FOURTH ANNUAL UNDERGRADUATE SYMPOSIUM
ON
INTERNATIONAL HUMANITARIAN ENGINEERING

Department of Mechanical Engineering
Michigan State University
East Lansing
2015

Room 165
Communication Arts & Sciences Building
10:20am - 11:10am

April 24th
Human-powered machine for re-cycling plastics in San Marcos La Laguna,
Guatemala

April 29th
Solar-thermal fruit dehydrator for the Childcare and Nutrition Center in Panyebar,
Guatemala

Never doubt that a small group of thoughtful committed citizens can change the world.
Indeed it is the only thing that ever has.
Margaret Meade (1901 – 1978)
American Cultural Anthropologist
ME491 INTERNATIONAL HUMANITARIAN ENGINEERING: A CHRONICLE AND A CHARACTERIZATION

W. H. Welch, MD (1850 – 1934) founder of the School of Public Health at Johns Hopkins University in Baltimore, Maryland, wrote, ‘It is a well-known fact that there are no social, no industrial, no economic problems which are not related to health.’

Dr Welch’s profound remark buttresses and sustains the vision of an international educational initiative launched over a decade ago when box ovens, heated by solar thermal energy, were developed for Tanzanian families. The subsequent International Humanitarian Engineering Program, which has featured projects in Guatemala, Honduras, India, Kenya and Peru, was born of hope and ignorance, sustained by good fortune and steadfast determination, and consummated by accomplishments that were unimaginable at the genesis, but upon reflection and further cogitation appear to be almost inevitable.

Authentic semester-long inter-disciplinary humanitarian projects motivate and accelerate undergraduate learning much more poignantly than traditional hypothetical academic classroom exercises. It is these compelling real-world off-campus international projects that provide the high-octane fuel that propels this program. Please note carefully this semester’s projects:

- Launching an entrepreneurial recycling initiative featuring a human-powered machine that cleans and shreds plastic containers from Guatemala City’s garbage dumps in San Marcos La Laguna
- Establishing a micro-enterprise at the Childcare and Nutrition Center in Panyebar, Guatemala, based on a solar-thermal structure that dehydrates fruit and vegetables to nourish children, to reduce post-harvest losses, and to generate an income-stream

The fabric of this design-intensive inter-disciplinary ME491 course is woven from a thread of ideas on humanitarian societal development that addresses the pressing needs of the 80 percent of the world’s population living on less than US $2.00 each day, intertwined with a second orthogonal thread comprising a triumvirate of fundamental ideas on inter-disciplinary problem-solving processes, entrepreneurship, and the diffusion of innovations that’s relevant to every single nation sharing our small planet. This warp and weft of interlaced fibers constitute the tapestry describing the solution strategy for solving the biggest challenge confronting humanity today: the very survival of the species.

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Students enrolled in this enthralling ME491 course are the visionaries and the bold ones. The dreamers and the doers. The explorers and the discoverers. The achievers and the magicians.

But these risk-takers must maintain paradoxical balances. They are committed to the traditional engineering practice of creating revolutionary new products that enhance the lives of the poor, yet they display personal panache; they are prepared to stand steadfastly alone, clinging tenaciously to their own personal convictions, yet they are willing to unite philosophically because of their commitment to teamwork; and they are relentlessly driven to create waves of positive change in international marketplaces, yet they are also cognizant of social, cultural and ethical responsibilities. Yes, this is indeed a complicated convoluted conundrum!

So, at the Fourth Annual Undergraduate Symposium on International Humanitarian Engineering pause to review the spectacular innovations developed by these ME491 students. Converse with them, marvel at their dedication to serving the poor, the marginalized, and also the under-represented at the base of the socio-economic pyramid in Guatemala. However, please be receptive to a potential personal transformation by this emotive exchange, and consider joining the students in serving the billions of men, women, and children, who through no fault of their own, are living in abject poverty.

In September 2014, the United Nations Goodwill Ambassador Emma Watson delivered a speech in New York City and concluded with the following string of words, “I’m inviting you to step forward, to be seen, and to ask yourself: If not me, then who? If not now, then when?” Will you step forward? Will you join the throng that serves the poor? Really, will you help?

Countless men, women, and children in Guatemala wish to join the ME491 students and the course instructor in sincerely thanking the Whirlpool Corporation for financially underwriting this International Humanitarian Engineering Program. THANK YOU!

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Human-Powered Re-cycling Machine for Plastic Containers in San Marcos La Laguna, Guatemala

Collaborators: John Barrie, Lori Hart, Monika Goforth
The Alternative Energy Collaborative, Ann Arbor, Michigan

Student Team: Micha Appel, Leo McLaughlin, Arthur Paquier, Mark Taylor

"Give a man a fish and he will eat for a day. Teach a man how to fish and he will eat for a lifetime." This quotation attributed to Confucius is the philosophy of the Appropriate Technology Collaborative (ATC) headquartered in Ann Arbor Michigan. ATC is a non-governmental organization (NGO) actively working in San Marcos La Laguna, Guatemala, with a mission of empowering low-income communities through the diffusion of technologies that improve the population’s quality of life of the population.

This ME491 project builds upon a pre-existing trade in San Marcos, where local residents currently make a living by gathering and sorting raw plastic containers, before selling them at a low profit margin to industrial recycling plants. ATC's vision is to bring recycling processes into a local facility owned by the village of San Marcos La Laguna, so that plastic materials can be processed on-site. In addition, this project will empower Guatemalan women by providing them with dignified employment. On-site processing of the plastic materials will permit plastic injection molded products to be manufactured along with filament for 3D printing, thereby launching an industry that serves people worldwide.

Shredding the discarded plastic into fine flakes and subsequently cleaning the flakes by environmentally-conscious methods is the primary objective of this assignment. If the cleansed and shredded plastic cannot be further utilized in a local facility, it will be sold to off-site industrial organizations for twice the price of the raw uncleansed plastic. Although industrial shredding systems and cleaning equipment are available in Guatemala, the high cost of the equipment and the high energy consumption are impractical for this village situation.

Therefore the team created a human-powered shredding machine that utilizes two adjacent parallel counter-rotating shafts incorporating a multitude of cutting teeth spaced longitudinally along their primary axes. This machine was manufactured judiciously so that it could be replicated easily with resources that are readily available in the Central American nation of Guatemala.

The team is convinced that when a small group of dedicated individuals focuses their efforts on making a change in the world, then there is nothing that cannot be accomplished. By utilizing clean, efficient, human-powered recycling methods,

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Guatemalan locals can dramatically enhance both their environmental and economic conditions. The production of this bicycle-powered machine could not have been accomplished without financial backing from Whirlpool Corporation and guidance from MSU faculty as well as the ATC staff.

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Solar-Thermal Fruit Dehydrator for the Childcare and Nutrition Center in Panyebar, Guatemala

Collaborators: John Barrie, Lori Hart, Monika Goforth
The Appropriate Technology Collaborative, Ann Arbor, Michigan

Student Team: Seth Rohr, Lisa Vogel, Nicholas Youngerman

Poor nutrition during the first one thousand days of a child’s life can have irreversible consequences for that human being. For millions of children, it means that they are, forever, stunted. Smaller than their non-stunted peers, stunted children are more susceptible to sickness; they achieve the lowest grades at school; they enter adulthood with a greater propensity to acquire non-communicable diseases; and when they enter the workforce, they earn less than their peers. Thus they perpetually struggle in a state of poverty, never achieving their full potential.

Guatemala is one of the most micronutrient-deprived countries in the world and it is the worst in Latin America. Food security is problematical and often suffers irrevocably due to natural disasters caused by hurricanes, floods, soil erosion and deforestation. The isolated village of Panyebar is populated by landless poor people who work on nearby plantations farming coffee and sugar. Children here struggle with malnutrition, they are frequently stunted, and they exhibit other chronic health afflictions because of their inappropriate diet.

The Panyebar Childcare and Nutrition Center in Guatemala assists in educating and feeding nutrient-dense foods to young children in the community. However, while foods with the appropriate micronutrients necessary for normal human growth are harvested in the region, this part of Guatemala is afflicted by “hungry months” when fruit is not in season and it is too costly for local people to purchase imported fruit. This unfortunate situation triggered the notion of creating a source of dehydrated foods for these “hungry months” and to also create an income stream for the Childcare and Nutrition Center.

A solar-thermal fruit dehydrator has been designed and manufactured by the MSU team to provide less perishable foods with more nutrition and also to provide a new source of income for the Education and Nutrition Center. Radiant thermal energy is harvested at no cost from sunshine by a large panel system and it heats an inclined ducted heat-exchanger through which air flows on its way to the drying chamber containing racks of sliced fruit. At the base of the chamber, the warm air enters and rises vertically through the sliced fruit before
moistened air ultimately escapes through the vents at the top of the chamber. Additional thermodynamic design features permit the hours of drying to be prolonged beyond sunset in order to enhance the proficiency of the fruit dehydrating process. Upon completing the construction phase of the project, a manufacture and assembly process will be formally documented so that the solar dehydrator will be easily reproduced in Guatemala.