by rotating them, playing animations of moving parts, and "exploding" the models to view individual components.

Guided Lessons provide trainees with a structured tour of the models complete with audio voice-overs and periodic quizzes to test their knowledge. For example, a trainee might be asked to identify a broken part of a locomotive before continuing.

Our *Oculus Rift Inspection and Training Tool* is an app for both Macs and PCs, powered by the Unity3D gaming engine and written in C#. It uses the Oculus Rift virtual reality headset and Myo Armband gesture controllers to give users a hands-on feel.



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# Urban Science Dealership Inventory Solution

Urban Science delivers consulting and software solutions that help automotive clients increase market share and boost profitability through high performing retail networks.

Automobile dealerships are responsible for purchasing their own inventory from their manufacturer. The dealer's goal is to purchase the correct quantity and selection of vehicles so as to optimize profitability and provide maximum customer satisfaction.

Dealers must consider many factors before making a purchase, such as consumer demand, current inventory and manufacturer allotments.

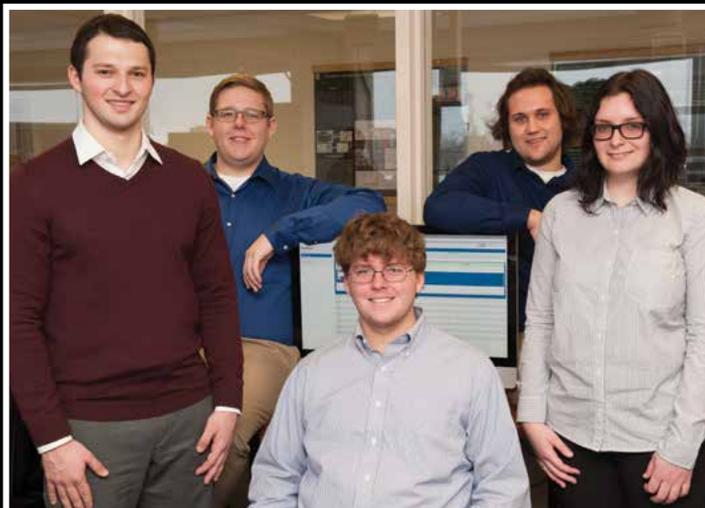
Our *Dealership Inventory Solution* provides a web application that enables dealers to optimize their purchasing power by making inventory purchasing recommendations. The system considers many factors, while still allowing the dealer to make the final decisions. Our web app also consolidates multiple systems by showing dealers their current and on-order inventory.

In addition to the web application, our system includes Apple and Android phone apps for dealership customers to view a dealer's inventory. Customers can not only determine whether a particular car is in stock, but can also find out where that car is on the dealership lot.

Our web app is built with Bootstrap, AngularJS and jQuery, with a Microsoft SQL Server database. Our mobile apps are built with Ionic, which uses AngularJS, CSS and HTML to deploy versions of our app to both Apple and Android devices.



URBAN SCIENCE.



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## Whirlpool Corporation Mobile Product Catalog

Whirlpool Corporation is the number one manufacturer of major appliances in the world, with approximately \$20 billion in annual sales in some 170 countries around the world.

Whirlpool markets their products under a number of well-known brands including Whirlpool, KitchenAid, Maytag, Consul, Brastemp, Amana, Bauknecht, Jenn-Air and Indesit.

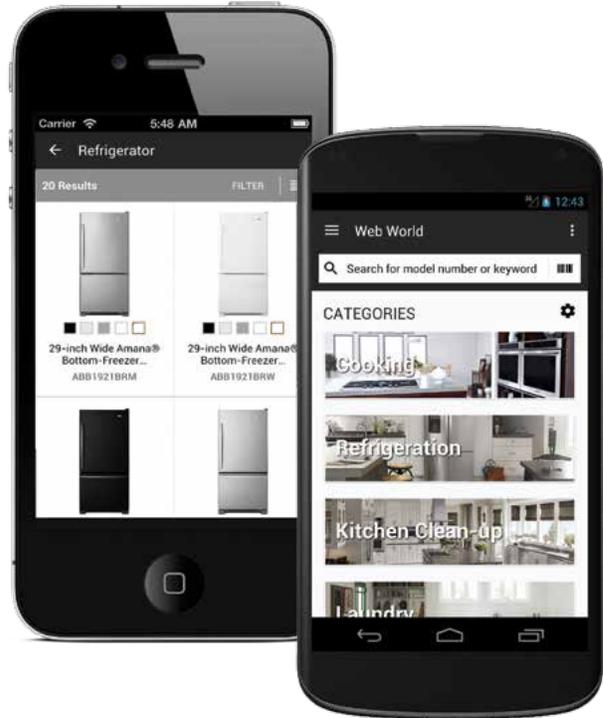
Whirlpool sells its products through a variety of retail outlets such as Best Buy, Home Depot and Lowes.

Our *Mobile Product Catalog* provides sales associates with a quick and easy way to obtain information for their customers about any Whirlpool product using their Apple or Android phones or tablets.

Our app shows appliance specifications, key features, images and other information for every Whirlpool product. As a result, sales associates spend less time searching for information and more time guiding their customers through the purchase of a home appliance that is right for their lifestyle.

Specific Whirlpool products are found either by searching by name or by browsing through categories of appliances. Filtering narrows the searches. Appliance features can be compared side by side. Sales associates can share search results with their customers via email and text messages.

Our *Mobile Product Catalog* is implemented in Swift and Java for Apple and Android devices, respectively. We use Google Analytics to provide Whirlpool with big data analytics on consumer interactions with the app.



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# Yello

## Syncing Mobile Data Without Internet Connectivity

Based in Chicago, Yello specializes in talent acquisition software designed for companies to collect, organize and search for information about potential job candidates.

Yello's software includes mobile applications used globally at large career fairs. Candidates submit resumes on recruiter tablets during the career fair. Company recruiters then access candidates' resumes and record notes about each.

Companies often have multiple recruiters at job fairs. In this case, the information on all of the candidates is kept synchronized and up-to-date across all of the mobile devices of each company using a wireless Internet connection.

Unfortunately, at some career fair venues there are no wireless Internet connections, while at others the connections are not reliable, causing information synchronization to fail.

Our *Syncing Mobile Data Without Internet Connectivity* system provides wireless network connectivity between mobile devices without a wireless Internet connection. Our software works for both Apple and Android phones and tablets.

At a career fair with limited or no Internet connectivity, one recruiter from a company creates a wireless private network session. Other recruiters from the same company then join that network so that all of the candidate information is synchronized between all of their devices seamlessly.

Our *Syncing Mobile Data Without Internet Connectivity* system uses the NSCoding and WifiDirect networking libraries and is written in Swift and Java for Apple and Android devices, respectively.



# yello



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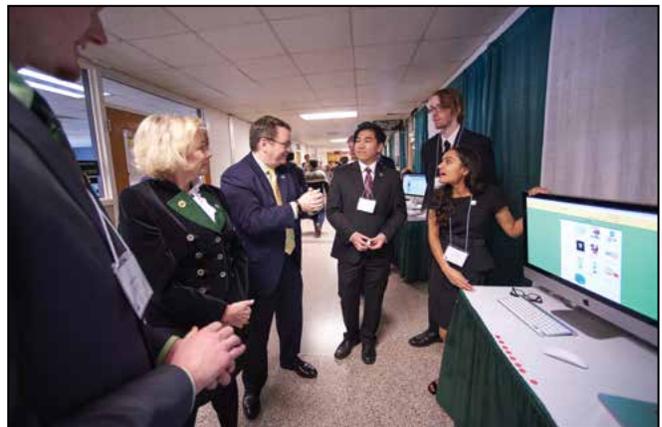
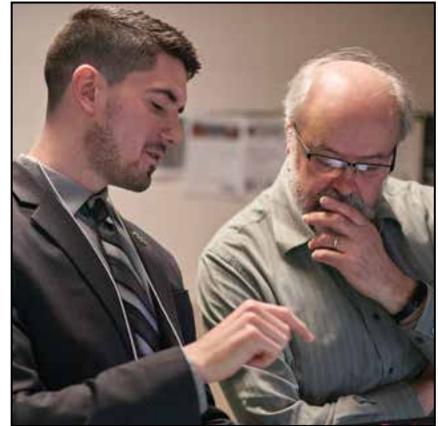
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