EWH CHAPTER OF THE YEAR COMPETITION REPORT

Chapter/University Name: University of Illinois at Chicago
Date: 4/3/2015

PROGRAMS/PROJECTS DESCRIPTION

Design Projects

Currently we have three teams of undergraduate students working on three separate projects. They are the Negative Pressure Wound Therapy device, Solar Autoclave Sterilizer, and Bike Pedal Generator.

Negative Pressure Wound Therapy

Skin and tissue injuries are often overlooked in developing countries due to a lack of resources available for proper wound care. Amputations are performed as a last resort to treat these injuries, while untreated injuries cause millions of deaths per year. There is a need for a wound care device to aid in the recovery of tissue injuries in third world countries. Our group seeks to address this need by developing a negative pressure wound therapy device made from materials easily obtained in developing countries.

The purpose of negative pressure wound therapy is to accelerate healing after skin and tissue injuries. The primary explanations for this accelerated healing are that negative pressure wound therapy physically brings the edges of the wound together, and removes fluid from the wound. Pulling together the edges of the wound and applying negative pressure is thought to increase cell proliferation, therefore accelerating tissue formation, and the removal of excess fluid allows increased blood flow to the recovery site. Negative pressure wound therapy can be used to treat both acute and chronic wounds, including trauma-induced wounds, surgical wounds, and vascular ulcers. In order to do this, the device must maintain negative pressure ranging from -75 to -125 mmHg. It should also be able to tolerate 10% to 85% non-condensing humidity, and be able to operate for up to three days.

Vacuum assisted wound closure devices, or "wound vacs" are currently available in developed countries to assist in recovery after tissue wounds. However, these devices cost $100 per day to rent, and over a thousand dollars to purchase, and are therefore not affordable for those living in developing countries. Our proposed device is cheaper than those available in developed countries, and is able to monitor its own pressure.

See Figure 1.

Solar Autoclave Sterilizer

Unsterilized medical equipment is the primary cause for infection in underdeveloped countries. Unequipped with proper sterilization technology, surgeons and medical professionals are forced to operate with used surgical tools to provide emergency operations, ultimately leaving patients with increased risk of infection, which may lead to death. Our EWH chapter has proposed a solar autoclave sterilizer as a method to sterilize surgical equipment in underdeveloped countries. The solar autoclave is a cheap and effective way to harness the sun's energy to kill bacteria. Solar energy is generated using a Fresnel lens and optics to focus heat onto a pressure cooker. The lens may easily be adjusted according to the sun's position in the sky to maintain the proper focal point. The pressure cooker functions as an inexpensive steam chamber and will house the medical equipment that needs to be sterilized.

Not only is our design inexpensive, it also comprises of materials readily available in underdeveloped countries. Our team strives to make the autoclave as simple as possible so non-English speaking and/or persons without a medical/science background can use our device effortlessly. We wish for our solar autoclave to fully aid in reducing infection in underserved countries.

See Figure 2.

Bike Pedal Generator

In developing countries, there is limited access to reliable electricity. While this may not be required for luxury services such as air conditioning, it is definitely a necessity in the healthcare industry, where precious lives are on the line. Some countries employ a rotational power grid where power is available to a certain sector of the city for a limited time. However, many of these countries do not have access to power at all. During intensive surgery, doctors might run into the problem of a power outage, in which critical systems will fail. Devices such as surgical lamps, heart rate sensors, infusion pumps, and communication terminals are in jeopardy of failing during the middle of surgery. Our solution to this problem is a cheap, easy to build, easy to maintain, and easy to operate bicycle generator. The power generated will be stored into eco-friendly super capacitors that also have the ability to be upregulated to discharge on different voltages for different devices. This in turn will allow multiple medical devices to run on their own and allow a surgical process to continue unhindered thus increasing the chance of a patient's survival.

This technology can be utilized in the hospital setting, where there are numerous people in critical condition. In these situations there can sometimes be low-quality generators that may or may not be functioning correctly, and this poses a threat to the patient receiving the surgery. Our bicycle generator will be able to produce the electricity required to power vital components, such as surgical lamps, ECG machines, and surgical pumps.

See Figure 3.

Kit Builds

50 Bioengineering Freshman Students built 25 ECG Simulator kits in teams of two. Kit building has become a part of our department's Freshman Engineering Success Program. This program strongly emphasizes preparing students for successful and meaningful careers and guarantees eligible freshman students a paid summer internship.

See Figure 4.

Vietnam Trip

In March 2015, two EWH students accompanied faculty advisor Dr. Miiri Kotche to Vietnam. The EWH-UIC group was a part of the International Pediatric Specialists Alliance for the Children of Vietnam (www.IPSAC.org), a large group of physicians and surgeons who have long-standing relationships with several women and children's hospitals throughout Vietnam. EWH-UIC presented current project work, and worked with three hospitals and a medical school to investigate potential collaborations. There was great enthusiasm for collaboration, and one project (low cost laminar flow hood – see below) that EWH-UIC intends to pursue over the course of the next year, in anticipation of a subsequent trip next spring. It was extremely beneficial for the students and advisor to have the opportunity to understand the needs and limitations in these hospitals in Vietnam. Furthermore, in addition to better understanding the environment and needs, we also had an opportunity to meet with clinical engineers at the hospitals and understand how they address issues with limited resources. It was very inspiring and educational for all of us! Finally, the students and faculty advisor will be discussing and sharing their experience with the entire EWH-UIC organization at the next upcoming general meeting.

Their experience is documented here: https://sites.google.com/a/uic.edu/uic-ewh-vietnam/

Future Activities

Laminar Flow Hood

The laminar flow hood is an essential piece of equipment in reducing contamination when mixing medication and handling infectious agents. Unfortunately, this necessary lab workspace can cost thousands of dollars.

Our design is a carefully enclosed cabinet made to prevent contamination of semiconductor wafers, biological samples, or any particle sensitive materials. This is achieved by air passing through a High-Efficiency Particulate Arrestance (HEPA) filter which removes all airborne contamination to maintain sterile conditions. Costs are also cut down by the materials used, which were considered by the locations it would be used in. Housing is constructed using plexiglass, plywood, and laminating adhesive. Estimated costs for our design are just under $500.

This project originated from the EWH-UIC Vietnam trip in March 2015. Hospitals do not have access to sterile environments, and are concerned about contamination while compounding and mixing medicine. Hospital acquired infections are a serious issue in the hospitals we visited, and mixing medication in a sterile environment is one way to reduce contamination and address

infection control. We plan to design and test our device in the next year to be used in several Women and Children's Hospitals in Ho Chi Minh City and Danang,Vietnam.

ORGANIZATIONAL ACTIVITIES

Chapter Structure and Statistics

Our student board consists of president, vice-president, treasurer, and networker positions.

President: The president's responsibilities include working with the Bioengineering Department to set up events and acquiring permission to use assets. In addition, the president must arrange general EWH events, hold board meetings, communicate with the national chapter of EWH, communicate with the EWH faculty advisor, and handle a variety of administrative duties. The president is also responsible for identifying and managing design team competition submissions.

Vice-President: The vice-president's responsibilities include working with the design team leaders and guiding them in the correct direction. In addition, the vice-president should be able to find help for teams or leaders if needed. The vice-president attends each of the design team's meeting at least once every 2 weeks. The Vice-president steps in in the absence of the president.

Treasurer: The treasurer's responsibility is to oversee all of EWH financial accounts, maintain communication with the Bioengineering Department, handle all expenses, apply for funding, hold fundraisers, and keep a detailed, accurate, and updated log of all of EWH's expenses and income. In addition, the treasurer is responsible for checking in members at GBMs, and keeping a clear record of each member's information, attendance, and involvement.

Networker: The networker's responsibility is to communicate with the EWH members and keep them aware of all EWH events, opportunities, and design projects. The networker is also responsible to keep the EWH website consistently up to date with information about all design projects, kit building, and upcoming events.

We currently have 43 members consisting of Bioengineering, Electrical Engineering, Mechanical Engineering, and Biology majors. Project meetings are held weekly and general body meetings are held once or twice a month for project updates and guest speakers.

See Figure 5.

Fundraising approaches

This year we held a fundraiser with the band Wilco where 20% of the proceeds from their online webstore was donated to our chapter. Our fundraiser raised $350.

More information about the fundraiser can be found here: http://news.uic.edu/wilco-sales-to-benefit-uic-student-group

Other Chapter Activities

Guest speakers:

Doctor Valerie Dobiesz

Dr. Dobiesz directs the global health education and humanitarian relief efforts within the Center for Global Health and is a Professor of Clinical Emergency Medicine in the Department of Emergency. She has lectured and taught courses on Wilderness Medicine and Emergency Medicine internationally in Peru, India, Nepal, Tanzania, Antarctica, Cuba, the Philippines, and the Caribbean as well as nationally and regionally. She was recognized for her teaching efforts with the American College of Emergency Physicians National Teaching Award in 2000.

Amit Paul

Amit is a graduate Bioengineering student at UIC. He presented his research project on developing a Low-Cost Digital Microscope.

Summer Institute Info Session

Former SI participant, Mark Kline, shared his experience in the program and his trip to Honduras.

EWH CHAPTER FEEDBACK.

Overall, our chapter has really enjoyed all the programs EWH has to offer. One suggestion we can make is updating the Projects That Matter list or possibly a form to propose projects. After reaching out to hospitals in Nepal and Danang, their feedback has shown us there is a great need for the development of inexpensive medical devices.

APPENDIX - PHOTOS, TABLES, SCHEMATICS AND ADDITIONAL MATERIAL

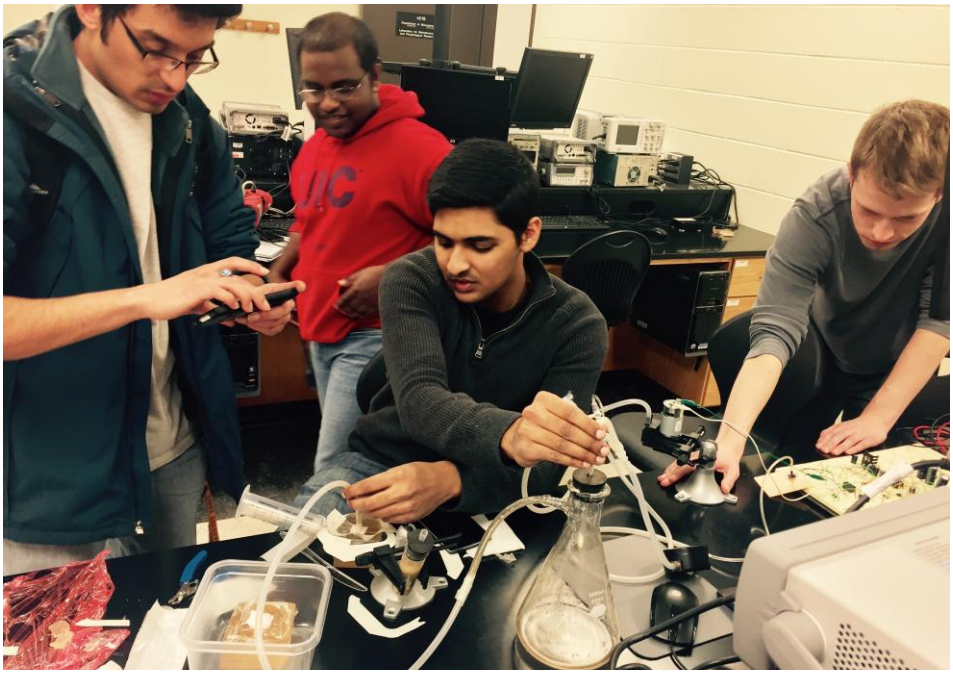

Figure 1 – Negative Pressure Wound Therapy team simulating a wound using ballistic gelatin

Figure 2 – Frame and lens for the Solar Autoclave Sterilizer project

Figure 3 – Bike Pedal Generator team building a prototype frame out of PVC piping

Figure 4 – Kit building as part of our Freshman Engineering Success Program

Figure 5 – General Body Meeting in a campus lecture hall