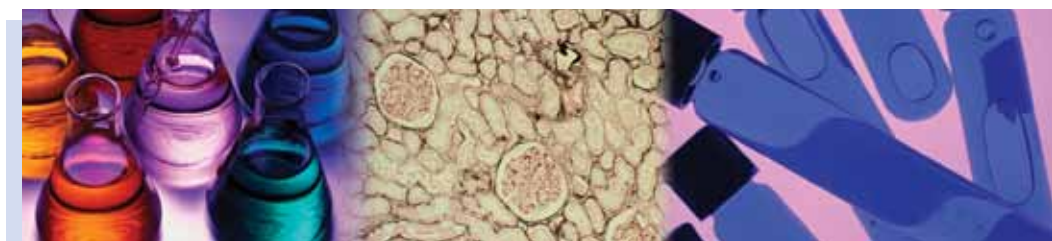


VANDERBILT

SENIOR DESIGN PROJECTS

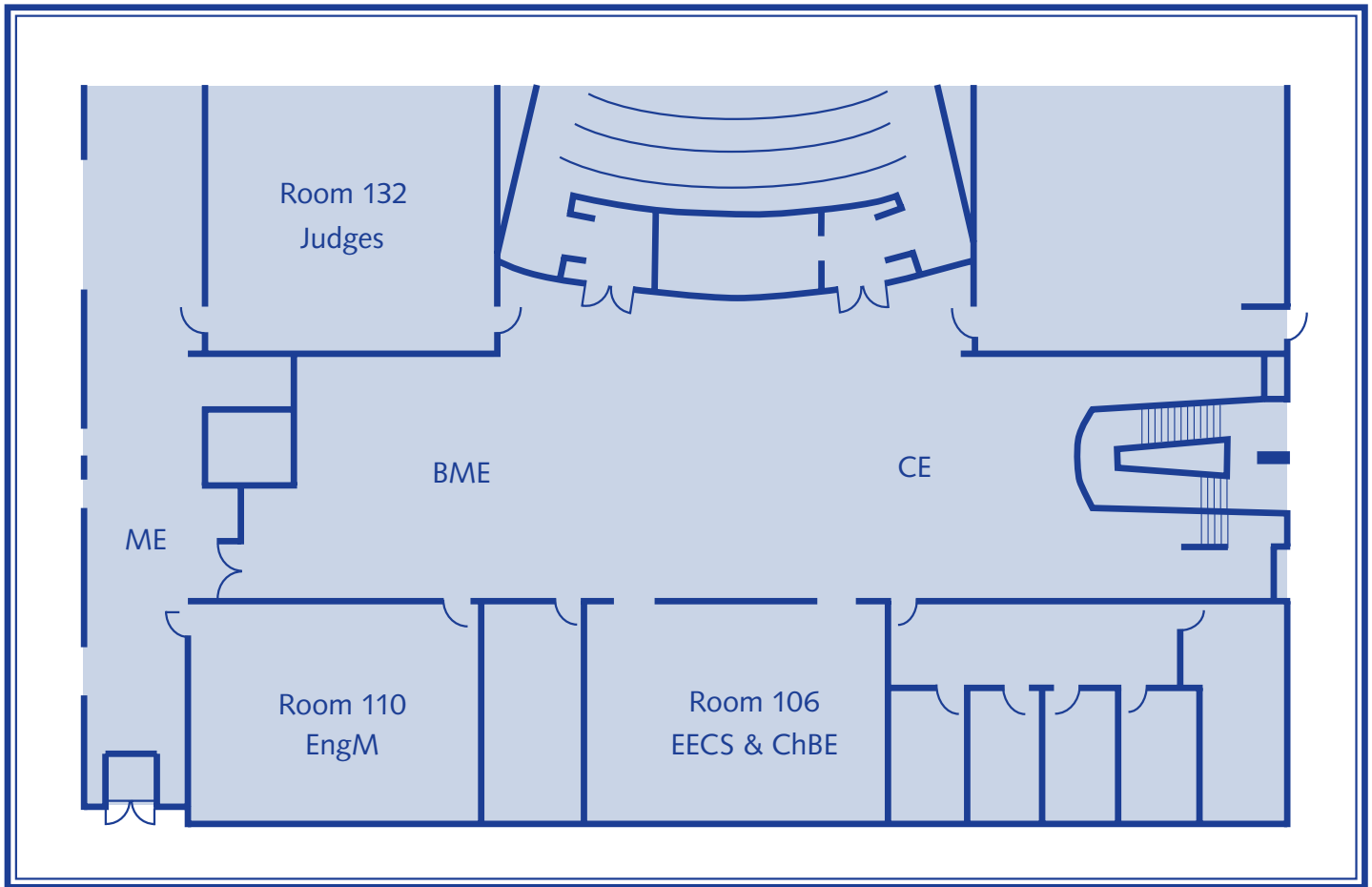
SCHOOL OF ENGINEERING



TUESDAY, APRIL 27, 2010
3:00–5:00 p.m.
FEATHERINGILL HALL



VANDERBILT
SCHOOL OF ENGINEERING



FEATHERINGILL HALL
ADAMS ATRIUM

Table of Contents

2009/2010 SENIOR DESIGN PROJECTS

DEPARTMENT OF BIOMEDICAL ENGINEERING

Ankle Alignment Project.....	4
Design of Biodegradable Vascular Constructs	4
Microprosthetic Implant for the Treatment of Erectile Dysfunction	5
Infrared Thyroid Visualization	5
Integrated Fluorescent Probe and RF Ablator	6
Limb Alignment System Development	6
Modular Retractor Project	7
Wheelchair Dynamic Center of Gravity	7
A Steerable Cardiac Catheter.....	8
Acoustic Sleep Apnea Detector	8
Anthropomorphic Phantom for CT and Ultrasound.....	9
Biogas to Electricity Conversion.....	9
Cardiovascular Model	10
Remote Alarm System for a Continuous Positive Airway Pressure (CPAP) Mask.....	10
Design of Scalable Biogas Digester for the Developing World	11
Infrared Camera and Wii System to Track Ultrasound Probe to Create 3-D Images	12
Intravascular Foreign Body Retrieval System	12
Non-electronic Blood Pressure Assist Device.....	13
Reusable Casting Apparatus for Custom Orthotics	13
Pulmonary Embolism Extraction Catheter Development.....	14
Rehabilitation Database for Traumatic Brain Injury Patients.....	14

DEPARTMENT OF CHEMICAL AND BIOMOLECULAR ENGINEERING

Solid State Lighting Using Nanocrystals.....	15
Vanderbilt Biodiesel Project	15
Production of Lycopene	16
Conversion of Glycerol to Fuel Range Hydrocarbon Mixtures	16
iPhone Applications for Chemical Engineering	17
Low Cost Room Lighting Solution for Bangladesh	17

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Horizon Wine and Spirits Site Layout.....	18
Annandale 166-lot Residential Development.....	18
TMG Data Center Site Development	19
Harpethwood High School Press Box Design	19
Southwestern Medical Office Building Design	20
AISC Steel Bridge.....	20
Design of Replacement Bridge over Duck River	21
Nissan Company Corporate HQ Building Design.....	21
American Society of Civil Engineers (ASCE) Concrete Canoe	22
Transportation Services for Mill Creek Mixed Development.....	22
Kingsport Wastewater Treatment Plant UV Disinfection System Upgrade	23
Redesign of Hartsville Wastewater Treatment Plant.....	23

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Project Dolphin—GPS Vehicle Route Tracking	24
Conference Laser Pointer System	24
Power Monitor	25
USB Oscilloscope	25
F-Spot Finder	26
A Portable Computing Platform	26
Particle Telescope	27
Portable Alert System	27

DEPARTMENT OF MECHANICAL ENGINEERING

Design and Thermal Modeling of a Mission-Critical Data Center	28
Thermoelectric Regeneration of Rocket Waste Heat	28
Feasibility Study on Solar Energy Generation on the Vanderbilt Campus	29
Design of a Quality Control Mechanism for Glucose Test Strips	29
Conoscopic Holography for Image Registration	30
Design of an Active Cannula Actuation Unit	30
Mistake-Proofing System for Automobile Starter Manufacturing	31
Rocket-Fuel Valve for Small-Scale Orbital Thrusters	31
Quality Inspection System for Diabetic Evaluation Sensors	32
Magnesium Armor Structural Improvements for Military Vehicles	32
Manufacturing Process Control for Rear Window Installation, Nissan Vehicles	33
Process Improvements for Production of Biodiesel Fuel	33
Design of an Improved Ink-Jet Printer for Two-Sided Copies	34

CAPSTONE PROJECTS / ENGINEERING MANAGEMENT

LeachXS: Innovation Strategy for Energy Production Residuals Modeling Software	34
Commercialization of Hyperthermia-based Cancer Research and Treatment Device	35
Innovation/Commercialization Strategy for Device for Rapid Detection of Pathogens in the Blood Stream	35

PREFACE

Senior design courses provide students with experience by working on real-world projects that involve budgets, reviews, and deadlines. Students learn about the principles of design, professionalism, licensing, how ethics affect engineering decisions, entrepreneurship, and the day-to-day implications of intellectual property. Students also gain experience in project management, develop team-based designing skills, and become proficient in oral and written communication.

A project can be conducted by an individual, a team of students from the same department, or a team of students from multiple departments. The capstone courses allow students to think about engineering design in an interdisciplinary way and provide a union from which interdisciplinary activities can evolve. This allows students an opportunity to experience the kind of multidisciplinary teamwork that they are likely to encounter in industry.

As their projects take form, student teams keep in touch with their industry and faculty advisors, hold meetings, write formal documentation and make presentations on their work. By the end of the year the teams produce a prototype or virtual demonstration of their solution.

The Vanderbilt School of Engineering recognizes the value of senior projects sponsored by industry and invites project sponsors—research and clinical faculty, industry representatives, and entrepreneurs—to submit project proposals. This provides meaningful projects of value to the sponsor, and it instills a professional orientation in the student team. If you or your company is interested in sponsoring a project or to learn more, please contact:

Stacy Klein-Gardner, Ph.D.
Associate Dean for Outreach
5305B Stevenson Center
PMB 351826
2301 Vanderbilt Place
Nashville, TN 37235-1826
(615) 322-6085 office
Stacy.klein-gardner@vanderbilt.edu

Ankle Alignment Project

DEPARTMENT OF BIOMEDICAL ENGINEERING

Team Members:

Garrett Sauter
Trey Kendall (ME)

Project Advisors:

Dave Martinez,
Engineering Consultant,
William Devries, M.D.

Primary Seminar Supervisor:

Paul King,
Professor of Biomedical
Engineering, Emeritus

PROJECT DESCRIPTION

The purpose of this project is to develop a device to be used in medial malleolus ankle fractures. Currently multiple clamps are needed to hold the fractured pieces into place while the orthopedic surgeon screws in two parallel screws. This project aims to create a device that will be unobtrusive to the surgeon and will guide the screws into place.

GOAL

The ultimate goal is to decrease the time of the surgical procedure and to align the screws to be put in parallel to each other. Project objectives include:

- To create a CAD model of the ankle alignment device
- To create a functioning prototype of the device
- To offer an alternative method to medial malleolus plate and screw methods to affix the fractured segment to the tibia

Design of Biodegradable Vascular Constructs

DEPARTMENT OF BIOMEDICAL ENGINEERING

Team Members:

Andrew Jallouk
Paul Guillod
Patrick Boyer (ChBE)

Faculty Advisor:

Hak-Joon Sung,
Assistant Professor of
Biomedical Engineering

Primary Seminar Supervisor:

Paul King,
Professor of Biomedical
Engineering, Emeritus

PROJECT DESCRIPTION

Cardiovascular disease is the highest cause of death in the U.S. Accordingly, it is important to be able to replace diseased vessels. We propose to use electrospinning techniques to generate a polymer scaffold for use as a vascular construct. The construct can be made of a wide range of shapes and sizes composed of fibers with diameters in the nanometer to micrometer range. We then plan to use load testing, burst pressure testing, and compliance testing to assess whether the scaffold is able to withstand physiological vascular conditions. We will then incorporate growth factors into the polymer scaffold to further aid in the regeneration of vascular tissue. Following in vitro testing of the material, the material will be tested in vivo and followed by clinical trials.

GOAL

Design vascular construct composed of “smart” materials (we may want to redefine “smart” as materials that can facilitate cellular proliferation and utilize the process of inflammation to encourage angiogenesis) to:

- Withstand normal physiological vascular conditions
- Slowly degrade while being replaced by vascular tissue
- Utilize the process of inflammation to encourage angiogenesis

Microprosthetic Implant for the Treatment of Erectile Dysfunction

DEPARTMENT OF BIOMEDICAL ENGINEERING

Team Members:

Robert Douglas
Matthew Schwartz

Faculty Advisor:

Franz Baudenbacher,
Assistant Professor of
Biomedical Engineering

Primary Seminar Supervisor:

Paul King,
Professor of Biomedical
Engineering, Emeritus

PROJECT DESCRIPTION

Our group proposes that a microprosthetic drug delivery for treating erectile dysfunction (ED) is a feasible and advantageous solution compared to current treatment methods. We begin this project with a previous report that we have generated that outlines the pathophysiology of ED and how we propose to create a solution. The solution is biomimetic in that it uses action potential signals from the dorsal nerve as the device input which is then filtered by a microcontroller to trigger drug release. The focus of this project for senior design will be in obtaining materials that can be used to create a large-scale prototype of the device that can be tested for proof of concept. We will be contacting several companies and experts to revise our design. Once our proof of concept experiments have been run, we will examine the economic feasibility and justification for our device.

Infrared Thyroid Visualization

DEPARTMENT OF BIOMEDICAL ENGINEERING

Team Member:

Isaac Pence

Project Advisors:

Anita Mahadevan-Jansen,
Professor of Biomedical Engineering
Dean Paras

Primary Seminar Supervisor:

Paul King,
Professor of Biomedical
Engineering, Emeritus

PROJECT DESCRIPTION

I am designing a real-time visualization system that employs the differential fluorescence of the thyroid and parathyroid tissues to aid in endocrine surgery. Considerations for the design include:

- The system must be easy to use, requiring little or no training. It should decrease necessary operative time, rate of unsuccessful operations, and lasting effects of hypoparathyroidism.
- The system should be easily integrated into the existing surgical setting to facilitate surgical ease.

GOAL

- Modify viewer for optimized light throughput
- Create necessary program interface
- Verify system in vitro
- Update Dean's IRB to allow data collection in surgical setting

Integrated Fluorescent Probe and RF Ablator

DEPARTMENT OF BIOMEDICAL ENGINEERING

Team Members:

Alex Walsh
Rachel Riti

Faculty Advisors:

Anita Mahadevan-Jansen,
Professor of Biomedical Engineering
Bart Masters

Primary Seminar Supervisor:

Paul King,
Professor of Biomedical
Engineering, Emeritus

PROJECT DESCRIPTION

Radiofrequency ablation (RFA) is used percutaneously and surgically to treat hepatocellular carcinoma (HCC) and colorectal cancer metastases in the liver when patients are not eligible for resection. Temperature control during this process is essential to ensure the effectiveness of this treatment. Current RFA probes use thermocouples at the tip of the electrode to monitor tissue temperature, which is not ideal. The electrode itself is not actually heated, but the tissue in contact with the probe is heated due to the tissue's electrical resistance. We have shown in previous studies that changes in tissue temperature can be detected as changes in optical properties using fluorescence and diffuse-reflectance spectroscopy. We have also seen that tissue fluorescence exhibits a temperature dependence that is independent of optical properties.

GOAL

Our goal is to design an RFA probe with an integrated fluorescence probe. This will include the combination of a delivery and a collection fiber optic alongside an RFA electrode. We expect that this fluorescence measurement will provide a more accurate and non-invasive temperature reading of the tissue being ablated during RFA procedures.

Limb Alignment System Development

DEPARTMENT OF BIOMEDICAL ENGINEERING

Team Members:

Megan Luh
Hao Luo (EE)

Faculty Advisor:

Michael Miga,
Associate Professor of
Biomedical Engineering

Project Advisor:

David Martinez,
Zimmer Corp.

Primary Seminar Supervisor:

Paul King,
Professor of Biomedical
Engineering, Emeritus

PROJECT DESCRIPTION

- Proof of concept that visual recognition software can be applied to the field of limb alignment in real-time for surgical procedures
- Improve the method of limb alignment used during surgical procedures because the current method is costly, time consuming, and accuracy is dependent on the calibration—surgeon setting up the instrument
- Create a new method that is more efficient, can be used in real-time, and is more economically profitable for hospitals

GOAL

In this project, we want to show with proof of concept that the visual recognition software can be applied to the field of limb alignment in real-time for surgical procedures.

Modular Retractor Project

DEPARTMENT OF BIOMEDICAL ENGINEERING

Team Members:

Zul Zolkaffly (EE)
Mohamad Osman
Hassan Atassi
Naziha Lazin
Azni Wahid (ME)

Project Advisor:

David Martinez,
Zimmer Corp.

Primary Seminar Supervisor:

Paul King,
Professor of Biomedical
Engineering, Emeritus

PROJECT DESCRIPTION

We hope to design and test a modular retractor that can be customized to any necessary situation. The design concept is similar to that of a wrench set, with one core component and multiple attachments that can easily be switched during a surgery. This will allow for a dramatic reduction in cost and also the number of tools used in surgery.

GOAL

The project will fulfill the following three objectives:

- Create a modular retractor to be used on orthopedic hip replacement surgery that is as effective or more effective than current retractors
- Keep the cost of the retractor under \$5,000
- Design the retractors out of durable, long-lasting material that can sustain many uses

Wheelchair Dynamic Center of Gravity

DEPARTMENT OF BIOMEDICAL ENGINEERING

Team Members:

Garrett Spiegel
Kyle Mobley
Andrew Lossing (ChBE)

Client:

Max-Mobility, Inc.

Project Advisor:

Mark Richter,
President, Max-Mobility, Inc.

Primary Seminar Supervisor:

Paul King,
Professor of Biomedical
Engineering, Emeritus

PROJECT DESCRIPTION

Manual wheelchairs have two large rear wheels and two small front casters that swivel. The location of the center of mass of the occupant between the rear and front wheels can have a significant effect on the performance of the wheelchair. If the weight is too far forward there is increased rolling resistance, increased tendency to be “pulled” down into side slopes, increased severity of impact with bumps or sidewalk cracks, and difficulty balancing in a wheelie position. The ideal solution is to have the weight as much over the rear wheels as possible. However, if the weight is too far to the rear, the wheelchair may tip over backwards. One solution is an anti-tip bar that prevents tipping, but these devices tend to limit mobility in certain situations, such as sidewalk curb cuts, and they do not allow the user to perform a wheelie for activities such as pushing across sand or braking down a steep hill. This project will develop a smart anti-tip system that will prevent tipping while still allowing full mobility in the community.

GOAL

- Research of available anti-tip systems currently used in wheelchairs and “smart” systems used in other technologies
- Development and design of Smart Anti-Tip System for manual wheelchairs
- Implementation of said device and testing of its efficacy

A Steerable Cardiac Catheter

DEPARTMENT OF BIOMEDICAL ENGINEERING

Team Members:

Michael Springer
Samuel Bearden

Project Advisor:

Michael Barnett, M.D.,
Vanderbilt University
Medical Center, Cardiology

Primary Seminar Supervisor:

Paul King,
Professor of Biomedical
Engineering, Emeritus

PROJECT DESCRIPTION

Catheters currently use a guide wire and the desired path is found through trial and error. A steerable catheter that allows a doctor to have full control of the catheter would simplify insertion and expand its functionality. Current steerable catheters exist; however, they are limited in their range of motion and are not fully controllable. Our goal in this project is to design a steerable catheter that is fully capable of maneuvering within the cardiac system and can be simply controlled by the doctor. The catheter and steering mechanism would have to be smaller than 1 cm in diameter. Along with this, the catheter would still have to be hollow and have an interface for the attachment of accessories.

GOAL

- Designing a rugged catheter capable of withstanding the tensions and compressions of insertion and removal
- Designing a steering mechanism for the catheter capable of 180 degree flexion within a turning radius to be specified at a later time
- Designing a user interface that allows precise control of the steering mechanism

Acoustic Sleep Apnea Detector

DEPARTMENT OF BIOMEDICAL ENGINEERING

Team Members:

Sean Hill
Dan Merritt (EE)
Alex Kuley

Project Advisor:

Brian Rothman, M.D.,
Vanderbilt University
Medical Center, Anesthesiology

Primary Seminar Supervisor:

Paul King,
Professor of Biomedical
Engineering, Emeritus

PROJECT DESCRIPTION

The purpose of this project is to develop a low-cost, lightweight instrument that detects and alerts for sleep apnea cases. The instrument will be comfortable to the user and will be placed just above the sternum at the suprasternal notch with an adhesive film. The instrument will be composed of a contact microphone coupled to an apnea detecting circuit outputting to a speaker and 2 LEDs. The speaker will alarm the user if apnea is detected. The LEDs will show if the device is on/off and if breathing has been detected. The entire unit will be water and shock resistant to keep from harming the patient.

GOAL

- Detect apnea
- Wake patient during apnea
- Lightweight to allow patient to sleep

Anthropomorphic Phantom for CT and Ultrasound

DEPARTMENT OF BIOMEDICAL ENGINEERING

Team Member:

Katelyn Herbert

Faculty Advisor:

Robert Galloway,
Professor of Biomedical Engineering

Primary Seminar Supervisor:

Paul King,
Professor of Biomedical
Engineering, Emeritus

PROJECT DESCRIPTION

The goal of this project is to create an ablation tool that will be able to provide information as to its exact location in respect to a tumor. This will be achieved by creating an anthropomorphic phantom of the liver. The phantom will be made out of silicone and contain “tumors” about 2.5 cm in length and 1 cm in width. The sound waves that are produced by ultrasound only create an image when they bounce off of interfaces of materials with different densities or other similar properties. For this reason, the “tumors” for the models in the past have been made out of plastic foam pieces. This was not ideal for testing purposes even though they were easily visible using ultrasound; the surgeons being tested were able to feel where the tumors were because the plastic foam of the “tumors” was so much harder than the silicone of the “liver tissue.” For this project, the tumors will be made out of a silicone and barium mixture to allow the sound waves to bounce off of the barium, and allow the tumors to show in the image without making them much harder than the liver tissue.

GOAL

This design project will use an anthropomorphic phantom in order to test the accuracy of the placement of an ablation tool. The main objectives of this project will be:

- Design the ablation tool with a high frequency signal transmitter
- Test the ablation tool in the air, create plots of output to signal source distance
- Test the ablation tool with anthropomorphic phantom, create demonstration mixture to allow the sound waves to bounce off of the barium, and allow the tumors to show in the image without making them much harder than the liver tissue

Biogas to Electricity Conversion

DEPARTMENT OF BIOMEDICAL ENGINEERING

Team Members:

Sung Bae
Daniel Rim (ChBe)
Chris Zachara (ChBe)

Project Advisor:

David Owens,
Vanderbilt Owen
Graduate School
of Management

Primary Seminar Supervisor:

Paul King,
Professor of Biomedical
Engineering, Emeritus

PROJECT DESCRIPTION

Biogas has been gaining popularity as an alternative energy source in third world countries where energy supply is limited. Though biogas has been effectively utilized for heating and cooking in these areas, there are currently no solutions for household conversion of biogas into electricity. Biogas energy is a promising idea for inexpensive energy in poor areas of the world. In this project, we hope to design an inexpensive, small-scale unit for biogas energy conversion

GOAL

- Come up with a comprehensive generator design that can be sold for a retail price of under \$40
- Output should be sufficient to power 1–2 light 100-watt bulbs for six hours a day

Cardiovascular Model

DEPARTMENT OF BIOMEDICAL ENGINEERING

Team Members:

Chase Houghton
James Clear
Meghan Murphy

Project Advisor:

Michael Barnett, M.D.,
Vanderbilt University
Medical Center, Cardiology

Primary Seminar Supervisor:

Paul King,
Professor of Biomedical
Engineering, Emeritus

PROJECT DESCRIPTION

The purpose of this investigation is to develop a cardiovascular model with the intentions of testing newly developed devices—including bioprosthetic heart valves, bovine and porcine valve, catheters, both steerable and non, and intracardiac devices intended for reaching the septum—viewing flow profiles associated with arterial (80–120 mmHg) and venous flow (10 mmHg), developing protocols and training doctors and operating room staff in cardiac procedures including stent delivery and valve replacement. The needs of this device are specified by Vanderbilt University Medical Center Department of Cardiology. Completion will be certified by VUMC cardiology fellow Dr. Michael Barnett.

GOAL

The goal of this endeavor is to develop a testable, modular device that may be used by research and commercial institutions for testing newly designed cardiac devices.

Remote Alarm System for a Continuous Positive Airway Pressure (CPAP) Mask

DEPARTMENT OF BIOMEDICAL ENGINEERING

Team Members:

Kathleen Grunder
Jessica Paulsen
Molly Rice

Project Advisor:

Roberta Leu, M.D.,
Vanderbilt University
Medical Center

Primary Seminar Supervisor:

Paul King,
Professor of Biomedical
Engineering, Emeritus

PROJECT DESCRIPTION

Continuous Positive Airway Pressure (CPAP) therapy is used to treat sleep apnea. The system works by holding the airway open through constant airflow. The system, consisting of either a nose or face mask, is very effective when used correctly. Sometimes, especially in children, compliance becomes an issue. Several different types of events including displacement of the mask or cessation of power to the system will impede its effectiveness. The purpose of this project is to create a remote monitor alert system to indicate when one of these events has occurred, so that the child's parents can address the issue.

GOAL

- Develop a remote alarm system that will alert parents in another room when their child's CPAP mask has slipped off
- Increase CPAP compliance in pediatric patients
- Give parents comfort in knowing that their child's mask is on and that they will be alerted if it comes off

Design of Scalable Biogas Digester for the Developing World

DEPARTMENT OF BIOMEDICAL ENGINEERING

Team Members:

Tiffany Cheng (ME)
Thomas Davis
Dawn Schmidt (ChBE)
Andrew Wu
Kyle Schroeder (CE)

Project Advisor:

David Owens,
Vanderbilt Owen
Graduate School
of Management

Primary Seminar Supervisor:

Paul King,
Professor of Biomedical
Engineering, Emeritus

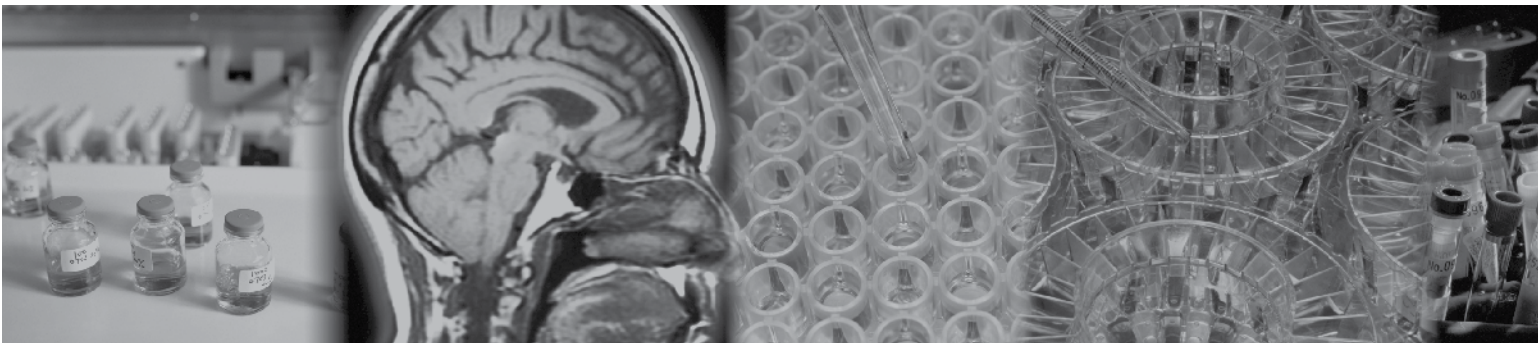
PROJECT DESCRIPTION

Bangladesh remains one of the world's poorest countries, suffering from inadequate sanitation and a poor energy supply. During Project Pyramid's most recent trip to Bangladesh, which evaluated the feasibility of a host of potential entrepreneurial solutions to poverty, biogas production using cow manure was determined to be a highly cost-effective method of generating cooking fuel. For example, collecting the manure produced by three cows during the night produced enough cooking fuel for a family of fourteen for that day. Additionally, biogas technology was found to be a potentially useful method for eradicating frequently overflowing latrines and widespread open defecation by coupling human waste with biogas production. Despite the potential health benefits and the reported cost-savings, biogas technology has not permeated the Bangladeshi market due to a product design and distribution mechanism that is cost prohibitive to widespread product usage. Through a partnership between the Vanderbilt Owen Graduate School of Management and the School of Engineering, the design team proposes to construct an improved biogas digester system at a price point that will allow the rural poor to finance and, therefore, independently purchase the biogas system.

GOAL

To enable biogas technology to be efficiently scaled throughout the country, resulting in a considerable reduction of poverty measures:

- Improved sanitation
- Increased access to energy
- Increased purchasing power from savings on fuel expenditures



Infrared Camera and Wii System to Track Ultrasound Probe to Create 3-D Images

DEPARTMENT OF BIOMEDICAL ENGINEERING

Team Members:

Jonathon Whitfield
Steven Walston
James Van Gambrell
Laura Owen

Project Advisor:

Christopher D. Lee, M.D.,
Vanderbilt University
Medical Center, Neurology

Primary Seminar Supervisor:

Paul King,
Professor of Biomedical
Engineering, Emeritus

PROJECT DESCRIPTION

Many imaging modalities today are able to create three-dimensional representations of parts of the body. However there are few three-dimensional modalities that are both portable and cost efficient. Lou Gehrig's disease, also known as amyotrophic lateral sclerosis, is a neurodegenerative disease that causes degeneration of motor neurons eventually leading to the atrophy of voluntary muscles. A crucial aspect of research for Lou Gehrig's disease is monitoring the muscle atrophy in the limbs. The current gold standard in muscle shape and composition imaging is magnetic resonance imaging. MRI is a proven modality; however, it is highly immobile, expensive, and can have long acquisition times. An alternative method that is currently used is ultrasound. Ultrasound can be used to measure the depths of the muscles periodically throughout an extensive period of time, months and even years. Currently, this method has many faults that could potentially be adjusted to validate itself as a better alternative.

GOAL

The goals of this project are to use an inexpensive infrared camera obtained from a Nintendo Wii remote control to track the location of the ultrasound probe at all times during data acquisition. Additionally, two algorithms will be created: one to track the ultrasound probe given the infrared camera data, and the other to create the 3-D image given the ultrasound and location data. Potentially, both current problems with ultrasound can be rectified with our project.

Intravascular Foreign Body Retrieval System

DEPARTMENT OF BIOMEDICAL ENGINEERING

Team Members:

Nathan Luibrand
Nick Luibrand
Luke Richards
Elise Adcock-Hinojosa

Faculty Advisor:

Michael Barnett, M.D.,
Vanderbilt University
Medical Center, Cardiology

Primary Seminar Supervisor:

Paul King,
Professor of Biomedical
Engineering, Emeritus

PROJECT DESCRIPTION

The current supply of intracardiac tools is limited. We are developing tools such as scalpels, forceps, and snares that can be applied to laparoscopic cardiac procedures. The current work plan is divided into two semesters. The remainder of the first semester will be used to continue researching useful design specifications for surgical use of the different tools and spending time designing the device using computer-aided design software such as AutoCAD. At the end of this first semester, our goal is to have one or more intracardiac tools designed and submitted to other companies for the construction of a prototype.

GOAL

We consider success in the academic year to be the completion of an acceptable prototype. We should be at a stage where the prototype looks promising enough for someone else to be willing to take the design to completion should we choose to conclude our work at graduation. However, the acquisition of a patent and subsequently using our prototype successfully in a patient would be our ultimate measure of success.

Non-electronic Blood Pressure Assist Device

DEPARTMENT OF BIOMEDICAL ENGINEERING

Team Members:

Laura Allen (ChBE)
James Berry
Casey Duckwall
David Harris (ChBE)

Client:

Engineering World Health

Project Advisor:

Professor Robert Malkin,
Duke University

Faculty Advisor:

Franz Baudenbacher,
Assistant Professor of
Biomedical Engineering

Primary Seminar Supervisor:

Paul King,
Professor of Biomedical
Engineering, Emeritus

PROJECT DESCRIPTION

While a large deal of research has focused on the elimination or the alleviation of “major killer” illnesses, the leading cause of death in the world is still cardiac illnesses. Blood pressure measurements are essential to heart health diagnosis. A traditional sphygmomanometer requires that its user be trained to detect ennuui while measuring an individual’s blood pressure.

When a sphygmomanometer is first inflated it compresses the artery, allowing no blood to flow. The sphygmomanometer is gradually evacuated, lowering the pressure on the blood vessel. The pressure at which the first vibrations are detected in the cuff is the systolic pressure. As more pressure is released, the number of oscillations transmitted will first increase before later decreasing. The pressure allowing maximum transmittance of oscillations is the mean blood pressure. Finally, the pressure at which oscillations once again cease being transmitted to the device is known as the diastolic pressure.

Engineering World Health is an organization dedicated to overcoming obstacles facing public health in developing nations using engineering and innovative designs. Alongside this organization, we propose the design of a device that would act as a supplement to a traditional sphygmomanometer, amplifying the region of pressures over which blood pressure oscillates. This allows for much simpler readout of sphygmomanometer data. The device should allow identification of at least systolic blood pressure, if not both systolic and diastolic pressures. Additionally, it should be durable with an extremely low cost and simple production parameters.

GOAL

- Determination of mechanical identification of pressure
- Design of a cheap adjunct to traditional sphygmomanometer
- Ensure ease-of-use of device

Reusable Casting Apparatus for Custom Orthotics

DEPARTMENT OF BIOMEDICAL ENGINEERING

Team Members:

Michelle Lowe
Ryan Cook
Keegan Compton
Michelle Sauer

Client:

Sole Supports Inc.

Project Advisor:

Matt Moore

Primary Seminar Supervisor:

Paul King,
Professor of Biomedical
Engineering, Emeritus

PROJECT DESCRIPTION

Currently, Sole Supports Inc. ships a foam casting box to practitioners, who take an impression of their patient’s feet and then send the used foam casting box back to Sole Supports Inc. After manufacturing the patient’s custom orthotics, Sole Supports Inc. discards the used foam casting box and ships a new unused foam casting box back to the practitioner. Because Sole Supports Inc. pays for shipping to and from the practitioner, annual shipping costs for the company are over \$500,000. We plan to address this issue by developing a reusable casting medium, which can be scanned by use of a 3D scanner, and sent to Sole Supports via the Internet. In addition to drastically reducing shipping costs, a reusable medium will also help to reduce waste and protect the environment.

GOAL

The purpose of this project is to design a reusable casting apparatus for custom orthotics that will:

- Reduce shipping costs for Sole Supports Inc.
- Maintain the casting methods used by Sole Supports Inc.
- Be environmentally friendly

Pulmonary Embolism Extraction Catheter Development

DEPARTMENT OF BIOMEDICAL ENGINEERING

Team Members:

Dustin Temple
Trip Cothren
Lauren Nichols

Project Advisor:

Michael Barnett, M.D.,
Vanderbilt University
Medical Center, Cardiology

Primary Seminar Supervisor:

Paul King,
Professor of Biomedical
Engineering, Emeritus

PROJECT DESCRIPTION

Our team of three biomedical engineering students from Vanderbilt University will work to design a catheter for percutaneous extraction of pulmonary embolisms. Our goal is to create a catheter that can be used for complete extraction of PEs ranging from 8 to 18 mm. We will focus on removal of embolisms from the first and secondary branches off the main pulmonary artery. In the future, we would like to see this therapy replace thrombolysis and become the primary treatment for pulmonary embolisms because of the low complication and high success rates. The catheter will be used by pulmonologists, interventional radiologists, and cardiologists alike.

GOAL

The goal of this project is to design a catheter that can efficiently remove an embolism from the pulmonary artery. The main goals of the project are:

- To research and evaluate current technology in pulmonary embolism extraction
- To design a catheter that can successfully remove embolisms percutaneously and completely without damage to the patient
- To produce a feasible prototype of our design

Rehabilitation Database for Traumatic Brain Injury Patients

DEPARTMENT OF BIOMEDICAL ENGINEERING

Team Members:

David Aaron Weinberg
Erwin Yap

Project Advisor:

Joseph Cheng, M.D.,
Vanderbilt University
Medical Center, Neurology

Primary Seminar Supervisor:

Paul King,
Professor of Biomedical
Engineering, Emeritus

PROJECT DESCRIPTION

The sudden onset of traumatic brain injury, a form of acquired brain injury, is a stealer of normal livelihood. TBI is the major cause of disability worldwide and occurs when an outside force traumatically injures the brain. Impaired working memory, damaged executive function, confusion and forgetfulness are results of TBI. An education tool for TBI patients to rehabilitate from the syndrome is desirable.

We plan on creating an interactive website using a combination of PHP with SQL to provide a step-by-step rehabilitation tool for TBI patients. A secured database will store the patient's information and track its progress by having the patients provide log-in information. The objectives of the project are listed below:

- To help the TBI patients become competitive in the job market after the injury
- To analyze patients' strengths and weaknesses on an assembly process
- To focus on the steps of concern by adding more details and automatically provide feedback to the users

GOAL

- Develop technology into both an educational and a commercial tool
- Improve memory from a neural standpoint

Solid State Lighting Using Nanocrystals

DEPARTMENT OF CHEMICAL AND BIOMOLECULAR ENGINEERING

Team Members:

Syamir Mirza Mohd Ismail
Mohamad Shah Fitri Othman
Zed Daliela Zulkafli

Project Advisors:

Bridget Rogers,
Associate Professor of Chemical
and Biomolecular Engineering,
and John Roth, Professor of
Chemical Engineering, Emeritus

PROJECT DESCRIPTION

Professor Sandra Rosenthal's (Chemistry) research group has developed ultra-small cadmium selenide (CdSe) nanocrystals that emit white light. This raises the intriguing possibility of using these nanocrystals as a white-light phosphor for solid state lighting applications. The goal of this project is to design a solid state lighting device incorporating these white-light emitting nanocrystals in the design.

Vanderbilt Biodiesel Project

DEPARTMENT OF CHEMICAL AND BIOMOLECULAR ENGINEERING

Team Members:

Nur Aliaa Aziz-Abdul Aziz
Nurul Asyikin Aziz
Nadzirah Mohd Mahamud

Faculty Advisors:

Bridget Rogers,
Associate Professor of Chemical
and Biomolecular Engineering,
and Robin Midgett, Electronics
Technician, Mechanical Engineering

PROJECT DESCRIPTION

Vanderbilt has a small biodiesel processing facility on campus. The process produces glycerol as a byproduct. The goal of this project is to identify an application and/or a product that would use all of the glycerol produced by this facility, thus eliminating the need for its disposal.

Production of Lycopene

DEPARTMENT OF CHEMICAL AND BIOMOLECULAR ENGINEERING

Team Members:

Angela Erion
Jessica Haley
Lauren Pulley
Adibah Rahim
Courtney Thomas

Faculty Advisors:

Kenneth Debelak,
Associate Professor of Chemical
and Biomolecular Engineering,
and John Roth, Professor of
Chemical Engineering, Emeritus

PROJECT DESCRIPTION

Most of the orange, yellow, and red colors of leaves, fruits, and flowers result from low concentrations of carotenoids. These essential nutrients in the human diet are thought to have health benefits by decreasing the risk of various diseases, particularly certain cancers, cardiovascular, and eye diseases. Lycopene is one of the most important carotenoids. Tomatoes are a rich source of lycopene. This project will examine the most promising sources of lycopene and methods of production of lycopene from its sources. Lycopene is currently produced by solvent extraction and subsequent purification. Extraction with supercritical carbon dioxide will be investigated. Some laboratory investigations may be required. Initial work will include the identification of potential sources, extraction and purification processes, and preliminary cost estimates to screen the best candidate technologies.

Conversion of Glycerol to Fuel Range Hydrocarbon Mixtures

DEPARTMENT OF CHEMICAL AND BIOMOLECULAR ENGINEERING

Team Members:

Daniel Vocelle
Remington Fischer
Joseph Mikhail
Andrew Payne
Devin Sullivan
Fredrick Hijazi

Faculty Advisors:

Kenneth A. Debelak,
Associate Professor of Chemical
and Biomolecular Engineering, and
Karl B. Schnelle, Professor of
Chemical Engineering, Emeritus

PROJECT DESCRIPTION

Glycerol, a by-product from the production of biodiesel fuel, is basically an alcohol. There is extensive work in the literature on the conversion of alcohols to hydrocarbons. The most well developed process is the Mobil process to produce gasoline from methane over a zeolite catalyst in a single step. Catalytic conversion of alcohols to olefins has been studied over a variety of other catalysts other than zeolites. Polyphosphoric acid has been used to dehydrate ethanol to produce ethers and ethylene. Longer chained hydrocarbons have been converted to fuel-like products also using polyphosphoric acid. The objectives are to: (1) examine the thermodynamics of the conversion of glycerol to hydrocarbon fuels, (2) conduct reactions of glycerol using a polyphosphoric acid catalyst to produce fuel-like hydrocarbons, (3) develop a kinetic model of the reactions.

iPhone Applications for Chemical Engineering

DEPARTMENT OF CHEMICAL AND BIOMOLECULAR ENGINEERING

Team Members:

Tracy Grant
Kimberly Lesnick
Joel Westwood
Michael Skoumal
Gary Owen
Guy Kopsombut (EECS)

Faculty Advisors:

Peter Cummings, John R. Hall
Professor of Chemical Engineering,
and Clare McCabe, Associate
Professor of Chemical and
Biomolecular Engineering and
Co-Director, Graduate Studies

PROJECT DESCRIPTION

The goal is to design the killer iPhone app for chemical engineering. This app—codename DistillNation—will be useful to every English-speaking chemical engineering student with an iPhone or an iPod Touch and can be purchased at a nominal cost. To design the app, the team must design every screen (i.e., provide a screen shot and navigation between screens) and define the functionality of every button. It needs to be complete enough that it can be put in the hands of an iPhone app programmer who has no chemical engineering experience and the programmer will be able to write the code. Example problems are (1) perform a McCabe-Thiele construction for a mixture of fluids described by Raoult's law, (2) compute a steady state mass and energy balance on a process with or without reaction, (3) solve design equations for a heat exchanger, (4) estimate an activity coefficient using UNIQUAC/UNIFAC. Potential revenues may be realized after expenses which would be used to support the undergraduate program.

Low Cost Room Lighting Solution for Bangladesh

DEPARTMENT OF CHEMICAL AND BIOMOLECULAR ENGINEERING

Team Members:

Greg Larson
Jared Robertson
Macy Skulman
Carly Jackson
Mason Hensley

Project Advisors:

Bridget Rogers,
Associate Professor of Chemical and
Biomolecular Engineering
Brian Wainstein,
MBA student, Vanderbilt Owen
Graduate School of Management

PROJECT DESCRIPTION

The objective of this initiative is to design a durable, easily manufactured, and affordable home lighting solution for the people of Bangladesh. The overall goal is to increase nighttime productivity by designing an innovative method of lighting. The product should be able to light a room that is 15 feet by 15 feet. The light source should be able to last for at least two years, but ideally it should last 10 years or more. The product should be manufactured mainly out of the most basic electrical components that are readily available with very few special parts needed, as to maintain a low cost of production. The final product ideally should cost \$5 or less, including installation expenses. However, for a higher quality product with a greater level of brightness, a cost of up to \$10, including installation expenses, would be acceptable.

Horizon Wine and Spirits Site Layout

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Team Members:

Jason Kanoff
Abdulrahman Alhammadi
Trevor Tait

Client:

Barge Cauthen and Associates

Project Advisors:

Anna Maddox, E.I.
Daniel Barge III, P.E.

Primary Seminar Supervisor:

Sanjiv Gokhale,
Professor of the Practice of Civil
and Environmental Engineering

PROJECT DESCRIPTION

Barge Cauthen and Associates is requesting a proposal with site layout, grading, and utility and drainage design for the project. The proposed project, located at the southwest corner of Industrial Parkway and Hydes Ferry Pike, entails designing the site to incorporate a two-story office and warehouse building with corresponding surface parking and a circulation route to properly serve the site. The site will require new water, sanitary sewer lines, and storm drainage. Goals for the project include the following:

- Develop two preliminary site layouts showing arrangement of building with vehicular parking, loading docks, and truck access. The owner will approve the layout for final design for submittal to the Metropolitan Planning Commission for compliance with Metro's Zoning Ordinance.
- Design the final layout
- Develop cost estimate for infrastructure improvements
- Prepare application packages for water/sewer availability and grading permit

Annandale 166-lot Residential Development

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Team Members:

David Brown
William Yzaguirre

Client:

Gresham, Smith and Partners

Project Advisor:

Mike Hunkler, P.E.

Primary Seminar Supervisor:

Sanjiv Gokhale,
Professor of the Practice of Civil
and Environmental Engineering

PROJECT DESCRIPTION

Gresham, Smith and Partners is requesting that the students prepare a proposal to design utilities, drainage, and transportation infrastructure for a 177-lot single family subdivision in Brentwood, Tennessee. Engineering services are required in the areas of transportation planning, water distribution engineering, sanitary and environmental engineering, and hydrology. The initial phase of the project will include a due diligence report for all utilities, a traffic study, and a conceptual infrastructure plan consistent with the layout provided by the developer's land planning consultant. Working in conjunction with the developer's land planning consultant, the team will be required to perform the following tasks:

- Design a water distribution system with required fire fighting capabilities
- Design a sanitary sewage system, including any associated pump stations and force mains
- Design a storm water drainage system and associated storm water detention and water quality treatment
- Evaluate traffic generation as well as impact on adjacent road network capacities
- Recommend needed improvements
- Develop construction cost estimates for the infrastructure improvements
- Prepare application packages for grading and environmental permits

TMG Data Center Site Development

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Team Members:

Bryan Kirk
Matthew Kuykendall
Kyle Schroder

Client:

Littlejohn Engineering Associates

Project Advisor:

Lennie Arnold, P.E.

Primary Seminar Supervisor:

Sanjiv Gokhale,
Professor of the Practice of Civil
and Environmental Engineering

PROJECT DESCRIPTION

Littlejohn Engineering Associates is requesting that the students prepare a proposal that includes the necessary civil engineering and permitting to construct the facility as described below. The project consists of site development for the TMG Data Center located in Brentwood, Tennessee. The team is responsible for the following elements:

- Site due diligence to determine the feasibility of constructing this product on this site. This includes investigating existing zoning, surrounding infrastructure, and regional storm water requirements.
- Preparation of Engineering Drawings
- The design of a storm water detention facility that will limit the post-development peak runoff rate to less than the pre-development runoff rate

Harpethwood High School Press Box Design

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Team Members:

Kristin Brozyna
Kate Jiranek
Mohd Hafiz Mohd Ghazali

Client:

RAE
SE&I

Project Advisors:

Michael Vines, P.E.
Ruth Alwes, P.E.

Primary Seminar Supervisor:

Sanjiv Gokhale,
Professor of the Practice of Civil
and Environmental Engineering

PROJECT DESCRIPTION

RAE/SE&I is requesting a proposal from the students to provide structural design services for a new press box for the Harpethwood High School in Brentwood, Tennessee. The press box will contain approximately 1,200 square feet and will be located behind the existing bleachers at the football field. The scope of work will consist of the following:

- Load determination based on applicable codes in Brentwood, Tennessee
- Schematic design of concrete and steel structural configurations, including lateral resisting systems
- Selection of a structural system based on cost analysis of the schematic designs
- Design of floor and roof framing systems
- Design of lateral resisting systems
- Design of foundation systems for the press box
- Production of contract drawings showing structural framing, lateral force resisting systems, and foundation systems

Southwestern Medical Office Building Design

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Team Members:

Michael Johnson
Josh Mullins
Jimin Chang

Client:

Stan D. Lindsey and Associates

Project Advisor:

Ben Nelson, P.E..

Primary Seminar Supervisor:

Sanjiv Gokhale,
Professor of the Practice of Civil
and Environmental Engineering

PROJECT DESCRIPTION

Stan D. Lindsey and Associates is requesting a proposal for services for the project described below. Services include the necessary structural design and preconstruction services to construct the facility. Schematic drawings and the project's geotechnical investigation will be made available to the students. The project consists of a three-story, 30,000-square-foot medical office building adjacent to the Southwestern Medical Center located in Lawton, Oklahoma. The project consists of the following tasks:

- Determine building code requirements
- Determine gravity, wind, and seismic loads
- Prepare preliminary designs for pricing for both a concrete and steel option
- Perform a pricing exercise and present a framing recommendation to the owner
- Complete lateral load calculations; analyze and design representative components
- Analyze and design gravity system (slab, typical beams, typical girders, typical columns, and other components)
- Review the geotechnical report and design typical foundations for lateral and gravity loads
- Prepare a foundation plan, typical floor framing plan, and roof framing plan

AISC Steel Bridge

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Team Members:

Micah O'Hare
Loren Vidnovic
Catherine Newman
Donald Williams

Client:

Structural Design Group

Project Advisors:

Warren Goodrich, P.E.
and Jennifer Acton

Primary Seminar Supervisor:

Sanjiv Gokhale,
Professor of the Practice of Civil
and Environmental Engineering

PROJECT DESCRIPTION

Structural Design Group is requesting that the students submit a proposal for the structural design, fabrication, and erection of a scale model of the river crossing. All phases will meet the requirements of the 2010 AISC Steel Bridge Design Competition. The services include the following:

- Preliminary design narrative describing the bridge model options to consider with a list of advantages and disadvantages for each system and a relative cost comparison
- Proposed schedule for submission of design development drawings, fabrication, and erection
- Provide the final design for the selected system. The submitted final design documents should adequately describe the structural steel model to be used for fabrication.

Design of Replacement Bridge over Duck River

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Team Members:

Marne Zahner
Malcolm White
Brock Petersen

Client:

Tennessee Department of
Transportation

Project Advisors:

Jon Zirkle, P.E.
Curtis Duncan

Primary Seminar Supervisor:

Sanjiv Gokhale,
Professor of the Practice of Civil
and Environmental Engineering

PROJECT DESCRIPTION

The Tennessee Department of Transportation project is requesting a proposal for hydraulic and structural design and preparation of contract plans for the replacement of the bridge carrying Industrial Park Road over the Duck River at L.M. 0.70, Maury County, Tennessee. The team is required to perform the following tasks:

- Perform the necessary hydrologic computations to determine the peak discharges for the 2, 5, 10, 25, 50, 100, and 500 year recurrence interval floods
- Perform a hydraulic analysis of the site based on the above discharges to determine flooding conditions without any structures and with the existing structure and determine the overtopping frequency if less than the 500 year event
- Describe existing conditions at the site (drainage area, design discharge, design velocity, design backwater, design overtopping, 500 year discharge and 500 year water surface elevation)
- Perform hydraulic computations sufficient to propose a structure that meets department design criteria (hydraulic adequacy, overtopping frequency, appropriate roadway profile, span arrangement, pier and girder selection, flood clearances, scour analysis, deck drainage)
- Prepare a hydraulic layout showing an elevation and plan along with the required hydraulic data shown on the layout, as well as a hydraulic design report that meets department standards, stamped by a licensed engineer
- After formal approval of the preliminary layout, complete the structural design for the bridge

Nissan Company Corporate HQ Building Design

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Team Members:

Eric Asher
Erin Kersh
Nicholas Hudson

Client:

Gresham, Smith and Partners

Project Advisors:

Sean B. Smith, P.E., S.E.
and Bryan Tharpe, P.E.

Primary Seminar Supervisor:

Sanjiv Gokhale,
Professor of the Practice of Civil
and Environmental Engineering

PROJECT DESCRIPTION

Gresham, Smith and Partners is requesting that the students submit a proposal for the project as described below. The proposed project is a new, high-profile corporate headquarters adjacent to Interstate 65, programmed for 10-story, in Franklin, Tennessee. The structure will be comprised largely of glass, and structured utilizing composite steel framing and concrete shear walls to resist lateral forces. A geotechnical investigation has been performed indicating a deep foundation system consisting of rock bearing concrete drilled piers will be necessary to support the structure above. The successful team will be required to perform the professional services consisting of the following:

- Prepare a code analysis report indicating required design dead, live, snow, wind, and seismic load criteria
- Serviceability requirements, including dead and live load deflections, wind drift limits, and seismic drift limits shall be included in the report
- Perform the necessary calculations using the load criteria defined above to determine the required gravity and lateral design loads for the beams, girders, columns, and shear walls
- Using the provided structural floor and roof layouts, design all primary gravity members
- Design the concrete lateral shear walls per the locations shown on the provided plans
- Design the deep foundation members
- Develop a cost estimate based on the design structural steel and concrete quantities
- Prepare engineering drawings to convey the design information above

American Society of Civil Engineers (ASCE) Concrete Canoe

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Team Members:

Jodie Leeka
Patrick McEnery
Caroline Lewis
Chase Blood
Nicole Lukens

Client:

Vanderbilt Chapter of ASCE

Faculty Advisor:

Lori Troxel, P.E.

Primary Seminar Supervisor:

Sanjiv Gokhale,
Professor of the Practice of Civil
and Environmental Engineering

PROJECT DESCRIPTION

Vanderbilt ASCE would like to develop a canoe made of concrete to be raced at the Southeastern Regional ASCE Conference. Vanderbilt ASCE is requesting that engineering students submit a proposal for design, fabrication, and racing of a concrete canoe. All phases shall meet the requirements of the 2009 ASCE National Concrete Canoe Competition rules. The Vanderbilt ASCE will select the concrete canoe to be constructed. Students will provide the final design. The submitted final design documents should adequately describe all phases of the concrete canoe construction. The following list outlines some of the responsibilities of the successful team:

- Research previous winners of ASCE NCCC competitions
- Organize team with managers and underclass students
- Calculate loads and stresses on the canoe
- Design the concrete hull, mold, reinforcing, concrete mix, and finish
- Design the safety training for mix design and canoe construction
- Perform a cost analysis for several types of construction
- Prepare a detailed project schedule
- Construct and race the canoe

Transportation Services for Mill Creek Mixed Development

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Team Members:

Jessica Ji
Goldie Schupak
Chelsea Lau

Client:

Metropolitan Government of
Nashville and Davidson County
(Metro) and Kimley-Horn and
Associates, Inc.

Project Advisors:

Christopher Rhodes, P.E., and
Jonathan Cleghon, P.E.

Primary Seminar Supervisor:

Sanjiv Gokhale,
Professor of the Practice of Civil
and Environmental Engineering

PROJECT DESCRIPTION

The Metropolitan Government of Nashville and Davidson County (Metro) and Kimley-Horn are seeking a proposal from the team for the purpose of analyzing the traffic impacts associated with a proposed development within Davidson County. The intent of this project is to determine the residual effects of the new traffic generated by the proposed Mill Creek Village development on the adjacent roadway network, and to determine mitigation measures to accommodate the new traffic added to the network. Metro Department of Public Works is selecting a consultant to provide these services on behalf of the developer of the Mill Creek Village, C2MR, LLC.

The project will be managed by the Department of Public Works and will include input from other stakeholders, such as the developer, C2MR, LLC, as well as the developer's architect and design engineering consultants.

This project will include the development of a Traffic Impact Study (TIS) per the guidelines set forth in the *City of Nashville and Davidson County Traffic Study Requirements*. The study will include, but not be limited to, analysis elements such as existing conditions assessments, traffic growth analysis, trip generation, trip distribution, level-of-service analysis, and determination of mitigation measures. A traffic signal warrant study at the primary project site driveway will also be required. If a traffic signal is warranted at the primary site driveway, a traffic signal optimization study will be required to coordinate the proposed signal with any adjacent, existing signalized intersections.

Kingsport Wastewater Treatment Plant UV Disinfection System Upgrade

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Team Members:

Nina Caraway
Amelia Shaw

Client:

Camp Dresser and McKee (CDM)

Project Advisor:

Katie Bell, P.E.

Primary Seminar Supervisor:

Sanjiv Gokhale,
Professor of the Practice of Civil
and Environmental Engineering

PROJECT DESCRIPTION

The City of Kingsport, Tennessee, and CDM are requesting that the students provide engineering and construction services related to implementation of a UV disinfection system at the Kingsport wastewater treatment plant (WWTP) under a guaranteed maximum price (GMP) contract. The students are required to:

- Collect and review data from the facility necessary for developing the basis of design for a UV disinfection system
- Obtain equipment proposals from vendors that manufacture both horizontal and vertical UV disinfection systems and develop construction costs, annual operating and maintenance costs, and lifecycle costs for each system evaluated
- Accompany Kingsport WWTP staff on site visits and use information gathered during site visits to develop a non-cost factor evaluation of the systems evaluated
- Based on the results of Tasks 3 and 4 make recommendations to the City on the preferred system and develop final engineering design drawings of the preferred system
- Develop bid and construction documents that will be used for establishing the GMP
- Provide construction, startup, and system acceptance for the selected system
- Provide progress updates and coordinate data and information collection needs

Redesign of Hartsville Wastewater Treatment Plant

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Team Members:

Ernie Crafton
Jonathan Duffey

Client:

Barge Waggoner Sumner
and Cannon (BWSC)

Project Advisors:

George Garden, P.E.
Bill Hamilton, P.E.

Primary Seminar Supervisor:

Sanjiv Gokhale,
Professor of the Practice of Civil
and Environmental Engineering

PROJECT DESCRIPTION

The Hartsville Water and Sewer Department and BWSC are requesting a proposal for modifications to the existing wastewater treatment plant in Hartsville, Tennessee. The successful firm will be required to:

- Perform population projections and design flow calculations for a suitable design life
- Determine design influent and effluent concentrations based on exiting flows and permit limits
- Provide system schematic process flow diagrams for the plant modification
- Prepare a complete hydraulic profile, integrating existing and modified treatment units
- Provide plant footprint and piping diagrams for the wastewater treatment plant
- Specify required air handling and pumping needs for the new and modified treatment units
- Provide opinion of probable construction cost based on equipment manufacturer quotations and other factors from Means Estimating documentation or similar reference
- Provide preliminary engineering report (including hydraulic calculations) for submission to Tennessee Department of Environment and Conservation–Division of Water Pollution Control in accordance with the Division design criteria for sewage works

Project Dolphin—GPS Vehicle Route Tracking

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Team Members:

Demetri Miller
Andrew Enkeboll
Muhaimin Aminuddin

Project Advisor:

Jules White, Research Assistant
Professor of Computer Science

Primary Seminar Supervisor:

Jeffrey D. Black,
Research Associate Professor
of Electrical Engineering

PROJECT DESCRIPTION

Project Dolphin is a robust tracking system that utilizes the location-based services of the Google Android platform. The system is comprised of three main components: the Google Android phone, the Web server, and the client services. Each vehicle to be tracked requires a GPS-capable smartphone operating on the Google Android platform. Each phone requires its data transfer services enabled by telecommunication providers. This is necessary to transmit location data gathered by the phone to the Web server. A direct power supply from the vehicle to the phone will need to be provided in order for the phone to be used continuously. The client services display vehicle locations through different mediums. An LED display will be used for displaying the estimated time of arrival. In addition to a physical display, client-side mobile applications will be developed for smartphones. This will enable view of van locations from any point where a user's smartphone can access the Internet.

GOAL

The intent of this project was to provide tracking capabilities for campus transportation vehicles. However, the goal of Project Dolphin has been broadened to include support for tracking any collection of vehicles.

Conference Laser Pointer System

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Team Members:

Dan Burger
Khairi Nik Hassan Suhaimi
Abdul Hadi Hussein
Maricus Jones
Joseph Liyana
Serkan Yaliman

Primary Seminar Supervisor:

Jeffrey D. Black,
Research Associate Professor
of Electrical Engineering

PROJECT DESCRIPTION

Many speakers use visual aids to complement their speeches. In most cases it is a presentation created using Microsoft PowerPoint or Google Docs that is projected onto a big screen using a digital projector. To bring attention to various points of the presentation, many of those speakers will use handheld laser pointers as well. Using a laser pointer can require looking, and perhaps talking, at the screen in order to give the presentation. This reduces the connection between the speaker and the audience and can make the presentation awkward and less effective. It may also be hard to use a laser pointer in a multiscreen setting where the presentation slides are shown on two or more screens in the front of the room.

GOAL

The goal of this project is to build a laser pointer system that consists of a handheld laser device, a monitor, and a mounted system. When the speaker points the laser at the monitor, the mounted system activates a brighter laser that points to the projected display at the same position where the speaker is pointing to the touch screen.

Power Monitor

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Team Members:

Ben Gotow
Haziq Mazlan
Mark Phelan
Cory Plastek
Chris Thompson

Primary Seminar Supervisor:

Jeffrey D. Black,
Research Associate Professor
of Electrical Engineering

PROJECT DESCRIPTION

It was brought to our attention that there was a strong desire on campus to be able to monitor washer and dryer cycles. After some research we discovered that, currently, the only solutions available for this would require complete replacement of all washers and dryers. Therefore, we tasked ourselves to develop a product that would be easily implementable with current washer and dryer setups. This also led us to consider the other possible implementations of this device. We decided to develop a device that could monitor any electronic device's power consumption. Therefore we designed a simple "plug-in" product that plugs in-between the wall and the electronic device's power cord. This device, in combination with a "client" and server, would allow for users to monitor the power any electrical device draws.

GOAL

With power data, one can view long-term trends, day-to-day usage, and immediate usage statistics. Hopefully, this idea will prove useful in an energy / cost saving sense and, in terms of washers and dryers, save time waiting for machines. Overall, our goals for this product are a relatively cheap per unit cost and an easy implementation with any set of electronic devices.

USB Oscilloscope

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Team Members:

Joseph Mannion Galvin III
Justin Z. Le Clair
Ali Ozdengiz
Alton Russell Sharpe

Primary Seminar Supervisor:

Jeffrey D. Black,
Research Associate Professor
of Electrical Engineering

PROJECT DESCRIPTION

This project involves building a simple oscilloscope that uses a laptop or desktop to view a signal. The oscilloscope will have two input coaxial connectors, one for the signal and the other for a trigger. The signal will be displayed on the computer continuously at the highest possible speed that USB can accommodate. The computer software will make some measurements including signal level and frequency of the input signal.

GOAL

The main objective of this project is low cost per unit in production. Accuracy of the signal sampling or viewing is a secondary goal. The usage of the oscilloscope is just to examine what a signal looks like; detailed measurements should be made with other equipment.

F-Spot Finder

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Team Members:

Adam Albright
Hamilton Turner
Rob McColl

Primary Seminar Supervisor:

Jeffrey D. Black,
Research Associate Professor
of Electrical Engineering

PROJECT DESCRIPTION

The average Vanderbilt student driver knows the frustration associated with trying to park their vehicle on campus. It is not unusual for it to take 20 minutes or more of driving through parking lots before locating a spot. Additionally, the scarcity of spots available on campus often encourages rapid driving in parking locations, in order to ensure getting a spot. The F-Spot Project is a system that aims to reduce this hassle and the associated dangers by monitoring the number of available parking spots in the student parking lot (F-Lot) and making that information available via mobile phone.

GOAL

The objective of this system is to increase efficiency of leaving and returning to campus by reducing the wasted time and fuel associated with hunting for a parking spot, as well as to provide a substantial quality of life improvement for student drivers

A Portable Computing Platform

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Team Members:

Spencer Crosswy
Ryan Rau
Randy Smith (ME)

Project Advisor:

Ted Bapty, Research Associate
Professor of Electrical Engineering

Primary Seminar Supervisor:

Jeffrey D. Black,
Research Associate Professor
of Electrical Engineering

PROJECT DESCRIPTION

For a user to give commands to and receive meaningful feedback from a remote system, he should be able to do so intuitively. Some spend their entire lives researching this very problem by studying human-computer interaction and developing innovative user interfaces. One approach is to have a common physical interface for multiple applications. Even if the interface does have a learning curve, a user only has to learn the interface once and can then apply the same control scheme to any number of situations. Our portable computer will include many of the same components as a traditional computer, except all pieces will be smaller and rugged enough to withstand a harsh operating environment.

GOAL

The goal of our project is to create a “portable computing platform” to serve as a universal hardware interface. Rather than move toward a totally integrated custom-made system, however, we will attempt to use as many off-the-shelf components as possible in order to maintain an easy-to-use and flexible development platform.

Particle Telescope

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Team Members:

Nasir Ab Razak
Mohammed Badri
Chris Bemiller
Brian Okorn
Rob Rucker

Primary Seminar Supervisor:

Jeffrey D. Black,
Research Associate Professor
of Electrical Engineering

PROJECT DESCRIPTION

The effects of cosmic radiation on electronic circuits are an important research topic in space exploration. Electronics must be trusted to work as properly in space as they do on the ground, or else the safety of personnel and machinery may be compromised. However, cosmic particles, such as electrons, protons, and alpha particles, may add energy to an electrical system in a collision. A bit in memory may be flipped by the energy added by a colliding particle. A bit flipped at the incorrect time may result in a system fault, which may become deadly in the harsh environment of space. This project is a proof of concept design of a particle telescope that measures the angles at which particles strike a circuit board using a scintillator and several cameras.

GOAL

This project aims to develop an approach to correlate microelectronic faults with particle trajectory in a space experiment. The trajectory data gathered by this project will help determine the effects of particle impacts from each possible trajectory. This project will help validate which particle trajectories produce which errors in a circuit.

Portable Alert System

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Team Members:

Yakeyna G. Anderson-McWhirter
Brennan M. Carmody
N. Aminah Hamzah
P. Aaron McCann (BME)
Hallee N. Wirtshafter

Primary Seminar Supervisor:

Jeffrey D. Black,
Research Associate Professor
of Electrical Engineering

PROJECT DESCRIPTION

The Portable Alert System is designed to be a functional device that alerts the user to the possibility of a fire through the detection of an audible sound from a fire alarm. The Portable Alert System is to be a complementary device to the current existing fire alarm detectors not designed for those with hearing difficulties. This device, which will be small in size and wearable, is targeted towards those who have difficulty being alerted by the existing fire alarms. The system consists of two methods of alerting the user. The first method used is vibration. The vibration that the alert system projects will be of a reasonable magnitude to ensure that the user notices the fire alarm detection. A second option used is a flashing light on the device.

GOAL

Among the stakeholders for this project are individuals with hearing impairment, the older population who are not easily alerted by high frequency audio output, and also heavy sleepers. The principal guidelines of this project are ensuring that the device is low-powered, low cost, and also has a flexible design that will allow for adoption into different kinds of applications.

Design and Thermal Modeling of a Mission-Critical Data Center

DEPARTMENT OF MECHANICAL ENGINEERING

Team Members:

Stefan Szlendak
Saunik Desai
Charley Kirby
Adrian Rossi-Mastracci (BME)
Siti Nur Amalina Mohd Halidi
Mohammad Shah

Client:

Walick-Kemp, Inc.

Project Advisor:

Greg Walker, Associate Professor of
Mechanical Engineering

Industry Advisor:

Andy Charron, P.E.

Primary Seminar Supervisor:

Robert Webster,
Assistant Professor
of Mechanical Engineering

PROJECT DESCRIPTION

The goal of this project is to design all aspects of a corporate data center. Power supply, heating and cooling, and fire suppression are primary concerns, among others.

Thermoelectric Regeneration of Rocket Waste Heat

DEPARTMENT OF MECHANICAL ENGINEERING

Team Members:

Travis Chan
Matthias Baxter Barringer
James Board
Samuel Nackman
Kyle Rosenstein
Nicholas Vass
Benjamin McKnight

Client:

NASA

Project Advisor:

Amrutur Anilkumar, Professor of the
Practice of Mechanical Engineering

Primary Seminar Supervisor:

Robert Webster,
Assistant Professor
of Mechanical Engineering

PROJECT DESCRIPTION

This project is part of Vanderbilt University's Student Launch Initiative, where students design high-powered hobby rockets and scientific payloads for NASA, with the aim of demonstrating robust aeronautical design and inventive scientific experimentation. Students undergo rigorous review by NASA throughout the year and participate in a launch competition against other universities in the spring. The scientific payload this year is a thermoelectric power generator aimed at enhancing engine efficiency.

Feasibility Study on Solar Energy Generation on the Vanderbilt Campus

DEPARTMENT OF MECHANICAL ENGINEERING

Team Members:

John Barrere
Matthew Greenhall (EE)
Joseph Petty
Abdullah Radzai
Whitt Tucker (EE)

Client:

Tennessee Valley Authority
Vanderbilt University

Industry Advisor:

James Ellis

Primary Seminar Supervisor:

Robert Webster,
Assistant Professor
of Mechanical Engineering

PROJECT DESCRIPTION

The goals of this project are to (1) determine all possible locations for installation of solar cells on the Vanderbilt campus, (2) identify cost-effective solar panel options and determine costs of installation and length of time until they pay for themselves, and (3) solicit bids for contractors to install solar arrays.

Design of a Quality Control Mechanism for Glucose Test Strips

DEPARTMENT OF MECHANICAL ENGINEERING

Team Members:

Jeb Phillips
Muhammad Rahimi
Awatif Zaini (EE)

Client:

Roche Diagnostics, Inc.

Industry Advisor:

Brandon Wilson

Primary Seminar Supervisor:

Robert Webster,
Assistant Professor
of Mechanical Engineering

PROJECT DESCRIPTION

The objective of this project is to develop an offline in-circuit test system for glucose test strips from multiple production process stages. The system will detect various failure modes and will aid in feedback to root cause analysis. The system includes a mechanical fixture that will locate, clamp, and probe the test strip in preparation for testing. The system will include an integrated PC containing software for an operator interface and an automated test routine. Software interface and routine will be developed such that test results are accurate, repeatable, and displayed in a meaningful manner to an operator. The system will be designed for use in a production environment with reliability, ergonomics, and maintenance considered.

Conoscopic Holography for Image Registration

DEPARTMENT OF MECHANICAL ENGINEERING

Team Members:

James Kenny
David Gostin
Jennie Wolfgang (EE)
Alia Farhana Abdul Ghaffar

Client:

Pathfinder Therapeutics

Industry Advisor:

Jim Stefansic

Primary Seminar Supervisor:

Robert Webster,
Assistant Professor
of Mechanical Engineering

PROJECT DESCRIPTION

This project involves giving surgeons “X-ray vision” when they perform surgery. The goal is to scan the surface contours of internal organs in the human body through a very small incision. These surface contours can then be matched to preoperative CT or MRI scan data to show surgeons the internal structures (blood vessels, nerves, tumors, etc.) before they begin to make an incision in the organ. The responsibility of the Senior Design Team in this project will be to take an initial prototype system consisting of a conoscope and an optical tracking device that has been used in benchtop experiments, to (1) design a mechanical interface that enables the device to work through a port in a pressurized abdomen, (2) design electrical interfacing to add control buttons to the device, and (3) develop an integrated software framework to coordinate the timing of measurements collected by the two devices and display data on a computer screen.

Design of an Active Cannula Actuation Unit

DEPARTMENT OF MECHANICAL ENGINEERING

Team Members:

John Tucker
Erica Hodulik
Stephen Goodman
Syuhada Yakub (EE)

Client:

Acoustic MedSystems

Industry Advisor:

Clif Burdette

Primary Seminar Supervisor:

Robert Webster,
Assistant Professor
of Mechanical Engineering

PROJECT DESCRIPTION

This project involves a mechanical design of a compact actuation unit, designed such that it may be either robotic or manually operated, to manipulate a novel steerable robot that is 1–2 mm in diameter, called an active cannula. The actuation unit must be designed to deliver an acoustic ablation probe to precise locations inside the human body for minimally invasive thermal treatment of tumors, based on information from 3D ultrasound guidance. This will provide a means of treating some kinds of cancer without surgery.

Mistake-Proofing System for Automobile Starter Manufacturing

DEPARTMENT OF MECHANICAL ENGINEERING

Team Members:

Alexander Alm
Fletcher Lewis
Muhammed Afiq Mohd Zaid
Abdul Che Halim

Client:

Denso Manufacturing Tennessee

Industry Advisor:

Steven Bodnar

Primary Seminar Supervisor:

Joel Barnett,
Associate Professor of the Practice
of Mechanical Engineering

PROJECT DESCRIPTION

Denso Manufacturing Tennessee (a subsidiary of Denso, Inc., Japan) located in Maryville, Tennessee, is a major supplier of automotive electromechanical components (starters, alternators, engine controls, etc.) to the auto industry. In the manufacture of automobile starters one of several forged components (clutch barrels) may be similar in general configuration, but differ in detail, such that damage to the manufacturing equipment may result if the various types of components are inadvertently mixed. The Denso Design Team's task is to design an inspection and control system to determine the details of each component's configuration and reject those not appropriate to the production machinery's proper operation.

Rocket-Fuel Valve for Small-Scale Orbital Thrusters

DEPARTMENT OF MECHANICAL ENGINEERING

Team Members:

Nur Izzati Ilyes (EE)
Michael Johnson
Christopher Popa
James Boyle
Dwight Bert

Client:

Orion Propulsion-Dynetics Corp.

Industry Advisor:

Mark Wells

Primary Seminar Supervisor:

Joel Barnett,
Associate Professor of the Practice
of Mechanical Engineering

PROJECT DESCRIPTION

Orion Propulsion Systems (a subsidiary of Dynetics Corp.), Huntsville, Alabama, designs and manufactures small rockets and rocket thrusters for NASA satellite orbital applications. The rockets produced by Orion are small liquid-fueled rockets used for altitude control and other applications that require precise control of thrust levels. The Orion Design Team's task is to design and test, using both conventional fluid-mechanical techniques and computational fluid dynamics (CFD) methods, an improved valve system for the rocket thrusters' fuel delivery system.

Quality Inspection System for Diabetic Evaluation Sensors

DEPARTMENT OF MECHANICAL ENGINEERING

Team Members:

Nathan Williams
Nathan Andress
Farah F. Iskandar (EE)

Client:

Roche Diagnostics, Inc.

Industry Advisor:

Brandon Wilson

Primary Seminar Supervisor:

Joel Barnett,
Associate Professor of the Practice
of Mechanical Engineering

PROJECT DESCRIPTION

Roche Diagnostics, Inc., Indianapolis, Indiana, is a division of Roche Pharmaceuticals, Berne, Switzerland, and produces diagnostic devices for diabetics care. In the manufacture of the diagnostic devices a test solution (chemical) is applied to the test device's electronic circuitry and allowed to dry. The Roche Design Team's task is to design and test a system for evaluating the quality and uniformity of the application of the test chemicals to the system's sensor circuitry.

Magnesium Armor Structural Improvements for Military Vehicles

DEPARTMENT OF MECHANICAL ENGINEERING

Team Members:

Richard Teruya
John Vollmer
William Segale
Thomas Pearson
Keith Lunkenheimer

Client:

The Military Systems Group

Industry Advisor:

Andy Copeland

Primary Seminar Supervisor:

Joel Barnett,
Associate Professor of the Practice
of Mechanical Engineering

PROJECT DESCRIPTION

The Military Systems Group (MSG) is located in Nashville, Tennessee, and is engaged in the business of designing, building, and testing upgraded armor and weapons-systems mounts for military vehicles. The MSG Design Team's task is to investigate the feasibility of joining military-grade magnesium alloys (armor plate) with conventional aluminum structural members. The objective is to combine the ballistic performance and light weight of the magnesium alloy with the relative ease of structural use of aluminum. The joining process for these alloys is to be friction stir welding (FSW). This project will be performed in conjunction with the Vanderbilt Welding Automation Laboratory.

Manufacturing Process Control for Rear Window Installation, Nissan Vehicles

DEPARTMENT OF MECHANICAL ENGINEERING

Team Members:

Rebecca Denny
Jeffrey Leonard
James Kong
James Des Cognets
Kyle McMillan

Client:

Nissan Motor Manufacturing

Primary Seminar Supervisor:

Joel Barnett,
Associate Professor of the Practice
of Mechanical Engineering

PROJECT DESCRIPTION

Nissan Motor Manufacturing of Smyrna, Tennessee, a subsidiary of Nissan North America, manufactures several models of Nissan motor vehicles. To prevent leaks around vehicle windows a sealing compound must be applied to the front and rear windows before their installation on the assembly line. The Nissan Design Team's task is to design an improved system for sensing and control of the window sealing compound application process. This design will work in conjunction with existing robotic positioning and application systems in current operation at Nissan.

Process Improvements for Production of Biodiesel Fuel

DEPARTMENT OF MECHANICAL ENGINEERING

Team Members:

Paul Beauchamp
Brendan Stiffle
Grayson Adkins
Nick Marino
Manraj Rangi

Client:

Vanderbilt Biodiesel Initiative

Faculty Advisor:

Robin Midgett

Primary Seminar Supervisor:

Joel Barnett,
Associate Professor of the Practice
of Mechanical Engineering

PROJECT DESCRIPTION

The Vanderbilt Biodiesel Initiative exists to promote the use of biodiesel fuel in VU campus vehicles. The Biodiesel Initiative manufactures biodiesel from oil/grease collected on campus that would otherwise be a discarded product. The VU-Bio-Diesel Team's task is to design a chemical-powder measurement system to dispense one of the primary ingredients in the fuel-conversion process.

Design of an Improved Ink-Jet Printer for Two-Sided Copies

DEPARTMENT OF MECHANICAL ENGINEERING

Team Members:

Aaron Jagoda
Bryan Edwards
Luqman Hakim Rohaizat
Mohd Izwan Ismail

Client:

Lexmark, Inc.

Project Advisor:

Joel Barnett,
Associate Professor of the Practice
of Mechanical Engineering

Industry Advisor:

Kent Ubellacker

Primary Seminar Supervisor:

Joel Barnett,
Associate Professor of the Practice
of Mechanical Engineering

PROJECT DESCRIPTION

Lexmark, Inc., Lexington, Kentucky, is a producer of ink-jet printers and other office equipment. The goal of this project is to design an improved ink-jet printer that will produce two-sided copies at a rate equivalent to comparable laser printers. The printer should maintain high standards for print quality and reliability. Easy and convenient user-interfaces are also required.

LeachXS: Innovation Strategy for Energy Production Residuals Modeling Software

ENGINEERING MANAGEMENT PROGRAM

Team Members:

Nick Berini
Erica Mills
Lindsay Ratterman

Client:

Department of Civil and
Environmental Engineering

Project Advisor:

John Bers, Associate Professor
of the Practice of Engineering
Management

Industry Advisor:

David Kosson, Professor and Chair,
VUSE Department of Civil and
Environmental Engineering

PROJECT DESCRIPTION

The objective of the project is to develop a business plan, marketing plan, and example marketing materials for LeachXS. LeachXS is a software tool developed to assist in assessing the environmental impact of contaminant leaching from a wide range of solid materials when in contact with water in the environment (e.g., wastes, recycled materials, combustion residues, construction materials in contact with infiltrating water from precipitation). Leaching in an environmental context is defined as the transfer of contaminants from the solid phase to the water phase. Contaminants then present in the water can degrade water resources, including impacts to ecosystems and drinking water supplies.

Commercialization of Hyperthermia-based Cancer Research and Treatment Device

ENGINEERING MANAGEMENT PROGRAM

Team Members:

Will Greene
Steve Ryan
Guru Shah

Client:

BioThermatics, Inc.

Project Advisor:

John Bers, Associate Professor
of the Practice of Engineering
Management

Industry Advisor:

Dennis Clark, General Manager

PROJECT DESCRIPTION

BioThermatics is a development-stage medical device company focused on enabling hyperthermia-based cancer research. Hyperthermia therapy is a cancer treatment that involves heating tumors to kill or weaken the cancerous cells, thereby improving the effectiveness of radiation, surgery, and anti-cancer drugs. The project is to develop an innovative commercialization strategy to help the client market this device technology to universities, medical research institutions, and for-profit businesses engaged in cancer research and commercialization activities. Specific tasks include the following:

- Additional market research to determine the best pathway to commercialization
- An assessment of how difficult it would be for potential competitors to produce working copies of this device
- Assessment of FCC regulations governing the use of radio frequencies for medical applications and how best to overcome this issue
- Identification and analysis of any miscellaneous issue that would mitigate the risks associated with entering this market and make this opportunity more attractive to investors

Innovation/Commercialization Strategy for Device for Rapid Detection of Pathogens in the Blood Stream

ENGINEERING MANAGEMENT PROGRAM

Team Members:

Margaret Durlacher
Seth Harkin
Bryan West

Client:

Sepsis, Inc.

Project Advisor:

John Bers,
Associate Professor of the Practice
of Engineering Management

Industry Advisors:

Richard Russell, Chief Financial
Officer, Mark Russell, Consultant

PROJECT DESCRIPTION

The Sepsis Multi-wavelength Detection Device can rapidly detect pathogens by using CCD micro assay and electron detectors to obtain a fingerprint of the pathogen and then compare it to a built-up library of known pathogens' spectra, molecular size, and electron configuration. The device is capable of not only detecting sepsis, but also will identify anything that has affected human blood whether viral, bacterial, chemical, biological, or radiological. Increasing the speed of diagnosis of pathogens in the bloodstream from 24 to 72 hours down to less than one hour will speed diagnosis and create the opportunity to apply highly accurate and effective treatments far sooner. The device has real potential to cut the death rate in half (450,000) and would save the U.S. medical industry over \$16,000,000,000.00 per year in treatment and hospitalization costs alone. The objective of the project is to research, develop a Commercialization Roadmap (to include a business plan and profit model), create a Program Management Plan, and provide other analysis necessary to create a pathway to full product realization.

THANK YOU TO OUR SPONSORS

Our sponsors generously support the senior design program.

Thank you for providing your time, experience, and financial support that make our program a success.

Acoustic MedSystems
Barge Cauthen & Associates
Barge Waggoner Sumner & Cannon
BioThermatics
Camp Dresser & McKee
City of Kingsport, Tennessee
Denso Manufacturing Tennessee
Gresham Smith & Partners
Hartsville Water & Sewer Department
Kimley-Horn
Lexmark, Inc.
Littlejohn Engineering Associates
Max-Mobility, Inc.
Metropolitan Government of Nashville and Davidson County
Nissan Motor Manufacturing
Orion Propulsion-Dynetics Corp.
Pathfinder Therapeutics
RAE/SE&I
Roche Diagnostics, Inc.
Sepsis, Inc.
Sole Supports, Inc.
Stan D. Lindsey & Associates
Structural Design Group
Tennessee Department of Transportation
Tennessee Valley Authority
The Military Systems Group
Walick-Kemp, Inc.
Zimmer Corp.

Vanderbilt Chapter of American Society of Civil Engineers
Vanderbilt University Biodiesel Initiative
Vanderbilt University Medical Center, Anesthesiology
Vanderbilt University Medical Center, Cardiology
Vanderbilt University Medical Center, Neurology
Vanderbilt University, Owen Graduate School of Management

VANDERBILT

SENIOR DESIGN PROJECTS

SCHOOL OF ENGINEERING

Tuesday, April 27
3:00–5:00 p.m.
Adams Atrium
Featheringill Hall



VANDERBILT
SCHOOL OF ENGINEERING

PMB 351826
2301 Vanderbilt Place
Nashville, TN 37235-1826

U.S.
POSTAGE
FIRST CLASS
Permit
No. 1460