ECE DAY 2016

Senior Design Projects | The Program

Boston University College of Engineering
Department of Electrical & Computer Engineering

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING | BOSTON UNIVERSITY

The Department of Electrical & Computer Engineering (ECE) prepares students to be Societal Engineers for the global economy of the 21st century, and allows them to conduct innovative research in evolving technologies like nanotechnology, photonics, signal and image processing, smart lighting, communication networks, and computer circuit design. With a renowned faculty, interdisciplinary research focus, cutting-edge facilities, and a diverse student body, ECE is at the forefront of the technological breakthroughs that are shaping the future.

Research activities in ECE are broadly classified into three primary areas: Electro-Physics, Information and Data Sciences, and Computer Engineering. Each area has distinct, faculty-centered groups. The boundaries between these groups are not sharp, and interaction across the different disciplines is encouraged and common.

In addition to rigorous class work, ECE degree programs urge students to pursue hands-on research under the guidance of our accomplished faculty and in cooperation with University-wide centers and cross-disciplinary collaborations. This combination of practical and theoretical education ensures a breadth of experience in innovative problem solving and exploration that will prepare students for careers in industry, academia, and government.

ECE SENIOR DESIGN

The senior design capstone course is the culmination of the undergraduate curriculum. Student teams serve volunteer customers drawn from industry, government, small businesses, non-profits, schools, artists, faculty, and staff. Senior design provides students with:

- Technical, communication, personal, and team skills needed for successful design in electrical and computer engineering
- Knowledge of specifications and standards, information collection, design strategies, modeling, computer-aided design, optimization, system design, failure, reliability, and human factors
- Proficiency in oral and written communication of technical information
- Understanding of team dynamics and ethical issues in design
- Experience in completing a design project for a small-scale electrical or computer system

ECE DAY AWARDS

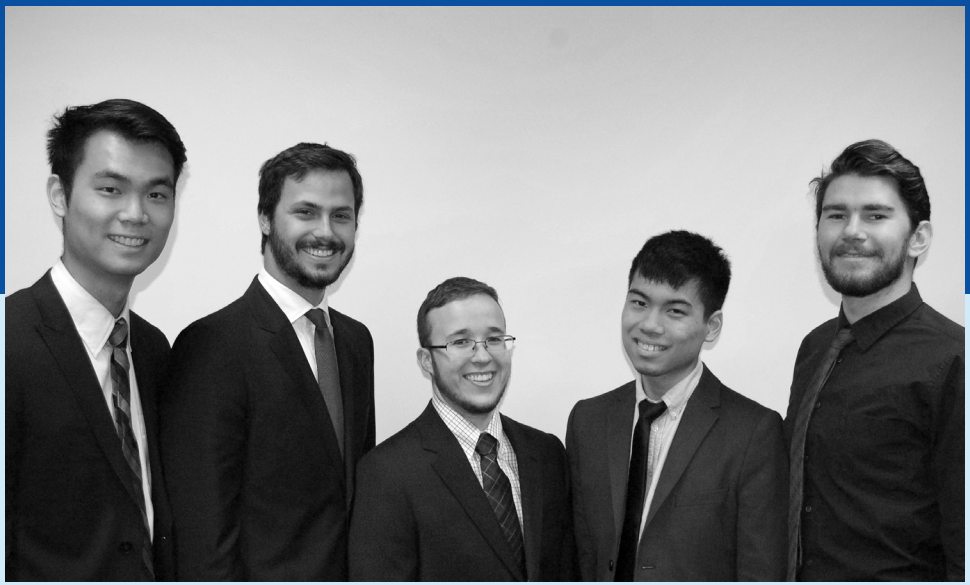
Best ECE Senior Design Project Award

Design Excellence Award

Michael F. Ruane Award for Excellence in Senior Capstone Design

Entrepreneurial Award

Space Physics Undergraduate Research Award

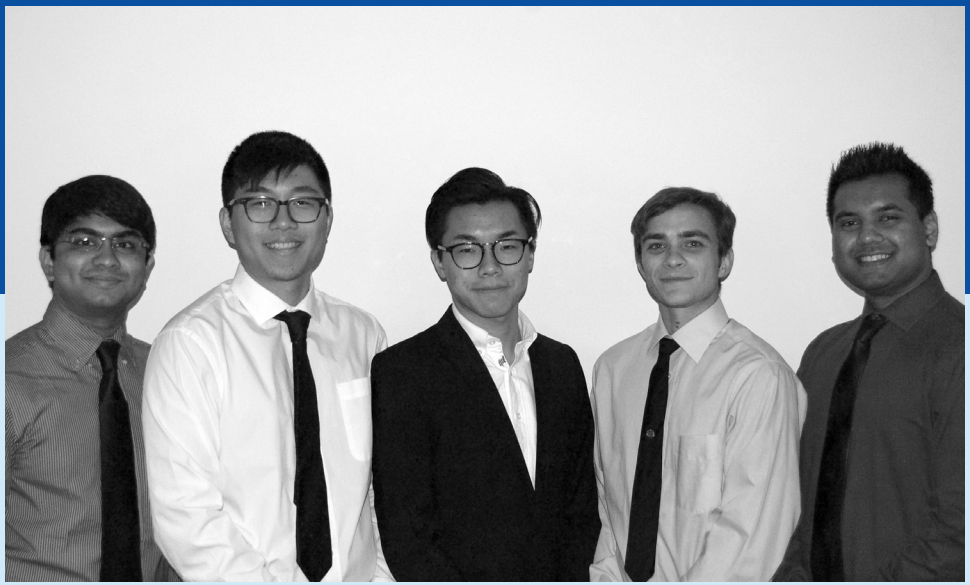


Team 1
Hively: Bee Hive Monitor System (Home Security for Bees)

Team members: Philip Zhang, Dimitrios Tsitsirigkos, Jesse Belanger, Winston Chen, Everett Carson

Client: Michael and Patricia Ruane

Monitoring beehives is difficult and inaccurate work. Hively is a tool that will allow beekeepers to monitor the status of their hives without the hassle of getting suited up or the cost of disturbing the bees. The system will autonomously collect measurements of significant environmental variables frequently throughout the day. The collected data will be sent to the cloud where it will be stored in a database and formatted into a well-designed website. Through this interface, the user will easily be able to observe the current status along with previous records of each hive in the apiary. It will provide spatial modelling of the monitored hive through heat maps, as well as tabular views for deep-diving into the data. All equipment is bee friendly and will not interfere with the regular behavior of the bees. Hively will be all-season weatherproof and run off of solar power. Ult imately, Hively is intended to provide beekeepers insight into the optimal conditions specific to their bees.



Team 2
Right Alert: Bike Detector and Alerting System II

Team members: Shantanu Shailendra Bobhate, Brian Tan, Teng Zhang, John McCullough, Mohammed Zishanuzzaman

Client: Professor Alan Pisano, Boston University

In the city of Boston, where countless bikers share the same streets as cars every day, bike safety is of utmost importance. Unfortunately, each year there are numerous collisions between bicycles and cars and the results can be fatal. One of the most dangerous situations bikers find themselves in is when cars make right turns across the bike lane. Sometimes drivers fail to check their side- view mirrors before turning, and as a result crash into bikers. Our team, RightAlert, provides a solar-powered system to warn drivers of oncoming bikers when a collision like this is imminent. A camera detects bikers traveling down the bike lane while an LED-lit traffic alert sign functions as a visual cue for drivers letting them know of the oncoming bike traffic. The RightAlert system is an intuitive tool for all drivers turning at an intersection. RightAlert provides a website which displays real time data while the system is running. It also allows for remote administration of specific system settings. Our system rivals are alternative technologies that dedicate themselves to warning only one vehicle and fail to log traffic information. We at RightAlert are making Boston a haven for both bikers and drivers and seek to further improve overall traffic research in the city by providing our findings.

Team 3
THOR: Autonomous Drone Platform for Agricultural Crop Analysis

Team members: Junkai He, Daniel Vasilyonok, Emily Ubik, Yiyang Wu, Barron Roth

Client: Muath Alshaykh, Graminor

Human labor is a significant cost for agricultural businesses in most countries, and especially in countries with high standards of living such as Norway. THOR aims to solve this problem. THOR will help farmers monitor overall crop health through the use of a drone for image collection, and a custom LiDAR sensor board for height data collection. The images and height will be processed in the cloud and the resulting map will give the user actionable information about their wheat plots. The final deliverables consist of a semi-autonomous DJI Phantom 3 drone with a modified built-in camera, custom sensor LiDAR board, iOS App and web interface, and fully functional AWS cloud back-end.

Team 4
Virtual Realty: Cyber-Physical Monopoly Game using Oculus Rift and Autonomous Robots

Team members: Zachary Ganger, Jedidiah Keenan, Maria Kromis, Zachery Sarkis, Nicholas Memme

Client: Professor Babak Kia, Boston University

Virtual Realty is a revamped and reimagined version of the classic board game, Monopoly, where a single user is embedded in a virtual reality board game against computer players. The game includes not only the physical board which will be traversed autonomously by robotic pieces, but also the virtual board, where the player can virtually explore the game board and surroundings. The virtual board will be comprised of an Oculus Rift game that includes both an aerial view and a walkthrough view. The physical board will be updated in real time according to decisions made by the user, therefore this project strives to exemplify the possibility of actions taken in a virtual environment having real time impacts on a remote physical location. Both the physical board and the virtual game work in tandem to preserve all the rules and components of the original Monopoly board game, while also giving the user the opportunity to explore the virtual world developed on the Oculus Rift through multiple vantage points. The virtual game will include visualization for the player's properties, money, houses/hotels, and current board position.

Team 5
SPARTN: Cyber-Security Hardware Digital Wallet

Team members: Raja Patel, Christopher Eng, Shan Liang, Frank Savoca, Assel Aliyeva, Andrew Lu
Client: Professor Babak Kia, Boston University

The wallet is an essential object used to carry many items needed on the go, such as money, credit cards, insurance cards, and IDs. As society moves toward an era of digitization, many analog objects are becoming electronic to take up less space, hold much more information, and become smarter. However, common wallets still remain analog and have yet to improve. SPARTN (Secure Password ReTentioN) Wallet is a slim, easily transportable device that combines various reference materials typically kept in a wallet (insurance cards, bank pins, SSN, passwords, identification cards, business cards, etc.) all into one device, significantly reducing wallet clutter. The SPARTN Wallet will securely protect these digital assets using modern encryption methods and require biometric authentication using a fingerprint scanner before displaying information on an e-paper display. Data will be added to the device using an Android application through a secure BLE connection. The hardware system consists of components optimized for low power use to last for long periods of time running on a coin-cell battery.

Team 6
Solar Clean: Demonstration Kit for Electrodynamic Screens

Team members: Kevin Rego, Bill Chaiyasarikul, Courtney Torres, Paul Moy (not pictured), Raaid Arshad (not pictured)

Client: Professor M.K. Mazumder, Boston University

The ideal solar farm is located in a region with plentiful sunlight, negligible cloud coverage, and on land unfit for farming. These deserts have one major issue for photovoltaic cells: dust. Dust deposition significantly hinders solar cell performance. The Electrodynamic Screen, or EDS, is a new technology for easily and efficiently cleaning accumulated dust off solar cells. It is a transparent film that is placed on the solar cell and will easily remove dust from the cell. The issue must confront is to convey that the EDS is in fact a viable solution that works and works well.

This group has designed, constructed, and fully characterized an EDS kit that demonstrates how an electrodynamic screen can be used to clean solar panels of dust deposition. The kit will consist of a viewable but enclosed space that contains the EDS, solar panel, and dust. An Android application will provide an interface for both controlling the system and for viewing feedback on certain important metrics. The solar power supply unit and the control system. Solar Clean will be easy to use, portable, and provide a convenient and effective way to illustrate how the EDS works.

Team 7
RemoteHCS: A Mobile Medical Testing Unit for Chronic Disease Prevention

Team members: Nicholas Morrison, Joseph Tierney, Minying Lu, Charles Uchida Evans, Ryan O'Flaherty

Client: Manish Ranjan, NanoHealth, India

The problem we are considering for this project is accessibility of healthcare in India, specifically concerning chronic diseases. Every year over 5 million people die from chronic diseases in India, accounting for 60% of all deaths across all age groups. (Mohan, 2014) Our client NanoHealth identifies one of the key contributors to this problem as being a lack of accessible healthcare especially in underserved communities. Currently, they have implemented a screening program in which they send social workers to communities to conduct medical tests to determine at risk patients. However, they are currently doing this manually recording patient information and diagnostic results on paper and using manual testing equipment. Our goal is to automate this entire process; offering a comprehensive system featuring an Android application as the user interface, a cloud server backend for managing patient records, and digital point of care medical devices. The value added for our customer in our design is the complete automation of all parts of the screening process. The only interaction necessary from the user will be to input the patient's information to create their record and setup the tests.

Team 8
E-Fire: Energetic Field Instrument Using Radiated Electrons

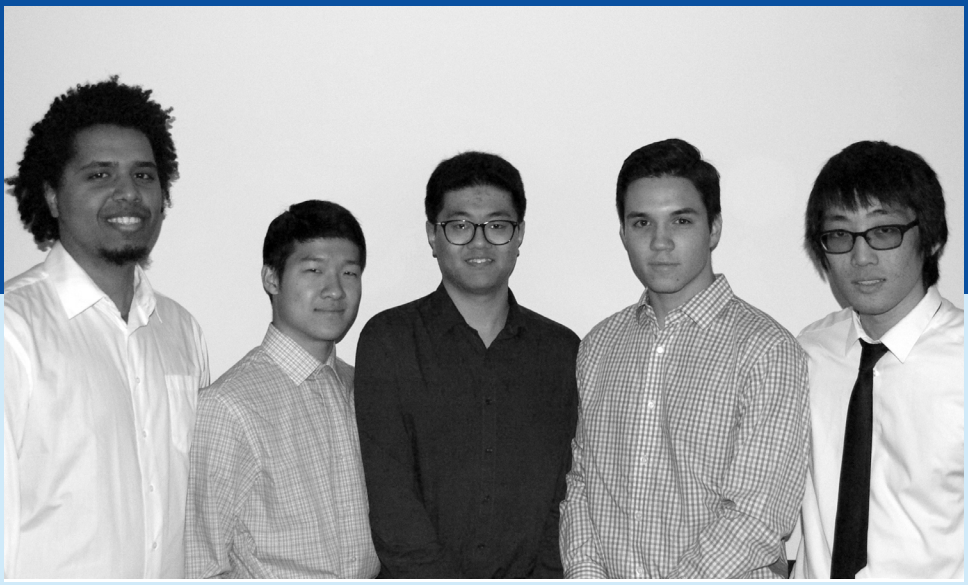
Team members: Nathaniel Michener, John Marcao, Casey Pelkowsky, Derek Kenyon, Junhao Hua (Neil)
Client: Professors R. Knepper, T. Fritz, B. Walsh, Boston University

E-FIRE (Electric Field Instrument using Radiated Electrons) aims to demonstrate a particle detection system for use in a larger-scale electric field detection instrument that will hopefully one day be used in near-Earth space. We will show that MIROC2, the custom integrated circuit provided by our customer, can detect charge pulses from a diode array struck by energetic electrons in a vacuum chamber. We will use a Beaglebone Black development board to control MIROC2, collect data, and send it to a Minnowboard Max where it will be displayed for interpretation. We will improve on previous designs of the MIROC2 PCBs, reducing unnecessary components and noise. Our customer may use the complete system to demonstrate effectiveness of the detector to other scientists or laypeople, and our customer's future collaborators will use our system design as a guide for constructing the full-scale satellite system.

Team 9
Mooove

Team members: Evan Feldman, Caitlin Manes, Ada U. Wong, Carrie Cramer, Jooyoun Hong
Client: Professor Babak Kia, Boston University

Cows are expensive in regards to both time and money. On average, a cow raised from birth to age 18 costs around 241,000 dollars, so losing a cow can be quite costly. There are many social and environmental factors that can influence a cow's lifestyle and health, so cow owners must keep track of their herd at all times. For dairy cows, it could be anything from the food they eat to how stressed they are that determines the amount of milk they produce that day. Mooove is a system that will sense the state of the cows to assist farmers in making smarter decisions and carrying out everyday tasks. The system alerts farmers of possible health issues or stressors by detecting abnormalities in heart rate and temperature of the cow. By also tracking the cows' step count, the farmer can find out how active the cows have been, and whether they are in heat. The anklet will use the Zigbee protocol to determine the location of each cow. From this, our unique social tracking feature allows farmers to understand the social hierarchy of their cows. This allows the farmers to regroup the cows into less stressful groups, thus increasing the quality of life for the cows. The anklet will also keep track of the noise level around the cow, giving the farmer more insight into how noise may influence the cow's behavior. This would indicate a problem that requires immediate attention. All of this information is displayed on a webpage, allowing the farmer easy and fast access to critical information about his/her cows.



Team 10
Girodicer

Team members: Thomas Berroa, Larry Sun, Yaoyu Chen, Luke Sorenson, Carlos Cheung

Client: Muath Alshaykh, Graminor, Norway

Every winter, thousands of suburban homes are affected by ice dams. As snow melts atop slanted rooftops, dams made of ice form near the edge of the roof. The ice dams cause water pressure to build and eventually leak into the home, potentially causing serious damage to the structural integrity of the house. Removal of the ice dams is a dangerous and expensive process as workers risk their lives to chip away ice or to install ineffective heating elements. Our project will deliver a safe and effective solution to detecting and alleviating ice dams on residential houses. An automated drone will use image processing to detect problem areas, communicate with the user through a phone application, and successfully deliver a calcium chloride payload to the target areas. This eliminates any need for human intervention with ice dams, i.e. climbing a ladder onto your roof and risking slipping off. Additionally, if our drone is provided as a service it would save the homeowner thousands of dollars compared to other ice dam removal solutions. This is the first system utilizing an automated drone to solve ice dam problems. This is also the first solution utilizing thermal image processing from above to detect warm spots on the roof, an indication that ice dams are likely to form below.

Team 11
Knock Knock

Team members: Ariya Shajii, Thomas Joncas, Andrew Kvartek, Matthew Beach, James Christianson, Abesari Woldeyesus

Client: Professor Babak Kia, Boston University

The Knock Knock team is creating a smart entry system that utilizes cloud-based image processing to unlock a door for authorized individuals and eliminate the need carry keys to enter one's home. Such a system will solve the problem of having to worry about having keys lost or stolen because it will be unnecessary to carry them in the first place. The system will consist of three major components: a web portal for system administration, a camera module, and a door unlocking module. Both hardware modules will have sleek enclosures and will easily be mounted to the door with no modifications necessary. There will be no clutter of wires because the system is completely battery powered and wireless. The Knock Knock system will be secure, reliable and completely safe because the system will not interfere with manually turning the door lock in case of an emergency. Upon recognizing someone has approached the locked door, the camera will scan the area for a face and compare this face to a database of authorized entrants stored in the cloud. If the person requesting access is approved, the camera will send a secure signal to the door unlocking module to unlock the door. Some of the most innovative features include the ability to allow users to customize which individuals may unlock the door during specific timeframes and view a time stamped history of unlocking activity. The Knock Knock system has potential to revolutionize the way homes are secured and make a key ring an obsolete idea from the past.

Team 12
Light bulb with variable output light field and dispersion pattern

Team members: Benjamin Moll, Igor Pereira de Paula, Mengyi Wang, Cristian Morales, Miguel Cortez Jr.

Client: Professor Thomas Little, Boston University

The problem our project seeks to address is inflexibility of today's lighting systems. An example of this inflexibility is that even if only a single user is in a room, current light bulbs still illuminate the entire room, thereby wasting energy illuminating unused areas. Our project will seek to remedy that by creating an LED light bulb whose output light field can be controlled by a user. Our light bulb will make use of the following systems: a flexible tube with a reflective interior coating to control the width and direction of the light leaving the LED, a system of microservos to control the tube's motion, a microprocessor to control the microservos, and a smartphone app to send user commands to the microprocessor. All of these will comprise our final deliverable product an LED light bulb and its accompanying smartphone app.

Team 13
Linear Actuator Controllers for Rocket Thrust Vector Control

Team members: Matthew Owney, Matthew Siwkiewicz, Dean De Carli, Jack Dolan, Alireza Bagheri (not pictured)

Client: Boston University Rocket Propulsion Group

The Boston University Rocket Propulsion Group (BURPG) is currently developing high-performance liquid engines to propel their 30' S-Class Starscraper rocket to the edge of space. The rocket does not have fins and is therefore naturally unstable. In order to actively stabilize the rocket a method of thrust vector control (TVC) is required. BURPG decided to implement an engine gimballing system as the method of TVC. This system requires high speed, high dynamic load aerospace grade actuators that have precise linear position control. Due to the strict power, size and integration requirements inherent to a sounding rocket, a custom solution is required.

Our final deliverable will consist of a custom hardware solution for the linear actuator controller, complete with assembled and tested backup units, a control and visualization plugin for the mission control GUI, integration into the avionics framework, physical integration into the rocket with an environmentally sealed enclosure, fully characterized transfer functions for the active stabilization system, and comprehensive documentation on the BURPG wiki.

Our technical approach will consist of a parallel track development for the custom hardware of the controller, the firmware for the microcontroller, the brushless DC motor control loop, and the mission control GUI. While the custom hardware is still being designed development boards will be ordered to allow for the parallel development of the firmware. The control system will be modeled and tested using MATLAB and the mission control GUI will be written in Java.

We are designing a custom piece of embedded hardware that is capable of controlling two 200W BLDC motors that drive linear actuators to a precise position, and have Ethernet communication capabilities. It is an innovative piece of hardware on a record breaking rocket. It allows BURPG to build a suborbital, liquid sounding rocket with a mission profile of an apogee
in space. They are able to reach this goal by ditching fins and utilizing active stabilization, and our controller allows them to gimbal the rocket engines.

Team 14
DictionBeary, Open Source Translating Teddy Bear A

Team members: Dean Shi, Tarana Chowdhury, Brandon Phan, Christine Duong, Codie Smith

Client: Professor Babak Kia, Boston University

With technology such as Skype and FaceTime, connecting with people around the world has become as easy as clicking a button. However one communication barrier that still exists is the language barrier. Studies conducted by the American Council on the Teaching of Foreign Languages indicate that interactive learning is the best avenue for learning a new language and that children are most adept to learning a new language. The objective of our project is to develop an educational tool and friend in the form of a plush toy for children to interact with in order to promote language learning.
Our final deliverable will include a teddy bear filled with a rechargeable hardware unit that obtains speech, connects to Wi-Fi, and outputs speech. The bear will perform translation and conversation in up to six different languages and progress will be measured by the child's vocabulary list, frequent word use, number of words learned over periods of time, and the rate at which they are learning new words. The bear will be accompanied with a web application that allows the parents to keep track of the child's progress and control and modify settings, such as the language that they are learning. Additionally, the bear will hold a mobile phone that displays emotions based on the context of the conversation. DictionBeary is intended to break down language barriers as we progress into a hyper-connected world and bridge communities further by enabling children.

Team 15

TED: Translating Educational Device, Open Source Translating Teddy Bear B

Team members: Zachary Lister, Annie Lane, Pablo Velarde, Paige Darby, Nikolaos Zapantis
Client: Professor Babak Kia, Boston University

Young children are most adept to learning a new language, yet they may not live in a bilingual environment. How can a monolingual parent take advantage of this critical period in their child's linguistic development? TED is a translating teddy bear that exposes children, ages three to five, to foreign languages by mirroring a preschool level curriculum of six topics: numbers, foods, animals, body parts, people, and household items. Specifically, TED provides the child with repeated exposure to foreign vocabulary through three teaching modes as well as two game modes to maximize the child's retention of vocabulary in a new language.

The system deliverables are comprised of three components: (1) a rechargeable bear that outputs speech audio and processes human speech input in 5 languages (English, French, Spanish, Greek, and Persian), displays images, and communicates to the Cloud over Wi-Fi; (2) an Android application for parents to control the bear's settings and view metrics on the child's progress; (3) a Cloud-based software platform including a translation database, curriculum state machine, metrics calculation, and storage.

Team 16
Power House for National Grid

Team members: Jeff Zhu, Ernie Beltre, Zhi Wei Fang, Abdulrahman Alosaimi, Yui Ham Yan

Client: Colleen Gardner, National Grid Sustainabililty Hub

The goal of Power House NG is to create an educational tool that familiarizes users with the power demand curve and suggests methods to improve it. Power House NG will utilize renewables instead of relying on peak power plants. Renewables are more environment friendly and save money on both sides, for the customer and the service provider. The final deliverable for this project will be a small-scale portable house with different types of loads (inductive, resistive, and capacitive) to represent a real house with appliances. The house will get power mainly from the wall outlet and secondarily from a solar panel to show their effect on the demand curve. Also, an interactive touch screen will be attached to the house to display real-time power information and the power demand curve.

Team 17
Professor Helper II

Team members: Braxton Brewton, Jiehong Brandon Xavier Chung, Daniel Kim, Andy Shen, Dereck Fagundes

Client: Professor Alan Pisano, Boston University

In this current age, professors often lead classes of dozens perhaps hundreds of students. When the student base changes semesterly, it can become difficult for professors to remember the names and faces of their students, whom they must interact with on a daily basis. The Peer App seeks to remedy this dilemma. The final deliverable will be a Google Glass app that utilizes OpenCV facial recognition algorithms to accurately detect faces of students and return their names to the user through a visual and audio cue. The Glass will interact by Wi-Fi to the algorithm and database, hosted on a cloud server. If successful, this app will be one of the first to provide OpenCV facial recognition on the Google Glass.

Team 18
Remote Monitoring and Pay-As-You-Go for Solar Home Systems for Rural Africa

Team members: Carlton Duffett, Samuel Chen, Yassine El Yousfi, Alexander Villa, Konstantino Sparakis
Client: Oolu, Inc.

Oolu Solar provides Solar Home Systems to villages in rural Senegal that have no access to electricity. Currently, Oolu Solar has no way of monitoring these solar units once they are deployed in the field. They also have no automated way of collecting and recording payments from their customers. We are developing a scalable, cloud based, mesh networking platform that reliably and affordably connects all of the solar devices in a village. This system will collect and store usage data offline for collection by an Oolu Solar agent once per month. This is an innovative approach that dramatically reduces cost and sets Oolu Solar apart from their competitors.

Ultimately this system will allow Oolu Solar to monitor its solar units and collect valuable data about the long-term usage of its products in the field. Agents will also be able to record payments on the go. This data and automation is critical to Oolu Solar's growth as they continue to seek investments in their startup and expand their business into neighboring countries.

Team 19
BreakerBot - Autonomous Breaker Alignment Robot

ECE Team members: (large photo)Daniel Gorelick, Neeraj Basu, Alex Wong, Kritpasitpong (Pete) Benjathatchaporn & ME Team Members: (small photo) Paul Gennaro, Emily Stern, Carolyn Nicolo, David Stern

Client: Consolidated Edison of New York

At Consolidated Edison electric grid substations, the conventional method for circuit breaker replacement is manually intensive and hazardous due to the physical strain as well as the chance for arc flashes. Our goal is to develop a process that will automate the alignment, insertion, and movement of the 800 pound circuit breakers, and deliver a device that is able to perform the required tasks. To align the breakers with the breaker cabinet, our team is developing an alignment algorithm which uses a combination of sensory input from two laser rangefinders, image processing, and gyro/accelerometer. In addition, our team is developing a web application which will allow the operator to control the robot from a distance, and thus stay out of harm's way. Finally, all of the motor control and processing will be run entirely on the Intel Edison microprocessor.

Team 20
Self-Monitoring and Status Reporting Solar-Powered Sailboat Bailer

Team members: Scott Thompson, Peter Goulakos, Paulina Phu, Rong Mu, Patick Fant

Client: Professor Mark Horenstein, Boston University

All sailboat owners, wherever in the world their boat may reside, deal with a common problem: rain. When it rains at the dock, water collects in the bottom of the sailboat, possibly leading to swamping of the boat. Existing solutions to this problem vary from manually bailing out the boat with a bucket, to more sophisticated bilge pumps controlled by a float switch. However, the problem with the majority of these solutions is that they require user intervention. If a boat owner lives far away from his or her boat, the repeated trips to check on its status are time-consuming and inconvenient. Our product, Sol-Mate, is the solution to this issue.

SolMate is an automatic solar-powered sailboat bailing system with remote notification capabilities. The system pumps out water when necessary and will stop to recharge itself with the solar panel if battery charge drops too low. At the same time, conditions on the boat are being monitored with sensors and a microcontroller. When the Sol-Mate system predicts that the owner may need to come to the boat, it will send a message to the owner using its built-in cellular module. This solves the previously mentioned user intervention issue. With Sol-Mate, sailboat owners won't be required to travel to their boat to know how it's doing; instead, their boats will notify them.

Team 21
Sensory Walk: A Physical Therapy Installation for the Carter School

Team members: Austin Schiller, Jian Feng Tan, Reva Scharf, Maya Saint Germain, Aidar Aidymbekov, Jesse Leinbach
Client: Principal Mark O'Connor, The Carter School

The Carter School is a Boston Public School that serves students with severe mental and physical disabilities. One metric of physical progress measured at the school is how far a student can walk, bike, or wheel on their own, unassisted by their aid. Currently, this is measured manually and there is no permanent means of motivating the students. This project aims to automate this process and store each individual student's progress. In addition, this project will serve as a valuable learning tool for the students. It will motivate the student to complete the task at hand, provide them with visual and audio stimulation, facilitate number sense, and reinforce their understanding of cause and effect.

A wall-mounted physical therapy assistance system will be installed along a stretch of hallway in the Carter School. The installation will consist of 21 numbered panels that will be spaced along the wall in one foot increments and have LEDs incorporated into them. The system will include active infrared sensors spaced with the numbers to detect the students' movement along the wall. When the sensor detects the student, it will signal the corresponding foot-marker to light up. Sound will also be integrated into this system to work in concert with the LEDs. The system will be modular, with each panel consisting of two PCBs with a microcontroller, LED-lit number, speaker, and IR sensor. The user interface of the system will be a touchscreen display hooked up to the Raspberry Pi that acts as the master module, controlling the microcontrollers in each of the panels with I2C protocol.

Senior Thesis
Timothy Chong

Current and future Big Data applications need memory bandwidths of the order of Terabytes per second. Researchers have proposed using optical links in place of electrical links for processor-to-DRAM communication as they provide higher bandwidth density and lower data-dependent energy. These optical links are however sensitive to temperature. This research project focuses on the thermal management of an optical network between a 16-core processor and DRAM. Two workload allocation techniques - in-order allocation and checkerboard allocation were evaluated for the 16-core system using Parsec benchmarks. Ramulator (a cycle-accurate memory controller simulator) was integrated into Gem5 (a full-system architectures simulator) for simulating the 16-core system. DRAM power values were generated with DRAMPower tool, and core power values were generated with McPat and Gem5 output statistics. Core and DRAM power values were used to perform thermal simulations with HotSpot. For the 16-core system, the temperature on the DRAM chips was observed to be very close to the ambient temperature. On the processor side, there was no significant difference in the temperature gradient across the rings as well as the maximum chip temperature between in-order and checkerboard workload allocation. The temperature mismatches between processor and memory chips were compensated by locally heating the processor ring groups to a target temperature. On average, compute intensive benchmarks enabled higher thermal power savings than non-compute intensive benchmarks as they could better heat up the rings and get the temperature ring groups closer to the target temperature.

SENIOR DESIGN FACULTY

Alan Pisano
Associate Professor of the Practice

Dr. Alan Pisano received a Ph.D. in electrical engineering from Northeastern University in 1974. He retired from General Electric in January 2010 after a 39 year career there in both Power Systems and most recently Aircraft Engines. There, he was responsible for numerous advanced controls technology programs and held a variety of managerial positions including Manager of Turboshaft / Turboprop Controls and Manager of Advanced Controls Technology and Planning. After retiring from GE as a Department Staff Engineer, he was appointed to the full-time faculty in the ECE Department at Boston University as Associate Professor of the Practice. He is currently the lead professor and course coordinator of the capstone Senior Design course in ECE and also regularly teaches courses in control systems and electric energy.

Osama Alshaykh
Lecturer

Osama is CEO of NxTec. He was CTO of Packetvideo Corporation, Scientist at Rockwell and Visiting Researcher at UC, Berkeley. Osama received a Ph.D in Electrical and Computer Engineering from Georgia Institute of Technology in 1996. Osama received Fulbright Scholarship and served as associate editor for IEEE Transactions on Circuits and Systems, Video Technology. He served as a consultant, board member and advisor for several companies and groups.

Babak Kia
Senior Lecturer

Babak is a full-stack hardware and software developer, covering the spectrum from low power wireless and sensor networks to full featured parallel and distributed computer systems.

GRADUATE TEACHING ASSISTANTS

Asher McGuffin

Asher McGuffin received a BS in Electrical Engineering & Math from Rice University in 2013. Asher worked on the development of a fully autonomous and robust UAV for exploration of the Martian surface from low altitude. As a grad student at BU ECE, he works as a Research Assistant in the Nanostructured Fibers and Nonlinear Optics Group.

Nicholas Nardelli

Nick is a second year PhD student in photonics who spends most days aligning lasers (and occasionally burning himself) in a quest to understand the fundamentals of light and matter (and to get paid). He received a BS in applied physics from Cornell University where he kept spirits high by basking in the aura of Carl Sagan's old house.

Nithin Sivadas

Nithin Sivadas is a second year Ph.D. student who spends most of his time studying the Aurora Borealis. Nithin completed his undergraduate and masters degree in Aerospace Engineering at the Indian Institute of Technology Madras, during which he worked as the project head of a university satellite program for several years.

Mounika Vutukuru

Mounika Vutukuru is pursuing a PhD in Electrical Engineering, researching Graphene and other 2D materials for strain engineered applications in novel devices. She graduated from BU with a double degree in Electrical Engineering and Physics, as part of the Class of 2015.

Taiyao Wang

Taiyao Wang is a Ph.D. candidate in systems engineering after he received his MS degree from Chinese Academy of Sciences. His research research interest focuses on improving the health care system using machine learning, statistics, and optimization methods.

Yue Zhang

Yue Zhang is a Master student of Department of Electrical and Computer Engineering from China. His research interests are cloud computing and big data. Now he is working at Paytronix Inc. as a senior data engineer from 2016.

THANK YOU!

Clients
Senior Design could not happen without the volunteer participation of our many customers. Thanks to all who suggested problems, encouraged their student team and challenged the seniors with their real-word engineering needs.

ECE Alumni Judges
Special thanks to ECE Alumni, who took time from their schedule to be with us today.

ECE & ENG Staff
ECE Staff worked countless hours to support the year-round needs of the senior design projects, and to coordinate the culmination event, ECE day. The staff ordered parts, installed software, arranged cost reimbursements, helped with travel arrangements, managed gifts given to projects, found vendors and services, and provided direct help with PCB design and assembly. The events of ECE Day were organized in the fall and many hours went into planning the rooms, equipment, awards, and luncheon for the seniors.

The Seniors
Finally, thanks to all the seniors—who did the work over the approximately 240 days since they first arrived in EC463. Good luck and congratulations from the ECE faculty!