

Technology and Human Behavior Change: An Example in Household Water Treatment

Keywords: sustainability, public health, water, preventable diseases

Background/motivation

The Millennium Development Goals issued by the UN have called for ambitious projects to achieve results in several areas by 2015. They include addressing hunger and poverty, health, and environmental sustainability. While private enterprise can meet some needs of less-developed countries, large non-governmental organizations (NGOs) play a major role in contributing to the MDGs.

A basic challenge for these NGOs is the implementation and scaling of solutions with both technical and human components. In particular, any technology for global health or improving quality of life typically requires complementary human behavior change to realize benefits.

Thus, a need exists to evaluate deployed solutions to assess effectiveness and barriers to adoption, to refine them, and to allocate resources efficiently. Evaluation can be costly, and often involves field workers gathering self-reported usage information, which is notoriously unreliable. Any system to aid the evaluation process must be financially sustainable: it must deliver sufficient value to stakeholders who are incentivized and able to pay for it.

Proposed research/work

We are developing a low-cost, household-level water purification product for use by NGOs in developing countries (see page 2). A novel feature for products of this type is the ability to record and store usage information, such as the volume of water treated, but also incomplete or unsuccessful use of the product. Because our design already includes a low-cost microcontroller, the usage-logging feature can be implemented with zero marginal hardware cost. Data can be retrieved from the device via a simple optical link utilizing the existing user interface hardware. Using a smartphone to do so, the usage data can be geotagged.

For large NGOs deploying this product, there are multiple benefits of access to this information that make it highly worth the cost of field staff to collect data and software services to manage it. Quantitative and ground-truth impact information can be provided to donors as well as organization management, guiding further resource allocation decisions. Incentives for regular usage can be offered to end-users, to facilitate initial changes of household water management habits.

Potential Impact in/to cyber-physical systems

This project is a small example of how the collection and dissemination of quantitative data by a cyber-physical system can guide human decision making processes critical for maximizing outcomes of development and humanitarian aid efforts. As the price of low-power wireless communication solutions continues to fall, this and similar systems can be made more or fully automated, further reducing operating costs and barriers to practical implementation.



Solar Powered Water Purification

The Water Crisis –Existing options are too expensive and fail

Non-governmental organizations rely on self-reporting to evaluate the effectiveness of household water disinfection methods. This results in inaccurate data, and inability to ensure water is being effectively purified.



The result is that **existing water disinfection options, including monitoring, are too expensive and fail** to meet the needs of the 900M people without access to safe water.

Solar Water Purifier: A Disruptive Solution to Lower Costs

- **The sun does all the work:** simple technology measures sunlight (UV) exposure and shows the user when the water is disinfected
- Self-contained, reusable, easy:
 - Fill with water
 - Put in the sun, press button
 - Wait for the green light
- 3-6 hours per batch in full sun
- Can be used for transport and storage
- **Nothing to replace or refill**, since it's solar powered
- At volume, **less than \$20/unit** for 5-10L capacity
- Records usage history for download by field staff



PotaVida Purifier

Development Plan

We are currently collaborating with World Vision to prototype and field-test our latest design. World Vision will be our first and largest customer; once proven in the NGO market, we can sell at lower cost to end users.

At A Glance

Focus: Water sanitation and hygiene

Status: Alpha Prototyping

Traction:

- 1st Place, international design contest sponsored by Rockefeller Foundation
- Seed grant from MIT D-Lab
- 1st Place & Best Innovation, U of Washington Business Plan Competition 2011
- Pilot innovation funding from World Vision US

Partners:

- World Vision USA and Zambia
- Cascade Designs, Inc.



Charlie Matlack, CEO
Electrical Engineer
Product design & circuit fabrication



Dr. Jackie Linnes
Ph.D., Bioengineering
User-centered design
Field experience in Nicaragua & Bolivia



Tyler Davis
Public Policy Analyst
Field experience in Indonesia & Mexico

Current Need: \$300K Funding for

- Domestic manufacture of 1K units
- Calibrate solar purification process
- 3 month field test with World Vision for usability feedback



Recent trip to Bimbe, Zambia, in partnership with World Vision Zambia.