D-Lab

Design Challenges

January 2005

Contents:

Note: Photos describing these projects were part of the original document, but have been removed for copyright reasons.

1. Commercial-scale dryer

1.1. Project Motivation: Food drying technology is well-established, but most systems are small scale. There is a need for dryers which produce food on a commercial scale and at export/commercial quality.

1.2. Technical Description: Specifics of scale and quality will be determined with community partner. Needs to low-cost and made from locally available materials. There needs to be a back-up power supply for winter and cloudy days.

1.3. Community: Appropriate Technology Services (ATS) in Lesotho identified this need and will work with the team on project development.

1.4. Project Status: The design of small-scale food dryers has not changed in 20-25 years. The technology is well-established but has not been used on a commercial scale.

1.5. Contact(s): DK Phakisi from ATS in Maseru, Lesotho

2. Commercial dough kneader

2.1. Project Motivation: Fresh bread is not available in many areas of Lesotho. With improved methods for preparation and baking, entrepreneurs can start bakeries and fill this need. A commercial-scale dough kneader is one technology that is needed.

2.2. Technical Description: Kneader would need to handle about 500 loaves per day. Should be non-electrical and use locally available materials.

2.3. Community: Appropriate Technology Services (ATS) in Maseru, Lesotho is interested in developing this project and would help with specifics and possible production and dissemination.

2.4. Project Status: There has been no previous work on this project

2.5. Contact(s): DK Phakisi at ATS in Maseru, Lesotho (contact information available)

3. Cooling without electricity

3.1. Project Motivation: In many developing countries food is wasted because it spoils before it gets to market or before it is consumed. Electric refrigeration is usually not an option because of lack of power. Batteries are expensive and not accessible in remote areas. If there were a low-cost, non-electrical way to cold store food it would be very useful.

3.2. Technical Description: Need to investigate exact temperature and duration of cooling requirements. The scale and details of the project will need to be defined with the help of the community partner.

3.3. Community: Appropriate Technology Services in Maseru, Lesotho and partners in Brazil.

3.4. Project Status: ATS has installed a cool room at Bethel Business and Community Development Center in Lesotho. There has been work on pot-in-pot ceramic cooling technology in West Africa and elsewhere. D-Lab has experience with demonstrating pot-in-pot technology in several countries. Students on this project will be coming up with their own design or improving on the existing ones.

3.5. Contact(s): DK Phakisi at ATS in Lesotho, among others

4. Patient Tracking for Home Based Care in Zambia

4.1. Project Motivation: It is estimated that in the next 10 years, 50 million people will die from HIV/AIDS related illness. The number of people who will need care is much larger than this. In Sub-Saharan Africa, agencies are trying to cope with this increasing demand for health care through distributed home-based care models. In order to provide the best care and distribute resources such as food and medication most effectively, these organizations have to be able to access and act on full information about the patients in their programs. But as these programs continue to grow, the outdated paper-based methods of data tracking are inadequate. A home-based care project may have 20,000 patients and not even know simple metrics, such as how many men, women, and children they are serving, or how many patients are suffering from tuberculosis. This is incredibly important from a care-giving perspective, and the information is also very valuable for impact assessment and fundraising to support the continuing programs.

Photos removed for copyright reasons.

From left to right: Nurses in a Lusaka clinic trained and using computers for maternity-care record keeping. A glimpse of the amount of information in paper-based systems. Joauin Blaya in Lusaka with a group of volunteer HBC workers we're working with to develop the system.

4.2. Technical Description: The Catholic Archdiocese of Lusaka, Zambia runs 60 Community Home-Based Care (CHBC) programs, with over 20,000 patients receiving care. They have a full paper-based information gathering system, and they have begun to digitize their data in excel, which is inadequate for the size and scope of their needs. Design and implement a data entry and analysis system to handle the data generated by this project. A suggested form would be an SQL database with a web-based (JSP) front-end for data entry and record analysis.

4.3. **Community:** The main community partner for this project is the Community Home-Based Care program run by the Catholic Archdiocese, and is staffed by hundreds of volunteers who spend their time taking care of their sick neighbors. The CHBC program is the largest in Lusaka, and they tend to set the example for the rest of the programs. We have close and enthusiastic cooperation from the director the program. Lusaka is a city of 2 million people, and it is estimated that in certain age-groups, the HIV infection rate is as high as 49% (based on anonymous blood-testing of prenatal care patients). There are resources being mobilized for care and prevention, and this project will make a big impact on those efforts. We are also working with a US based non-profit called the Power of Love Foundation to implement broader IT solutions for community based health care in Zambia.

4.4. **Project Status:** There is a large team of MIT students working on a large-scale implementation of a generalized patient-tracking system. This project fills an immediate need and will contribute to this larger project as well. The CHBC has some of their data in electronic form (in excel) and they have computing resources available. This particular component is in the **planning and specification** stage.

4.5. **Contact:** Will DelHagen

5. Low-Cost Water Testing: Bacteria

5.1. **Project Motivation:** Membrane filtration is a relatively simple way to get quantitative data about the level of bacterial contamination of a water sample. Current methods require expensive equipment and either use disposable plastic labware, which is expensive and produces a large amount of waste or reusable glassware, which requires sterilization between every use. This project is to develop an inexpensive membrane filtration apparatus.

Photos removed for copyright reasons.

Existing system produced by Millipore (cost: \$528 - \$1758)

α-Prototype: Aligning the filter apparatus

β-Prototype: Field-testing in Haiti

5.2. **Technical Description:** The β-prototype developed in last year's class is fully functional, but work needs to be done to re-design the device for mass-production, in particular: the number of parts needs to be reduced, methods for multiple production explored and the filter support system redesigned.

5.3. **Community:** Several communities were involved with the field-testing of the prototype developed in last year's D-Lab class, including the St. Bonifice Hospital in Haiti, the MIT Civil Engineering M. Eng. Program and the Centro Technico San Alonso Rodriguez in Honduras.

5.4. **Project Status:** A functional prototype was developed during last year's D-Lab class, however many of the parts were machined by hand. The project is ready to move from the prototype stage to a mass-produced product. In addition, a plan for dissemination of the technology is required.

5.5. **Contact(s):** The main contact for this project is Amy Smith; Daniele Lantagne of the Center for Disease Control is also available as a consultant.

6. Low-Cost Water Testing: Chemicals and Turbidity

6.1. Project Motivation:

Unsafe drinking water contributes to serious water borne diseases that affect tens of millions of people per year in the developing world and leads to million of deaths. Implementation of water treatment systems in countries such as Honduras and India is therefore of the highest priority. As part of these water treatment implementation projects, the water needs to be analyzed prior and post treatment.

During D-lab 2004 a group of students implemented an improved low-cost system for bacteriological testing in water. However, there still remain many other tests that need to be made and currently rely in expensive equipment and/or chemicals.

Specifically, one D-lab past project focused in the use of chlorine for water treatment. In this case, tests for water turbidity and chlorine content need to be run. An accurate commercial turbidity meter costs $800 and there are cheaper versions for $300. In the case of chlorine analysis, even though the kits only cost $35 for 50 tests, the chemicals necessary are not readily available in country. Designing low-cost turbidity and/or chlorine tests would allow the people in Bonito Oriental (Honduras) to test their water in a regular basis to determine whether the chlorination process is working appropriately and therefore ensure safe drinking water for the 20000 inhabitants in the community.

At the same time, another D-lab group found out that, in India, the Green Revolution left behind an excess of pesticides that currently contaminate the drinking water. Analysis of pesticides in water is expensive. A cheaper, chemically based methods for pesticides analysis would allow research institutes all around India to get reliable data on the quantity of pesticides residue and will empower them to start an awareness promoting program and encourage the government to enforce stricter laws concerning the use of chemical pesticide.

6.2. Technical Description: (objective, specifications, scope of work)

The D-lab 2005 team could focus in one or more of the following tests: turbidity, chlorine content, and pesticides content.

The specific goal for the semester would be to develop a low-cost system for analyzing the water and to validate the system by comparison with commercially available kits. The necessary kits for comparative turbidity and chlorine measurements are readily available at the Edgerton Center (contact via Amy Smith). For pesticides, Toxicon lab (Bedford, MA) currently tests for chemical contents at the cost of $100/sample.

As good starting points in designing these kits, the students could start looking at cheap commercial versions of each meter.

A low-cost version of a turbidity meter, which is based in the ability of seeing through the sample at different sample heighs has been previously used, but its accuracy is questinable. This sytems consists of a tube (usually PVC) that can be filled with the water to different levels. Determination how much water can be added until the observerer stops seeing the end of the tube is a measure of turbidity. This sytem could be a good starting point but would need to be improved, tested and calibrated. A completely different test could be devised as well.

In the case of chlorine and pesticides testing, students could look at the composition of each chemical used in the commercial kits and try to find locally available products that could be used instead. contact in the Chemistry and Chemical Engineering department can be made to help in this task.

6.3. Community:

<u>Honduras:</u> Bonito Oriental community, in the northern coast of the country, has currently built 15 water chlorination systems that distribute drinking water to 20000 people. D-lab groups have been working with the water committees in this community for the past 12 months and have made several contacts.

Contact with the community is usually made through our local partner, a local non-profit organization called Centro Tecnico San Alonso Rodriguez (CTSAR), which is based in Tocoa (45min away from Bonito Oriental).

Contact information: Gines Suarez (director of the CTSAR)

<u>India</u>: D-lab groups have been working with the NARI Research Institute for the past months. Contact information is available through Sam Davies.

6.4. Project Status:

This is a new project in itself, but builds on previous experiences of past D-lab groups. While a lot of work has been done in developing a low-cost system for bacteriological analysis, D-lab groups have recently found that they still rely on expensive kits to analyze other aspects of the water. The long-term goal is to develop low-cost versions of all the water analysis kits that are required to ensure safe drinking water.

While the intellectual part of the design challenge needs to be tackled from the beginning, the contacts with the respective community partners are already very strong and will therefore facilitate development of more appropriate tests and the feasibility of in-country testing.

6.5. Contact(s):
Amy Smith
Marta Fernandez Suarez (chlorine and turbidity, Honduras)
Sam Davies (pesticides, India)

7. Charcoal Extruder

7.1. Project Motivation: Haiti is 98% deforested, in part due to the production of wood charcoal for cooking fuel. An alternative method for producing charcoal has been developed in D-Lab using the waste product from sugar cane processing, known as bagasse. The hand-formed briquettes made during this process work well, but do not burn as effectively as wood charcoal. We believe that if we can make compacted briquettes, their performance will improve.

7.2. Technical Description: A device that compacts carbonized bagasse and produces briquettes of a higher density is required. It should produce at least 5 briquettes per minute and cost less than US$50 to produce. It should be able to be made by small-scale metal workers in Haiti.

7.3. Community: There are several organizations in Haiti who are partners in this work: The Friends of Petit Anse, in Cape Haitian, RATRAP in Fond des Blancs, and the Edem Foundation in Les Cayes. There is great interest throughout Haiti, and once we have finalized the process, there are many other organizations that have expressed interest in becoming involved. We have also started working with community partners in Thailand and Kenya.

7.4. Project Status: An initial prototype has been constructed during last semester's 2.009 class. It produces charcoal briquettes that perform similarly to wood charcoal and were well-received by Haitians. The prototype needs to be refined, however, as it is currently too expensive to be a feasible design.

7.5. Contacts: The primary contact for this project is Amy Smith; Gerthy Lahens s the leader of the Friends of Petit Anse; Shawn Frayne, the charcoal master, is available as a technical consultant

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8. Run-of-the-River Micro Hydro

8.1. Project Motivation: In Lesotho and many other places in Africa, grid electricity is often not available to a large portion of the citizens who live in more remote areas. By taking advantage of the water that is flowing in the large rivers using basic turbine technology, electricity could be created at a low cost and distributed to villages near the river.

8.2. Technical Description: The objective of this design challenge would be to develop a working generating "island" made of as many locally available materials as possible as cheaply as possible that would provide a constant supply of electricity to a community. A raft with large turbine blades would be anchored in the river, allowing it to float with the water level. Sedimentation prevention and trash rack creation are two main issues that need to be tackled by the design team. There is also a possibility of using solar panels as an alternative way to power these generating islands.

8.3. Community: *Bethel Business and Community Development Center (BBCDC)* – Local campus that wants to use generating rafts as a way to teach students about micro hydro. *Appropriate Technology Services (ATS*) – Wants to work on cheaper ways to provide rural electrification.

8.4. Project Status: This project is still in the conceptual stage. There was some work done on the design of the power station by VITA volunteers in the early 1990s. Head and flow measurements have also been taken along parts of the Senqu.

8.5. Contact(s): Matt Zedler

9. Community mapping tools

9.1. Project Motivation: There are two main motivations behind this project. For one, in many areas – equally in a busy urban slum or the spread-out interior regions of a country – it is difficult to come to know about the government/NGO/natural resources available, ongoing projects, available tradespeople, etc. Second, being able to participate in a local mapping activity can bring people not only knowledge about where they live, but pride and an increased sense of belonging.

Photos removed for copyright reasons.

From left to right: A community map of Mangueira de Botafogo, Rio de Janeiro; one of the areas mapped; community mapping by GPS in New Hampshire

9.2. Technical Description: Community mapping tools would create an interface to GPS and/or GIS information to lay out a digital map with appropriate features. The interface may include, for example, easy ways to make various visual labels and tags to describe a resource or other memorable site.

9.3. Community:
This project was originally conceived for mapping the favelas of Rio de Janeiro and the indigenous village and individual settlements on the Ilha do Bananal, Tocantins, Brazil. It can be generalized to other communities world-wide.

Potential contacts:
Reinhard Goethert: Research Associate with Department of Architecture, Special Interest Group on Urban Settlements, does community mapping research worldwide

Isabella Massa de Campos: Recently completed community map of Mangueira de Botafogo, a community of ~11,000 people in Rio.

9.4. Project Status: There are low-tech tools and curricula available at MIT that would be useful to learning about the purpose and method of community mapping. Community mapping by GPS has been started at a basic level, but not in these types of communities and without the user interface at the computer to add specific resources in a recognizable way.

9.5. Contact(s):
Leo Burd

10. Keyboard Driver for Native Languages

10.1. Project Motivation: Allowing true international access to digital technology requires accessibility and easy input for local languages. For many languages, there is no standard layout, and common characters may be difficult to enter without more advanced skills.

The potential impact of such a project would be huge. Although we have a couple partner communities who have already expressed a need for this, the idea can be generalized to meet the needs of small communities around the world who are just now getting access to computers.

Photos removed for copyright reasons.

From left to right: Thiago Moreira from the Universidade de São Paulo gets the first computer online on the Ilha do Bananal. USP is interested in collaborating with MIT D-Lab on software projects – the new computer center on the island would be a great place to test them out; The Inỹ language consists of 13 consonants and 12 vowels, not all of which are easily accessible on the conventional Portuguese keyboard mapping; While many people in this community are bilingual in Portuguese, being able to use local languages with modern technology facilitates continued teaching and use.

10.2. Technical Description: The keyboard driver for native languages would give people the ability to create custom keyboard layouts from extended character sets and then apply them to their computer, in combination with some way to label the keys.

10.3. Community: This project was originally conceived for an indigenous community of Inỹ speakers (of which there are about 1,700). The flexbility of allowing people to "roll their own" driver means that it can be generalized to meet language requirements in many, many communities. It is particularly useful to groups in small language groups who may not be bilingual and are just being introduced to computers.

Potential contacts:
Universidade de São Paulo: Computer science students and professor interested in collaborating on software projects (particularly for Brazil).

10.4. Project Status: This is a new concept which grew from the goal of creating a driver for the Inỹ language spoken by some indigenous groups in Brazil. D-Lab Brazil (Fall 2004) was involved in the opening of a computer lab in a Inỹ-speaking community. That community would benefit from the ability to modify the standard Portuguese key mapping to include easy access to letters used in their alphabet, like /ỹ/ and /tx/.

10.5. Contact(s):
Leo Burd

11. Model House

11.1. Project Motivation: There are a lot of great technologies available to improve quality of water, sanitation, food storage, etc. Spreading the word about these techniques even within a community can be difficult. The model house is a (multi-year?) D-Lab project which integrates many of the separate technologies into a model house for a particular community. This model would serve as an example for teaching others within the community and would represent a holistic approach and an objective for future D-Lab teams.

Photos removed for copyright reasons.

From left to right: This project will lead to the development of a role model house using appropriate technologies and education. Deciding what a model house needs is half the work; Lots of material – like this not-so-small pile of roofing tiles – are provided by programs with good intentions but imperfect understanding. A model house could demonstrate the materials and technology needed to both other community members and outside organizations; Is this what the model bathroom looks like? What is missing? What D-Lab technologies would be appropriate?

11.2. Technical Description: For this term, a team would decide what aspects of the model house need to be considered, then work on the integration of two or more technologies together (e.g., water collection to water transportation to water storage) or an aspect of the house for which there is a need for a new device.

11.3. Community: There are two current target communities. First, the settlements in Tocantins, Brazil, for which a model house could be developed. Second, a model village idea for Zambia. This would also include economic activities and other aspects not limited to the household.

11.4. Project Status: Many of the individual technologies needed exist – either from projects here or elsewhere – but the challenge is synthesizing them into one household (or village) and figuring out how to educate others in the community about the concept and reasons for change.

11.5. Contact(s):
Model house, Brazil: Leo Burd,
Model village, Zambia: Kurt Kornbluth

12. Water collection

12.1. Project Motivation: Simple wells are prone failure and contamination, and the methods of transporting water commonly used are not necessarily safe, sanitary, or efficient. Getting water for family, garden, and livestock could be significantly improved in individual settlements in Brazil.

Photos removed for copyright reasons.

From left to right: A water collection system developed by the Rural Health student group at a boarding school near the settlements; Water contamination from uncovered and unlined wells is common. This is a dead frog in a well; Could you drag 600+ L of water like this every day? How else could this water be transported? Is this a clean, safe, or efficient way of transporting water?

12.2. Technical Description: This is a systems problem with several possible components:

- Learn why the settlements do not use some of the most common technologies worldwide (e.g., hand and treadle pumps)
- Develop a water extraction system to provide residents with clean, safe water in a more efficient manner.
- Provide a new means of transporting water that is more efficient and sanitary
- Develop a means to protect wells from contamination and make them seafer by covering them somehow

12.3. Community:

The settlements these are meant for are large (~10 acres) plots of land with one family group (about 5-10 people) living on them. Most of them grow their own food and raise animals, and do not have outside income.

Escola Canuanã – Grupo de Saúde Rural: The Rural Health student group at the boarding school near the settlements has developed some great water collection techniques, and is a good contact to the community.

12.4. Project Status: There are water collection devices in Tocantins, as well as many international models that are not used in the area. It is not known why these (like treadle and hand pumps) aren't used. The community partners have been working on this problem for a while and are excited to continue working with MIT D-Lab.

12.5. Contact(s):

Leo Burd

13. Domestic Cocoa Roaster/Grinder

13.1. Project Motivation: In Samoa, cocoa grows on trees, but to prepare it as a drink requires about an hour of roasting and grinding, for a few cups of *koko Samoa* . That involves hot, smoky, tedious effort.

13.2. Technical Description: A device that would combine roasting and grinding, to be used in the home in the manner of a bread machine, could have a market in 10,000 homes in rural Samoa.

In present practice, roasting and grinding are intimately related: Grinding is done with a mortar and pestle heated by the same fire that was used to roast the beans over a metal sheet. The steps are as follows:

1. Cocoa comes in pods 15 to 20 cm long, 5cm diameter, that contain bean-like seeds immersed in a gel. The pod is split open with a machete, and the seeds removed.
2. The gel is removed either by fermentation (for 5 days) or by burning off on the roasting sheet.
3. The beans are roasted on a metal sheet over an open wood fire. Midway in the process, the skins come off, or can be removed by picking up the hot bean and squeezing the skin off. People who are good at this don’t burn their fingers.
4. The large wooden mortar (capacity 0.5 litre) is heated by exposure to the fire.
5. When suitably dark in color, the beans are individually moved by hand from the sheet to the mortar.
6. The roasted beans are pounded by a heavy pestle, into a paste, having the consistency of thick mud.

Following these steps, the drink is prepared by adding sugar and water. The roaster/grinder would ideally perform steps 3-6.

Electric mains service (220v 50 Hz) is available almost everywhere on Samoa, making electric operation possible, but flexibility would be increased by an alternative power source.

Pre-ground cocoa is available in markets, but is thought to be inferior to that produced by the above process. The domestic roaster/grinder potentially could produce a lower-cost, higher quality *koko Samoa.*

13.3. Community: Rural households in Samoa; restaurants

13.4. Project Status: New project; no work done to date.

13.5. Contact(s): Allen Armstrong

14. Low cost X-ray for TB screening

14.1. Project Motivation: Tuberculosis is one of the most common illnesses for HIV-positive people. To treat TB properly it is important to diagnosis it correctly. The best method for diagnosis is by X-ray but the machines arexpensive and non-portable. There is a need for a less expensive machine that could accurately screen for TB.

14.2. Technical Description: Screen would need to be portable and not film-based. (The most expensive and complicated part of the x-ray process is the development of the film).

14.3. Community: There is a need for this product anywhere that TB is commonly found. Africa has a particular need because of the high HIV infection rate. This need was identified in Makhotlong, Lesotho, where there are a number of NGOs and Peace Corps Volunteers working on HIV/AIDS issues.

14.4. Project Status: There is a lab at MIT developing film-less X-ray. The first step in this project will be to identify the status of that work.

14.5. Contact(s): Professor Richard Lanza at MIT and Colleen Dunst in Lesotho (contact information available)

15. Solar Water Disinfection Container

15.1. Project Motivation: During the most recent D-Lab trip, experiments were done to explore alternative methods for solar disinfection of water. It was found that plastic water bags with a very shallow aspect ratio disinfected water much more quickly than the 2-liter bottles that are most commonly used, however these bags are inconvenient in terms of filling, carrying and dispensing.

15.2. Technical Description: There is a need for a bag that is inexpensive, easy to fill, comfortable to carry and effective in disinfecting and maintaining the sterility of the water within. This project entails designing a water storage container that effectively meets all these criteria. Other considerations include material selection, manufacturing techniques and project sustainability.

15.3. Community: D-Lab is currently working with communities is 8 different countries all of which experience problems with the bacterial contamination of water. Insight into the particular customs and locally available resources in these communities are available through the D-Lab network.

15.4. Project Status: Currently, this project is in its initial stages. Experiments were performed in Haiti, Ghana and Samoa and have provided insight into the best shape for solar disinfection. The other aspects of the design have not yet been addressed.

15.5. Contact(s): The main contact for this project is Amy Smith; Daniele Lantagne of the Center for Disease Control is also available as a consultant.

16. Water Disinfecting Filters with Colloidal Silver

16.1. Problem or need: Colloidal silver water sanitation filters that do not lose the silver after many liters of water pass through.

16.2. Technical description: It's been known for centuries that silver kills bacteria. The idea here is to incorporate colloidal silver "nanoparticles" into a porous ceramic pot and flow water through the pot to sterilize it. The small size of the silver particles makes it super effective against bacteria. Potters for Peace currently paints the suspension of colloidal silver (in water) onto the surface of the pots, but over half the silver washes away with the first use of the pot! The goal is to figure out a chemical or physical way to make those silver nanoparticles stay put, without compromising (better yet, while improving) the ability of the filter to kill bacteria and provide water at a reasonable flow rate.

Initial ideas include coupling the silver to the ceramic surface (and the inner surfaces of pores) using polyelectrolytes; growing organics around the nanoparticles, mixing the organics into the clay, and then firing off the organics to leave the silver inside the pores; or making a cavity in the pot (again, maybe using an organic layer) so that the silver is kept away from the surface.

16.3. Community:

Potters for Peace

Potters for Peace uses these filters Nicaragua and Southeast Asia, and possibly other places, too. We can be in touch with them throughout the design process, and use their infrastructure to try out our design in the field.

Daniele Lantagne
Centers for Disease Control

Daniele has data on current filter design and sent a list with many important questions and design possibilities. She'll probably be able to provide useful feedback about our approach.

16.4. Status: Figure out a chemical (e.g. polyelectrolyte coupling) or physical (e.g. a cavity left in the pot by organics, or silver carried into the pores by an organic like sawdust) way to keep silver inside the ceramic and distributed in a way that is good for disinfecting water. It's a pretty interdisciplinary project, dealing with materials science, chemistry, microbiology, and engineering. I think it'd be good for those of us who don't have as much of a Mech E oriented approach to engineering.

Tens of thousands of filters are already being manufactured in Central America, South Asia, and Africa. Users found that the flow rates through the pots declined as debris from dirty water clogged the pores in the ceramic. The proposed solution to this problem is scrubbing, but doing so may exacerbate the problem of silver loss. This project would deal specifically with the problem of silver loss due to attempts at unclogging the filter, though it could veer into novel approaches to disinfection via colloidal silver.

16.5. **Contact:** Anna Bershteyn

17. Peanut Sheller/Grinder

17.1. Project Motivation:

Ground-nuts are peanuts. It is more profitable for villagers to convert crops into higher value products before they transport it. If villagers from Mwape, Zambia can turn their groundnuts (peanuts) into peanut butter before they transport it to markets, each shipment would be more valuable because peanut butter is worth more than the same volume or weight of ground-nuts. In short, there is a need to design a ground-nut sheller and peanut butter maker at the village level.

17.2. Technical Description:

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To design a low cost device for converting peanuts into Peanut butter. Ground nut sheller – current designs are metal, consisting of a rotating round grinder moving back and forth through a circular trough. Pictures and rough dimensions are available. This device needs to be redesigned so that it can be made more cheaply and brought to Mwape. Alternatively, another device that performs the same function and can be made in the village should be designed.

3 or 4 people should be able to design and build a groundnut sheller and peanut butter maker by this summer.

In Mwape ground nuts, wood, wood worker are available. In nearby towns (Petauke, 80 km. Dirt road) there is metal, welders

17.3. **Community:** (partners, stakeholders)

Stakeholder	Role and interest in project
Mrs. Sarah Zulu	• Chief of Mwape, who has to approve everything that happens • Concerned about well-being of villagers • Has the power to appeal for funding from local sources • Member of co-op and co-op's financial board
Lazarus Mwape	• Brother of chief, but lives in Lusaka • One of the leaders and organizers in Mwape
Winston Mwale	• Friend of village, experience in larger scale farming with government Lusaka connection • Originator of "model village " idea
Co-op members	• Can use devices to make peanut butter and sell them in the market for more profit than trying to sell groundnuts
Villagers	• Can give peanut butter to their malnutritioned children as a source of protein

17.4.

17.5. Project Status

We have looked at devices available in th Capital city (Lusaka) and they are too expensive. We have met with village head men and chief and they are interested in Peanut butter as a cah-cop/product.

17.6. Contact(s):

Jessica Vechakal or Kurt Kornbluth.

18. Pedal-powered water pump

18.1. Project Motivation: Many areas have safe water that is available from deep wells. If electricity or gas is not available, water has to be hoisted up by hand bucket at a time. The deeper the well and the bigger the need for water, the more strenuous the task.

18.2. Technical Description: Build a pedal-powered water pump to be used for a variety of well depths and water outputs. Use bicycle parts as much as possible in the construction. The design should require a minimum of modifications between different well depths, and should be easily manufactured and serviced in a small local shop. (objective, specifications, scope of work)

18.3. Community:

Maya Pedal of Chimaltenango, Guatemala, manufactures pedal-powered machines. They have produced and installed a number of different pumps of their own design, but they build each machine specifically for a well setting. They would like a more standard design they can produce.

Bikes not Bombs of Boston would be interested in distributing plans for building similar pumps in other parts of the world.

18.4. Project Status:

A collaboration project with Maya Pedal is in the works through the MITERS student group. A number of alternative designs to choose are available, including the one Maya Pedal currently uses. No design evaluation or brainstorming has taken place on the MIT side yet, so this is a pretty open project.

18.5. Contact(s):

Radu Raduta
Carl Kurz at Bikes not Bombs
Mario Juarez at Maya Pedal

19. Pedal-powered washing machine

19.1. Project Motivation: In many parts of the world, clothes washing is a strenuous task performed mostly by women. Traditional techniques require accessing a nearby river or pulling out large quantities of water from a well. The hand rubbing of clothes is difficult and time-consuming.

19.2. Technical Description: Build a pedal-powered washing machine to be used in rural, low-income homes. Use bicycle parts as much as possible in the construction. Important criteria are: user comfort, wash quality, and water and soap economy.

19.3. Community:

Maya Pedal of Chimaltenango, Guatemala, manufactures pedal-powered machines. They have developed a number of prototypes, but none have been produced in quantity. They are interested in a design, and asking them for the feedback they received on the original prototypes would be a good place to start.

Bikes not Bombs of Boston would be interested in distributing plans for building similar machines in other parts of the world.

19.4. Project Status:

A collaboration project with Maya Pedal is in the works through the MITERS student group. A number of alternative designs to choose are available, including the ones Maya Pedal has already tried. No design evaluation or brainstorming has taken place yet on the MIT side, so this is a pretty open project.

19.5. Contact(s):

Radu Raduta
Carl Kurz at Bikes not Bombs
Mario Juarez at Maya Pedal

20. Improving bicycle machine manufacturing

20.1. Project Motivation:

Bicycle technology is widely available even in the poor areas of developing countries. Maya Pedal, an NGO in Chimaltenango, Guatemala, produces a number of pedal-powered machines that improve the productivity of farmers. However, their manufacturing process is largely artisanal, requiring a lot of time and skill on the part of the manufacturer.

20.2. Technical Description:

We would like to rethink the production methods for one of their most popular designs: the multipurpose grain miller and corn husker. This means thinking in the frame of locally available tools and materials to simplify the production, allowing Maya Pedal to employ more workers with fewer qualifications. Productivity enhancements would also reduce the manufacturing time, and producing more units is also economically attractive for Maya Pedal.

At this point the most promising advance seems to be the use of a jig system to hold components in place throughout assembly. The challenge is to create a jig for the manufacture of the pedal powered miller, and re-think the production around the use of the jig in order to improve productivity.

20.3. Community:

Maya Pedal of Chimaltenango, Guatemala, manufactures pedal-powered machines, and has expressed interest in jig technologies for their machines.

Bikes not Bombs of Boston would be interested in exporting these manufacturing technologies to other developing countries (think Whirlwind).

20.4. Project Status:

A collaboration project with Maya Pedal is in the works through the MITERS student group. Kurt has offered to teach a jig building class. More information on the manufacturing process at Maya Pedal needs to be collected.

20.5. Contact(s):

Radu Raduta
Carl Kurz at Bikes not Bombs
Mario Juarez at Maya Pedal

21. Bridging the Digital Divide – Sustainbly

21.1. Project Motivation: (problem or need? Potential impact?)

India's rural unemployment rate is 68%, 80% of India lives on less than $2 per day, and India has only 0.7 million internet connections for a population of one billion. At the same time, computer vision researchers need help labeling images.

We believe that the needs of both of these communities can be addressed through a synergistic collaboration. We intend to employ the rural people of India to label digital images while providing them with supplementary income, introducing them to the many IT-based services provided by organizations like TARAhaat, and creating a real economic incentive to bridge the digital divide.

21.2. Technical Description: (objective, specifications, scope of work)

Participants in this project will design software with unique requirements

- it must create an enjoyable user experience in order to retain TARAhaat's prospective customers
- it must be accessible to people who have never used a computer before
- it must be accessible to illiterate people
- it must run on TARAhaat's existing hardware and software platforms
- it must be distributed via TARAhaat's existing data delivery system
- it must measure the performance of the user in order to assess labeling accuracy
- it should minimize training time and maximize labeling throughput without sacrificing the above requirements

We will examine issues of software usability and basic computer training, performance metrics accuracy assessment, software distribution, the ethics of outsourcing, the legality of international employment, and evaluating the actual short- and long-term impact of this sort of employment on the lives of those we employ. We intend to follow a rapid prototyping-testing cycle in collaboration with TARAhaat and HOC, Inc.

21.3. Community: (partners, stakeholders)

- the people of rural India
- TARAhaat
- computer vision researchers
- HOC, Inc.

21.4. Project Status: (where does this fit into the big picture project? What work has been done on this so far?)

We have a preliminary prototype and we have some commitment from HOC, Inc. to test the software we create and from TARAhaat to deploy it, but there remains a good deal of work to be done.

21.5. Contact(s): (who should they talk to in order to learn more?)

TARAhaat is interested in working with us to evaluate whether this form of employment can be used to help market their rural community computer centers.

HOC, inc., a software development firm in India has agreed to work with us to test our software with rural people.

Sam Davies, a PhD student at CSAIL studying computer vision.

22. Lowering the Barrier to Community Radio

22.1. Project Motivation: (problem or need? Potential impact?)

"Community radio gives community members access to information because it gives them access to the means of communication. The most relevant information - educational and developmental - is disseminated and exchanged. Important local issues are aired. A free market place of ideas and opinions is opened up and people are given the opportunity to express themselves socially, politically and culturally. Community radio helps to put the community members in charge of their own affairs." (From "How to Do Community Radio", a UNESCO publication available.

In January, 2005, D-Lab students worked with a university in Punjab to produce a radio broadcast that solicited questions about agricultural practices, health, and sanitation from rural villagers and sought answers from local experts. The program piqued local interest when it was broadcasted at a local government radio station, and the students who produced the program are now interested in setting up their own radio station.

22.2. Technical Description: (objective, specifications, scope of work)

The goal is to research and design a low-cost community radio transmitter that broadcasts a clear FM band over a distance of 5 km. This challenge requires knowledge of analog circuit design, as well as working knowledge of signal processing (6.003). D-Lab students will research existing low-cost radio transmitters and explore the possibilities of reducing the cost. The project will also involve research into the transmission laws in India.

22.3. Community: (partners, stakeholders)

- SLIET University, Punjab, India
- Rural communities surrounding SLIET: Sangrur, Duggan

22.4. Project Status: (where does this fit into the big picture project? What work has been done on this so far?)

This project has impact beyond SLIET, India. Low-cost radio transmitters could be used throughout the world to bring together rural communities. We spoke with the government officials in charge of the process required to get a community radio broadcasting station license in India, and we have some guidelines for the process.

22.5. Contact(s): (who should they talk to in order to learn more?)

SLIET is interested in working with us to use the radio.

Amit Pahwa a student a SLIET who is interested in moving forward with the community radio project.

Eric Mibuari the student lead the design and implementation of the radio broadcast in January.

Sam Davies, another D-Lab contact.

Community Radio Netowrk: http://www.communityradionetwork.org