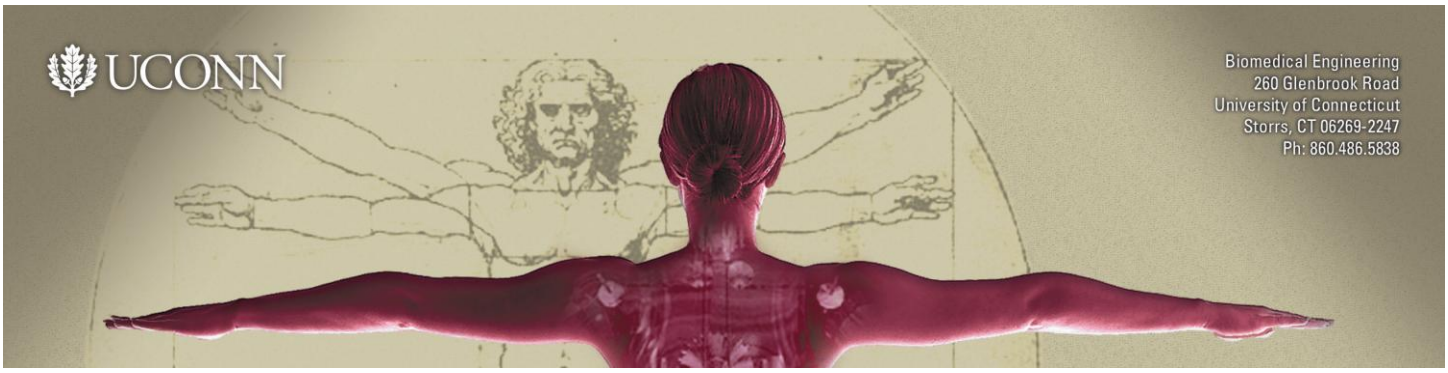

BIOMEDICAL ENGINEERING
SENIOR DESIGN DAY

Friday, April 23, 2010

Project Presentations: 1 to 4 PM
ITE Building, Room C80

Biomedical Engineering Program
The University of Connecticut

BME 4900 Senior Design Projects

Team 1
HANSS with Biofeedback and Multi-function Table
Team Members: Liz Hufnagel, Mark Galiette, Dan Tichon

Sponsored by the NSF

This project is to design and build a head and neck support system, along with a multi-function, adjustable table for a 10 year old girl with Cerebral Palsy. The client has difficulty maintaining an upright, seated position, and is confined to her powered wheelchair for the majority of the day. The head and neck support system will ensure proper upper body and head positioning of the client, and the multi-function table will provide a customized workspace that fits the needs of the client and her current wheelchair.

An upright and squared shoulder position will allow the client to communicate better with friends and family, perform reading and schoolwork activities with ease, and will allow a comfortable support for her transition from incorrect and distorted positioning to a healthy correct position. A unique feature of the head and neck support system is the incorporated biofeedback switches. When seated in the correct upright position, the client will activate touch sensor switches to complete a circuit that outputs music through an iPod. This feature is personalized for the client, and will promote correct positioning using positive reinforcement. The table will provide an electronically adjustable, hardtop desk for the completion of schoolwork, reading, and computer activities. This table will enhance the academic and recreational activities that the client performs on a daily basis.

These products are completely customized to fit the dimensions associated with the client and her wheelchair. This unique fit, as well as the use of a biofeedback system, separates this product from any other that is available on the market.

Team Number 2
The ATPC-X42 All-Terrain Power Chair
Team Members: Niaz Khan, Selome Mandefro, Alex Mann, Vikram Shenoy

Sponsored by the NSF

The aim of this project is to design and build a rugged power chair with a low center of gravity for Annalee Hughes. Annalee, who is 10 years old, has cerebral palsy which affects her ability to sit up straight and stand. Previously when operating her power chair in her family's backyard, she has tipped the chair over due to the hills, rocks and uneven terrain present. Annalee does not have the core strength necessary to get upright by herself if this happens, which is why it is necessary to create a chair that is able to traverse this landscape.

The ATPC-X42 has been built on the chassis of an old power chair and will be operated via joystick control; however several modifications have been made and the chair has many new features. One of these features is large, off-road tires that give the chair greater stability and allow operation on a variety of surfaces, including grass and dirt. The chair also has a modular seat assembly which can be adjusted as Annalee grows. The safety features include a harness and seat belt, as well as a contoured seat to prevent jostling while the chair is in use. There is also a tilt sensor with an alarm that will warn Annalee when she approaches slopes that are too steep to travel on. Finally, the chair has auto-actuation which will work in unison with the tilt sensor to help maintain Annalee's posture as she rides up and down hills.

Team Number 3
Assisted Walking Device
Team Members: Scott Kopp, Andy Czyzowski, Sijie Jason Wang

Sponsored by the NSF

The Assisted Walking Device (interchangeably referred to as the "Device") is a gait trainer for a girl with cerebral palsy. Because she has severe lower extremity spasticity, she has never learned to walk.
The purpose of the Device is to provide a stable and adaptable gait trainer, utilizing leg bracing to restrict her involuntary motion while promoting normal walking motions. The Device was custom-designed for the client to meet this purpose.

The Device is a full-size walker, including a full base with wheels, leg and foot braces, and hip, chest, and arm rests. The client can climb into the device from the rear by first sliding her feet into the foot braces, then equipping the leg braces, and then pulling herself up into the arm and chest supports. She can open close the leg braces by pushing a button on a control box mounted next to the arm rests. This secures her into the device. For additional security, a soft, broad strap can be worn on across her back to prevent her from falling backwards.

With practice, the Assisted Walking Device will enable the client to develop better leg control and strength. Ultimately, it will significantly improve her independence and quality of life.

Team Number 4
The Portable/Compactable Power Wheelchair
Team Members: Kristie Astoria, Nate Storie

Sponsored by the NSF

The NSF has granted funds for a lightweight & portable power wheelchair for a 10 year old girl, Annalee Hughes, who suffers from cerebral palsy. Annalee currently has

multiple power chairs but they all lack the portability for her parents to transport them for different social activities. These social activities are important for the growth of young children. During this project we designed a lightweight, portable power chair that allows her parents to singlehandedly transport it with relative ease.

The power wheelchair was designed after the Atm' Power Wheelchair manufactured by Invacare. Invacare designed the original wheelchair but it didn't use direct drive motors and was too large for Annalee. The project was to reduce the size of the chair to better fit Annalee's size and make it as safe as possible for her physical condition. Also, to alter the Atm' design by making it into a direct drive power wheelchair, this was achieved by building a transmission to reduce the speed of the motors.

Team Number 5
The Joe- Kart
Team Members: Morgan Templeton, Marek Wartenberg, Mike Fitzpatrick

Sponsored by the NSF

This project was to design a remote controlled, battery powered go-kart for a child with Cerebral Palsy. The client is a 6 year old boy, who has very little motor control due to his CP. His lack of motor control prevents him from driving traditional go-karts. This specially designed go-kart will give him the opportunity to use a go-kart as well as an opportunity to learn some of the controls, due to the dual seat design. A chassis was purchased; however, several modifications were made to meet his specific needs.
The go-kart is remote controlled so that someone can drive him in the go-kart with riding in it. However, it has a dual seat design, so that a passenger can drive along with the client. A holder has been installed on the chassis for the remote. This will allow the client to try to use the steering joystick, while a supervisor controls the speed and braking. The remote is also equipped with an emergency kill switch which shuts down the go-kart and initiates the brake. The client has an adjustable seat so that as he grows, the seat will be able to grow with him. He will be able to use this go-kart for many years.

Team Number 6
The Endovascular Tissue Resection Tool
Team Members: Cathy Yee, Chris Guay, Josh O'Brien

Sponsored by Dr. Wei Sun, University of Connecticut

The purpose of the design project is to create a minimally invasive endovascular tissue removal device for the removal of calcified aortic valve leaflets. The device will be inserted into the femoral artery, and threaded endovascularly to the aortic valve. Due to the tight path of the arteries that the tool must travel through before reaching the aorta, it must be collapsed inside a catheter with the ability to expand when at the destination of the aortic valve. When in the proper location, the two expandable portions, termed the cutter and the holder, will open up with linear actuators. An external motor will power

the serrated cutting blade, on the proximal end. The cutting of the calcified tissue will produce calcified debris, which will in practice be vacuumed out of the body, so as to not clog up the circulatory system. The vacuum removal of calcified debris, however, will not be within the scope of the project. After cutting, the device will be collapsed back into the catheter and threaded back out of the body. The use of a serrated blade with leverage provided by a backplate and positioned by linear actuators was a design that developed from a hybrid of the initial designs.

All the calculations of the forces and moments, and all measurements and constructions must be very precise because heart surgery is a very delicate procedure. Although this poses less risk than traditional open heart surgery, this percutaneous removal of calcified valve leaflets still entails many risks to the patient if not done correctly. Retesting and redesign will be an inevitable process of such a delicate procedure. The project has some realistic constraints that pertain to mechanics, economics, and manufacturability. The finished aortic valve leaflet removal device will have a significant impact on healthcare. The device can be used in surgical rooms of hospital for minimally invasive, and therefore safer heart surgery. The risk of morbidity and mortality will be reduced significantly, having a positive impact on health globally.

Team Number 7
Automated Retracting Coaster (ARC) Slide
Team Members: Stephen Kustra, Hillary Doucette, Sarmad Ahmad

Sponsored by the NSF

The purpose of this project is to design and construct a modified slide for a client with cerebral palsy. The client has minimal motor control and difficulty maintaining his posture. This limits his ability to ride on traditional playground slides. In the past, the client has ridden on a slide called the "Extreme Coaster" manufactured by Step2. The coaster has a car to sit in while descending down a ramp from a top platform. This device, however, could not account for the client's difficulty maintaining posture and the operator's strain to push the car back up the ramp. To create a recreational device that could support the client safely and reduce the strain on the operator, the ARC Slide was designed and constructed.
The ARC Slide has a custom built car for the client to sit in; fully equipped three harnesses, arm rests, leg rests, and foot rests. The slide has a lift motor to automate descent and a winch motor and cable that attaches to the rear of the car for retraction. When the car reaches the top platform, the winch hook is automatically released with the use of a spring-loaded mechanism. Currently, there are no similar devices on the market that accommodate for the client's needs.

Team Number 8
Team Members: Robert Blake, Craig Goliber, Alanna Ocampo

Sponsored by the NSF

Projects for Joey Toce:

- Adapted Hungry, Hungry Hippos
- Adapted Snow Sled
- Device Control Panel

Our client, Joey Toce, has mixed type quadriplegic cerebral palsy. The muscle tone in his arms and legs fluctuates and as a result it is difficult for him to exert sufficient force for certain activities. Also Joey has motor planning difficulties and his trunk region is most affected by the cerebral palsy.

The idea behind the adapted Hungry, Hungry Hippos Game was to modify an existing Hippos board game so that the client could have full independent control while playing. This was accomplished by creating a device that would attach to the game and provide the required force to push on the levers. The final design utilizes a motor and swing arm which is contained in a housing unit. The unit can then be attached to the board game and with the push of a button will activate essentially replacing the need so supply force to the original board game levers. This design was built with the client's needs in mind, and is better suited to him than any existing product currently available.

The idea behind the adapted snow sled was to provide a safe and secure way for the client to be pulled around in a sled. This was accomplished by securing the client to the sled through a seat and harness system, making sure that sufficient head and trunk support were provided. The final design uses a seat which was designed for use as a swing, and is permanently mounted in a sled. The seat has an adductor between the legs, and a full body harness built in to secure the clients shoulders and waist, also it is tall enough to provide proper head support.

The idea behind the Device Control Panel was to allow the client control over certain objects within his room at the touch of a button so that he would not need to get up and move around. This was accomplished by creating a control box containing push buttons that would wirelessly control a CD player, and a DVD player. The final design utilizes four jelly bean push buttons that will play/stop the DVD player, and will play/stop the CD player through the use of an RF signal. This design was again built with the client's needs in mind, and will provide him the independence to operate these devices.

Project for Ohio University:

- Software Memory Recall Game

The software memory recall game was designed for people with Alzheimer's disease, dementia, or others who suffer from memory loss due to advanced age. The clients who

would use this software have main cognitive deficits such as short term memory loss of names and faces of family or friends, and loss of basic faculties meaning disorientation. The memory recall game was designed because speech pathologists recommend repeated use of images to improve memory recall and in this way the software will try and provide support. The final design allows the software package to be installed on a Windows PC and will accept digital images and names that are specific to each individual user as well as a default package of pictures and names preloaded. The game will then display an image and prompt the user to speak the name into a microphone, and in so doing compare the auditory input to the corresponding word. Correct and incorrect answers will then be conveyed to the user, and a time and score system is implemented along with some statistical analysis.

Team Number 9
TACS: Thermoacoustic Cell Sorter
Team Members: Michael Lalli, Nimesh Patel, David Pillittere

Sponsored by Dr. Shiva Kotha

The thermoacoustic cell sorter is an experimental device designed to be more portable and cost-effective than the flow cytometers that are currently on the market. Existing flow cytometers are hulking machine costing tens of thousands of dollars that require the employment of trained technicians to operate. The TACS device could fill a need in the medical market by automating a number of blood tests which would have cost too much using a flow cytometer.

TACS consists of microchannels which contain cells suspended in an aqueous solution, electronic portions including the laser diode, ultrasound sensors, and signal analysis software, and electrically actuated gates to direct fluid flow. Microchannel molds were created using photolithography. The device is smaller and less expensive than existing products by employing a laser diode and driver, which is a circuit board not much larger than a standard microscope slide, and ultrasound sensors made from Polyvinylidene Flouride films. Electrically actuated gates are built into the microchannels using Ferrous Oxide nanoparticles suspended in a PDMS gel. The gates are actuated by the software program.

Team Number 10
The Circular Stapler Compression Sensor

Team Members: Ronny Bejarano, Johana Redden, Antonio Costa

Sponsored by Covidien

The goal of this project is for the students to develop a system that will determine the compression forces that Covidien surgical instruments exert on tissue. Covidien has attempted to adapt readily available off-the-shelf technologies that are used to measure contact forces. There are some caveats namely, force translation, with these technologies

due to the fact that their stapling devices have gaps where the tissue is captured to allow for staple formation.

The development of our device consists of three important components; LabVIEW, electrical circuit design and sensor/PCB enclosure. The Circular Stapler Compression Sensor device has been design to maximize the efficiency and reliability to acquire data when perpendicular forces are applied on tissue. The circular stapler provided by Covidien will be integrated with our sensor device, in order to detect, translate, and log the correct contact forces to circular stapling.

Team Number 11
Improved Tissue Thickness Measurement Device
Team Members: Sam Azer, Clifford Locke, Peter Masso

Covidien is a surgical devices company that collaborates with medical professionals to create innovative healthcare solutions. Their surgical staplers for use during laproscopic surgical procedures are among their best-known and most widely-used products. These staplers deliver staples of various sizes, and the size of the staple deployed during any given procedure depends on the thickness of the tissue being stapled. There is currently no industry-standard device for tissue thickness measurement. Covidien has developed two devices, the Endogauge and the Toveytron, to measure tissue thickness, but these devices suffer from a lack of repeatability and reproducibility, i.e., the measurements are highly operator-dependent.

Covidien tasked this team with the design and implementation of a tissue thickness measurement device that solves many of the problems associated with the current devices and may be used with a 12-mm laproscopic port. The final device is automated and has the ability to store measurements internally memory for later review. A digital display (LCD) shows the measurements as they are taken and serves as the centerpiece of a functional and user-friendly interface. The device is hand-held, with a rear handle that contains all of the electronic components, including a custom printed circuit board (PCB), the LCD, three push buttons to control the device, and a DC motor. This motor is connected to a moving jaw via a shaft, which fits into a 12-mm port; this moving jaw compresses tissue against a stationary lower jaw. Position feedback in the motor is manipulated to produce measurements.

Team Number 12
The RevoBike
Team Members: Drew Seils and Shane Tornifoglio

Sponsored by the School of Engineering and School of Business
Entrepreneurial Senior Design Program

The market need identified was that current designs for upright stationary bikes make them difficult to access for the elderly and those recovering from hip/knee surgery and injuries. Stationary bikes are considered one of the best modes of rehabilitation for recovering patients and those going through physical and occupational therapy. It is a zero impact exercise that enhances the range of motion of the lower extremities without even the stresses caused by the patient's body weight.

To solve this problem the RevoBike was designed to allow for easy walk in access, tilt assisted sit down, motorized seat adjustment, and tilt assisted standing for exiting the machine. The RevoBike has also been designed with an onboard energy generation system. It powers all of its onboard electronics and charges its battery from the kinetic energy generated by exercising on the bike. The RevoBike is also fitted with two AC outlets for powering and charging conventional devices such as a cell phone of laptop.

The Biomedical Engineering (BME) Senior Design course is intended to engage students in a meaningful experience by bringing together concepts and principles learned in the biomedical engineering curriculum, extend this theory to practical application, then to plan and construct a finalized product.

This experience is comprehensive, reflecting all aspects of the engineering design process along industry guidelines. Problem solving for large-scale, open-ended, complex and sometimes incompletely defined systems is the primary emphasis of these courses.

Students use the web to describe and report progress on their project. Students have also utilized the web to facilitate communications with other universities in joint projects. The Senior Design homepage is located at:

http://www.bme.uconn.edu/bme/ugrad/bmesdi-ii.htm

Interested individuals are welcome to visit this site to experience first-hand what BME senior design is all about.

For more information regarding the BME Senior Design course contact:

Dr John D. Enderle:
Phone: (860) 486-5521
E-mail: jenderle@bme.uconn.edu

The BME Program wishes to thank our sponsors for their generous support.

Covidien
60 Middletown Ave
North Haven, CT 06473

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