Connecticut College of Technology Student Research Programs

Year 2010 through 2016 Student Projects

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A National Science Foundation Center of Excellence
This brochure is dedicated to the Connecticut community college and university students, during 2010 through 2016 that worked tirelessly on the research projects described in this brochure.
The College of Technology (COT) is a unique infrastructure that consists of Connecticut’s twelve community colleges as well as eight public and private partner universities. Through these partnerships, seamless pathways from the community colleges to the four-year universities are created and provide numerous benefits to students starting in the community colleges who decide to go on to complete a four-year degree. The two core programs are Engineering Science and Technology Studies, which has 17 options among the community colleges.

In 2012, the COT and its Executive Director received the New England Board of Higher Education Merit Award for the State of Connecticut and an additional grant from the National Science Foundation (NSF) to collaborate with educators and business and industry in Germany.

Regional Center for Next Generation Manufacturing

The COT model has received national recognition as an industry responsive educational model and in 2004 received a $3 million Advanced Technological Education (ATE) award (#0402494) from the NSF to establish the Regional Center for Next Generation Manufacturing (RCNGM), a second NSF award (#0903209) of $2.8 million in 2009 and a third award (#1205104) of $3 million in 2012 to continue the exemplary work of the RCNGM, one of seven NSF ATE Advanced Manufacturing Centers in the nation.

The RCNGM addresses the need for highly skilled workers in the new manufacturing workplace by building programs that provide resources to educators and students interested in learning new technologies in manufacturing. The RCNGM is directed by the COT and administered by Tunxis Community College.
Research Project Descriptions

Students from the Connecticut College of Technology and CT universities applied for admission to the Programs for the purpose of conducting research initiated by select Connecticut and U.S. government organizations.

From 2010 to 2015 all student research projects were administrated by the Life Support and Sustainable Living Program (LSSL) which was funded by a grant from the NSF (DUE ATE #0903131). The selected students focused on real world research projects that addressed life support and sustainable living challenges that were facing America.

Students admitted into the 15 week program initially attended a 3 week workshop that taught them essential professional skills such as team building, project planning, and project management. Training in 3D solid CAD modeling and 3D printing was also provided.

From 2015 to 2016 the Mechanical and Manufacturing Technologies Program (MET²), (NSF DUE 1400610) was created. This program was essentially an extension of LSSL but added training in entrepreneurial skills, intellectual property essentials, and microcontroller programming.

Students work in self-managed teams, each having a technical advisor along with coaching and mentoring support. The students receive a stipend during the program and submit a comprehensive report at the conclusion.

An abstract of each report follows on the next pages.
2016 Projects
Mission Statement
Using innovative manufacturing technologies to improve the production, customization, and availability of prosthetics devices for children.

Synopsis
The Prosthetic for Kids Project has been broken down into several stages due to its complexity. The long term goal of this project is to create a trustable product capable of being marketed and distributed in America and the world. In order to do so, the design process of this project must follow meticulous analysis and testing to ensure all aspects of the product meet or exceed the market standards. The first stage of the project was developed in spring 2015; during the MET2 session held that year. During this period the team selected was able to create a prosthetic arm that met the requirements of the project. Moreover, a prototype was manufactured to prove the efficacy of the design and the different features that made this project unique. This design became the basis of project; further developments were based on the prototype created in spring 2015.

The second stage of the project (current one) targets the creation of an interface, or socket, to connect users with the prosthetic arm, as well as the optimization of the arm design from stage 1. The socket interface is critical in the success of this project because of two important factors: first, the socket is the part responsible for holding the prosthesis in place; second it allows the user to operate the prosthetic arm. Creating a socket design that does not require complex manufacturing processes and lengthy fitment sessions represents a game-changing achievement for this project and the prosthetics industry.

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Landon Benzullo  Central CT State University
Alex Cartwright  University of Hartford
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Embedded Microcontroller Design Project

Smart Guitar V2

Mission Statement
The mission was to create a functional prototype of a high end guitar that incorporates microprocessors and touchscreen technology to enhance the user experience for musicians of all skill levels.

Synopsis
The Smart Guitar V2 team initially aimed to recreate the original smart guitar project with their own built in touchscreen computer. They researched the cheapest way to obtain their goal by finding the cheapest parts needed. After obtaining the necessary components, they needed to find out how to make a program that can replicate the iOS app featured on last year’s project. Once the program had easily achieved what they had hoped, they then added several effects to manipulate the sound of the guitar. They proceeded to package the wiring connections and the components into the body and secured everything with two 3D printed shields.
Mission Statement
Develop a manually operated transportation system that captures its residual energy to purify an onboard water source for developing countries.

Synopsis
The Traveling On-board Aquatic Specimen Irradiation System, also known as Traveling OASIS, started out with an idea of creating a cart that could be pulled easily by a human or animal without causing any harm, and generate power to filter and purify polluted water for human and animal consumption and also human sanitation. This cart would be designed not only to pull heavy loads but it would also be able to carry a water purification system and filtration. There would be two septate reservoirs, one for the polluted water and one for the clean water. As the cart is pulled along to its destination, the rotating axis of the wheels would generate power through some sort of power generation system that would then be stored in batteries. This power would then run the purification system.

The team had to think of goals and action steps that were obtainable within the three-month working time span. The team came to a decision to split the project up into three different stages. For 2016 the team only had enough time to work on stage 1 which focused on the filtration system and the purifying system.

A multimedia filtration system was selected because it could filter bacteria/pathogens and viruses up to a 95% level and some pollutants to undetectable levels. The most important part is that it is a low maintenance system that requires inexpensive material and equipment.

The purification system is made up of an ultra violet light system. The benefits from using this method compared to others is that it will kill microorganisms up to 98%, only requires lamps changes about every 9000 hours. It would only need an occasional filter change. The UV light does not need much power, which would make it perfect to run off the power from a cart.

An operational prototype was successfully built and demonstrated.
Energy and Environmental Design Project

Green Infrastructure

Mission Statement
To produce a versatile electrode probe kit which records water infiltration systems to monitor the success of green infrastructure for the United States Geological Survey (USGS)

Synopsis
The project keeps a record of water reclamation by soil that is introduced to the soil by green infrastructure. Examples of green infrastructure that do this are permeable pavement, bioswales, rain gardens and green roofs. This issue is very important for the environment and for the health and safety of people. In Connecticut and many other parts of the world, global warming has caused fewer rain falls, but the rain that we do get is often more intense and of a greater volume. This often means that streams and rivers can be over flooded.

Also, do to large amounts of areas covered by roads, parking lots and buildings there is no way for water to be introduced to the soil where it lands. By having water enter the soil early, our rivers and streams will not be inundated and our aquifers will be replenished. We depend on ground water for a steady supply of water and it is important that aquifers be replenished by rainfall seeping through soil.

A working prototype of a tubeless and a tube design was fabricated. Resistivity data from both designs in gravel and beach sand was collected. We received immediate feedback on the gravel readings and slower results with the sand and potting soil. The data from the tube design showed the more reliable sensor data.

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Mission Statement
The Wireless E Data team aims to reduce the size of last year’s prototype by switching to the PIC microcontroller supported by a custom PCB design. The team also intends to implement a graphical user interface, “home base”, powered by a Raspberry Pi. Ultimately, the team will create the first Wireless E Data network.

Synopsis
Once all team members were up to speed, the team ported a “lightweight” version of the Arduino software to the PIC platform. Simultaneously, the team designed, ordered, and tested its first PCB iteration late February. This was a tremendous success and morale booster for the team as the group did not have any prior experience in PIC software development or PCB design.

Next the team split into two subgroups, each with its own primary and secondary goals. One portion of the group focused on PCB design and software development; the other focused on mechanical design and document control. By mid-March the team had settled on their second PCB iteration and ordered a total of seven boards. At this time the team also began to 3D print enclosures for the devices, the mechanical design involved two iterations before settling on a working design. Lastly, the team completed and tested the Raspberry Pi “home base” software.

The team struggled with unexpected software and hardware complications. Features that performed without issue in a test environment did not perform as expected when tested in a “real-world” fashion. The PIC software did not always detect a fall, and our “home base” would lock up and become unresponsive at times. This forced the team to push additional revisions of both the PIC and Raspberry Pi software. It also became apparent that battery life was an issue. With too little time to redesign the circuit, the team switched to lithium batteries as a “quick fix” solution. With the help of great teamwork, cool heads, and three 12hr+ meetings, the team achieved their goal of creating the first Wireless E Data network.

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Mission Statement
Provide Westminster Tool a state of the art centralized cooling system to reduce energy consumption for temperature sensitive machines.

Synopsis
Westminster Tool wanted at least one different cooling method for their manufacturing machines that would have the excess heat dumped outside the building keeping the workspace in workable temperatures. This would mediate the need for year round cooling with their industrial air conditioners saving the company money year-round.

The team broke into three sub groups that could focus on three different technologies that would do the same job as the current system but with an overall decrease in cost and carbon footprint. We narrowed down the options into three systems: geothermal technology, cooling towers, and external chillers.

After calculating the total heat output all the chillers dumped into the workspace we then calculated the amount of work the air conditioners did and how much electricity was consumed yearly. After the systems were picked the ROIs and BEPs were calculated which included the up-front cost of the systems, installation, and the power needed to run them yearly.

The team concluded that the external chillers method was not capable of having an acceptable ROI compared with their existing geothermal system.
Energy and Environmental Design Project

Green Manufacturing Facility – Company X

Mission Statement
Conduct research including a full cost benefit analysis for an innovative manufacturing facility that is fully functional and highly energy efficient.

Synopsis
The Company X team began with the idea of an innovative, efficient, and creative manufacturing plant that would use as much renewable energy as possible. This would be an ideal facility that would be as effective and efficient as it is environmentally friendly. It was decided that the company would be limited to two acres of land with a budget of five million dollars. The facility would also be making aluminum alloy wheels which would affect the manufacturing flow and therefore the company layout.

The most important task in this project was effectively planning what steps to accomplish before others. The team found that research on renewable energies, research on company sections, and designing a rough floor plan were the most important. They then selected what kinds of renewable energies to use and found information on estimated costs for installation.

They then refined the basic floor plans that were made by editing them in a CAD program. They also added additional parking spaces and a large area for trucks to pick up and drop off materials. With all of our space split into sections, they effectively organized the manufacturing floor for product flow in batches of four. This involved researching the type of wheels that would be made, the process for making them, and the cost of machines. These machines would then be roughly organized into stations and efficiently placed in the manufacturing section of the facility.

The proposed facility uses renewable energy for sixty percent of its energy consumption, fits within two acres with room to expand, and stays within our budget of five million dollars.

This project should continue for at least another year in order to refine the current layout, create a more in depth manufacturing flow, and include a full three dimensional virtual walkthrough of the facility.

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Mission Statement
To design an emergency rescue raft that integrates existing technology into smart fabric creating a more reliable product during life threatening situations.

Synopsis
After researching existing tent and raft design technologies along with the use of “smart” fabrics the design of an enhanced emergency sea rescue raft became the focus of this project.

For the raft a tent like structure was chosen, which correlates with the most successful current raft designs, and which will provide shelter from the harsh elements out in the ocean.

In the rescue raft market a RF transmitter is rarely attached to the raft. It this design it was desired to integrate a transmitter, which would send out our location coordinates, of the actual raft itself providing a detailed location for rescue. The raft incorporated GPS signaling capabilities so that the user would be able to track their coordinates, and then send these coordinates out through an RF antenna to nearby rescue centers.

Additionlly the walls of the rescue raft have fiber optic fabric panels. These panels alternate with solar fabric panels on the exterior of the raft. The fiber optic panels are attached to a sensor on the top of the raft, which is triggered through the presence of low light. The purpose of these panels is to create a SOS signal that will begin in the evening.

Along with the solar panels piezoelectric fabric will be used. By integrating the piezo electric fibers into the flooring and flag fabric of the raft, any movement from the waves/wind of the ocean would create energy.

All energy created can then be stored in batteries that would also be integrated into the fabric to power any electronics used within the raft. Using 3D printed battery cells the energy generated from the solar panels and piezoelectric fabrics would charge the battery cells lined on the inside of the emergency raft. This creates a self-sustainable rescue raft for any duration of being lost at sea.

The team was able to create a working prototype.
Mission Statement
This project aims to create an easy to use phone application to aid the visually impaired in navigating a busy world by utilizing a Quick Response reader camera to scan 3D printed QR codes.

Synopsis
Building upon previous iterations from the Life Support and Sustainable Living (LSSL) Program, the IntelligEyes project has created an easy to use phone application to aid the visually impaired in navigating a busy world. In previous years of the LSSL program, a Quick Response (QR) reader camera that scans 3D printed QR codes was developed. This project looks to build on this technology to create a fully functional prototype.

The purpose of this project is to complete a three dimensional prototype of a three sided Quick Response (QR) trapezoid, to aid the visually impaired. Currently, many buildings are equipped with the Braille system; however, these Braille signs provide very limited information to the visually impaired. IntelligEyes will increase the range of information that can be provided to the visually impaired. This QR trapezoid can be used with any device with smart phone capabilities that has the application installed and the required application is easily accessible to the general public. The application will send the user to a website that hosts directional audio files. We are looking to implement the prototype will into a “real world” facility.

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Mission Statement
The goal is to design a small, low cost 3D printed Unmanned Aerial Vehicle (UAV) kit for high school students nationwide that can be used as a teaching tool for lessons in SolidWorks, Rapid Prototyping, and 3D Printing.

Synopsis
The Micro Unmanned Aerial Vehicle (UAV) team has been hard at work designing, prototyping and testing a 3D printed micro UAV kit. The requirements for the UAV are that it be compact, lightweight and easy to assemble. The design aspect of the drone was accomplished using SolidWorks, while simultaneously 3D printing prototypes in order to find the right balance of minimal weight and strength of material.

The target demographic of the project is students across the country, via teachers providing classroom instruction. The kit includes the drone with essential components such as flight controllers, motors, rotors, speed controllers, and proper connections along with instructions on the UAV’s assembly. What sets this project apart from the competitors is our step by step design instructions that are given to students to create their own versions of the UAV through SolidWorks.
Mission Statement
The goal of this project is to design, manufacture, and test a modular permeameter prototype that can be used for a wide variety of purposes, including contaminant tracer tests, in addition to measuring hydraulic conductivity, which will ultimately offer the U.S. Geological Survey a device with a higher functionality at a lower cost.

Synopsis
Conventional permeameters are devices that measure hydraulic conductivity of a given soil sample but are limited in their usefulness to the US Geological Survey (USGS) because of their inability to perform other flow through tests. The Permeameter Redux Team has designed, manufactured, and tested a modular permeameter prototype that can be used for a wider variety of purposes, including contaminant tracer tests, which will ultimately offer the USGS a less expensive but more functional device.

The United States Geological Survey (USGS) originally sought out to design and build an inexpensive, meter-scale permeameter after discovering the shortcomings associated with the smaller, more expensive ASTM (American Standard for Testing and Materials) standard permeameter in spring of 2014. The latter could only be used in determining soil hydraulic conductivity, but not in quantifying the ways in which contaminants move through a sediment column. By developing a larger scale permeameter, the team will be able to perform tracer tests in order to achieve this goal. A prototype was constructed by hand using wood and acrylic during the summer of 2014 but failed in testing because it proved not to be watertight. The team’s objective is to come up with an improved design and utilize 3D design and printing to manufacture and test a functional, inexpensive, meter-scale permeameter.
Energy and Environmental Design Project

Personal Grid – Increased Efficiency

Mission Statement
Most houses pull electricity from the grid in the form of 120 volts (V) of alternating current (AC). Most devices in a house run on 12V of direct current (DC), which requires AC to be transformed into DC, resulting in 20 to 40 percent of energy loss. The goal of this project is to research and design a method in which power can be wirelessly transmitted in the form of 12V DC through a house with electrical magnetic waves, which can be delivered to a receiver attached to various devices.

Synopsis
Energy is wasted everyday though transforming 120 volts (V) of alternating current (AC) to 12V of direct current (DC). This happens in the majority of houses across the nation and this transforming of currents results in 20-40 percent energy lost. AC is able to deliver high power to houses over long distance, it can travel many miles where DC can’t. But, there are only a handful of devices and appliances in a house hold that use AC while the remainder operate on DC, or have the potential to run on DC but have built in transformers. The Grid team has researched wireless power technology to develop an energy efficient personal grid, by transmitting 12V DC from a green personal grid wirelessly. Power will be sent from a transmitting magnet copper coil to a receiving magnet copper coil. This innovation to the grid will result in more houses installing green energy sources i.e. solar panels, windmills that will charge up a system of batteries that will feed the wireless system resulting in less energy loss.
Mission Statement
This team aims to use innovative manufacturing technologies to improve the production, customization, and availability of prosthetic devices for children.

Synopsis
It is very difficult for disadvantaged families to provide a better life for children who rely on prosthetic devices. This project seeks to design and create a more affordable prosthetic hand for children by using innovative engineering technologies to lower the costs of production, allow inexpensive customization of parts, and increase product accessibility.

This project combines the experience and knowledge of six engineering students in the creation of a more affordable prosthetic device for children. The prototype created proves the feasibility and versatility of these devices. This prototype uses servos and microcontrollers attached to muscle sensors to provide smooth actuation of the hand, with at least one degree of freedom. The materials used in the hand and arm have been selected to ensure quality, safety, and reliability at fractions of the price of commercial prosthetics. The modularity of the parts makes it easier to replace damaged components, which reduces maintenance times and the costs of new parts. This design also allows the parts to be created not only by 3D printers, but also common manufacturing facilities, making it possible to manufacture these devices across the world.
Embedded Microcontroller Design Project

Smart Guitar

Mission Statement
The goal of this team is to develop an innovative guitar for musicians using state of the art technology and smart phone capabilities. The team will create a guitar that allows the user to modulate sound using an iPhone application.

Synopsis
The Smart Guitar team will produce a prototype incorporating development of an iPhone application (app) and a guitar pickup for transmitting signals. With our design, the iPhone is capable of receiving a signal from the guitar’s pickup. An app on the iPhone will be capable of changing the volume, tone, or effects and then transmit the signal to an amplifier or speaker.

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Kevin Coiro  Gateway CC
Marc Cacioppo  Gateway CC
Mechanical/Aerospace Project

Space Suit – Improved Functionality & Mobility

Mission Statement
The goal is to research the use of advanced techniques and materials, such as Shape Memory Alloys and additive manufacturing, to develop improved space suit components that are easier to use and universal instead of specialized.

Synopsis
The Space Suit team has designed and prototyped unique space suit components, such as micro scissor lifts, to incorporate the use of Shape Memory Alloys. The Shape Memory Alloys are used to move the scissor lift while latex is used to move it back to its original state. The scissor lifts have been integrated into a full boot design. The team has also researched the use of soft engineering and compressed air as actuators to expand and contract different components of the Space Suit. We believe that both of these techniques will lead to a better space suit that is lighter, easier to take on and off, and provide better mobility while worn.

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Mission Statement
This research project focuses on harvesting energy released through vibrations [mechanical energy]. Using electrical components called “piezos” the team will create a cell phone case to convert vibrations from the normal movement of a cell phone into usable electrical energy.

Synopsis
The main scope of this project is to try to improve upon the Surge device for harvesting energy using better materials and innovative equipment. We sought to develop a cell phone case that is capable of harvesting the energy created through the vibrations of normal cell phone use. That harvested energy would then be converted to provide an energy source for other uses. This would create a free, clean and renewable energy source. As part of this project, we investigated the use of piezoelectricity, the best materials for the cell phone case, and the utilization of the Arduino board.
Mission Statement
The goal of this project is to investigate the possible presence and application of 3D printers aboard U.S. Coast Guard vessels.

Synopsis
With the rapid development of 3D printing technologies there is potential for use of this technology aboard large vessels such as the United States Coast Guard cutters, where structural problems can cost large amounts of time and money, and possibly even lives. To investigate a beneficial application of 3D printers, the USCG Repairs at Sea team will design, manufacture, and test a method for patching ruptured pipes that is superior to current methods and easily reproducible through 3D printing, which can be used at sea under unfavorable conditions.

The goal of the Repairs at Sea team is to explore the benefit of having a 3D printer aboard large seagoing vessels like USCG cutters. The Coast Guard presented us with the problem of critical pipes bursting and needing to be patched quickly, and the current method has a number of drawbacks. The team came up with two main designs of a simple, no-tools-required patch that could be 3D printed. The benefit of utilizing 3D printing for repairs is that it offers the ability to reproduce them as repairs as needed, allows the integration of a feature like a built-in rubber seal for better containment, and easy modification such as scaling to fit different size pipes. The designs were improved to include an integral closing mechanism to eliminate the need for tools and a stackable design so patches can be linked together to cover long cracks. We had limited resources and our simple ABS models weren’t ideal, though they do demonstrate a simple and superior way the Coast Guard can use to contain leaks that could be very reliable with the right machines on board or even on base.
Mission Statement
The Wireless E Data team aims to create an inexpensive wearable device that promotes fall safety and awareness in “high-elevation” construction sites.

Synopsis
The goal is to design a device that sends a distress signal from the harness when a construction worker has fallen or presses their panic button. The device incorporates the Arduino microcontroller and Xbee radio communications chip. The Wireless E Data Project exploits the power of the Arduino and Xbee radio chip to create a peer to peer emergency alert system. When attached to a safety harness our device can detect when a worker has fallen. During a fall the device will alert all other workers in the area by producing an alarm, flashing a strobe light, and also causing all the other devices to vibrate. These alarms continue until all devices on the network are power cycled.

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2014 Projects
Mission Statement
To design and build a functional microcontroller prototype of a Safety Harness Alert System (SHAS) to alert workers in the event of a fellow worker falling.

Synopsis
The SHAS project began in 2012 when students at the University of New Haven built a proof of concept circuit board design.

The 2014 SHAS team started the project by deciding to use an open source microcontroller Integrated Development System (IDS) called Arduino from Ivera, Italy. The Arduino uses the low cost Atmel ATmega328 chip.

Writing programs to control the Arduino proved to be the most time consuming and difficult part of the project. The next critical step was to get multiple SHAS units to communicate with each other. The team selected an XBee radio frequency chip for this task. Coding this chip to communicate with the Arduino board and with each other also proved to be challenging.

The final, and more manageable, challenge was designing a housing for the electrical components. The team completed two designs using a Computer Aided Design software package called SolidWorks. The designs were then manufactured using 3D Printing technology.

In addition to completing the prototype, the team was also able to realize some of their secondary goals. The team was able to determine a target market. The team also learned about the different state and federal laws governing worksite safety and equipment. There was some incredibly useful information regarding the correct response time to accidents. However, the team found that there were no specific laws applicable to the SHAS. There are no specific laws because there is simply nothing like the SHAS currently on the market.

A Phase II of this project is anticipated in 2015.
Mission Statement
Design and build an efficient Unmanned Aerial Vehicle (UAV) to lower the cost compared to the current market using SolidWorks CAD software and rapid prototyping 3D printers.

Synopsis
Early on the team decided to breakout into two separate design teams due to logistics and to essentially have a best design demonstration.

The first teams design was constructed of a truss design to help minimize the weight and amount of plastic being used. The truss design allowed the team to run the electronic cables through the arm instead of exposing the wires. It also featured an external battery strap that required strips of Velcro or zip ties. The UAV also has insert able arms that must be screwed in to “lock” into place. The motor mounts required some drilling and separate motor mount plates. After the first build improvements in ease of use were easily identified.

The second team targeted areas where it might be confusing or too time consuming to assemble all the parts. They first made the arms clip-in instead of having screws to assemble. A battery compartment was designed so that you can open and close it for quick and easy access. Fillets were added where needed to help reduce high stress areas and to make the structure more stable. A significant new feature was added, mainly, a camera mount specifically designed for a Go-Pro camera. The motor mounts were changed to enclose the motors and to have a separate mounting plate. After several design iterations the final design resulted in a very light weight UAV.

Two teams, two designs, resulting in two UAV flying in the air. In the STEM community we live in today there never is just one “best” anything. This project bore this out.
Mission Statement
To improve existing green technology by creating a more efficient way of capturing energy from a stationary bike while motivating cyclists.

Synopsis
Some exercise bikes use generators to capture electricity. However, the output power is related to the rotational speed of the wheel alone, which results in a loss of energy.

In order to lessen this loss and create a more efficient product, it was decided to use a more productive system composed of four parts connected to each other. A bike will hook up to a gearbox in order to control and lower the torque. The gearbox will also be connected to a continuously variable transmission (CVT), which regulates the revolutions per minute (RPM) ranges. The CVT in turn will be connected to an alternator, designed to produce a certain amount of power and linked to a generator controlled by a computer. The implementation of this device will allow us to create a retrofit regenerative design that not only capture the user energy but also minimize the loss of energy observed. It will also provide the opportunity for the gyms to profit from the hard work of their customer. As a benefit, the energy captured could be used to charge batteries for common personal electronics as well as lowering costs spent on electricity at the same time.

The initiative of this year’s team was to try and create a functional prototype for a proof of concept. An attempt to formulate a viable system capable of handling design goals compatible with preliminary design ideas was achieved.

This project is in its first year phase within the program and will continue in 2015.

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Gateway CC
Mission Statement
The mission of this project was to complete a three dimensional prototype of a three sided Quick Response cube to aid the visually impaired.

Synopsis
Currently many buildings are equipped with the Braille system to aid the visually impaired. This cube can be used with any device with smart phone capabilities with appropriate applications that are easily accessible to the general public. The application will send the user to a website that hosts directional audio files. The prototype will potentially be implemented into a facility. This year the team changed the model from having the QR code on the cube to having the QR codes being able to slide in and out of the cube itself.

The team found that trying to 3D print in more than one color on each side of the cube was not satisfactory. The creation of multi slide thin plate like squares was the solution. In office building the cubes can be mass produced and the extra squares can be printed upon request with appropriate information. The team also changed the QR codes by inputting the web link into a compressed text URL.

The team conducted many interviews with the visually impaired. The final design reflects the findings.

A Phase III of this project is anticipated and will incorporate multilingual audio files is to serve other countries.
Mission Statement
To update and extend the current grade 7 Information and Communications Technologies (ICT) curriculum of Ghanaian schools to an effective blended learning activities course.

Synopsis
The teams vision was to complete a blended learning experience that complimented the current Information and Communications Technologies (ICT) curriculum. The focus was to prepare the students with a framework for 21st century learning. This framework describes the skills, knowledge, and expertise students must master to succeed in work and life. It is a blend of content, knowledge, specific skills, expertise and literacy. The completed course is designed to supplement the existing ICT curriculum with rigorous projects that develop essential skills for success in today’s world, such as critical thinking, problem solving, communication and collaboration.
2013 Projects
Mission Statement
To develop a modern system of delivering directional information to the visually impaired using QR (Quick Reader) Codes and Cell phone applications.

Synopsis
Based on an invention of Prof. Eric Flynn at Gateway CC (New Haven, CT) the team was tasked with creating an alternate form of Braille reading using a cell phone software application.

Normally sight impaired people use their fingers to read Braille code. Alongside the normal Braille code a plastic panel would contain QR code. QR code (abbreviated from Quick Response Code) is the trademark for a type of two-dimensional barcode first designed for the automotive industry in Japan. The QR code created by the team contained a unique webpage link.

To simulate what the software application (app) would do the team first created a novel webpage application. When the QR code is scanned by the phone’s QR reader the code produced takes you to a web page that contains a voice message of the physical location of the phone. The team created the web page that rendered correctly on the cell phone that captured the QR code.

A cell phone software application is currently being written that will contain everything with one click of a app icon.

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 Gabriel Geist
University of New Haven
Middlesex CC
Tunxis CC
Middlesex CC
Mission Statement
To further investigate piezoelectric devices that will new ways to recycle energy and access it where electricity may not be readily available.

Synopsis
In following the research and design process as taught at the 2013 LSSL Winter Intersession the team was able to produce a model floor lined with piezoelectric devices which can effectively convert the mechanical energy from movement on the floor into renewable energy.

When a piezoelectric material is subjected to a mechanical deflection/stress, an electric current across the device is generated. This current can be stored into a battery for future electronic applications. The model floor did do so whenever movement is going on and can either charge a capacitor or immediately light a Light Emitting Diode (LED) that was built in the perimeter of the platform.

In the future, further research can go into optimizing the output voltage of the piezo devices that occur from different human interactions.

The project was deemed to have been successful and met several educational objectives.
**Mission Statement**
To design and construct a working system that recovers waste heat energy and converts it into useable electrical energy.

**Synopsis**
Converting oil (heat energy) to electricity is a well established technology.

Converting waste heat energy into usable work energy such as a rotating flywheel or an electrical generator is the goal of this project. Research and building prototypes on two systems was the mission of this project.

The first system investigated was a magnetic motor Stirling engine. A Stirling engine is a heat engine operating by cyclic compression and expansion of a working fluid at different temperature levels such that there is a net conversion of heat energy to mechanical work. It is the inclusion of a regenerator that differentiates the Stirling engine from other closed cycle engines. The team successfully ran an engine at Housatonic CC (Bridgeport, CT).

The second system investigated, not involving heat, was a Faraday wheel. The Faraday Wheel uses the Lorentz forces created by electrons moving azimuthally through a magnetic field to create a potential difference between different points on the radius of the wheel. The Faraday wheel was one of the first examples of a magnetic field being used to produce electricity. A successful prototype was built and run by the team.

The team learned how harnessing so called waste energy is an important engineering technology.
Mission Statement
Phase I – Complete building, compiling, and manufacturing of a see-thru nuclear power plant model and demonstrate the operation to the Nuclear Regulatory Commission on February 15, 2013.

Phase II – Design, develop, and incorporate a steam turbine system to the model.

Synopsis
Through a donation from the U.S. Nuclear Regulatory Commission, the University of Hartford has had the opportunity to create a functional sub-scale model of a see-through nuclear power plant powered by electricity rather than nuclear fuel. The purpose of this sub-scale model is to educate people through demonstration about how nuclear power works. The purpose of the model being see-through is so that people can actually see what is happening inside the different components while it's running and understand all of the concepts and processes much easier than they would if they were simply looking at a diagram.

Using the latest CAD software, Autodesk Inventor, SolidWorks and LabView, the team created a working model that was demonstrated on February 15, 2013 to representatives from the Nuclear Regulatory Commission. The demonstration was televised on a local Hartford television station.

The research in acquiring a steam turbine has been completed. The turbine will be installed the Fall of 2013.

Joseph Ancona
Gatewau CC
Jesse Philippi
Naugatuck Valley CC
William Story
Naugatuck Valley CC
Sarah Matloff
University of Hartford
Mission Statement
To improve, complete and test the final prototype of the Solo Transfer Wheelchair (STW), which will facilitate the transfer of a patient to and from a bed with minimal effort. Much of the fabrication will be done in collaboration with students at Platt Technical High School in Milford, CT.

Synopsis
The STW project began in 2010, but due to the complexity of the project, it had to be continued into 2011, 2012 and was finally completed this year (2013).

The goals of the 2013 STW team were the same as previous teams. The complex lateral transfer system for the upper seat portion of the chair was finally completed and fabricated (using NC machines), and with the help of students from Platt Technical High School (Milford, CT).

An additional goal for the 2013 STW team was to complete the design of the seat and leg rests for the wheelchair. The final design incorporated locking hinges for the seat and leg rests that allowed for the sub-assembly to flatten out into one single surface for the patient to lie on. The seat would then slide on the lateral transfer rails and tip to transfer the patient into their bed.

The final prototype was successfully completed and demonstrated to doctors and staff at Gaylord Hospital in Wallingford, CT on June 14, 2013. The event was hosted by world renowned Physician Dr. David Rosenblum. Dr. Rosenblum is medical director of physical medicine and rehabilitation and spinal cord injury research at Gaylord. Dr. Rosenblum provided design recommendations to the 2010 team.

Patents for the final design have been applied for by Nootools LLC. Students will be named on the patents.
Mission Statement
To provide advanced prototype designs for Unmanned Aerial Vehicles (UAV) at a low conceptual cost using 3D printing technology, while visualizing the models using Computer Aided Design (CAD) software.

Synopsis
Half of the research was focused on the UAV system components, and the structural design. Initially it was decided to go with a 920 KV motor, an 18 amp ESC, and 10x6 propellers. Once the parts were purchased the designers began their work. Concurrently the team looked at different options for batteries and flight controllers. The team ended up choosing a 3s Lipo battery and a Hobby King KK2.0 flight control system.

The other half of the research looked into honeycomb structures. It was discovered that the honeycomb structure provided a nice rigid design. This gave the team designers ideas and inspiration for their quadcopter arm design. They were able to calculate the distance between the motors using the selected propeller dimensions.

The design team then started to work on the design of just the UAV’s arm, which includes the motor mount, rotor housing, and the connected wire run. Each designer was able to offer their own take on a design in concert with the team’s basic research.

Using Gateway Community College 3D printers part fabrication was started on several of the designs. Several team members have volunteered to continue to build a final working prototype during the Summer and Fall semesters.

Chad Whitney
Manchester CC
Manchester CC

Alex Kali
Housatonic CC
Housatonic CC

Miyanda Mudingayi
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UConn
UConn

Steve Haldezos
University of New Haven
University of New Haven

Jack Conway

Daniela Liberatore
2012 Projects
Mission Statement
The mission is to build a unit which creates ice and hot water without the use of electricity or fossil fuels, thereby providing an alternative source of energy to people around the world, especially to those in under-developed regions.

Synopsis
Research and experimentation was done to determine the suitability of a vortex tube for the production of ice and hot water. Compressed air and crude prototypes were used for experimentation. Experimental data revealed rapid temperature changes and vast temperature separation between the hot and cold ends of the vortex tube. Successful results were achieved in production of ice and melting wax (theoretical proof of phase change of water). Research established the best alternative energy sources for powering the unit, as well as other pertinent background information on vortex tube theory and marketability of the product.

The presentation prototype consisted of two cylindrical Plexiglas chambers with coiled copper tubing. Energy supplied by the vortex tube is conducted through the copper tubing to the interior of the chambers where ice or steam is formed.

There were six phases in this project as follows:

1. Research.
2. Determining and obtaining appropriate supplies and equipment.
3. Experimentation.
5. Manufacturing of prototype.
6. Creation of an ideal prototype using SolidWorks software.
Mission Statement
The goal is to quantify the amount of CO\textsubscript{2} that is currently being emitted from natural gas refineries and to investigate if the CO\textsubscript{2} emissions are being captured. Also to investigate the potential to utilize and store these emissions.

Synopsis
There is a notion that Natural gas is a cleaner, more environmentally friendly energy source than oil and coal. While it does burn cleaner than its counterparts, the majority of the contaminants (primarily carbon dioxide, hydrogen disulphide and mercury) are extracted and expelled during the refinement process. This results in lower local pollution at the combustion site, at the expense of heavy pollution at the refining, or “Sweetening” plant. EPA data shows that overall carbon emissions from natural gas are on par with the other major fuel sources.

EPA regulations mandate that the companies capture these emissions in a manner that “reflect the best current technologies and processes.” One method is to utilize the carbon dioxide in a process known as enhanced oil recovery. The CO\textsubscript{2} is gathered through a process known as “post-refinement carbon capture” with chemical solvents that have a high affinity for bonding with carbon, usually an amine. The CO\textsubscript{2} gas is then injected into a depleted oil field, which increases the volume, and lowers the viscosity and surface tension of the remaining oil. This slurry is pumped to the surface and the oil is refined for consumer use, while the CO\textsubscript{2} is re-injected into the oil field.
Mission Statement
To develop a prototype and find optimal design conditions for converting plastic to its oil form to promote a cleaner environment and source of energy.

Synopsis
Today, plastic waste is a growing problem for our environment. Oil is one of the major compounds in plastics. When plastics are heated the oil vaporizes while other products remain in liquid form. This oil vapor can then be condensed and may then be burnt as-is or further processed to be used in other applications, rather than not be used and have this plastic waste remain in the environment.

The team did much research on the feasibility of this project. They determined that this project is a possibility. They came up with many different potential sources for plastics to be used in the process, but have not yet decided on which would be the best. This will come when the model is built and the team begins to collect data on the different operating conditions required for the recovery of hydrocarbons from each of the different plastics. The team also developed an electronic model with team specific design features.

This year, the students were able to build and test a functional model. A specific type of plastic (milk carton material) was used in the model, and the hydrocarbons were successfully extracted. The extracted hydrocarbons were flammable, but the exact chemical composition of the hydrocarbons remains to be identified.

The project has a potential to continue, were students can experiment with the yield ratios of different plastic materials, work on identification of product yields and improve the initial design model.
Mission Statement
Conducting research initiated by NASA and Hamilton and Sundstrand. Our mission is to investigate and research possible methods of thermal rejection allowing NASA to create a capsule or habitat that can withstand the large change in thermal variability from Low Earth Orbit (180 mi) to the geostationary orbit (24k mi).

Synopsis
NASA intends to deploy long term research missions to greater distances from Earth in order to expand research capabilities. Currently, NASA has been restricted to sending manned missions to Earth’s inner orbit because they have not yet developed a manageable heat rejection system for a geostationary habitat.

The current heat rejection systems that are implemented are designed for different parameters that do not require automation and do require regular maintenance. The company is now seeking a new, autonomous system that will be able to withstand constant radiation while providing a stable, livable habitat for crew members. The habitat will maintain this stable environment for as long as the crew members will be on board for their mission. Upon the crew’s departure the habitat will enter a hibernation state in which the lowest operational workload will take place.

Several different thermal control systems are being analyzed and compared. While considering thermal control systems and their effectiveness, factors such as the system’s geometry and impact preparedness must be considered. Experimental data suggests that a two phase capillary action heat transfer system with rod shaped geometry is an optimal candidate for implementation. Project elements are:

- Studying previous heat rejection systems.
- Calculating unknowns vital to system.
- Preliminary ideas.
- Analysis
- Decision and refinement
- 3D modeling using SolidWorks

Christian Wysocki
Alex Kali
Joseph D’Amico
Victor Martinez
Stephane Jean-Pierre

University of New Haven
Housatonic CC
Norwalk CC
Housatonic CC
Housatonic CC
**Mission Statement**
To complete the development of a prototype solo transfer wheelchair which facilitates the transfer of a patient to and from a bed with minimal effort.

**Synopsis**
The Solo Transfer Wheelchair project was introduced in the 2010 LSSL Program and was the original invention of Structured Solutions II LLC of New Canaan, CT. The team from 2010 consisted of eight team members.

The 2011 team picked up where the 2010 team had left off (creating a scissor lift mechanism for the base of the chair). The 2012 team picked up where the 2011 team had left off. The new goal was to complete the seat and its lateral transfer mechanism. This entailed several key developments:

- Creating virtual 3D SolidWorks models of the seat and the lateral transfer mechanism and incorporating them into the previously existing SolidWorks model of the wheelchair base
- Rapid-prototyping a proof-of-concept model of the lateral transfer mechanism which was followed by machining the actual aluminum rails.

The Phase III design that included the lateral transfer mechanism was successfully designed. Phase IV will fabricate all the parts, assemble the wheelchair and conduct hospital tests.

**Contributors:**
- Chris Lachapelle  
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Mission Statement
The mission is to design an innovative shovel assistor that helps in reducing effort and risk of injury aimed at the global market.

Synopsis
With an aging population in the U.S. and the desire to help others around the world involved in manual labor we are focusing on the goal of reducing stress on the body when involved in activities such as shoveling and digging. With a few adjustments, the team built a prototype of the design originally sketched by Nootools owner Mark Noonan.

The device has a belt for support and a progressive spring curving up over the head. A string is attached from that to the shovel shaft. When shoveling, the device transfers the stress from a person’s shoulders/upper back to their hips. The progressive spring is ultimately assisting with the dirt/snow load, making it easier on the person’s body. We tested our prototype at a motion analysis lab using an ENG machine. The data we collected displayed that shoveling with our device decreased upper trapezoid muscle activity.

This project consisted of:
- Project Planning/Team Building
- Strong Communication
- Field Research
- Designing Process
- Building of Prototype
- Testing of Prototype
- Final Project Presentation

Steve Haldezos
Chad Whitney
Brittany Franco
Amber Sorensen

Manchester CC
Manchester CC
University of Hartford
University of Hartford
Mission Statement
Work towards the completion of a sub-scale see-through model of a nuclear reactor in order to educate students and help them visualize the inner workings of a nuclear power plant, by August 16, 2012.

Synopsis
Through a donation from the U.S. Nuclear Regulatory Commission, the University of Hartford has had the opportunity to create a functional sub-scale model of a see-through nuclear power plant powered by electricity rather than nuclear fuel. The purpose of this sub-scale model is to educate people through demonstration about how nuclear power works. The purpose of the model being see-through is so that people can actually see what is happening inside the different components while it's running and understand all of the concepts and processes much easier than they would if they were simply looking at a diagram.

Using the latest CAD software, Autodesk Inventor, SolidWorks and LabView, a team of students from different state colleges and universities has created many 3-D model parts of the see thru nuclear power plant. From these drawings and models most of the physical parts have been created.

Graduate student Jason Smith and project directors Tom Filburn and Cy Yavuzturk are managing the project along with help from students in the LSSL program, or the Life Support and Sustainable Living program, to design and construct the model. Once the project is completed the reactor will be use as an educational tool at the University of Hartford to teach heat transfer classes and the new nuclear curriculum. Occasionally, the see thru model will be publically displayed at locations like the Connecticut Science Center.

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Tunxis CC
Jack Conway  
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William Bruni  
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George Recor  
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Mission Statement
To design and develop a virtual manufacturing center using an open source 3D software package for Connecticut Colleges of Technology, Regional Center for Next Generation Manufacturing, to be used primarily for educational and prototyping needs.

Synopsis
Virtual Manufacturing is increasingly viewed as an indispensable tool for increasing the efficiency of the choreographed inner workings of industrial processes. Many companies across various fields utilize virtual manufacturing, such as Boeing reducing fuel costs in aircraft skin panels by modeling them within the virtual environment.

The COT RCNGM Virtual Manufacturing Center (VMC) project seeks to develop an environment that will demonstrate the power of this new paradigm in a meaningful way for students studying related fields. The 3D software used is Open Simulator which is an open source multi-platform, multi-user 3D application server used to create a virtual environment (world). Open Simulator is written in C# language and is called scripting. Each script represents a text document containing a list of instructions that need to be executed by a certain object so that the desired automated action could be achieved.

Student participants will work together with COT staff to design and develop the COT VMC to illustrate case studies of virtual manufacturing. The project was broken into several key phases, some completed by all group members and other tasks were broken up by specialty. The phases are below:

- Research
- Practice Building & Scripting
- Conceptualization of Case Studies
- Construction

The team will also explore the use of Virtual Worlds in Architecture, Engineering and Construction project design.

Brian Mulhall  University of Connecticut  
Michael Brosnan  University of Connecticut  
Dinh Thanh-Lam  University of Connecticut  
Lingyi Zhang  University of Connecticut  
Courtney Collins  University of New Haven  
Jasmine Dumas  University of Hartford
Mission Statement
To create a successful Lunar Robot for moving dirt to protect a proposed habitat on the moon from radiation, to be submitted to Hamilton Sundstrand and NASA by 2Q 2012.

Synopsis
NASA is interested in future habitats that can be places on the surface of the moon and perhaps Mars. These habitats need to provide shelter from cosmic radiation for the astronauts. One potential solution is to move surface soil (regolith) into position to act as a shield. No "winning" concepts have been produced that can efficiently move this material for habitat protection. The process would have to be automated, so the building of a robot or device is necessary.

The strategy for the project was broken down into three parts:

1. Brainstorm ideas for the robot prototype
2. Research moon regolith, electromagnetic radiation, and cosmic radiation specifically.
3. Model the prototype using SolidWorks software.

There are guidelines that must be followed when building the robot regarding its size and weight. Since there is radiation involved, there is also a concern about the materials being used. A third obstacle in the process is the regolith, itself. The Regolith is not composed of the same material as Earth sand, and it can be devastating to equipment. The restraints and potential problem areas are what makes this project very challenging. These are the problems that plague engineers at NASA and other companies every day. This project gives a little taste of what a typical day as a NASA engineer is like.

Sean Belleau
Scott Klasner
Andrew Leahy
Marquette Jones
Brett Murno
Alicja Urbanczyk
Benjamin Lamy
Sarah Matloff**

Gateway CC
University of Hartford
Tunxis CC
Manchester CC
University of Hartford
Central CT State University
Northwestern CT CC
University of Hartford
Mission Statement
Simulate and analyze the existing traffic control system on Albany Avenue (RT 44) in order to develop alternatives for minimizing traffic delays, fuel consumption and pollutant emissions.

Synopsis
Due to continuous traffic congestion along RT 44, the Smart Traffic Control team investigated a network comprised of 15 intersections to analyze travel time and most critical (oversaturated) bottlenecks. In addition, investigation and research was done into an adaptive smart traffic control system and progression analysis, both being considered as viable solutions to decrease traffic delays.

An engineering study was applied to simulate current traffic conditions using an advanced computer program named CORidor SIIMulation (CORSIM). The purpose of this simulation was to help provide insight into the development of a sustainable and smart traffic signal control system to minimize vehicle delays, pollutant emission, and fuel consumption.

The team members examined the existing field conditions, interviewed the city traffic engineer, conducted data collection, simulated the network, researched different alternatives to congestion and recommended a cost effective and short implementing solution.
**Mission Statement**

To develop and improve an affordable device for use in dental surgery to alleviate gum tissue change, improve flow rate, eliminate noxious bleach fumes, and storage of caustic chemicals.

**Synopsis**

Open Inventors wanted assistance in the development of a novel new device for use in dental surgery. Currently, dental surgeons use bleach (sodium hypochlorite) as a means of disinfecting and surface cleaning during endodontic surgery. The company has a new device that uses electrolyte reaction to separate a common electrolytic into an active and inactive solution. This approach has been tested with crude prototypes and preliminary data shows excellent performance. The unit consists of two main chambers each with an electrode and a connecting chamber.

The apparatus is designed to address the needs for root canal treatment by surgeons and dentists.

The project was broken into five phases. These phases were divided among the team members based on their field of concentration. The phases were:

- Research
- Designing Process
- Solid Works
- Manufacturing of Prototype
- Ordering Project Supplies

The project used the very latest 3D solid modeling computer software during the design thanks to a grant from the SolidWorks Corporation.

A basic structure of the new and improved prototype was successfully built.
Mission Statement
To create a new “environmentally-friendly” navigation method to address increasing concerns of motorists on rising fuel costs and pollutant emissions.

Synopsis
Congestion in roads during peak hours is a major concern that causes pollution to the environment through fuel evaporative emissions and exhaust pollutants. As quoted by US EPA report “Driving a private car is probably a typical citizen’s most “polluting” daily activity”.

GPS is used for business purposes for many different reasons. It has helped our business world become more successful. Many GPS products are being used by businesses and government agencies to track their vehicle locations using wireless communications. Some GPS receivers have been integrated into mobile radios, cellular phones and mobile data terminals to meet the needs of vehicle fleet managers. Many pilots are turning to GPS as a supplemental navigation aid for their aircraft. At sea, GPS receivers are used on recreational and commercial vessels to provide real-time latitude, longitude, time, and course and speed information, and assist with coast-line and harbor navigation. Surveying and mapping consist primarily of the collection and processing of position information and usually requires specialized GPS equipment.

The projects initially started as a design project. The objective is to design a GPS or in dash navigation system that would give drivers an option to choose a third route which is “Eco-Route”. However, our research revealed that there are products that already exist and solve this objective. The scope of the project changed the perspective to researching. The purpose of the research project is to explore into subject to get optimized results on how congestion is related to emission.
Mission Statement
To design a mechanical pump system capable of accepting multiple types of fuels for a high efficiency engine in development.

Synopsis
This platform is designed to run on multiple fuels including ethanol, bio-diesel, and hydrogen but the fuel injection system is incomplete. Our goal is to design a fuel pump that is projected to operate a diesel engine that will operate at efficiency greater then 50%, and significantly reduce emissions, while reducing weight, part counts, and manufacturing costs compared to existing engine designs.

With high gas prices and the concern for global warming, now is the time to research and develop ways of reducing car emissions. Developing a fuel pump for a diesel engine that can be up to 50% more efficient than existing engines will significantly reduce these emissions and save us money at the gas pump.

Over the course of this project we attempted to make use of new technologies and techniques in order to not only move forward but expand our skill sets. The team utilized the computer aided drawing software package known as SolidWorks.

As the project progressed we became familiarized with fuel injection and rotary engine technology thanks to our project sponsor company. That introduction brought us a wealth of knowledge including several computer controlled and mechanically controlled fuel systems as well as the reasoning for using each.

Max Accardo University of Hartford
David Kurtz University of Hartford
David Goldberg University of Connecticut
PJ Paneru University of New Haven
Eyas Azzuni University of Hartford
Mission Statement
To redesign a prototype of the Magic Flashlight from Eye Ear IT, Inc. adding newer technology in a more ergonomic form, to expand the customer demographic.

Synopsis
The first Magic Flashlight was originally developed as an educational aid for young children. It was designed to scan bar codes from specially made books that call on associated audio content stored within the flashlight.

Phase I of the project was to become familiar with microcontrollers and identifying a microcontroller suitable for the project’s needs. It was imperative to take into account the physical constraints of the new device. A virtual prototype was created concurrently with the electronic breadboard hardware.

The team spent several weeks learning and gathering information on various microcontrollers. Once the appropriate microcontroller was chosen, the team was split into two smaller groups that kept in constant contact with each other. As a result, several SolidWorks designs were created, with each having an important segment that eventually contributed to an ideal prototype for the Magic Flashlight. Progress was made with the image capture, the writing of a program based on a microprocessor that was chosen and the enabling of wireless transmission using a different microcontroller.

Software to interface the camera with the microprocessor and then to obtain wireless transmission to a host computer was designed.

It is anticipated that hard coding will comprise the bulk of the Phase II research in 2011-2012.
Mission Statement
To research and develop a method of converting plastic to its oil form, to promote a cleaner environment and source of energy.

Synopsis
Today, plastic waste is a growing problem for our environment. Oil is one of the major compounds in plastics. When plastics are heated the oil vaporizes while other products remain in liquid form. This oil vapor can then be condensed and may then be burnt as-is or further processed to be used in other applications, rather than not be used and have this plastic waste remain in the environment.

The team did much research on the feasibility of this project. They determined that this project is a possibility. They came up with many different potential sources for plastics to be used in the process, but have not yet decided on which would be the best. This will come when the model is built and the team begins to collect data on the different operating conditions required for the recovery of hydrocarbons from each of the different plastics. The team also developed an electronic model with team specific design features.

The team has come up with a description of the apparatus required to carry out hydrocarbon recovery. They have a general design and some design features they would like to implement in the model to experiment with efficiencies. This project has a potential to have a model built for a LSSL team next year. The building of the model would allow the team to prove the theory we have stated. Also, by analyzing data for a variety of operating conditions and plastics, we could begin to come up with a more exact use for this idea depending on the results. A model is definitely the next step in the advancement of this project.

Christian Tovar
Central CT State University

Joshua Toler
Manchester CC

Matt Ares
University of Connecticut

Shalin Shah
University of Connecticut

Emilio Flores
Central CT State University
Mission Statement
To develop a portable life support system for the purpose of supporting human life during field and laboratory testing for the University of North Dakota’s next generation space suit by May 2011

Synopsis
Several years ago the University of North Dakota, funded through the North Dakota Space Grant Consortium, began the development of a planetary space suit for the purposes of training its students in fields useful to NASA and to test new technologies. It is with this goal that they have begun and almost finished a second generation of a student designed planetary space suit. Approximately 18-24 months ago, several students at the University of Hartford began working with the University of North Dakota. Due to the previous work of key faculty members at the University of Hartford, those working at the University of Hartford were able to take on the responsibility of developing the Portable Life Support System for the University of North Dakota’s space suit.

The current design that UND has is not a portable system, and requires the user to be followed by an air compressor. The parameters that they would like in a system that mounts on the back of the suit, and allows the user to be able to traverse on their own without the aid of someone else or an “external system”. To develop this UND asked the University of Hartford (UH) to create a portable life support system for their NDX-2 space suit. The UH worked on it for some time until the task became too large for the UH team and they asked the life support and sustainable living program (LSSL) to incorporate the project into their program to get different members of collegiate.

The results of this project have been submitted to Professor Clara Fang. A continuation of this work is anticipated for the 2011-2012 academic year.

Brian Mulhall
Joshua Milas
Eric Steinberg
Eugene Sung
Jonathan Dunne
Amelia Edward
Redi Nasto

Manchester CC
Naugatuck Valley CC
University of Hartford
University of Connecticut
Tunxis CC
Central CT State University
University of Connecticut
Mission Statement
To develop a wheelchair which facilitates the transfer of a patient to and from a bed with minimal caregiver assistance.

Synopsis
The Solo Transfer Wheelchair project was introduced in the 2010 LSSL Program and was the original invention of Structured Solutions II LLC of New Canaan, CT. The team from 2010 consisted of eight team members.

The 2011 team picked up where the 2010 team had left off (creating a scissor lift mechanism for the base of the chair). The new goal was to complete the seat and its lateral transfer mechanism. This entailed several key developments:

- Reviewing previous team’s research to bring the 2011 team up to date
- Learning to use SolidWorks to create 3-D models
- Creating virtual 3D SolidWorks models of the seat and the lateral transfer mechanism and incorporating them into the previously existing SolidWorks model of the wheelchair base
- Rapid-prototyping a proof-of-concept model of the lateral transfer mechanism and later completing an aluminum prototype

The completion of the 2011 project resulted in a physical proof-of-concept prototype of the lateral transfer mechanism and a 3-D SolidWorks model of the seat, back rest, leg rest, and reclining mechanism design.

A Phase III design will most likely be the next step in the project evolution to continue in 2012.
Mission Statement
The mission of the Sustainable and Smart Traffic Signal Control team was to collect data, simulate existing network, design and evaluate alternative scenarios, and implement the best solution to decongest traffic and minimize pollutant emissions in downtown Hartford.

Synopsis
This project objective was to investigate the traffic flow of several intersections along the Farmington Avenue corridor. In addition, investigation and research was done into an adaptive smart traffic control system recently installed at the intersection of Asylum Avenue and Woodland Street in the city of Hartford, CT. An engineering study was applied to simulate current traffic conditions using an advanced computer program named CORSIM (CORidor SIMulation). The purpose of this simulation was to help provide insight into the development of a sustainable and smart traffic signal control system to minimize vehicle delays, pollutant emission, and fuel consumption.

The team members examined the existing field conditions, interviewed the city traffic engineer, conducted data collection, simulated the network, researched different alternatives to congestion and recommended a cost effective and short implementing solution.

The results of this project have been submitted to Professor Clara Fang. A continuation of this work is anticipated for the 2011-2012 academic year.

Firat Akcay  
Mohammad Jarrar  
Ricardo Harris  
Mahmoud As’ad  
Samantha Farley  
Ana Maria Mosnegutu  
Jeffrey Portal  

University of Hartford  
University of Hartford  
University of Connecticut  
University of Hartford  
University of Hartford  
University of Hartford  
University of Hartford
Mission Statement
To identify the ultimate method of cooling for steam power plants, and to estimate the cost and loss of generation capacity if all of the steam power plants in Connecticut using once through condensers were switched to air cooled or cooling tower systems.

Synopsis
There are two main types of condensing methods in steam power plants; once through condensers and cooling towers. Cooling towers have been deemed the best management practice by the EPA because once through condensers kill fish eggs and larvae, but cooling towers are less efficient, more costly, and produce more carbon dioxide emissions. The DOE partnered with a team of LSSL students to do a cost/benefit analysis of the condensation methods in Connecticut.

The project was broken down into three parts. The team worked simultaneously on all parts, with each member researching areas pertaining to their experience.

- Condensing Method and Efficiency
- Cost
- Environmental Impacts

The project culminated with the decision that it is more economical and environmentally conscious for large power plants to use once through cooling condensers than cooling towers or dry air cooling, and the finding that there is going to be a 130-226 MW (2-3%) generation loss if all of the once through condensers at large Connecticut plants are switched to cooling towers.

George Keryakos  
University of New Haven

Daniel Drzal  
Housatonic CC

Jay Richardson  
University of Connecticut
Mission Statement
To design and create an affordable, efficient, wireless imaging device for dermatologic personal use.

Synopsis
Many people have dermatologic issues, which require a specialist to analyze. Typical skin conditions may require an initial visit to a primary care doctor and a referral to a dermatologist to inspect the area. Doctors currently have the ability to take pictures and videos of skin conditions, which they can share within the medical community or for publication purposes. By making a consumer device that can bridge the gap from the traditional approach of an office visit to a web based medical diagnosis capitalizing on modern technology available.

The dermascope project is applying current technology in creating a dedicated dermatologic camera to capture images of skin afflictions; patients from home can receive necessary medical diagnosis. The treatment is possible through a dedicated website which contains a network of dermatologists willing to provide medical treatment and diagnosis from images.

Phase I – Accomplishments
- Operational camera device with proto board technology demonstrated.
- Determining medical requirements and limitations.
- Research optical possibilities.
- Evaluate other vendors with similar devices.
- Virtual design of case utilizing SolidWorks.

Phase II – Future work required
- Transmit data through WI-FI or blue tooth.
- Integrate camera with more complex development boards.
- Installation of components within case.
2010 Projects
Mission Statement
Characterize the bowel sounds in premature infants (neonates) using signal processing in an effort to aid in FDA approval for a prototype stethoscope.

Synopsis
Starvation is a major cause of death for premature infants. It is difficult to determine how much food an infant has taken in. It is even more difficult to determine if the infant is hungry in the first place. One way to determine hunger and the amount of food consumed is to monitor the infant’s bowel sounds.

The team attempted to characterize bowel sounds in both infants and adults using signal processing equipment and LabVIEW computer software. It was felt that taking real life sounds and attempting to characterize the sounds would assist in FDA approval for Dr. Eric Campana’s stethoscope invention studied during the 2009 LSSL program.

The team was able to discover three specific sounds, a “click” a “lub dub” and a “call of doom”. All three sounds are different and imply different actions on the stomach’s part. A Discrete Fourier Transform (DFT) was made on all three sounds in order to characterize the signals. As a result the team was able to prove that they could electronically recognize sound and the same sound could be isolated among different people and different times.

A continuation of this work is anticipated for the 2010-2011 academic year.
Mission Statement
To develop a portable life support system for the purpose of supporting human life during field and laboratory testing for the University of North Dakota’s next generation space suit.

Synopsis
The University of North Dakota is now working on the second generation planetary space suit. The university invited LSSL students to help design a Portable Life Support System (PLSS) to be used in laboratory and field testing. The PLSS will replace NASA’s current backpack type design.

A Biomarine BioPak 240, manufactured in Exton, PA, was retrofitted for integration to the PLSS. The BioPak 240 is on demand closed circuit rebreather apparatus currently used in mine rescue, firefighting, and hazmat cleanups. Significant modifications were required to meet PLSS specifications. They were:

- Circulate oxygen-nitrogen mixture
- Extend duration to 4 hours
- Remove CO2, humidity and other race contaminants
- Regulate and monitor pressure
- Monitor suit conditions such as temperature, O2 and CO2 levels through sensors.

The upgraded design uses oxygen-nitrogen mixture, enhanced CO2 scrubbers and ice canisters.

Virtual CAD models of all the PLSS components were created in Autodesk Inventor software. The model included the mass flow controller, a pressure reducing regulator, a pressure retaining ring, gas cylinder mounts, battery packs, power supplies, and ventilation fans.

Fabrication and assembly of the PLSS and a scrubber test chamber will commence during the 2010-2011 academic year.

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Redjan Nasto  Naugatuck Valley CC
Amelia Edward  University of Connecticut
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Mission Statement
Design a hydrogen refueling infrastructure considering necessary number of stations given different factors in the state of Connecticut.

Synopsis
Connecticut is the home for several leading hydrogen fuel cell manufacturers. Because vehicles powered by fuel cells do not emit CO$_2$, they are finding wide acceptance in the public transportation (buses) community. Vehicle (cars) utilization is hampered by the lack of hydrogen fueling stations. The actual production of hydrogen led by companies like Proton Energy (Wallingford, CT) is not an issue, the distribution is.

This team undertook the ambitions research project of creating a Phase I distribution plan for the State of CT. To accurately pinpoint where these stations could be placed extensive data was gathered from the US Census, CT Department of Transportation, as well as other sources.

Utilizing ArcGIS computer software the team created detailed maps of station locations to cover the major travelling routes within the state of CT, including the New York to Boston corridor.

The Phase I plan has been submitted to the CT Department of Transportation for review.
Mission Statement
The mission of this project was to develop a way to more efficiently scrub carbon dioxide from the flue gas produced by coal fired powered plant.

Synopsis
A typical power plant generates 3,700,000 tons of carbon dioxide (CO$_2$), which is as much carbon dioxide as cutting down 161 million trees. 54% of our electricity comes from power plants. New ideas to reduce CO$_2$ emission are being explored such as CO$_2$ scrubbing. Currently, the capture of CO$_2$ is performed experimentally on a large scale by absorption of CO$_2$ onto various amine-based solvents. In this project, TEPAN (ammonia based compound) is being used to scrub the CO$_2$ out. The parameters for this experiment are simulated from a 500 megawatt coal plant which burns 1.4 million tons of coal each year.

Experiment consists of an apparatus that was built initially to test the scrubbing of CO$_2$ in a spacesuit. Same apparatus was modified for conducting research and experiment to find the CO$_2$ scrubbing capability of amine sorbent beads (TEPAN) in a coal fired power plant’s flue gas parameters (High humidity, high temperature and high pressure). In order to test how the CO$_2$ reactor operated with the high water content of flue gas- the gas stream was percolated through heated water.

In the apparatus the gas stream mixture (CO$_2$ + N$_2$ +H$_2$O) is fed by two mass flow controllers and a humidifier. The volumetric flow rate of this mixture is determined before they flow through the reactor and at the exhaust. The exhaust CO$_2$ is measured as a percentage of the total flow rate. The difference between what is going into the system and coming out of the systems is what is absorbed.

Continuing the research and coming up with better ways of scrubbing CO$_2$ will be the focus of the research for the 2010-2011 academic year.
**Mission Statement**

To research, develop, and create an energy efficient ground source heat pump utilizing a solar collector to support the heating and cooling of buildings.

**Synopsis**

The project’s aim was to perform an analysis for the potential installation of a new direct exchange ground source heat pump (GSHP) on the University of Hartford campus and explore how to increase the efficiency by designing a hybrid GSHP. A traditional GSHP is a device that uses the energy stored in the ground to support the heating and/or cooling of a building.

While ground source heat pumps and solar thermal collectors have been utilized for many years, a hybrid GSHP, using the sun’s thermal energy to indirectly aid the efficiency of the GSHP, could have a dramatic impact in the field of energy. Essentially, the solar collectors add additional heat to the ground in order to prevent the ground temperature from dropping too low to be an effective heat source.

The heat pump selected for this project relies on a closed loop system. The system relies on well holes being bored into the Earth down to a depth of several hundred feet. Pipes are installed in the well holes and connected to a heat exchanger. The team determined that the soil structure on the campus to be an acceptable drilling site.

In summary, the team concluded that the hybrid system will run as a conventional GSHP during times when building cooling is needed, and as a hybrid ground source heat pump (using the solar collectors) when heating is needed in the coldest months.

The team felt that their final design was a truly unique application and has been presented to the school administration for possible implementation.
Mission Statement
The mission was to characterize ionized gas induced flow devices to re-energize boundary layer flow over a curved surface and prevent flow separation.

Synopsis
The complete understanding of air flow in turbines and jet engines is an important area of interest in achieving fuel efficiencies. The elimination of air turbulence, separation, over surfaces is highly desired. This team’s primary objective was to take extensive data to characterize the relationship between flow separation and the use of a plasma actuator to prevent this separation over a curved and flat surfaces.

Wind tunnel equipment was fabricated that employed a positive bias constant voltage DC plasma actuator to prevent flow separation over surfaces. Experiments were conducted to investigate the relationship between separation points along a constant curvature, free stream velocity, actuator current density, electrode spacing, and distance of an electrode stage to an unmodified separation point.

Experiments consistently showed decreases in static pressure along the surface with the actuator on when compared to the values of an unmodified boundary layer. Separation is inevitable; however anything done to delay the separation would have positive effects on any flow device. The data collected demonstrated which parameters affected a delay.

Adding additional stages of actuators to prevent separation will be the focus of the research for the 2010-2011 academic year.
Mission Statement
To investigate life support and structural design issues for a long-term lunar habitat with an emphasis on power, weight, and volume requirements.

Synopsis
NASA’s long-term goals include an eventual return to the lunar surface as part of the Constellation program. Lunar missions will be conducted in three phases. Phase two of this plan focuses on extended lunar surface stays of up to 180 days. Because of their relatively long duration and the difficulty of regular resupply, these missions will require a greater level of closure within the environmental control and life support system than previous spacecraft. Water and oxygen must be conserved and recycled and the systems used to regulate and sustain a livable environment must be as maintenance and consumable-free as possible.

This team focused on gathering as much data on life support requirements as possible, conducting initial trade studies on potential environmental control and life support technologies, and sizing the habitat module interior based on subsystem, storage, and crew space needs. The final report included 3D design models created in AutoCAD. The interior designs were created in SketchUp.

The work accomplished thus far serves as a baseline for future development. A continuation of this work is anticipated for the 2010-2011 academic year and will include thermal and material analysis to provide radiation shielding.

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Mission Statement
The mission was to develop a wheelchair which facilitates the transfer of a patient to and from a bed with minimal caregiver assistance.

Synopsis
Approximately 500,000 people in America are wheelchair bound. The challenges of living from a wheelchair are often frustrating including the challenge of getting in and out of bed. Structured Solutions II LLC of New Canaan, CT partnered with a team of LSSL students to design and fabricate a proof of concept wheelchair.

The project was broken into five phases. The team worked concurrently on all the phases dividing the research based on team member expertise.

- Market Research and Current State-of-the-Art
- Legal and Regulatory Research
- Design Research
- Virtual Design Prototypes
- Proof of Concept Fabrication

The five phases of the STW culminated with a proof of concept prototype fabrication made by using wood and other inexpensive materials.

The project used the very latest 3D solid modeling computer software during the design thanks to a grant from the SolidWorks Corporation.

Phase II of the project will commence during the 2010-2011 academic year.
Mission Statement
Using simulation software to quantify the positive effects that an intelligent traffic control system has on the amount of fuel consumption and subsequent vehicular emissions.

Synopsis
Mankind has had a negative impact on the environment by emitting dramatic increases in the levels of carbon dioxide and methane to the atmosphere. Vehicle emissions are a leading contributor. By upgrading existing traffic control systems it is possible to significantly reduce the fuel consumption thus reducing the emissions. By implementing programs that focus on idling reduction (i.e. stuck in traffic), traffic engineers have been able to reduce emissions.

The main focus of this project was to conduct an analysis of one network in the city of Hartford. A network is a string of intersections that usually consists of one main intersection and small surrounding intersections. Analysis is a two part operation, data collection and computer simulation.

The team spent several weeks learning what data to collect and then collecting the data. Once the data collection phase was completed a computer simulation was run using the Synchro program. By adjusting the traffic light timing, phasing, and altering lane geometry the software was able to minimize fuel consumption and vehicular emissions for this network.

The results of this project have been submitted to the City of Hartford. A continuation of this work is anticipated for the 2010-2011 academic year.

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Mission Statement
To study the water flow and heat transfer for the next generation space suit, in order to provide NASA with recommendations for a new design’s viability, as well as to investigate the thermal load inside the Orion capsule for a post-landing cooling system.

Synopsis
Space Suit - Currently, the space suit heat rejection is accomplished by using a porous plate sublimator. The team investigated using a design that utilizes evaporating water through a hydrophobic, porous Teflon membrane.

The team concluded that the use of a membrane based water evaporator seems like the best solution for extensive extravehicular activity due to its high performance in rejecting heat and it is not sensitive to contamination which gives it a long lasting life time.

Orion Capsule - After the Orion Capsule (OC) lands in the water, the crew must remain alive until a rescue team reaches them. Heat rejection is critical. The team calculated the thermal load inside the capsule due to different factors such as electronic load, metabolic load (astronaut’s body heat) and water thermal load. These calculations enabled the team to determinate the exact amount of power needed to cool the capsule to an acceptable temperature.

Cooling is provided by a single-loop propylene glycol fluid loop with a radiator and a fluid evaporator system. The total heat load was calculated to be 6.25 kW. The post-landing requirements are 3.3 kW.

The final report has been submitted to NASA for review.
**Mission Statement**
The mission was to research self-sustaining energy wind turbines and propose an implementation plan for the people of Herat, Afghanistan.

**Synopsis**
Heart, one of the biggest cities in western Afghanistan, with a population of 350,000, is unable to maintain a constant supply of power. They must rely on imported power from Iran and use diesel generators. The reconstruction of this city will require a local and reliable source of power generation.

The team’s wind studies revealed that western Afghanistan has ideal conditions for the operation of wind turbines. The power grid layout of Herat would allow for the installation of wind turbines on the outskirts of the city without having to dramatically affecting the current electrical infrastructure. There are already wind turbine farms in other parts of Afghanistan.

There are a few companies which offer low cost, low maintenance wind turbines specifically for use in third world countries. The team discovered that the French built Vergnet turbine would meet the team’s specifications. These relatively inexpensive turbines are shipped in one case, assembled on-site and raised using a hydraulic winch. The company has installed these wind turbines in portions of northern Africa with conditions very similar to that of Afghanistan.

After doing a demand analysis the team concluded that the installation of 945 of the 275 kW rated Vergnet wind turbines would be sufficient to replace the power imported to Heart. Operation of these turbines only half of the time, over one year, would be enough to make up for the initial cost and the cost of maintenance for the first year.

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