Senior Design Projects

Biomedical Engineering Technology Expo and Competition

Friday, April 24, 2015
8:00 a.m. – 3:30 p.m.
FIU Engineering Center
8:00am  Breakfast
8:40am  Welcome by Dr. Ranu Jung, BME Chair and Professor
8:50am  Introduction and Orientation by Dr. Anthony McGoron, BME Undergraduate Program Director
9:00am  Team 1: Flexible Source Arm for Near-Infrared Optical Scanner (NIROS)
        Sponsor: Optical Imaging Laboratory, Florida International University
9:30am  Team 2: BioKeen Weight Dependent Accu-ringe
        Sponsor: Miami Children's Hospital
10:00am Team 3: Automated Microshunt Cutting & Inspection System
        Sponsor: InnFocus Inc.
10:30am Team 4: Oropharyngeal Airway with Tongue Traction Interface and Optimized Airway Patency
        Sponsor: Dr. Julio Gallo of the Miami Institute
11:00am Team 5: Expanding the Use of Capillary Microextraction of Volatiles to Biological and Clinical Settings
        Sponsor: IAD-x, LLC
11:30pm Team 6: Radial-Ulnar Deviation and Change of Grasp for a Hand Assistive Device
        Sponsor: Miami Children’s Hospital
12:00pm Team 7: Air Removal from a Liquid-Drug Injection System
        Sponsor: SHL- Pharma
12:30pm Team 8: Incubator 37 SIII
        Sponsor: BioRad
1:00pm  Team 9: Modular Knee with Disposable Osteoarthritis Simulating Joints
        Sponsor: Stryker Mako
1:30pm  Judges Deliberations and Lunch (BME Conference Room)
2:30pm  Senior Design Award Ceremony and Reception
Congratulations Seniors!

As senior Biomedical Engineering students at Florida International University, you have come to the end of an incredible journey. Your Senior Design Projects are a reflection of your efforts and your Capstone undergraduate experience.

Your work is an illustration of the many skills you have sharpened during the course of this yearlong project. You have discovered new ways of thinking, designed and developed an engineering solution for a practical problem, and collaborated with your teammates to deliver innovative solutions. It is encouraging to see your accomplishments and to have witnessed your growth as students.

As you embark on the next stage of your education and careers keep the confidence that comes from having enhanced your knowledge, remain inquisitive and have the courage to achieve your dreams.

Ranu Jung
April 2015

Florida International University
Spring 2015
Senior Design Projects
Flexible Source Arm for Near-Infrared Optical Scanner (NIROS)

Team #1: Stephanie Gonzalez, Brandon Cardenas, Kevin Maestre, William Noundou
Faculty Advisor: Anuradha Godavarty
Company Sponsor: Optical Imaging Laboratory, Florida International University

Abstract

NIROS is a near-infrared optical scanner developed by the Optical Imaging Laboratory, which is used to monitor the wound healing of diabetic foot ulcers. Currently, the existing device is limited due to the excessive specular reflection (or glare) detected by the camera. The objective for the senior design project is to redesign the device’s source package in order to achieve better control of the light illumination while minimizing specular reflection. The methodology to overcome the specular reflection is to develop an articulating arm for the source light so as to avoid the angles at which there is the most reflection occurring. The developed prototype will be tested in comparison to the existing NIROS device (that has a fixed source arm) via phantom and in-vivo studies on a normal foot. Overall, NIROS offers an objective imaging approach to monitor the healing of a wound in diabetic foot ulcers that incorporates a handheld, ergonomic design for ease of use without any artifacts.
BioKeen Weight Dependent Accu-ringe

Team #2: Kareem Eusebe, Vanessa Baron, Zeshan Khan, Ricardo Louissaint, Jose Ramos
Faculty Advisor: Dr. Wei-Chiang Lin
Company Sponsor: Miami Children’s Hospital

Abstract

Emergent hospital situations require accuracy and efficiency. Currently the dispensing method of RSI cartridge drugs requires manual calculations and over 4 steps from drug to IV. Drug-specific dispensing syringes have been engineered to minimize dispensing time and maximize precision compared to current modalities. Biokeen has designed an epinephrine, atropine, and lidocaine cartridge adapter for direct transfer of drug from cartridge to our “Weight Dependent Biokeen Accu-ringe”. This product simplified the workload for our healthcare professionals by increasing the accuracy of the ml to kg correlation calculation, decreasing steps needed from cartridge to IV, and provided a user friendly, weight dependent modality of drug dispensing. The target population includes healthcare professionals responsible for administering the mentioned drugs. Biokeen has engineered and produced a weight dependent syringe accompanied with a drug cartridge adapter. The overall goal is to provide the quickest and safest method of drug dispensing to all pediatric patients.
Automated Microshunt Cutting & Inspection System

Team #3: Juan Loayza, Anthony Giordano, Cristina Moya, and Ramiro Alvarez
Faculty Advisor: Dr. Jessica Ramella-Roman
Company Sponsor: InnFocus Inc.

Abstract

Glaucoma, which is associated with buildup of pressure within the eye, is the second leading cause of blindness worldwide. Our company sponsor has developed a microshunt that reduces intraocular pressure by moving the fluid from the anterior chamber to the subconjunctiva. The microshunt must meet certain dimensions to be inserted into the eye and maintain proper fluid flow. The current process of cutting and measuring the microshunt is manual, and consequently, takes a full work day to manufacture 25 microshunts. The purpose of this project is to create an automatic system that will cut a batch of microshunts, take images of them, and then conduct image analysis to measure dimensions such as proximal length, distal length, and outer diameter. Ultimately, the process will be completely automatic so that fewer steps are required to cut the microshunts, subjectiveness and variability in the process is reduced, and more devices can be produced.
Oropharyngeal Airway with Tongue Traction Interface and Optimized Airway Patency

Team #4: Vintanya Crawford, Irwin Cabrera, Wisk Wensy Derifond, Stanley Nicolas
Faculty Advisor: Dr. Michael Brown
Company Sponsor: Dr. Julio Gallo of the Miami Institute

Abstract

Oropharyngeal airway devices (OPA) are used for patients undergoing general anesthesia during facial plastic surgeries without intubation and are crucial for maintaining airway patency. When the patient is anesthetized, the tongue can obstruct the airway due to tongue and jaw muscle relaxation. Current modalities, such as the Berman and Guedel airways, have smooth surfaces that do not prevent tongue retraction and, consequently, airway obstruction. Also, these modalities offer a way to remove saliva and blood from the airway but do not provide a means to efficiently maintain airway patency. Our device is optimized to provide two ports to affix cannulae: one for consistent oxygen delivery to the patient airway, and one for accurate monitoring of carbon dioxide levels. Additionally, our device creates traction with the tongue and optimizes airway patency. Compression, Tension, Flexural, Computational Fluid Dynamics, and Smoke Testing were used to verify the design and efficiency of our device.
Expanding the Use of Capillary Microextraction of Volatiles to Biological and Clinical Settings

Team 5: Elizabeth Solis, Raj Shah, Gabriella Fernandez
Faculty Advisor: Dr. McGoron
Company Sponsor: IAD-x, LLC

Abstract

Inaccurate and delayed diagnoses account for the majority of deaths for the 2 million people diagnosed with bacterial infections each year. Dr. Almirall and his team from the FIU Chemistry and Biochemistry Department have created a Capillary Microextraction of Volatiles (CMV) tube that can collect volatile organic compounds (VOCs) for further analysis. By employing spectrometry, the analysis of the VOCs captured by the CMV tube is used to detect biomarkers associated with pathogenic bacterial agents. Our device aims to provide the interface between the patient and the CMV tube in order to control the delivery of patient’s breath through the CMV tube to make the diagnosing technique practical.
Radial-Ulnar Deviation and Change of Grasp for a Hand Assistive Device

Team #6: Brett Davis, Rene Lauzurique, Flavia Lopez, Emmanuel Rodriguez
Faculty Advisor: Dr. Ranu Jung
Company Sponsor: Miami Children’s Hospital

Abstract

The purpose of the project is to design and construct an improved version of a hand assistive device for children with symbrachydactyly. The E-nable community has successfully designed affordable, accessible, 3D-printed devices that provide solutions to most problems brought on by the disease. A major issue with current devices is their limited functionality. The objective of this project was to improve the functionality of the current hand assistive device "The Raptor Hand" by the addition of another degree of freedom (radial-ulnar deviation) and re-position the thumb to provide a cylindrical pinching grasp. SolidWorks, a 3D-modeling/simulation software, was used to create the design and conduct the mechanical engineering analysis, and an Ultimaker 2.0 3D-printer was used for prototype manufacturing. Verification tests for range of motion, grasp closure, and user satisfaction were performed. The increased functionality offered by our design enhances a current cost-effective prosthetic and could improve the user’s experience.
Abstract

The purpose of this project is to develop an air venting device that will be implemented into SHL-Pharma’s upcoming drug delivery product line. SHL-Pharma’s current prototype introduces the possibility of decreasing the time and money pharmaceutical companies spend on producing an airtight drug delivery system. Also patients get a product that minimizes the effort to inject drugs packaged in a vial. Unfortunately, SHL-Pharma’s current prototype has the risk of injecting air into patients if not monitored or controlled. The goal is to create a functional prototype that will vent out any air present in the liquid drug prior to injection, while maximizing drug delivery volume and minimizing the size of the device without increasing injection time. The next phase is for SHL-Pharma to incorporate this into their new product line. A system of membranes and a strategically designed enclosure is used to vent air and deliver liquid drug. A series of integrity testing such as leak tests and statistical analysis are performed to ensure the project’s success.
Abstract

The Incubator 37 SIII is created primarily for blood grouping. This system is basically an assembly of 4 vials in the shape of a card. The current incubator used are not time efficient and samples are still susceptible to over-incubation. As a result, this leads to unnecessary increased labor cost and invalid blood typing results respectively. The latter can further lead to acute hemolytic transfusion reactions. The objective of our project is to address these issues by designing an open incubator that will eliminate the wait time between incubation of samples with a system of timers and alarming systems for each individual sample. The alarms will indicate when a sample is done incubating, and if a test is nulled due to over-incubation. Because DiaMed is one of the leading companies globally in blood group serology, this incubator will be compatible with Diamed’s ID system.
Modular Knee with Disposable Osteoarthritis Simulating Joints
Team #9: Christopher Rangel, Helen Portela, Mitchkaard Lafontant, Gian Simone and Michael Vilca
Faculty Advisor: Dr. Ranu Jung / Dr. Brian Hillen
Company Sponsor: Stryker Mako

Abstract

Osteoarthritis, one of the most common forms of arthritis. Over time, the cartilage, starts wearing away making the space between the bones decrease, leading to bone to bone rubbing that results to pain and stiffness. Mimicking the disease state on phantom models can assist in improvements to procedure efficiency. Currently a true anatomical analog is not commercially available.

The output of this project is to create a modular knee with disposable osteoarthritis simulating joints of the medial, lateral, and patellofemoral regions with a reusable master model to test in conjunction with Stryker Makos’ MAKOplasty® Knee resurfacing implant device. In turn, this model will help improve testing scenarios that mimic clinical conditions without excessive costs of using cadaveric specimens.
The Department of Biomedical Engineering thanks the engineers and managers of the sponsoring companies as well as our clinical sponsors for offering the Senior Design projects and for their continued student guidance and support.