UCONN
SCHOOL OF ENGINEERING

Computer Science & Engineering

MAY 2014

SENIOR DESIGN

www.cse.uconn.edu

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MESSAGE FROM THE DEPARTMENT HEAD

Dear Colleagues, Friends, Students, and Alumni,

Welcome to the Department of Computer Science & Engineering (CSE). CSE has excellent faculty expertise and a strong research record in traditional and emerging areas of computer science and engineering. Additionally, the department continues to grow at a rapid pace in terms of research funding, publications, service to the profession and community, and national and international visibility and recognition. Our leading-edge research contributes to the high quality and the reputation of our undergraduate and graduate programs, and it enhances the success of our graduates at all levels (B.S., M.S., Ph.D.).

CSE resides in the Information Technologies Engineering Building that contains state-of-the-art research and instructional facilities. I invite you to browse our web site where you will find overview and detailed information on our academic programs at the undergraduate and graduate levels, research and teaching profiles of our vibrant and productive faculty, and student societies. I know you will find something that sparks your interest (www.cse.uconn.edu).

REDA A. AMMAR
DEPARTMENT HEAD
reda@engr.uconn.edu

COMPUTER SCIENCE & ENGINEERING

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Team 1: GPS Based Asset Tracking System

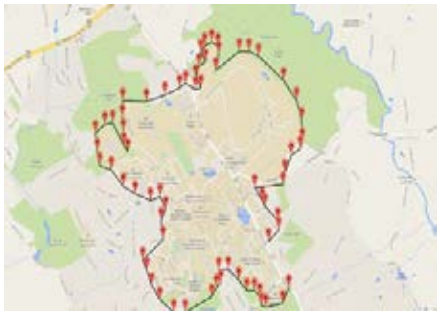
(From left) James Ryan, Joseph O'Shea, George Quach, Robert Kirschner, Brendan Palko

Sponsored by: Delonti
Sponsor Advisor: Zhijie Jerry Shi

Delonti

Asset management in corporate environments is a complex and detail oriented task. Assets consist of all manner of mobile business related capital, which encompasses everything from heavy machinery used at construction sites to laptops or portable electronic equipment. Efficient asset deployment requires managers to monitor a combination of maintenance, security, and use optimization.

The GPS Based Asset Tracking System provides administrators and asset managers with the ability to monitor the status of assets online. Asset positions can be retrieved and viewed by managers in real time through a web interface. Assets can be assigned to geofenced areas, allowing the application to notify users when assets leave a designated location or path. Geofencing ensures the security of assets by making sure they do not leave an assigned area, or that assets in transit do not deviate from a designated route. Maintenance information and notifications are provided for each asset to let administrators and asset managers know when and what kind of maintenance an asset requires. All this functionality is combined into one web interface, which allows users in a company to access the assets and geofences that are assigned to them. A phone based client accessing the same back-end data provides the same management functionality in a mobile environment.



Team 2: Logicbroker Mobile Application

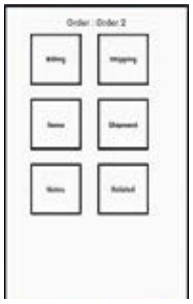
Members (Left to Right): William Reynolds, Michael Tedford Jordan Robidas, Jarrett Bassett, Ben Macko

Sponsored by: Logicbroker
Sponsor Advisor: Chun-Hsi Huang

For our Senior Design project, we chose to work together with Logicbroker. Logicbroker is a cloud-based integration hub enabling the automated exchange of inventory, catalog, and order information by connecting your website, internal systems, and trading partners. The project was to take their online web portal and create a mobile application for Android and iOS that contains the same features.

Using this mobile application, Logicbroker clients can log on and retrieve up to the minute information on existing orders, billing, and shipping information. The project began with the design phase. The group worked with Logicbroker staff Joshua Bleggi, Chip Sockwell, and Peyman Zamani to design a template for the mobile application that closely resembled the web portal. Next, the group created mockups for each page of the mobile app and wrote the accompanying documentation. The program code is written in HTML, CSS, PHP, and Javascript, with the integration of the application to the phone using a program called PhoneGap.

We separated the coding and development phase into two parts, front end user interface and backend database integration. The first step in coding this project was to create an interface that is user friendly and feels similar to the web portal. The next step was to use databases and create the ability to update the user's information such as billing and shipping addresses that exist in Logicbroker's systems. This application represents the best efforts of both Logicbroker and us, students of the University of Connecticut School of Computer Science. The prospect of working with a small company on mobile development initially excited the group and now we believe that together we have created a product that is consistent with Logicbroker's design objectives and seamlessly meshes with the online web portal.



Team 3: PassTrak

Peer driven, accessible position tracking

Sponsored by: University of Connecticut
Sponsor Advisor: Zhijie 'Jerry' Shi

Zhi 'Ken' Liang, Nicholas Briganti, Cody Grant, Ryan Bedard, Kevin Oliveira

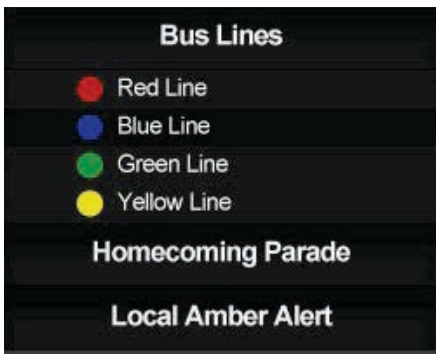
PassTrak

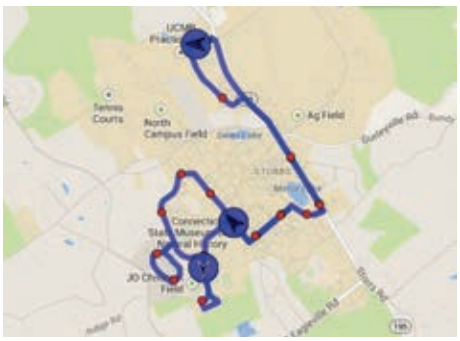
PassTrak (short for "passive tracking") is a new way to track active targets without a dedicated Global Positioning System (GPS) installed on the target. Rather than using a specialized piece of hardware, PassTrak allows for a peer based reporting system on the current and future locations of a selected target of interest. Allowing for both anonymous and private route tracking, PassTrak allows for both a cheap and accessible tracking solution with minimal hardware overhead. In today's society, fifty-five percent of the United States' adult population own a smart phone with GPS and high speed mobile data capabilities. PassTrak leverages the computational power in your pocket to bring forth an efficient tracking system that can be utilized by anyone, anywhere, at minimal cost.

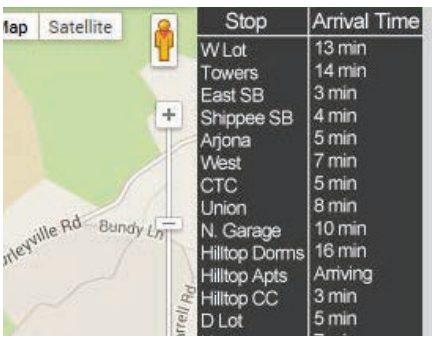
When a user submits the location of a target of interest via PassTrak, the relative location of the target is sent to the application's backend where it is aggregated with other user submissions. These submitted items are then analyzed for the purpose of achieving maximum accuracy of the target's future location on its route. Over time, the previous data gathered is analyzed to derive trends in the subject's tracking which will also be accounted for in any future accuracy calculations.

The current iteration of PassTrak uses the UCONN bus system as a proof of concept where a user can submit sightings of UCONN's Red and Blue line busses. The existing bus tracking allows for a proper control sample space as the relative bus location provided by PassTrak can be compared to the absolute location provided by the bus' on board GPS unit.

Practical uses for passive tracking include bus route tracking, asset tracking, parade monitoring, as well as Amber Alerts. No current software in the market provides a similar tracking experience with the simplicity that PassTrak provides.







Team 4: ParkSmart

From left to right: Jimmy Liang, Benjamin Thompson, Michael Palinkas, Gregory Szilagyi, Ian Dardik.

Sponsor Advisor: Dong-Guk Shin

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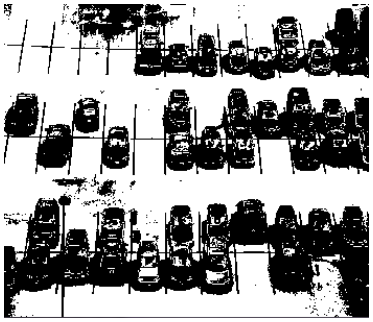
ParkSmart is a prototype system developed during CSE 4940 in the academic year of 2013-2014. This system allows users to determine how many empty spaces exist in one or more parking lots through a web or mobile interface. Users are able to use this system to determine the current number of spaces available in a lot and use this information to determine whether they should attempt to find a spot in a certain parking lot or instead search for a spot in a different parking lot. In the final system, this data will come from several cameras in parking lots across campus; however, in the current stages of development a cheaper alternative is used. The system currently uses recorded footage from a security camera overlooking a campus parking lot. Another source of data used in testing is a scale model of a parking lot with a webcam mounted above it. There will be several ways for users to make use of the system. The primary interface between users and the system is through a large map on the front page of the website. This map shows the status of the parking lots around campus using different colors, as seen in the picture below. The website will also have available more detailed information about parking lots, such as the total number of parking spaces and the type of parking permit required to park in the lot. Users are able to register on the website, which then gives them access to several additional features, such as customized text message alerts. Users can also use the mobile application to receive GPS routing directions to the nearest parking lot that has free spaces.

ParkSmart is currently being implemented by two servers. The tasks of storing the database, running the image processing algorithms, and hosting the website are split between the two servers. The key component of the entire system, the image processing algorithms, was developed using the open source image processing library OpenCV. This library provides many useful and necessary tools that were used to manipulate images and derive information about how many parking spots where occupied by cars. Two of the pictures below are examples of the output of image processing algorithms used in the system.



Team 5: Let's: A smartphone based platform for creating and sharing social events

Project Advisor: Mohammad Khan

Design group photo. From left: Isaac Casanova, Jack Gallagher, Yamiel Zea, Alex Buck, Matt Nunemacher

Social networking is beginning to lose sight of the original purpose for which it was created; to allow people to connect. As current social networking platforms are often entirely based on their presence on the Internet, it is easy for developers to lose sight of the actual *social* aspect of social networking. For instance, one of the common social challenges for people today is being able to schedule small events and get ideas across effectively to numerous people all at once. Currently, one of the most popular approaches is to create a Facebook event and invite people to that event. However, this approach is quite inconvenient for small spontaneous events such as getting a quick dinner or inviting friends over for a quick chat. Another popular alternative is to use text messaging service to discuss event plans, which can quickly become unmanageable for large number of people, and can create miscommunication and confusion.

To address the aforementioned challenges, in this project, we investigate a smartphone based application (i.e., Let's) that allows users to create spontaneous public events for everyone in an area (e.g., play Frisbee with anyone within a certain area), and to create private events for a selected group of people only (e.g., close friends). In short, this application allows users in an area to connect with each other in a much more personal and efficient way. More specifically, the Let's app is designed to allow users to interact socially in real-time, face-to-face. Let's enables users to meet in person, to grab a coffee with someone, or to play Frisbee with the people who live nearby. Hence, not only Let's allows a user to go beyond what traditional social networks primarily focus on, i.e. features and advertising within the social network itself, but Let's does it in a way where users can meet new friends, catch up with old friends, and explore the places around.

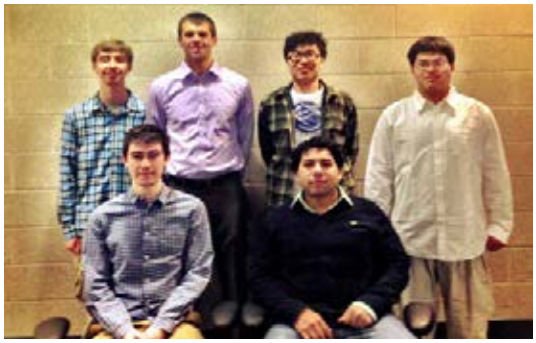
Let's sign up screen.

Events displayed on a map.

The events feed.

Team 6: Project TUSK - The Ultimate Score Keeper; Android Application for stat tracking

Advisor: Vincent Huang



Back (from left): Ryan Pacifici, Greg Reinhold, Yu Zhang, Cheung Chen
Front (from left): Joe Sullivan, Edwin Olivos

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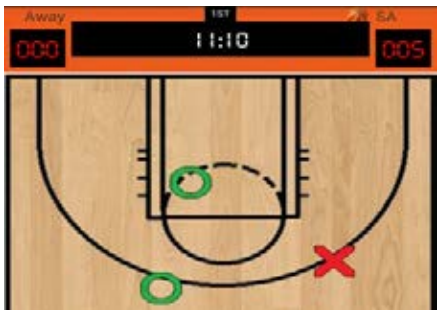
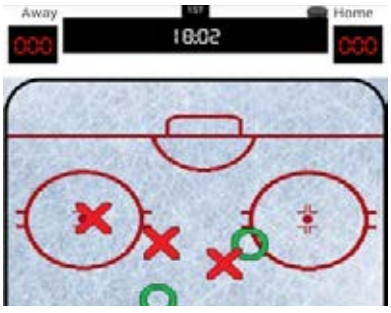
Sports have become an important part in most people's daily lives. Most kids grow up playing a sport, and it is common to have a favorite sport and team. The popularity of sports in today's culture has opened a large market for sports-related applications. Now, with the increase in smartphone ownership, mobile applications dealing with sports have become popular. There is currently a large market for applications that will allow you to view statistics of professional sports teams, which is what most people follow. However, the market for applications to record statistics of local games has been mostly overlooked. The few applications that target this market typically focus on one particular sport, and are only used for personal score keeping without the ability to share your records. Our project aims to target this market and provide a multi-sport score keeping application that will give detailed statistical analysis of user-recorded statistics that can be shared with other users easily.

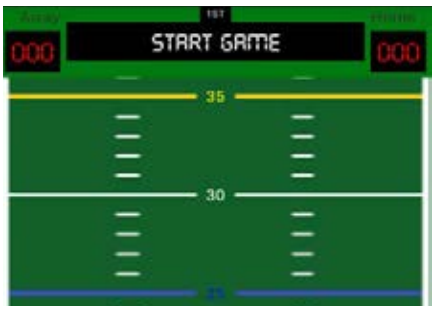
TUSK, The Ultimate Score Keeper, is an android application that will provide a user-friendly graphical interface to make recording statistics for players and teams simple. With a graphical layout of the playing field, the user will be able to record detailed information about games to view and analyze. There will be several sports options within the application, such as basketball, soccer, and hockey. However, the application is being designed to allow for future updates to include a larger range of sports. The user will even be capable of sharing their recorded statistics with others easily. With multiple sports, user-friendly graphical interfaces, and the ability to easily share data, TUSK should fulfill a target market that has been relatively ignored up to this point. Some examples of our target users would be parents recording their child's sports games and their team records. In addition to recreational use, TUSK can serve as a powerful tool for scouts looking to recruit players for teams at the college and professional level, being able to record detailed statistics, view statistical analyses, and share their findings with other scouts quickly and efficiently. TUSK is a powerful tool that is designed to be easy to use no matter what your skill level is.



Basketball user interface



Hockey user interface



Football user interface

Team 7: 3D Aircraft Patch Fabrication and Repair System

Design team. From left: Tom Panek, Alex Chantharasouk, Mohamed Zaid Bhura, Arjun Mohan, Allen Ngu, Faris Jadadic.

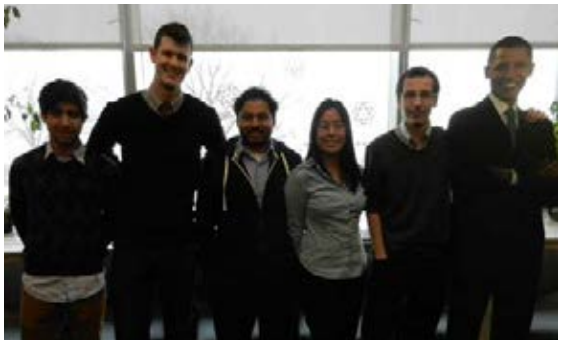
Sponsored by: Triple Helix, Sikorsky
Sponsor Advisor: Scott Mallory, Jason Bittner, Michael Urban

The process of repairing current day aerial vehicles can be both timely and costly. In the event where a repair is needed immediately, these two minor circumstances could prove to result in unwanted consequences. The current process for repairing a damaged one foot by one foot area on a fuselage for example requires an extensive number of steps for a complete repair. Along with having to search through numerous files and instructions pertaining to that particular area can be tedious and could add room for error. Overall a simple repairing and documenting process could take about one or two days. In fields of operations, this could prove fatal when the situations are time sensitive.

A proof of concept for an alternative means of repair was developed. To initiate the repair process, a helicopter or other aerial vehicle would be scanned for damages. The scanned part would then be stored into a database labeled with an appropriate part number. If there is a pre-existing part number, it would display any related information to the history of the repairs pertaining to that specific damaged area and log the new repair. Otherwise, it would create a new database entry for the damaged part and log the repair. The information is then sent to the software for printing a repair patch, where the details are then sent over to a 3D printer. Lastly, a 3D patch is printed, then applied to the damaged area on the helicopter.

Team 8: Height Detection, Barcode Reading, and Reed-Solomon Algorithm

Sponsored by: Pitney Bowes
Sponsor Advisor: Dong-Guk Shin



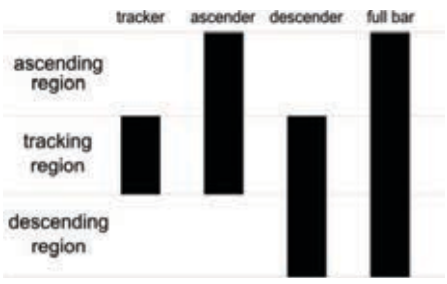
From left to right: Samir Dahmani, Steve Kimble, Ashish Billava, Marion Ma, Ivan Pozdnyakov.

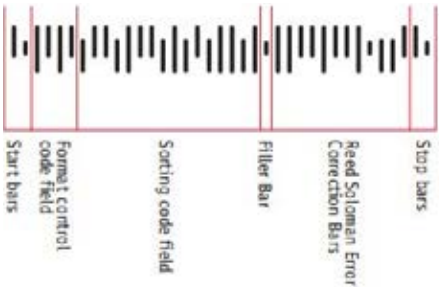
Pitney Bowes
Engineering the flow of communication™

Height Detection:
Given an envelope image, our problem was to calculate the envelope height and the angle of the envelope's upper edge to the horizontal. We applied conventional image detection techniques by using the Moravec algorithm in combination with our own algorithms to meet the problem requirements. The goal of the problem was to program an efficient algorithm to search for envelope corners. To have the program work with all the potential envelope images, we applied various analysis techniques to verify the correctness of our result given various test sets of envelope images. We want to guarantee that our procedure works for as many potential cases as possible and that it integrates correctly into Pitney Bowes' existing envelope detection system.

Barcode Localization and Reading:
To improve the mail sorting process, many postal systems have adopted the use of one-dimensional four state height-modulated barcodes as the standard for coding mail pieces. Four state barcode allows for updated tracking and address correction. The barcode consists of evenly spaced bars of identical thickness with four different heights. Our image processing software is tasked with localizing and reading barcodes on the envelope based on parameterized clear zones, bar height ratios, number of bars, and spacing. Any implementation will have to successfully deal with inconsistencies and distortions in the barcode patterns during image processing. As an output the software should return one base four number for each expectable barcode.
Two algorithms were compared for barcode localization: a robust but noise sensitive line detection using Hough Transformation and relatively slow but less sensitive morphological approach using Bottom-Hat Filter. Corner detection using Moravec Algorithm for barcode reading yielded notable results making it ideal for determining barcode height.

Reed-Solomon Algorithm:
To mitigate error in barcode recognition and implementation, the information encoded into the barcodes must be oversampled in order to recover from errors. In short, the information is redundantly sampled, so that upon decoding, the oversampled data can be correctly recovered. This is accomplished by a series of calculations to assess, locate and correct for errors in the oversampled data. Assuming that there are not too many errors to correct in the barcodes, the final result of the error correction yields the proper information expected.





Team 9:
Online Textbook and Educational Marketplace

Group Members (Left-Right):
Top: Gulzar Dalal, Jonathan Scannell, John Iovino,
Bottom: Adam Rapp, Turesh Jainarine

Project Advisor: Chun-Hsi Huang

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The objective of this project was to create an online web-portal for the exchange of textbooks and other educational material at the university. This educational tool creates an opportunity for students to interact and exchange information with one another. These items include the ability to list and browse textbooks that a student may be looking to buy or sell and the ability to look for or offer tutoring assistance. The user can access these features through the website, in additional to an accompanying mobile application.

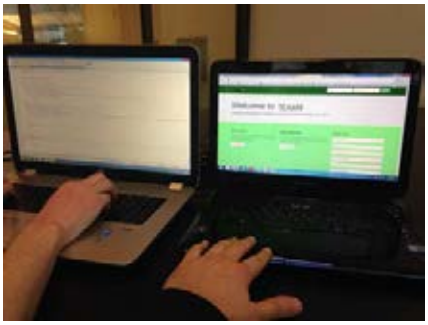
Students at the university have the ability to register for an account on the site if they have a UConn email address. Once registered, users can log into the site to browse and list educational material, such as textbooks. A user can list the classes that they are currently or have previously taken and list their skillset in a particular subject. They also have the ability to seek tutoring for a skillset or class that they are taking. Each user has a profile on the site where they can list this information and also browse other student's profiles as well. Users have the ability to "connect" with one another to make it easier to find classmates that they know or wish to interact with the future.

Our site is built upon an Apache HTTP server with a MySQL database and PHP is used as the means of communication between the client and the database. The client user interface is built using the Bootstrap framework which contains HTML and CSS design templates. The accompanying mobile was developed for the Android platform.

This project is motivated in the fact that it would be incredible useful to have a service that coordinates the exchange of educational materials and information between students. We have worked to create an online learning community where students can share the knowledge that they have and seek the knowledge that they want.

Our Goal:

"To create a smart place for students to interact and share knowledge"



TEAM9

Team 10: THAR
Wearable computer and accessibility device

Sponsor Advisor: Dong-Guk Shin

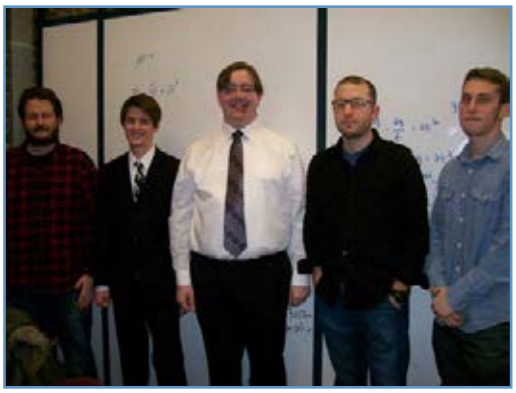
THAR
Trans-Human Augmented Reality

Group Members from left to right:
James DiCicco, Dash Winterson, Rebecca Loeser, Patrick Long, Stelios Kalogeridis

Our project has two main objectives: To design an open-source system aimed at providing support for a multitude of different peripherals, and to implement that system on hardware that one can carry around with them whenever and wherever they please. These objectives will be accomplished by combining the strengths from multiple different products such as a smartphone's mobile connectivity, Google Glass's ubiquitous computing concept, and a laptop's computational power and graphical interface. The main strength lies in its potential to be used for any purpose. The usability of this device, other than being a full computing machine, can be expressed through a variety of applications and programs that we plan to implement on the machine. These potentially include, and are not limited to, interactive map applications, American Sign Language translation, Medical applications, Video games incorporating local geography and topography, A Global Positioning System for directions and maps, music, programming, language learning and translation, and a general interface for going about one's day with things like the time, date, weather, meetings, and alarms displayed on the heads up display.

THAR aims to provide a user with a highly portable and powerful device. Essentially, it is a wearable computer. Ideally, the primary and end goal is to have a heads up display, with the actual computer housed in a backpack or a belt pouch. On the heads up display, a small camera would be mounted. There would also be an armband and perhaps a glove containing other hardware, such as those for controlling the device like a mouse or a gesture system.

Team 11: Web Interfacing HVAC Remote Control System



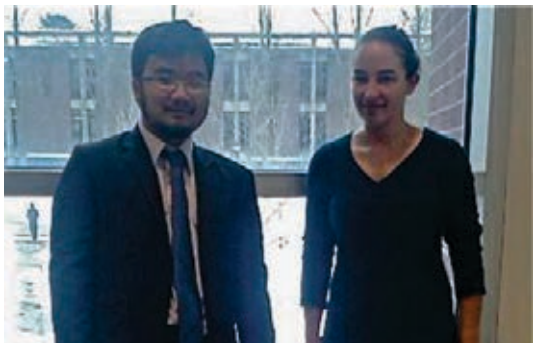
Richard Carello, Michael Gibson, Edward Felekey, Christopher Snay, Matthew Pierce

Sponsored by: Emme
Sponsor Advisor: Dave Schiopucie

In this project, we explore a scalable energy management solution leveraging EMME devices. Unlike standard heating and cooling systems that are often non-adaptive and waste significant amount of money and energy by heating or cooling a space unnecessarily, EMME devices save energy by enabling a user to control the temperature in each individual room leveraging a sophisticated suite of sensors, called Smart Controllers™, These sensors help to determine which rooms require additional heating, cooling, and circulation, allowing the necessary rooms to be targeted without affecting the rest of the house.

In our project, to enable remote monitoring and control leveraging EMME devices, we developed a web portal and integrated the EMME device to a web server over the Wi-Fi. This integrated framework allows users to control their HVAC equipment from computers, smartphones, and other web-enabled devices. Additionally, to support large number of users simultaneously, which can led to significant delays in response time between user input and HVAC feedback, in our system, real-time feedback from the EMME devices are stored in MySQL database, and displayed on client devices as needed. A web-hosted PHP script is developed that interfaces with the database to handle queries and updates in real-time. Finally, our modular design allows developers to easily customize the user interface and add functionalities to the system.

Team 12:
Home Control Network



Man Nguyen and Jessica Stenman

Sponsored by: University of Connecticut
Project Advisor: Mohammad Khan

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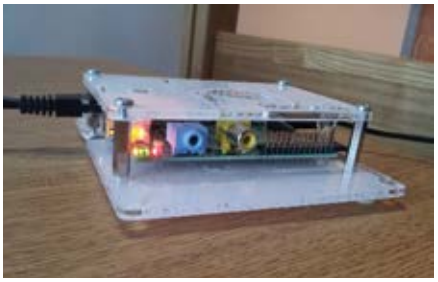
With wide adoption of Internet enabled wireless sensor technology and smart Wi-Fi enabled home appliances, users are increasingly interested in operating and monitoring various home appliances remotely and more efficiently to save energy. Not surprisingly, home automation has gained significant attention from research community and industry in recent years. For example, Belkin Wemo light switches allow users to turn on/off their lights at home by using their smart phones, Kwikset Kevo's bluetooth enabled Deadbolt let users securely open their doors using their smart phones.

However, most of the products in the market usually use proprietary hardware and software solutions to communicate with the devices. Due to this, it is quite inconvenient for users to control various devices using different software and platforms. Also, it prevents joint control of devices when needed. For example, currently, users cannot configure the system such that the light switch of Belkin will automatically turn on when user opens the Kwikset Kevo Deadbolt via Bluetooth.

To address this, in our project, we investigate a computing platform using readily available hardware and software components. More specifically, we use a single Raspberry Pi to interface and communicate with multiple devices. Moreover, for remote operation, we develop a smart phone application that enables users to monitor and control the status of different appliances using their smartphones.



Team 13: Smarter Water Mobile Application

Pictured Above (left to right): Peter Xu, Ian Brunjes, Andrew Boba, Julie Cappello, Robert McCartney (advisor)

Sponsored by: IBM
Sponsor Advisor: Robert McCartney

The Smarter Water Mobile Application is a mobile application designed to run on both Android and iOS devices. The project is intended to create a user-friendly game and involve citizens of a particular area in maintaining their city's water infrastructure. The application is specifically built for Rotterdam, Netherlands, where there exist large portions of the city below sea level. As such, awareness and maintenance of water infrastructure is crucial to the city, so our application is designed to keep citizens involved throughout the process. Users of the application will submit pictures of and notes about various water infrastructure within the city they are located. In doing so, they will gain assets in the game component of the application, providing incentive for the people to explore the entirely of Rotterdam's water. This will help to maintain the structures and ensure that there are no issues going unnoticed within the city.

The application will provide a few primary components for the user: a map with settings to overlay water infrastructure assets as well as assets of the game, a user profile screen which allows users to track their progress in the game, and a settings/log-in configuration screen, where users will be able to connect their Twitter accounts so that they may then post pictures from around the city. The game itself is a territory based game, where the player attempts to expand their checked-in territory within the city. This is achieved by traveling to and posting pictures of various water assets that are accessible around the city. This will add these previously undiscovered locations to the users' ever-growing territory, upon which they must actively maintain it through playing the game. The project, from a broader perspective, is also intended to demonstrate the capabilities of the IBM technologies used in creating it (Integrated Operations for Water and Worklight). The project is sponsored by IBM through the Students for a Smarter Planet initiative.

Team 14: Additive Manufacturing Scaffolding Generation

Sponsored by: Pratt & Whitney
Sponsor Advisor: Adam Rivard
Faculty Advisor: Thomas Peters

From left to right: Alexa Thomsen, Kayla Bliesener, Ragini Phansalkar, Tiffany Hoang, Sinh Le, George Kramer

In additive manufacturing, a file representation of a part is fed into a specialized machine that builds the part by depositing material one layer at a time. In most cases, it is undesirable for the part to be built directly on the build plate. Furthermore, depending on the structure of the part, some local regions may require scaffolding to prevent distortions or collapses from occurring during the build process. There exists professional additive manufacturing software that generates this scaffolding. Unfortunately, licensing can limit the scenarios in which this software can be used and it can be costly to purchase. The objective of this senior design project is to implement a general-purpose program which emulates the critical scaffolding generation functionality of professional additive manufacturing software by automating tasks pertaining to the generation of scaffolding for a part produced in a powder-bed, electron-beam melting machine.

To automate these tasks, the program follows the process flow that is shown in Figure 1 of importing the file representation of the part, visualizing the part, generating the scaffolding for the part, and exporting the scaffolding to a file representation. An iterative loop exists between visualizing the part and generating scaffolding for the part because the user may want to adjust parameters which control how the part is processed and will need to see the scaffolding generated again before exporting to a file representation. To generate the scaffolding for the part, an algorithm is used which identifies unsupported regions such as those shown in Figure 2. These regions are represented by triangles. Once unsupported regions cannot be grown any further, then for each unsupported region, line supports are generated at regular intervals as vertical planes. These planes are lower-bounded by the build platform and upper-bounded by the unsupported region. The points which compose the vertical planes are triangulated and normals for the triangles are calculated. Finally, the triangles composing the line supports are output to a file representation which is used to build the part as shown in Figure 3.

This team gratefully acknowledges generous partial funding for this project under the broad Senior Design Project agreement between United Technologies Corporation and the University of Connecticut. Any opinions or findings expressed here are solely the responsibility of these team members, not of the United Technologies Corporation.

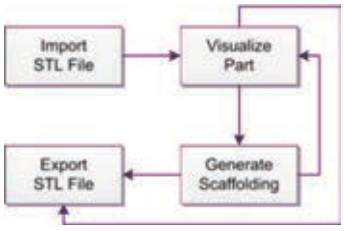


Figure 1: Process flow diagram followed by the program

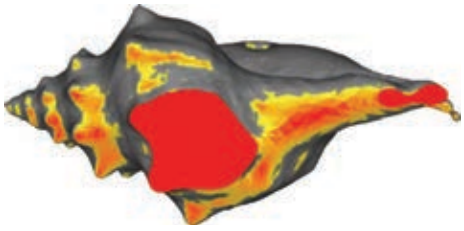


Figure 2: Bottom view of a conch shell showing a heat coloring of the unsupported regions

Figure 3: 3D-printed UConn logo with perforated scaffolding

Team 15: Application of Genetic Algorithm to Optimization of Part Orientation in Additive Manufacturing

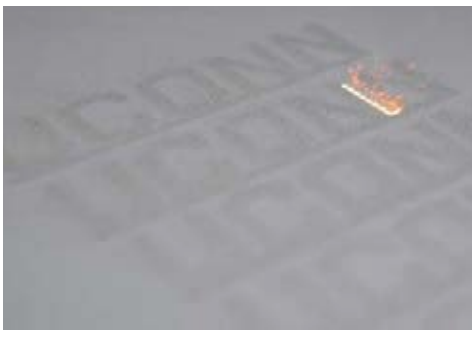
Sponsored by: Pratt & Whitney
Sponsor Advisor: Tom Peters

From left to right: Stefan Bobrowski, Joseph Raver, Evie Uddin, Linda Hoang, Thomas Lee, Eric Adamson.

This semester we undertook a semester of research in the field of Additive Manufacturing. Our research informed a conceptual design for a software tool that analyzes a three-dimensional model of a printable part and gives optimized orientations with respect to the build time, material cost and several quality factors of the part. We discuss the motivation for the project, identify key constraints and state the major conclusions we have made through our research and design efforts. We provide an overview of what we plan to accomplish in the following semester and give rough milestones for the completion of various components.

The goal of our project is to find optimal orientations with respect to several quantifiable criteria. Build height is the main driver of material cost and fabrication time. Scaffolding should be minimized to maintain the surface finish at attach sites. Surface finish takes into consideration certain surface distortions that may be caused by the stair stepping effect, scaffolding attachment sites, or build plate attachment sites, and can lead to increased post-processing time. Finally, the average cross-sectional area is an important metric because larger layers tend to produce more part distortion.

We found that an optimal orientation with respect to a particular criterion often conflicts with that of another criterion. We have therefore decided to implement a genetic algorithm to optimize for multiple criteria simultaneously. A genetic algorithm imitates the natural selection process. In this case, we can treat the candidate criteria as chromosomes and then evaluate the clusters of chromosomes in order to select the most fit. The four main stages in a genetic algorithm are initialization, selection, mating, and termination. In initialization the candidates are randomly generated, and then in the selection stage, the candidates are ordered by fitness and consecutive candidates are paired for mating. The fitness function is defined in the terms of the optimization criteria, which is a weighted sum. Next in the mating stage, crossover occurs, where the algorithm combines the genes of the mating pair, and lastly, the genetic algorithm is terminated when the fitness evaluation falls within a set tolerance, and a number of orientations can be returned. We have chosen to implement genetic algorithm because it offers desirable advantages, such as the ability to search a wide area of cost surfaces concurrently, and it can return a list of optimal values.



COMPUTER SCIENCE & ENGINEERING FACULTY PROFILES

REDA A. AMMAR
Professor
Ph.D., University of Connecticut, 1983
reda@engr.uconn.edu
- Performance Engineering
- Underwater Computing Network
- Big Data Analytics
- Real-time Distributed Systems

MUKUL S. BANSAL
Assistant Professor
Ph.D., Iowa State University, 2009
mukul@engr.uconn.edu
- Computational Biology and Bioinformatics
- Computational Molecular Evolution
- Combinatorial Optimization
- Algorithms

KEITH BARKER
Professor
University Teaching Fellow
Director, Graduate Certificate in College Instruction, Ph.D., Sheffield University, 1966
keith.barker@uconn.edu
- Computer Science Education
- Curriculum & Technology Development
- Instructional Design

JINBO BI
Associate Professor
Ph.D., Rensselaer Polytechnic Institute, 2003
jinbo@engr.uconn.edu
- Machine Learning
- Statistical Data Mining
- Convex Optimization
- Biomedical Informatics

JUN-HONG "JUNE" CUI
Professor
Ph.D., University of California, Los Angeles, 2003
jcui@engr.uconn.edu
- Computer Networks
- Embedded and Cyber-Physical Systems
- Underwater Networks and Smart Ocean Technology

STEVEN DEMURJIAN
Professor
Ph.D., The Ohio State University, 1987
steve@engr.uconn.edu
- Access Control for Secure Software
- Biomedical Informatics
- Ontology Design

GERALD L. ENGEL
Professor
D.Ed., Pennsylvania State University, 1974
Gerald.engel@uconn.edu
Stamford Branch
- Computer Education
- Social and Ethical Impacts of Computing

SWAPNA S. GOKHALE
Associate Professor
Ph.D., Duke University, 1998
ssg@engr.uconn.edu
- Social Media
- Software Engineering
- Performance and Dependability Analysis

SONG HAN
Assistant Professor
Ph.D., University of Texas, Austin, 2012
song@engr.uconn.edu
- Cyber-Physical Systems
- Real-Time and Embedded Systems
- Large-Scale Real-Time Data Management
- Wireless Networks and Mobile Computing

CHUN-HSI HUANG
Associate Professor
Ph.D., State University of New York at Buffalo, 2001
huang@engr.uconn.edu
- Graph Algorithms
- Parallel Computing
- Cluster/Grid Computing
- Bioinformatics

MOHAMMAD MAIFI HASAN KHAN
Assistant Professor
Ph.D., University of Illinois, Urbana-Champaign, 2011
maifi.khan@engr.uconn.edu
- Large Scale Distributed Systems
- Software Performance and Reliability
- Behavior-based Mobile Authentication
- Healthcare Interventions

ION MANDOIU
Associate Professor
Ph.D., Georgia Institute of Technology, 2000
ion@engr.uconn.edu
- Approximation Algorithms
- Combinatorial Optimization
- Bioinformatics
- Computational Genomics

ROBERT McCARTNEY
Associate Professor and Director
of Undergraduate Studies
Ph.D., Brown University,1988
robert@engr.uconn.edu
- Computing Education
- Informal and Self-directed Learning
- Commonsense Computing
- Artificial Intelligence

JEFFREY A. MEUNIER
Lecturer / Assistant Department Head of
Undergraduate Education and Outreach
MS, University of Connecticut, 1999
jeffm@cse.uconn.edu
- Computer Science Education
- Microcontrollers, Automation, Robotics
- Programming Languages
  and Abstract Machines

LAURENT MICHEL
Associate Professor
Ph.D., Brown University, 1999
ldm@engr.uconn.edu
- Combinatorial Optimization
- Constraint Programming
- Local Search
- Programming Languages
- Artificial Intelligence

TOM PETERS
Professor
Ph.D., Wesleyan University, 1982
tpeters@engr.uconn.edu
- Computational Topology
- Computer Aided Geometric Design
- Computational Geometry
- Design Theory

SANGUTHEVAR RAJASEKARAN
Professor
Ph. D, Harvard University, 1988
rajasek@engr.uconn.edu
- Applied Algorithms
- Bioinformatics and Computational Biology
- Big Data Analytics
- High Performance and Parallel Computing

ALEXANDER C. RUSSELL
Professor
Ph.D., Massachusetts Institute
of Technology, 1996
acr@cse.uconn.edu
- Computational Complexity
- Cryptography
- Distributed Computing

DONALD SHEEHY
Assistant Professor
Ph.D., Carnegie Mellon University, 2011
Donald@engr.uconn.edu
- Computational Geometry
- Mesh Generation
- Topological Data Analysis

ZHIJIE "JERRY" SHI
Associate Professor
Ph.D., Princeton University, 2004
zshi@engr.uconn.edu
- Computer security
- Sensor networks
- Computer architecture
- Embedded systems

DONG-GUK SHIN
Professor
Ph.D., University of Michigan, 1985
shin@engr.uconn.edu
- Bioinformatics
- Visual User Interfaces
- Intelligent Software Agents
- Semantic Data Modeling
- Scientific Databases
- Database Interoperation

ALEXANDER A. SHVARTSMAN
Professor
Ph.D., Brown University, 1992
aas@cse.uconn.edu
- Distributed Computing and Fault Tolerance
- Electronic Voting Systems and Security
- Parallel and Distributed Algorithms
- Formal Specification and Modeling

BING WANG
Associate Professor
Ph.D., University of Massachusetts, 2005
bing@engr.uconn.edu
- Computer Networks
- Multimedia
- Distributed Systems

YUFENG WU
Associate Professor
Ph.D., University of California, Davis, 2007
ywu@engr.uconn.edu
- Computational Biology
- Bioinformatics
- Algorithms

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The Information Technologies Engineering (ITE) Building is home to Computer Science & Engineering and Electrical & Computer Engineering departments. ITE houses an extensive learning center, specialty training facilities and some of the most innovative research labs in the country for advancing cutting-edge engineering technology.

This 110,000 sq. ft. high-tech gem is situated between the Homer Babbidge Library and School of Business building at central campus. The concourse level holds teaching labs, along with a 350-seat auditorium. Classrooms and a large computing learning center are found on the ground-level first floor. Administrative offices, faculty offices and research labs of the Computer Science & Engineering Department occupy the second floor. Similarly, the fourth floor is occupied by the Electrical & Computer Engineering Department. The intervening third floor boasts an executive conference room, research labs, spillover faculty offices and a faculty lounge.

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- Doctor of Philosophy degree in Computer Science and Engineering

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