BU College of Engineering

Capstone Design Project - Project Descriptions

Electrical & Computer Engineering

ENG EC463 Senior Design I
ENG EC464 Senior Design II
ECE Department
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Fall 2009

This listing includes customer suggestions for possible senior design team capstone projects, to be completed in fall 2009 and spring 2010 semesters. The Electrical & Computer Engineering Department welcomes suggestions for future projects. Students work in teams of five, usually with a mix of electrical and computer systems majors.

A special thank you to all our volunteer customers!

30 - Title	UHF RFID Choropleth Map
Technical areas	Computer Science coursework; Physics / EE coursework; Basic networking experience; Basic mechanical skills
Customer's Project Description	At ThingMagic we often find ourselves characterizing the "RF friendliness" of environments our RFID readers operates in. The goal of this project is to automate the collection and display of this data. To collect data, an iRobot Create programmable robot , USB-Based RF power meter, and ThingMagic RFID reader will be used. Control software will be required to read measurements from the power meter, record if an RFID tag read attempt was successful and correlate these events with location coordinates from the robot. Additional software will be required to process and display the data. This utility should be a web based or desktop application capable of presenting data in real time. Data will ideally be displayed as a choropleth map. The storing and offline processing of data should also be supported. Ideally, the result of this project will be a useable hardware prototype, control software, and a processing / display utility that aids in the characterization of environments for RFID applications.
Deliverables	iRobot Create – based robot hosting the following USB Based RF Power Meter and RFID Tag; Control software for robot and payloads; Processing Utility Software for recorded data
Customer's Contact Information	Satyan Shah, Validation Engineering Manager, ThingMagic One Broadway, 5th Floor Cambridge MA 02142 617.682.3769 (Office) satyan.shah@thingmagic.com
Customer's Supplied Items	• iRobot Create Developers Kit • 1 ThingMagic network-based RFID reader • Various RFID tags • 1 USB Based RF Power Meter, cable, and antenna APIs for iRobot Create, RFID Reader and RF Power Meter

13 - Title	Automotive Night Vision System
Technical areas	Electronics, computer engineering, C/C++/MATLAB, image and video processing, DSP
Customer's Project Description	An electronic system to assist with night time driving. The system is capable of scanning the road in front of a moving vehicle and visually relaying this information to the driver via a heads-up display on the windshield. A high-definition infrared camera scans the road. This video feed will be analyzed by the system for objects such as traffic signs, debris, and other cars. The Heads-up display will outline the contours of these objects and will relay important textual information such as the specific details written on street signs. This information will be clearly displayed on the windshield. The driver will be able to control the system via a touch screen monitor. The control panel will allow the user to control on/off, brightness, settings, etc. Entire system (camera, HUD, touch screen, processing equipment) should run off of standard car battery. 
Deliverables	One unit meeting specifications above. Extra: API to heads-up display functions.
Customer's Contact Information	Mikhail Gurevich | 203-293-8313 216 E 49th st, 5th fl | New York NY | 10017 mikhail.gurevich@gmail.com |
Customer's Supplied Items	Working concept MATLAB code, hd video camera, video capture adapters and computer cards, touch screen display

22 - Title	3Tube: Immersive Tube for You
Technical areas	System integration, software development, image processing
Description	Currently, a new version of YouTube is under development with two anticipated enhancements: higher resolution (partially in use) and immersion (experimental phase). The immersive YouTube will be passive, i.e., user cannot interact with the data reproduced on a 3-D display. The goal of this project is to develop a proof-of-concept immersive system permitting such interaction, that could be used for immersive YouTube, 3-D TV, or mixed-reality gaming (mixture of computer graphics and real video). The task is to design, integrate, and demonstrate a real-time, eyewear-free, 3-D display that renders 3-D video with correct perspective in response to viewer head motion. The system should use 2 digital video cameras (e.g., FireWire) as data sources, and reproduce the 3-D video on a 9-view lenticular LCD screen. Such a screen requires no glasses and renders 9 perspectives allowing viewer-screen interaction. Since lenticular displays require that viewer be within 3-4 feet from the screen, an out-of-range alarm is desirable. The main challenge in this project is real-time execution, starting with video stream decoding, through depth recovery, to rendering of 7 virtual views, and finally multiplexing the original and virtual views into a single displayable image. These heavy computational requirements are unlikely to be satisfied by any CPU and thus execution on a GPU needs to be considered.
Deliverables	A lenticular immersive display with no glasses that renders correct perspective in accordance with viewer position working in real time from two video cameras.
Customer Contact Information	Prof. J.Konrad, ECE and Minor Ventures, San Francisco, CA 617-353-1246 PHO 443 Boston MA 02215 jkonrad@bu.edu
Customer Supplied Items	The customer will provide FireWire video cameras, graphics cards, and 3-D screen, as well as detailed description of depth recovery, view rendering and view multiplexing algorithms.

09 - Title	Self-tuning Guitar
Technical areas	Acoustics; signal processing; e-mags; electronics
Customer's Project Description	Build a self-tuning system adapted to a 6-string travel guitar. So-called robo-guitars exist as proof-of-concept. The project should develop a reliable physical interface to the standard tuning pegs and the sensing and control systems to adjust the strings to within a tolerance of approximately 5 cents in frequency. Several standard tuning options should be available. It should be possible to specify a novel tuning scheme as well. Operator interface should be comfortable and convenient. The system should be portable and attach to the guitar, or be integral to the guitar in a way that does not impede playing or musician comfort.
Deliverables	A working prototype with reports on testing and servicing.
Customer's Contact Information	Prof. Kotiuga — ECE Department prk@bu.edu
Customer's Supplied Items	This is a legacy project. The documentation and hardware from 2009 will be given to the team. Access to the solid printing systems in ME will be arranged.

34 - Title	Camera peripheral board for tracking
Technical areas	Sensing; communications, soft design for embedded systems/FPGAs, board design
Customer's Project Description	Camera systems for security and safety typically assemble COTS camera components with powerful computer resources. These systems can be cumbersome to develop for novel applications. A low cost peripheral board is desired for developing imaging systems, especially systems that can track an interesting object in their field of view. This might be a vehicle, a person, or an object in a manufacturing line. The project should select a suitable camera/image device, and a scheme for steering it. Other appropriate features can be added to make the peripheral board versatile for designing other applications (e.g. using the NanoBoard's remote control or communications interfaces. The peripheral board shall be compatible with the Altium NanoBoard 3000 peripherals slot. Peripheral board design will use the Altium Design CAD.
Deliverables	Working prototype of the peripheral baord (not just breadboard), documentation, drawings, and documented software
Customer's Contact Information	Dan Fernsebner — Daniel.fernsebner@altium.com Altium, Inc — www.altium.com 1900 West Park Dr Suite 280 Westborough, MA 01581
Customer's Supplied Items	Altium NanoBoard 3000. Board design will use the Altium Design CAD. Several boards may be available to the team to speed development of subsystems. Related Altium IP for peripheral boards will be made available.

31 - Title	Digital stethoscope with GUI and SD storage + Bluetooth
Technical areas	medical, signal processing, networking, wireless
Customer's Project Description	The digital stethoscope prototype system will be based on an existing battery-powered Blackfin EZ-KIT evaluation board and any existing and custom student-designed add-on cards. The analog portion of the system captures the acoustic sound waves of the heart and lungs. Design analysis will be required to decide whether the audio converter on the EZ-KIT will satisfy common digital stethoscope requirements. The analog signals must be amplified and digitized so they can then be sent to the Blackfin processor for storage, signal analysis, signal display, and compression and transmission via Bluetooth. A Bluetooth module card and a LCD card will be made available to the students. For teams interested in hardware design, we encourage consolidation of the hardware boards after proving functionality with existing cards. For software implementation, the preferred RTOS is VDK, which ships with the ADI VisualDSP development tools.
Deliverables	Working prototype of the system, documentation, drawings, and documented software
Customer's Contact Information	Tom Lukasiak, Analog Devices, Inc. Rick Gentile (781) 461-3653, 3 Technology Way tomasz.lukasiak@analog.com, Norwood, MA Richard.Gentile@analog.com, www.analog.com
Customer's Supplied Items	Blackfin processor development boards and tools. Bluetooth module card, LCD display card

33 - Title	Assistive System for Traffic Safety
Technical areas	Sensing; communications, energy harvesting; proximity detection, warning systems
Customer's Project Description	The advent of hybrid and electric vehicles has made traffic increasingly hazardous for the visually impaired – now they cannot hear or see oncoming traffic. This project shall develop a system to warn pedestrians of approaching vehicles. The system should be as compact and lightweight as possible, to avoid impeding the pedestrian. It should harvest energy from the pedestrian's motion to increase working time. The oncoming vehicle is available as part of the design, e.g. detecting the pedestrian, signaling its presence, or causing the pedestrian's equipment to alert them of the hazard. The more explicit and informative the alert, the better!
Deliverables	Working prototype of the system (not just breadboard), documentation, drawings, and documented software
Customer's Contact Information	Elias Elias Griff Technologies, Inc 1131 Randolph Avenue Milton, MA 02186
Customer's Supplied Items	Griff Technologies engineers will assist the team, and Griff's on-site resources for manufacturing can be made available.

18 - Title	Temperature-controlled Transport Device
Technical areas	Electronics, sensing, power supply, mechanical design, styling
Customer's Project Description	This is a potential commercial product for the skin care business. A container for transporting skin wax products needs to maintain a minimum temperature during transport over the common range of New England temperatures. The container should also serve as a warming device to soften the wax before application. An interface should allow selection of one of a range of temperatures. An indicator should show the setting and actual temperature. Wax volume should be 12 oz, and the container should fit into a pocket or small purse. The device should be battery powered, and rechargeable. Since it is a consumer product, style is very important, and the final design must give careful attention to the weight, volume and appearance of the product. Safety is a concern, primarily prevention of overheating.
Deliverables	A working prototype with test results and a user's manual.
Customer's Contact Information	Ms. Barbara Siegel — Total Skin Care Boston tscboston@yahoo.com — 1028 Commonwelath Avenue 617 783-0565 — Boston, MA 02215 http://tscboston.com/
Customer's Supplied Items	Samples of waxing products and information on softening/melting characteristics. Examples of standard wax containers.

03 - Title	Networked Sensor Array and Accessories
Technical areas	Analog and digital electronics, control, MCU, firmware, wireless connectivity, Desktop software for configuration
Description	A group of devices that contains a microcontroller, transceiver and control logic. Two subgroups of devices will be developed. The first contains sensors which will be signal conditioned and reported to a central controller, the second contain devices to be controlled by the central controller. The schematics will be used to generate a group of PCBs which will be built and tested by the team. A communications protocol will be developed by the team and both the master and slave ends will be coded and debugged. A PC application will be developed to configure the individual nodes.
Deliverables	A packaged PCB with scanning and data collection circuitry and firmware. A PC program that interfaces to the devices for configuration. A documented wireless comm. protocol
Customer Contact Information	BNS Solutions 153 Washington St MA vindag@bnssolutions.com 353-6521 Walpole 02032 www.bnssolutions.com
Customer Supplied Items	Development board, development tools, training, project budget

28 - Title	In-car observation and collaborative system
Technical areas	hardware (wifi or optical transceivers), communications (fast connection establishment and handoff), embedded systems (drivers for communication hardware and interface to GPS or in-car systems), GUI (for navigation and data display), web data exchange, and web server construction
Customer's Project Description	This project is to construct the electronics, computing, and communications components of an in-car traffic data observation unit that operates in concert with other participating vehicles. The end system, using a local GPS, will assess position and velocity in a vehicle and will leverage data originating from other vehicles to assess and disseminate local traffic data including congestion. Core components of the system are: vehicle position, bearing, and speed measurement (e.g. GPS); in-car computing (e.g., Netbook), vehicle to vehicle communications (e.g., wifi or optical), user data display (e.g., navigation system, google maps), and regional data dissemination (e.g., internet based server and web host). The project entails efforts in hardware design (wifi or optical transceivers), communications software (fast connection establishment and handoff), embedded systems (drivers for communication hardware and interface to GPS or in-car systems), GUI design (for navigation and data display), web data exchange, and web server construction.
Deliverables	20 functional transceivers; All source code and documentation; All design documents; Presentation materials; working system; Demonstration using transceivers at 6 and 12 o'clock; two mobile platform Data display in vehicles Data collection, hosting, and serving via web host.
Customer's Contact Information	Prof. T. Little, ECE tdcl@bu.edu Smart Travel (entrepreneurial entity)
Customer's Supplied Items	• If an optical solution is proposed, funding may be provided via the Smart Lighting project. • Have 50 Openmoko wifi chips available

EC463 Class Meetings BU *Fall 2009*

	Week-Class	*Date*	*Senior Design Class Topics*	*Read*	*Homework - Friday*
	1-1	9/3	Overview + Testing Videos	1	
	1-2	9/8	Design Process	2	Team Requests – 9/8
	2-3	9/10	Examples -Requirements & Specs	3	
	2-4	9/15	Guidelines - Project Def & Req Reviews	4	Project Selection – 9/15 5 pm
	3-5	9/17	Model PDRR	5	
	3-6	9/22	Practical Skills #1 PDRR - (2 teams)	6	
	4-7	9/24	PDRR (4 TEAMS) (25 min/team)	7	
	4-8	9/29	PDRR (4 TEAMS) (25 min/team)	8	
	5-9	10/1	Practical Skills #2 – Ethics	9	PDRR Documentation (T)
	5-10	10/6	Overall feedback from PDRR	10	
	6-11	10/8	Guidelines + Model CDR; Mockups	11	Ethics Memo (I)
	6-12	10/13	No class-Monday Schedule	12	
		10/15	Practical Skills #3 - Globalization, Patents		
	7-13	10/20	Concept Design Reviews (55 minutes per		
	8-14	10/22	Team) 2 Parallel Classrooms		
	8-15	10/27	(Includes project mockup)		
	9-16	10/29	Overall feedback CDR		CDR Documentation (T)
	9-17	11/3	Practical Skills #4 - Management		
	10-18	11/5	Guidelines + Model 1st Deliverable		Mockup due at lab bench (T)
	10-19	11/10	Practical Skills #5 - Testing		
		11/12	Guidelines for PDR + Proposal		Test Plan (T)
	11-20	11/17	No class- 1st Deliverables (30 min/team)		
	12-21	11/19	No class- In lab testing; some evenings		Test Report (T)
	12-22	11/24	Videos Projected in classroom (live)		Test Video (T)
	13-23	11/26	Thanksgiving Holiday		
	14-24	12/1	Evaluation, Feedback, Questions		
	14-25	12/3	Preliminary Design Reviews (55 min per		Self-evaluation memo (I)
	15-26	12/8	Team) 2 Parallel Sessions in PHO203,204		
	15-27	12/10	PDR continue		Team evaluation (T, I)
		12/11	Reading period (no final in EC463)		Proposal + Contract (T) due 12/11

Please consult CourseInfo site for the any updates to this schedule. *10/07/2009*

Version 2 mfr *(T) – Team; (I) - Individual*