Microsoft Research

External Research Digital Inclusion Program

HealthLine Offers Speech-Based Access to Medical Information

When cutting-edge innovations are employed to confront urgent real-world problems in poorer regions of the world, the results can be transformative. Here's the story of how one team of researchers is using technology to improve healthcare delivery in places where doctors and medical facilities are scarce.

The disparities between developed nations and the developing world are nowhere more pronounced than in the availability and quality of healthcare. The severe shortage of health workers and medical facilities in poor regions of the world is reflected in dramatically higher mortality rates, particularly among childbearing women and young children.

In recent years, these pressing healthcare needs have led to the increasing adoption of a "community health worker" (CHW) model, in which community members—usually women—are given training in how to provide basic healthcare and how to determine the severity of illnesses. These workers are paid a modest wage to assess whether patients have a mild illness that requires only a simple course of treatment or are sick enough to warrant visiting the nearest doctor—who might be many miles away and reachable only on foot or by using the only vehicle in the village.

The effectiveness of CHWs varies widely, depending on their training and level of education. In many areas, CHWs are illiterate or low-literate, so they must be trained

Dr. Roni Rosenfeld of Carnegie Mellon University, the lead researcher on the HealthLine project.

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Fast Facts

Project: HealthLine

Project Principals:
Dr. Roni Rosenfeld, Dr. Rahul Tongia and Jahanzeb Sherwani, Carnegie Mellon University

Partners:
Aga Khan University,
Health and Nutrition Development Society (HANDS)

Web Site:
www.cs.cmu.edu/~healthline

Profile:
HealthLine is a speech-based telephone information system that provides crucial medical information to community health workers. This toll-free system is being pilot tested in rural Pakistan to determine how best to design speech-based information delivery to low-literate users in the developing world.

Digital Inclusion Program

The Microsoft Research Digital Inclusion Program provided US$1.2 million in research funding in 2006 to empower academic researchers worldwide to tackle technological challenges that could positively affect health, education and socioeconomic conditions.The 17 recipients, selected from among 162 proposals from 34 countries, received technology resources as well as project funding.

The Digital Inclusion Program is administered by the External Research group within Microsoft Research and is part of the group's ongoing commitment to investing deeply in innovative research. The External Research group collaborates with the world's foremost researchers in academia, industry and government to move research in new directions across nearly every field of computer science, engineering and general science.

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>
> **—Jahanzeb Sherwani, graduate student at Carnegie Mellon University**

and supported without use of the written language. This can severely limit their ability to access medical information beyond the rudimentary knowledge they acquire during their training, which might last just a few weeks. Not being able to look up additional information to verify their assessments can also lead to errors. In fact, a 2002 study of 500 Pakistani CHWs found significant gaps in their knowledge, with 79 percent unable to identify simple pneumonia in a case-based test.

Addressing this weakness in the CHW model was the challenge embraced by a team of computer scientists at Carnegie Mellon University (CMU) in Pittsburgh, Pa., and community health researchers at Aga Khan University in Karachi, Pakistan. Together, they set out to develop a speech-based telephone information system, called HealthLine, to provide crucial medical information to CHWs. HealthLine was one of 17 academic research projects made possible through Microsoft Research's Digital Inclusion Program in 2006.

CMU Professor Roni Rosenfeld, an expert in speech and language technologies, joined with Ph.D. student Jahanzeb Sherwani, CMU Professor Rahul Tongia and Aga Khan University Professor Mehtab Karim to develop and pilot test HealthLine in rural Pakistan.

HealthLine focuses on expanding healthcare knowledge and access generally for CHWs, and it specifically targets the potential use of cell phones—an affordable, accessible and increasingly widespread technology in the developing world—to disseminate information. The system can be used from any kind of phone, but CHWs usually perform their work by visiting patients in their homes, and most homes in poor regions do not have a landline.

"The benefit of our system is that you don't need a smart phone, you don't need a desktop computer, you don't need a laptop—you just need something that can make a phone call," says Sherwani.

In the first phase of research, conducted in mid-2007, a group of low-literate CHWs tested a toll-free phone number that offered recorded information (in Urdu, the national language) about the two most critical health issues affecting maternal and child health in Pakistan: diarrhea and pneumonia. If the user said "pneumonia," for example, the system would offer seven subtopics, including prevention and treatment. After the user specified a subtopic, the system would play recorded information drawn from an existing health pamphlet. The user could at any time verbally prompt the system to repeat the information or choose a different topic.

Speech recognition systems are widely used in developed countries, but they are generally limited to simple transactions, such as looking up flight arrival times or booking a train ticket, and they are often complemented by easily accessible printed and online information. The design challenge with HealthLine—which is built on Microsoft® Speech Server 2007 beta—has been how to structure the interaction so CHWs can get the information they need but not be overloaded with more than they can absorb in a single phone call.

"We're looking to discover, or propose, some design principles for speech interfaces that would be relevant for low-literate users in the developing world," says Sherwani. "Very little is known about design principles for that context." Such a set of design principles would also be applicable to speech recognition systems serving any number of purposes in the developing world, from providing information to rural farmers to giving citizens easier access to information about government programs.

The HealthLine team, which has been aided in the field by the Pakistani nonprofit organization Health and Nutrition Development Society (HANDS), is refining the system based on the results of the first pilot, which involved CHWs who work for a HANDS maternal and child health program.

The researchers concluded that for better comprehension, the information segments should be shorter, with the user having the option to request further details at each juncture. They also plan to modify the kind of wording used because text written for a printed document is not always well suited to auditory comprehension.

The next prototype, to be tested in early 2008 with CHWs of varying literacy and training levels, will also include more topics—such as hepatitis, diabetes and sexually transmitted diseases. This is where a speech-based user interface could prove superior to an approach such as a touch-tone system. "If you have three topics, touch-tone is good enough," says Sherwani. "But if you have 30 or 300 topics, you'd have such a huge hierarchy of menus to go through to get to any specific topic that it would be too frustrating. With a speech interface, you can easily and directly drill down to the piece of information you want."

The team envisions a third phase that will monitor real-world use of the system, with an eye toward scaling it for use throughout Pakistan. "The model of speech over the phone has so much promise for the developing world that there should be many, many projects looking at this approach," says Sherwani.

Rosenfeld notes that "a very tiny fraction" of academic research projects undertaken by computer science departments address developing world issues. "But it's growing," he adds. "Microsoft Research is really helping to make that happen."

Another challenge is creating fruitful collaboration between development workers and experts in the technical fields. "Those of us who develop the technology and know what it can do don't always know what it can be good for," says Rosenfeld. "People in the field sometimes underestimate or overestimate what technology can do. The process of cross-education—of really working together and educating each other—is very bandwidth intensive."

Rosenfeld says that the HealthLine team has been fortunate in this respect. "We hit upon people who right away bought into the idea and got excited about it. They understood it." He is optimistic that the momentum can continue. "If we can make it work decently, they will come," he says.

For Sherwani, a native of Pakistan, the project's potential to attract further interest and funding has helped determine the trajectory of his graduate-level work. Spearheading what he calls "my dream project" has allowed him to apply his expertise to addressing pressing social needs in his home country. "Our work might be a model for other organizations in Pakistan as well as the government," he says. "That visibility could then lead to the system's use in other countries."

This approach exemplifies what Microsoft Research is trying to achieve through its collaboration with researchers worldwide and through its Digital Inclusion Program: a way for innovative projects to apply exciting advances in areas such as speech recognition to solutions that measurably improve people's lives.

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—Dr. Roni Rosenfeld, Carnegie Mellon University

Carnegie Mellon University in Pittsburgh, Pa.

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