Appendix A: Challenge Statement 3

Wearables to the Rescue

Summary

The word *wearables*[1] typically calls to mind small activity or fitness tracking devices, such as the Fitbit or Apple Watch. These products are meant to promote better health, fitness, or sleep, and higher productivity. But the potential of this technology goes well beyond traditional fitness-oriented applications. With their capacity to monitor and measure vital signs and other bodily statistics, sense environmental conditions, collect data in real time, and send alerts and communications, consumer wearables could drastically change lives in the developing world. The potential of wearables as a game changer in public health and safety should not be underestimated.[2] Students will be asked to design a low-power, cost-effective, practical, durable wearable technology for use in low-resource settings to improve either disaster warning and response or access to adequate water, sanitation, and hygiene.

Background

Disaster Warning and Response

In 2015, a total of 150 major natural disasters were recorded, affecting millions of people worldwide. For example:

- In April 2015, a magnitude 7.8 earthquake struck Nepal, killing more than 8,800 people. The quake damaged or destroyed 900,000 buildings, triggered avalanches in the Himalayas, and left almost 1 million children out of school.[3]

- In November 2015, weeks of rain caused severe flooding in the southern Indian state of Chennai. 379 people died, and 100,000 acres of cropland worth about $190 million were destroyed. This flood came just after what some scientists said was one of India's longest heat waves. Temperatures climbed to a record 118°F.[4]

- In Ethiopia, below-average rainfall for several years caused crop failures and livestock death, devastating farmers' livelihoods. The Ethiopian government estimated that about 8.2 million people were in need of food assistance.[5]

Most of the world's population lives in cities and is susceptible not only to natural disasters but to other emergencies such as fires, which frequently occur in slums, informal settlements, and other densely populated urban areas. In these areas, homes are typically constructed of cheap materials like scraps of iron and connected to hazardous electrical lines. Additionally, there are few roads, making passage for emergency vehicles difficult. When emergencies occur, residents often do not know whom to contact for assistance, and first responders—when available—may have difficulty

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locating the emergencies and responding in time.[6]

Urban areas such as these could benefit from reliable systems that spread information quickly, to do everything from alerting people to impending disasters to helping communities recover after a disaster occurs.

Wearable disaster-warning and post-disaster-response systems could help communities reduce risk and help themselves. Functions that these wearables might perform include, but are not limited to, the following:

- Sending alerts in the days, hours, or minutes before a disaster strikes.
- Creating or improving warning and/or emergency services systems for residents and emergency personnel.
- Creating or improving methods for locating loved ones and/or distributing resources following a disaster.

Water, Sanitation, and Hygiene

Worldwide, an estimated 748 million people lack access to safe drinking water and hygienic sanitation facilities.[7] Another 2.4 billion lack improved sanitation facilities, and 946 million still practice open defecation.[8] Increasing access to adequate water, sanitation, and hygiene (WASH) can contribute significantly to improved health outcomes, and is particularly important for efforts aimed at reducing the burden of disease and malnutrition. The United Nations estimates that about half of all hospital beds in developing countries are filled by people with illnesses that are preventable through basic improvements in WASH.[9] Additionally, approximately 50% of malnutrition is associated with repeated diarrhea or intestinal infections as a result of unsafe water and/or inadequate sanitation and sufficient hygiene. Improvements in these areas are critical to break the cycle in which chronically malnourished children are more susceptible to infections generated by inadequate WASH, and in turn become even less capable of absorbing vital nutrients.[10]

Women and children are disproportionately affected by inadequate WASH services. Handwashing with soap is a key component of clean and safe birthing practices. Children suffer needlessly from water- and sanitation-related diseases, such as diarrhea, which can physically and mentally stunt children, affecting them for their entire lives. Even when it doesn't kill, diarrhea weakens children and increases mortality rates from other opportunistic diseases, such as acute respiratory infections. Other illnesses related to inadequate WASH include cholera, malaria, trachoma, worm infestations and guinea worm disease. And in a growing number of countries—especially in urban areas—natural or man-made pollution of water sources threatens millions of people.[11]

Improving WASH can have dramatic effects on education, development, and health. Parasites consume nutrients, aggravate malnutrition, and affect children's physical and mental development, resulting in poor school attendance and performance. The need to gather household water, as well

as a lack of separate sanitation and washing facilities in schools, discourages many girls from attending school full time, and forces some to drop out. Poor sanitation also has heavy economic costs in terms of health spending and loss of productivity. Lastly, promoting improved hygiene practices and increasing access to water and sanitation facilities helps reduce infections among people living with other life threatening illnesses, including HIV/AIDS.[12]

WASH wearables could promote hygienic practices and/or water quality monitoring in ways that include, but are not limited to, the following:

- Promoting handwashing in schools and workplaces.
- Educating communities about the importance of WASH and good hygiene.
- Focusing on sanitation, water quality, and hygiene at the household level.
- Accelerating the adaptation of existing WASH programs.

The Challenge

Design a low-power, cost-effective, practical, durable wearable technology for use in low-resource settings to improve either disaster warning and response or access to adequate water, sanitation, and hygiene.

Success Criteria

Solutions will be judged based on the following criteria:

- **Innovation:** Is this a breakthrough in thinking or design? Ideas that show the greatest innovation will be viewed more favorably.
- **Quality of Presentation:** Is the concept concisely and clearly explained?
- **Commercial Viability:** Does an interesting and viable market exist? Can the idea be commercialized within two years? Is there a clear strategy for commercializing the idea?
- **Sustainability:** What is the social impact? Is the technology scalable?
- **Teamwork:** Was the experience a collaborative endeavor?

Additional Considerations

- A successful solution *should not* require a significant commitment of additional resources, policy changes, or improved core infrastructure for success.
- A successful solution *should* be designed with the user in mind. Consider the supporting ecosystem, existing infrastructure, cultural, religious, or other regional factors, as well as the need for privacy of data and personally identifiable information.
- A successful solution *should* be cost effective and affordable for the target consumer.
- A successful solution *can* address change in one particular country or region, and does not have to apply globally.
- Successful teams *should* complete and properly submit all deliverables on time.

- Successful teams *should* demonstrate that they worked collaboratively.
- Successful teams are *encouraged* to work with a mentor, if possible, and interact with him/her on a weekly basis.

Notes

The Global STEM Alliance would like to thank UNICEF, FROG, and ARM "Wearables for Good" challenge for sharing some of the content for this challenge.

1. Wearable devices are defined as clothing and accessories that incorporate computer and advanced electronic technologies with practical functional features, use sensors to measure conditions (either within the body or the environment), and track and monitor resulting data over time to create a map of events.
2. Use Case Handbook, Wearables for Good Challenge. UNICEF. http://wearablesforgood.com/WearablesForGood-UseCaseHandbook.pdf
3. Worst Natural Disasters of 2015. World Vision. http://www.worldvision.org/news-stories-videos/natural-disasters-2015
4. Ibid.
5. Ibid.
6. Ibid, Use Case Handbook, Wearables for Good Challenge.
7. Water Supply, Sanitation, and Hygiene Development. World Health Organization. http://www.who.int/water_sanitation_health/hygiene/en/
8. Progress on Sanitation and Drinking Water. 2015 Update and MDG Assessment. UNICEF and World Health Organization. http://www.data.unicef.org/corecode/uploads/document6/uploaded_pdfs/corecode/Progress-on-Sanitation-and-Drinking-Water_234.pdf. 2015
9. WASH and Poverty. WaterAid Post 2015 Toolkit. 2015.
10. Ibid, page 2.
11. How WASH Relates to Health, Education, and Development. Water, Sanitation, and Hygiene. UNICEF. http://www.unicef.org/wash/index_healthandeducation.html. June 30, 2015
12. Ibid.

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