

Message from the Director



Dear friends,

t is my pleasure to share the
Department of Computer Science and
Engineering's Senior Design 2018-19
Year in Review Report. Senior Design has
had an outstanding year with multiple
crowning achievements, including the
following highlights:

- Completing our largest number of projects (20)
- Pioneering our first Senior Design VM model

- Initiating the Senior Design AWS platform, Slack community, and GitHub organization
- Establishing the Senior Design
 Service Center within the University of Nebraska system
- Developing a service-level agreement with the CSE System Administration Group and a memorandum of understanding with Design Studio
- Expanding the support model and our community engagement with the Lincoln Community Foundation to increase the number of nonprofit projects for the next academic year
- Opening the door to new partnerships across the University of Nebraska system (the UNL, UNMC, and UNO campuses) for innovative interdisciplinary projects for the next academic year

These achievements enhance our ability to provide a unique capstone experience for our students that will give them the experience and confidence needed to succeed in their post-graduate careers. Some of our students will continue their

academic journeys into graduate school to contribute to the advancement of cutting-edge scientific research. Some of our students will land their dream jobs to design and develop the next generation of information technology solutions. We are honored to have worked alongside them this past academic year.

We hope that their participation in Senior Design was very special and a highlight of their educational experience at UNL. We thank all the project sponsors, volunteer coaches, mentors, faculty, and staff who help foster the flourishing Senior Design community. Our best days are ahead of us and we look forward to leveraging our supportive community to take us to the next level.

With Gratitude,

Christy Thomas
Director of Senior Design

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Senior Design Mission

Senior Design provides a project-based capstone course that gives students a design-centered educational experience. Our students focus on the applications of software and systems engineering principles to solve complex problems through the design, development, and implementation of innovative computing systems.

Senior Design Core Values

Our core values reflect the Department of Computer Science and Engineering's 50-year history, mission, and beliefs:

By teaching essential skills and providing globally recognized research and training opportunities, we prepare students for the most challenging, innovative, and fastest-growing careers of the 21st Century. Featuring world-class facilities, a groundbreaking curriculum, the University of Nebraska-Lincoln's Department of Computer Science and Engineering is one of the country's top computer science and engineering programs.

Interested in sponsoring a project?

Please fill out the project proposal form:
go.unl.edu/senior_design_project_proposal

Interested in being a coach?

Please fill out the coach application form: go.unl.edu/senior_design_coach_application

Senior Design Statistics

40,798

OF SLACK **MESSAGES THIS YEAR**

143

OF **SLACK USERS**

2013

OF FILES **UPLOADED TO SLACK**

50

#OF **SLACK CHANNELS**

16,000

TOTAL # OF STUDENT DEV. **HOURS**

21.6

OF MONTHS OF STUDENT **DEV. HOURS**

300+

HOURS OF **SPONSOR MEETINGS**

12.5

DAYS OF **SPONSOR MEETINGS**

110

TOTAL **STUDENTS**

Technologies Used

8







6







5













Project Domains

- 11 PRODUCT DEVELOPMENT
- **6** WEB DEVELOPMENT
- **B**USINESS DEVELOPMENT
- 6 DATA SCIENCE
- 3 INTERNET OF THINGS

- 3 RESEARCH & DEVELOPMENT
- **2** VIRTUAL REALITY
- **2** AUGMENTED REALITY
- **2** ALGORITHM DEVELOPMENT
- **GEOGRAPHIC INFORMATION SYSTEMS**



Sponsor: Nebraska State Museum

Project: **Morrill Explorer**

The Nebraska State Museum sponsored the creation of an iOS application using augmented reality to help users further explore the new exhibits in the recently renovated fourth floor of the museum. The fourth-floor renovation included the addition of many new digital, interactive exhibits, one of which is a "Parasite Table" constructed out of a giant touch screen that allows users to learn all about parasites that are native to Nebraska. The Senior Design team was tasked with creating content to complement this parasite table by allowing users to interact with some of these parasites and their hosts that were also featured throughout other exhibits in the fourth floor. Users can access this additional parasite content by visiting the appropriate exhibit and scanning the content trigger placed on a nearby placard.

When the app recognizes an exhibit, it automatically displays an augmented reality animation of the host and parasite, along with a short description of the specimens. Augmented reality was chosen as the medium for the animations since they are displayed on top of the real world so that the specimens on display can be digitally brought to life in the museum. Unlike virtual reality which engulfs the user's entire perspective, augmented reality involves digitally rendered objects placed on top of the real world as shown through the mobile device's camera view on the screen.

In order to provide the ability for future developers to easily port the application to Android, the team implemented Apple's ARKit augmented reality framework through the cross-platform game engine Unity. The team also used Unity to create unique educational games for each parasite shown in the app. In addition to Augmented Reality animations and educational games, each featured parasite has its own section in the app with a short, educational video, a puzzle, and a brief description of its parasitic behavior and importance to the ecosystem.

The Team

Matthew Martin

Brandon Huettner Sasha Tenhumberg Shaun Ban Ziyuan Ye Austin Kremke Product Manager and Squad Lead

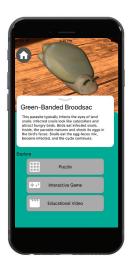
Development Manager Developer

Developer Developer Developer

(through December 2018)











Sponsor: CompanyCam

Project: **CompanyCam**

The team was tasked with implementing a variety of measuring tools to aid in the verification, and saving of measurements using augmented reality. The team delivered 3 tools: ruler, pitch, and the area tool. The ruler tool measures lines drawn between two user-selected points. The pitch tool is able to measure the degree of deviation from a horizontal plane. Finally, the area tool, is able to find the area measure of a user-drawn polygon.

Aside from feature parity between the iOS application and Android, the team was also able to implement a number of development procedures—such as automated build testing—to ensure a working build was always remotely available. Automated unit testing was also put in place for certain methods of the application.

As rendering anything in Sceneform and 3D vectors in general was still relatively new to us, setting Sceneform up was the first challenge we had. We first used OpenGL to render any new objects in the 3D scene to get a grasp of how the tool should work, then, after consulting CompanyCam's Dr. Dan for help, we then reverted back to using Sceneform to render objects as the interfaces and classes that came with it were much more useful with regards to the project.

The next tool that we worked on was the pitch tool that measures the degree of deviation from a horizontal plane. A major challenge was to create an entirely new CustomPlane class, as the basic functions in Google's ARCore only identifies vertical planes and horizontal planes. So, the solution was to create a CustomPlane class to identify planes with varying degrees of slant. Starting from Release 4, we tackled the Area Measure tool once measurements from the RulerTool were completed. This tool is tricky to implement as the structure behind the vertices of an area in Sceneform is very different from measuring the area of a polygon in 2D. In Sceneform, vertices are nodes/anchors and the first node would serve as a parent to any subsequent new vertices added to the polygon which are child nodes to the parent node. Dr Dan provided guidance and some documentation for the algorithm behind measuring polygons.

The Team

Zack Blase

Luis Ramirez Brooke Lampe Sing Chew Jianzhi Lou Yuki Shiratori Squad Lead and Development Manager Product Manager











Sponsor: Witawas Srisa-an and Suzette Person Project: CSE Course Scheduling

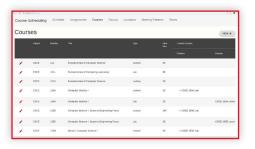
This project is intended to create a stable and reliable system to aid in the process of scheduling courses for the CSE department. The system will import CSV files and schedule courses automatically. It will also allow users to reschedule courses manually rather than automatic scheduling only.

The team's solution was divided into three separate components: a script to load semester data, a website to display it, and a scheduler to compute future semesters. Considering the end-user environment of the CSCE server, we decided on using Ruby on Rails for our application framework. Our sponsors gave us various CSV files filled with previous semester scheduling data. The script takes in this data, parses it, and then generates objects using Rails' object to SQL mapping. Since the CSV files given to us were meant to be run only once—as the scheduler and website are meant to serve as interfaces for future changes—we saved time and tested its validity only on the input data we had been given. The scheduler is intended to save our sponsor weeks of time manually fixing conflicts. Since it uses local search, we can ensure that the scheduler finishes running in a finite amount of time. Since our scheduler pulls out data straight from the database and then saves it back when it is done, the results will be able to immediately be visualized on the website.

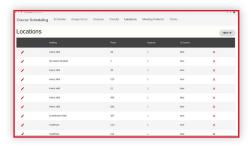
Lastly, the website is meant as the manual interface necessary when small manual changes must be made. There are a few instances where making rules/constraints for the scheduler is far more tedious than is necessary. These cases are consistent across semesters, so manual management is far more effective here than automatic scheduling. To fulfill that requirement, the website is fitted with all the functionality required to manually change any of the data, including adding, editing and removing objects.

The Team

Etnan Penn	Squad Lead and Dev. Manager
Yiqun Qian	Product Manager
Christian Farmer	Developer
Sam Flint	Developer
Sijing Lin	Developer
Yucheng Wu	Developer



Course Scheduling	Schedule Assignments	Courses Faculty Location	s Meeting Patterns Terms						
Meeting Patterns									
	Coyo	Start Time	End Time						
1	MWF	12:00	13:20	×					
/	None	00:90	00:00	×					
1	w	1830	16:20	×					
1	Mw	15:00	16-45	×					
1	T	18:90	19:45	×					
1	w	10:30	11.45	×					
1	w	13:00	14.15	×					
/	MWF	14:00	15:20	×					
1	R	18:30	10.45	×					
		12:00	13.45	v					







Sponsor: **J. Ron Nelson, Leen-Kiat Soh, Samantha Cooper**Project: **Erudite**

Our first challenge was to develop a student-friendly login. For young students—especially those still learning basic reading skills—remembering a complex username and password can be a difficult task. To solve this, we created a login solution which presents the student with three image categories: foods, colors, and animals. The student can then click to cycle through these images and choose their password. Students should find this easier and faster than typing in a complicated password! Our student-friendly login is also COPPA compliant as it doesn't require any personal information from the student.

The next challenge was to improve the website's accessibility, appearance, and functionality for students, parents, and teachers. We began by reworking the navigational flow and data presentation of the website. Students, parents, and teachers are now presented with buttons which clearly direct them to the relevant portions of the site for playing the game, managing a classroom, or viewing student performance. Adults have new account management options such as the ability to delete their account, change a forgotten password, or link existing student accounts to a parent account. Student performance graphs were streamlined and simplified to make it easier for students, as well as adults, to track their progress. Teachers now have the ability to download an entire classroom of data as a .csv file; and a "Gameplays" tab helps teachers to know what and when students are

playing. Parents may also now receive invitation emails to join the site if a teacher creates an account for their child.

Our final challenge was to develop a new "Sounds to Words" game. The goal of this game is to improve students' auditory working memory—that is, their ability to hold and manipulate letter sounds in their heads. The task in "Sounds to Words" is to pick out the correct word from a set of 2 or 3 words, given a random sequence of three letter sounds. To get kids excited to play the game, we developed a fun "desert mining" aesthetic complete with jewels, iackhammers, and treasure chests! If a child gives a correct answer, a jewel will appear on the screen. Incorrect answers receive a muted response. At the end of the game, a professor character appears with an exciting animation. The idea is generally to reward student success and to give them encouragement when they struggle. This will help motivate students to learn. To tie it all together, we updated the website to properly store and display the student performance data coming from "Sounds to Words."

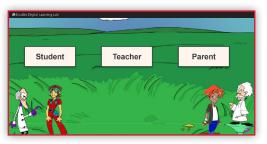
The Team

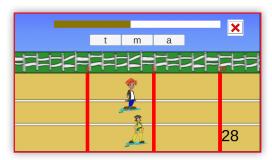
Jaehyeon Yang Grant Harrison

Jason Hitchcock-Sivak Developer
Jianfei Shao Developer
Jingchen Wang Developer

Development Manager Product Manager and Squad Leader Developer Developer Developer











Sponsor: **CLAAS**

Project: **Grain Harvest Logistics**

The purpose of this project is to create a Progressive Web Application (PWA) that generates the optimal path to harvest crops. Instead of developing a native iOS native app, we chose to develop a PWA. The reason is that no installation is required for a PWA and its content could be cached beforehand, so users can still browse without an Internet connection.

There are two phases of this project, the first phase is the Demo Tool. Sponsors want this tool to be able to run offline, so we cached 6000+ images in our webpage. When users have Internet access, the cache function will automatically start.

The second phase is the Consumer Tool. Other than one pre-selected field shape in Demo Tool, users can upload their own field shapes to our webpage in Consumer Tool. They can choose the crop type (Corn or Wheat), the input unit (Metric or Imperial), Harvester Model (740TT or 760 TT), and header Width (30 ft or 50 ft) base on their preference.

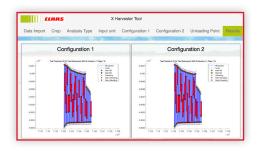
The Team

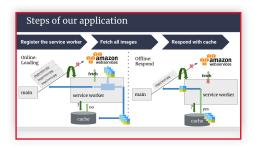
Pingyang He

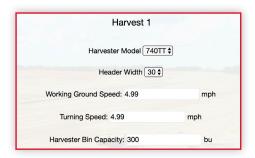
Fei Yu

Yang Deng Tao Yao Adam Schlichtmann Product Manager, Squad Lead and Web Development Development Manager and Web Development Web Development MATLAB Development MATLAB Development











Sponsor: Holland Computing Center

Project: Interactive Tour Application

Holland Computing Center (HCC) gives tours on a weekly basis to a wide variety of visitors, ranging from prospective faculty and students to the general public. To date, HCC has incorporated wall displays, virtual reality environments, various animations, and other techniques like live action role playing, with the goal of engaging visitors and introducing aspects of computational science to their guests. The predominant goals include education and outreach.

The greatest shortcomings of these current solutions is that they have limited involvement and expansion opportunity. Virtual reality environments have one person truly participating, while others must watch. Role playing suffers from similar problems, only involving a necessary number of people, and animations and displays can't extend past HCC offices. These solutions suffer from limited engagement and outreach, thus the need for an additional solution was realized.

The HCC student development team developed an application that takes advantage of augmented reality technology to solve these problems. The application can be deployed on any iOS mobile device, allowing for a much greater participation ratio, compared to virtual reality environments or role playing. We wanted to keep the application interesting for our target audience of prospective undergraduate students ranging in potential ages from 13-18, so we created an augmented reality scavenger

hunt involving objects in or around the Holland Computing Center. When an object of interest is found and scanned, based off of provided hints, a short informational video about the object will play. The application also supports scanning and reading faculty nameplates, to deliver some basic information about those who work within the Holland Computing Center. These two modes are accessed and used separately, and future teams will be able to add items of interest to either mode, or create new modes and functionality all together—one such example of possible expansion is reading a conference room number and showing you what times the room is currently reserved. This solution helps to resolve both problems of visitor involvement, and future expansion opportunity, all while keeping the goals of education and outreach in mind.

The Team

Jacob Petersen Noah Loos Hanlin Zhao Zheng Wang Chenxi Yu Minjung Kim Squad Lead Product Manager Development Manager ARkit and Testing Text Recognition and UI ARkit and UI Text Recognition and Testing











Sponsor: Lincoln Public Schools Project: Standard Response Protocol System

When danger arises at a school, it is of utmost importance that faculty are able to respond in the fastest way possible. The Standard Response Protocol is a nation-wide system currently used by LPS that their faculty can use to keep both teachers and students organized when handling an incident. However, faculty must be notified of dangerous situations quickly if they are meant to act. This project is a mobile application that serves as a means of sending out an alert message to the teachers of a school.

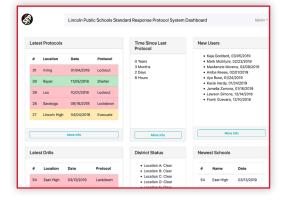
On the mobile application, all users will be prompted to log in with their LPS credentials upon opening the app. Authorized users can initiate a protocol and the system will send a notification to all related users based on the schools to which they are subscribed. During the incident, users can send messages to update the situation or deactivate the protocol if the event has been cleared. On the website application, all the data from both real-life incidents or drills and a list of accessed users will be populated accordingly for administrators.

The mobile application was made using Xamarin for Visual Studio on Mac OSX. The mobile application uses MVVM pattern to navigate between different views. On the

other hand, the website application was made using the MVC pattern. For single sign-on authentication, both log-in tokens and secure data access are protected by using Shibboleth. Notifications will be taken care of by Firebase and Apple Notifications.

The Team

Aidan Clarke Anh Nguyen Addison Higley Grahm Manley Seth Hampl Dakota Seng Squad Lead
Product Manager
Development Manager
Developer
Developer
Developer









Sponsor: Madonna Rehabilitation Hospitals

Project: Generation of Client Software Application to Receive, Analyze and Store Wireless Sensor-Driven Performance Data

The Madonna Rehabilitation Hospital Senior Design team has a unique challenge of working on one of engineering's cornerstone project archetypes, an embedded system. The primary objective of this project is to create a system that a clinician can use to wirelessly collect and observe health-related data in real time. This system requires a variety of different software and hardware components to complete the task outlined above.

The sensors are the marquee hardware components of the project. We have constructed our own proprietary sensors by combining several open-source hardware modules. While each sensor consists of its own exact makeup, most, if not all, contain a WiFi broadcasting chip, an Arduino, and a sensor module. The sensors are powered via a USB input.

The Web application is the client-side application that the clinician will use to monitor the results of the session in real time. The clinician will attach the relevant sensors onto their patient and, upon beginning the test, the data collected by the sensors will be sent live to the Web application. Upon completion of the test, the clinician has the ability to either choose to permanently save the recorded sessions data or discard it.

In order to accommodate the large amount of data that may one day need to be stored as a result of this system's use, we have created an SQL Server database. We utilize stored procedures to retrieve information from the database that has recently been collected by the sensors in use.

The Team

Randy Scheffler

Harrison Hruby Andrew Buckwalter Josh Martin Collin Vanloon Squad Lead and Development Manager Product Manager Developer Developer Developer









Sponsor: Dr. Berthe Choueiry

Project: **CSE Math Day**

Math Day is an event held every fall at UNL where over 1,500 high school students come to participate in several competitions related to the field of mathematics. Usually, around 300 volunteers are needed to help with various parts of the day. As a result, the planning and coordination of the event and its volunteers takes a lot of work, and it is important for the manager to have an interface that allows them to do this efficiently. The purpose of the Math Day project is to create a robust administrative interface for the Math Day event manager to set up and run the event each year.

The first portion of the interface for managing the Math Day event relates to the organization of the event. This involves functionality for creating and adding new event dates to the system and defining opening and closing dates for the volunteer applications. Volunteers are only able to submit applications in between those dates, and the system automatically manages the acceptance of applications. This project also includes the ability to manage the activities and tasks that volunteers can be assigned to, and applicants can specify their preferences for different tasks.

The second portion directly relates to the management of the volunteer application related properties such as their recruiters, affiliations, statuses, and classes. The system now allows the Math Day event manager to view and update existing data as well as create a new one because

they are subjected to change overtime. Additional information such as the number of volunteers belonging to each type of property is added to support the statistics analysis and decision-making process of whether or not a new value should be added for the next year.

The final part of the interface is the ability for the administrator to manage everyone who applies to volunteer for the event. This includes viewing and manipulating all of the volunteer application data, viewing a list of all the users who have applied, and emailing them important information about their involvement in the event. This functionality is incredibly important for the administrator when in the process of assigning jobs for each of the volunteers to do. The administrator must look at the volunteer's connection to the University (student, staff, etc.) and available times when assigning tasks, and this part of the interface allows for easily viewing this information.

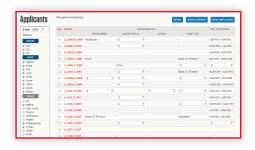
The Team

Jasmine Boyer

Denis Komissarov Trieu Hung Tran Khang Phan Timothy McCaslin Squad Lead and Product Manager Development Manager Developer Developer Developer











Sponsor: **Nebraska Department of Transportation**

Project: Vehicle Crash Information Portal Dashboard

The Nebraska Department of Transportation (NDOT) is in need of a user interface for visualizing data and generating reports for their existing crash analysis data cube. The previous system was unable to export data to formats accessible to other software. Data analysts were spending too much time manually transferring and entering data for reporting. The significant rate statistical method within the data cube is not up-to-date with the national standard.

The following are the expected deliverables:

- A skeleton structure implementation of the Empirical Bayes method called the Empirical Bayes Estimate (EBE) within the data cube.
- All the Hazardous Location Analysis reports transformed into exportable reports within the SSRS portal.
- Documentation for the EBE and reports.

The plan for final deployment includes a demonstration of the final reports and EBE, handing off the software to the sponsor development team to be deployed in their environment, and a final meeting after the showcase to make sure every documentation and software piece is given back to the NDOT sponsors.

The Team

Mickey (Tuyet) Tran Colton (Zhenchang) Qi Alex (Alejandro) Pages Charlotte (Jingwen) Yang Irene (Tianqing) Feng Project Manager
Development Manager
Estimate Developer
Estimate Developer









Sponsor: **Nebraska Environmental Trust**Project: **Grant Management Functions**

The Nebraska Environmental Trust is responsible for distributing Nebraska Lottery money to worthy environmental projects around the state. In the past, grant applications were made on paper and managed using a legacy Microsoft Access system. But in recent years, Senior Design teams have been building an ASP.NET MVC Web application to allow the Trust to move the grant application and management process online. This year's team added functionality to allow applications to be approved online and introduced some of the functions necessary to document progress and fund projects after their applications are approved.

The team started the academic year by learning the ropes and making small improvements. A function was added to export contact information to CSV files for mail merges. Filters were added to the internal contact search. Later in 2018, major changes were made. Features were added for grants administrators to approve applications and send letters and emails to project managers. Project managers were given a page to display all their current projects.

This spring, the team introduced functions to allow project managers to create and submit finalized project budgets, and for grants

administrators to approve or reject those budgets. Similar functions were implemented for the creation, submission, approval, and search of disbursements requests. Finally, creation, submission, and approval of matching funds reports was accomplished. The Nebraska Environmental Trust is close to a "paperless" system which fulfills the organization's environmental commitment.

The Team

Buck Cronk Mark Hollis Thiam Kiat Sim Linlin Chen Jesus Salazar Squad Lead and Product Manager Development Manager Developer Developer Developer











Sponsor: Byrav Ramamurthy, Francisco Munoz-Arriola, Yu-Che Chen, DeeDee Bennett

Project: **NEO-SAT**

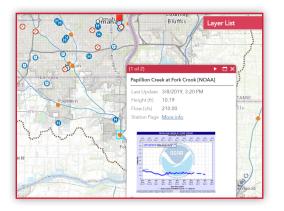
Emergency managers in the state of Nebraska often deal with flooding and other natural disaster events, which can be very hectic and require quick and clear visualization of vital data to help guide their efforts to mitigate the problem. There are numerous sources of data and tools that can be used to accomplish this, but consolidating all of this data requires a lot of time and effort that emergency managers don't always have due to the unpredictable and hectic nature of their job. This is particularly true of many counties in Nebraska where their emergency managers often have multiple roles and duties.

Our solution, NEO-SAT (Nebraska Online Situational Awareness Tool), is a GIS application designed to address these issues. NEO-SAT displays data relevant to flooding events in the form of data points on a map. This includes information such as active stream/river gauge readings, floodplain locations, active weather radar, police/fire station locations, school locations, etc. It can also be used to complete forms to submit to FEMA for reimbursement of damages. NEO-SAT is designed to be an easy-to-use, low-cost application that can be used on any desktop or mobile device.

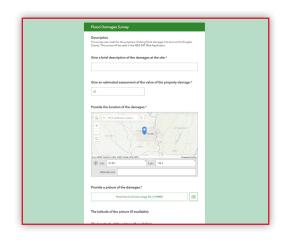
NEO-SAT eliminates all of the extra hassle of gathering data through numerous sources and interpreting it to determine to best course of action. All of the data an emergency manager could need during a flood event (and other kinds of disasters in future iterations) is available to them on a single organized screen.

The Team

Jake Field Cale Harms Hallie Hohbein Isaak Arslan Miracle Modey Team Lead and Product Manager
Development Manager
Developer
Developer
Developer









Sponsor: Mike Fields and Melanie Eirich

Project: **NET - Virtual Capitol Tour**

NET tasked our team to develop a project using Unity3D and C#. The project was to mimic the website experience that they had already developed. The core challenge that our team had to overcome was the lack of knowledge with Unity3D and C#. This led to extra time learning the needed skills and knowledge to effectively develop the project. Once we were somewhat familiar with Unity3D, we found ourselves constantly restructuring our project for increased optimization which set us back in some of our later features.

Another large task was the implementation of NET's server information into Unity3D. The process involves pulling HTML data from the servers of NET and parsing them into something usable to Unity3D. The idea is to render the HTML and convert it to an image format, which is easily usable by Unity3D and it's tools.

Another part, but just as important, was the mobile version of the project. Again, the team lacked valuable resources and knowledge in mobile development. This led to slow development times and backtracking. The mobile version of our project was very important because schools require cost effective ways to distribute the vr experience.

The Team

Darin Barth

Josh Miller Micheal Baumfalk Di Zhao Fuxiao Ma Squad Leader and Development Manager Product Manager Developer Developer Developer











Sponsor: **Speedway Motors**

Project: **iOS Application**

The Senior Design team was tasked with creating an iOS application for Speedway Motors, a Speed Shop that specializes in street rod and racing products. The overall goal of this application is to provide services attached to Speedway to the mobile platform for the first time. The solution created allows users to interact with Speedway Motors staff through a live chat, pick up orders outside the store, and have access to an FAQ and knowledge base. The solution was developed using Swift, along with Objective C frameworks and SDKs. The target user of the application is Speedway customers, though the app does not directly have shopping functionality.

Much of the application depends on the user interface, which is an important aspect for usability and ease of use. The application is streamlined in approach and only takes a few screens for the user to access any functionality within the application. The application is also designed to work on several different devices, allowing for more accessibility across different generations of iPhones. The application also includes geolocation capabilities for Curbside Pickup, and routes live chat messages through an SDK already in use in Speedway's systems.

In addition, there are pieces that allow for promotional information to be sent out through push notifications and banners on the home page. It also contains the interface required to communicate with the Speedway servers using JSON, as well as a basic login screen. The end goal of this application is to bring a new way for Speedway Motors to communicate with its customers as well as providing a new way for customers to engage with them.

The Team

Derek Vogel

Product Manager and Squad Lead

Hussain Al-Lawati

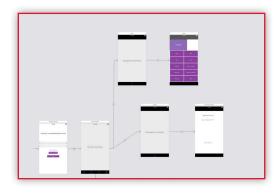
Development Manager

Josiah Ngu **Georges Nchouwat Developer**

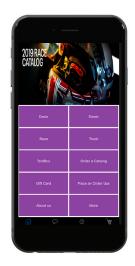
Developer

Mingyuan Ma

Developer









Spreetail

Sponsor: **Spreetail**

Project: **360-Degree Photography**

The goal of the Spreetail Senior Design Project was to create a process for taking automated 360-degree photography of rotating products for use on Spreetail's new site, Spreetail.com. There are three main components to the project that work together to provide an automated photography solution for the user. These components are comprised of a user-friendly front end, a hardware component to take images, and a communication system to transfer data and images between the front end and hardware components.

The solution's front end allows a user to view preview images of the product on the turntable to ensure that the product will be in the center of the frame. It also allows users to capture a full rotation of images of the product, which are displayed for the user, so that they may select which images they'd like to keep. These images are stored in Spreetail's Azure Storage to be used for Spreetail.com. The hardware component consists of two DSLR cameras, two camera tripods, a rotating electric turntable, and a computer tower running Linux to control the cameras.

The solution created will improve the labor intensive process of product photography. Users can place an item on the turntable, start the photo taking process, and proceed to getting the next item in the warehouse. The photos produced will allow Spreetail to create a component for 360-view to be used on their website, increasing the photo quality compared to other ecommerce sites.

The Team

Taher Ahmed

Squad Lead and **Product Manager**

Brett Middle

Jared Nightingale Development Manager

Anthony Tran HaoZhou Li

Developer Developer Developer











Sponsor: Chris Bourke and Joshua Steelman

Project: VR for Structural Engineering

The Virtual Reality for Structures project was presented to the team as a concept: SAP2000 structural engineering software in a virtual reality space. Structural engineering software such as SAP2000 does not inspire and intrigue users the same way that an immersive and realistic VR space does. Creating a product that can be enjoyed by users who are familiar with SAP2000, and intrigues users who have never opened SAP2000, was the primary goal of this project.

The solution we have created is a virtual reality builder tool, created with Unity, that mirrors some functionality of SAP2000. The builder program allows users to build structures in VR and visualize analysis results for those structures calculated by an instance of SAP2000 running on the same computer. The ability to run load analyses on structures is a cornerstone of SAP2000. To facilitate this functionality, we created a "SAPTranslator" backend program that allows structure data to be exchanged between our VR builder and SAP2000.

This project is exploratory in nature, with there being no publicly available information on using Unity and SAP2000 in cooperation. Throughout the project's life cycle, new paths and solutions had to be forged to create a product that allows structures to be not only

built, but also analyzed and visualized in a VR environment. With the help of a group of civil engineering students, we identified what functionality was most valuable and created a product that satisfies the goal of creating an eye-catching structural engineering builder.

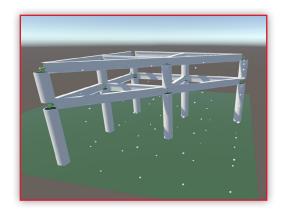
The Team

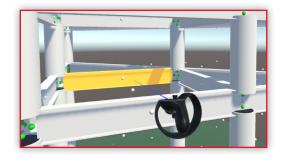
Crystal Warta

James Griess Kameron Heyen Nicolas Esser Dylan Finley Andy Cui Product Manager and Squad Lead Development Manager Developer Developer Developer

Developer









Sponsor: Massimiliano Pierobon and National Science Foundation CISF CCF-1816969

Project: **WetCoDe**

WetCoDe stands for Software Framework for Wet Communication System Design Automation. It is a software tool to aid in the forward engineering of systems based on "living" communicating devices. The WetCoDe is envisioned to bring together computer scientists and biologists to design and develop systems based on information transfer through molecules and biochemical reactions.

The project achieves this by combining the power of mathematical simulations supported by the open source platform iBioSim, and algorithmic information theory analysis. Combining the computationally intensive simulations with the empirical nature of the information flow estimation algorithms, the challenge of the project is to have the application available to users, while keeping it robust and stable.

The project was executed by first implementing a solution as a "proof-of-concept" to run the simulations through application in a local server. Once this was completed, the next step was to add in the analysis functionalities that the user would want in evaluating the information transfer through these systems. This allowed the team to focus on the structure of the website and the theoretical algorithms separately. Then, the website and simulations were ported to its official hosting server, where computational tasks were handed off to the

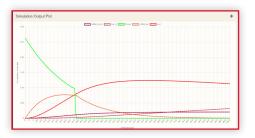
Open Science Grid (OSG), an open platform to run tasks on computers across the nation for scientific purposes. The last step of the project was to connect to this framework with the hosting server and algorithms to fully deploy the website.

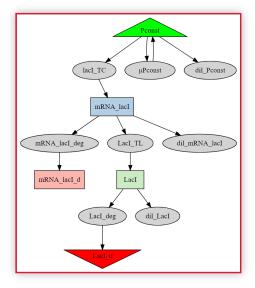
The Team

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Development Manager Developer Developer Developer Product Manager









Sponsor: Norm Schaeffer

Project: **Enkadia Synexsis**

The Senior Design team was given two major objectives which encompassed software and hardware development. The software team was assigned to create a software development kit (SDK) for A/V professionals to programmatically control their A/V components. The sponsor required these libraries to be brand-agnostic.

The hardware team needed to create a plug-n-play solution to A/V device management. The sponsor specified a low cost rack unit which would include: an eight channel relay board, eight channel digital I/O port, TCP/IP control networked components, an external eight-port network switch and an internal five-port network switch. The hardware would use a low-cost Raspberry Pi as the controller. Combined with the Synexsis control library, this hardware provides end-users an interface to their existing components.

During the journey, the team faced several challenges. First, the proper architecture for software development needed to be determined. Second, much of the manufacturers' documentation was not ideal. The third obstacle for the team was the communications protocols required for audio-video components. We believe meeting each of these challenges resulted in a more reliable and robust product.

The sponsor suggested the use of Visual Studio as the IDE for our software development. The Synexsis code base is written in C# and uses the .NET standard 2.0 framework to provide multi-

platform compatibility. The team has completed function libraries for components such as: projectors, codecs, DSPs, video switchers, IPbased relay boards, cameras and IO boards. To control the devices, the group implemented TCP. SSH and HTTP communication protocols. A public API of defined command sets is implemented and public functions are exposed to Unit and Integration test suites. To house the hardware components, a 3D model of the rack unit was built using the online tool, Protocase Designer. The physical prototype of the case was manufactured and populated with components according to the sponsor's requirements. Using off-the-shelf hardware, the sponsor is currently using a version of Enkadia Synexsis to control A/V devices in Nebraska Hall. The Enkadia Synexsis team is confident our hardware, integrated with the Synexsis control library will disrupt the AV industry as we lower the cost of A/V controls and provide end-users a brand agnostic development kit.

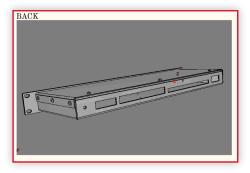
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Development Manager
Developer
Hardware Lead
Developer
Developer

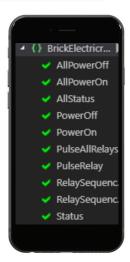














Sponsor: Dipti Dev, Santosh Pitla, Ashu Guru

Project: **Sensi Plate**

To collect data, we are using a 3-D printed plate. This plate has up to 4 cups where food can be placed. Each cup sits on a force sensor that measures the weight of the food in the cup. The sensors are connected to a Pi 3 which collects data on the amount of food consumed and then saves that information to AWS.

To display the data in an easily digestible manner, we've developed a prototype for an application that will allow parents to monitor and understand their child's eating habits while in carecenters (daycares, schools, etc.). To help provide context to parents about their child's eating habits, we've provided recommended values based on Child and Adult Care Food Program guidelines and the U.S. Department of Health and Human Services guidelines. This should help parents better understand what healthy eating habits look like and evaluate their child's habits in comparison.

The Team

Ryan Downey

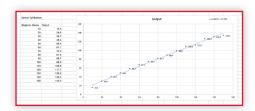
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Developer Developer Developer Developer





After Calibration								
Sensor 1	Scalar = 1.75		Sensor 3	Scalar = 1.7		Semior 4	Scalar = 1.72	
		Percent difference	Weight In Grams		Percent difference	Weight In Grams		Percent difference
50	49.1	1.816	50			50		
60	\$7.7		60			60		
70			70			70		
80			80			80		
90			90			90		
100	101.5		100	100.3		100	97.9	
110			110			110		2.4
120			120			120	116.82	
130			130			130		
140			140			140		
150	147.2	1.894	150	153.2	2.111	150	547.5	1.6







Sponsor: **WEX Health**

Project: 834 Carrier File Mapping Tool and File Transformation

WEX Health provided the leading billing and payment platforms for employers and administrators. The compliance and regulatory requirements, generating letters and invoices, and the ability to handle multicarrier and multi-plan and ancillary products and processing of thousands of payments daily from consumers are the keys to the WEX Health partners and consumers.

The Wex Health 834 Carrier File Mapping Tool and File Transformation is a Web application that allows clients to create their own templates that will be used to generate the 834 files. Since the website is client-facing, the front-end design is a particularly important element. The user interface was designed to abstract the technical nature of the 834 files by including a tree structured list of fields that allow the user to intuitively select desired fields and mappings.

The Senior Design team also had to create an all new database table structure to deal with the data used to construct the 834 files. A new API service with Http endpoints was created, which allows the system to capture carrier notification data. This includes all data related to a carrier notification (template used, subscriber and member data, partners, etc.).

The template associated with each notification is used to determine the output and how the final file is formatted. After an XML file is generated based on a template, it is converted to a final X12 ANSI format through Azure and made available to the partner.

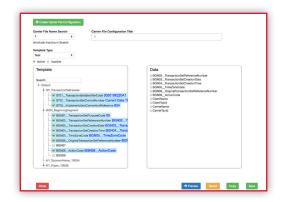
The Team

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WFX Health

Lincoln Public Schools

CompanyCam

Madonna Rehabilitation Hospital

NEOSAT

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Speedway

Nehraska State Museum

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Victori Grdina

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Guest Speakers

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Bonita Sharif
Doug Durham
Jason Wilkinson
Jen Skidmore
Kristen Aldrich
Kyle Conway
Nick Hershberger
Paul Cooper

Topic

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Development Behaviors
Showcase Keynote
Career Placement
Career Placement
Senior Design Dev Processes
Working Agreements
Customer Discovery





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