

*External Research Digital Inclusion Program*

## Portable Diagnostic Device Can Help Save Lives

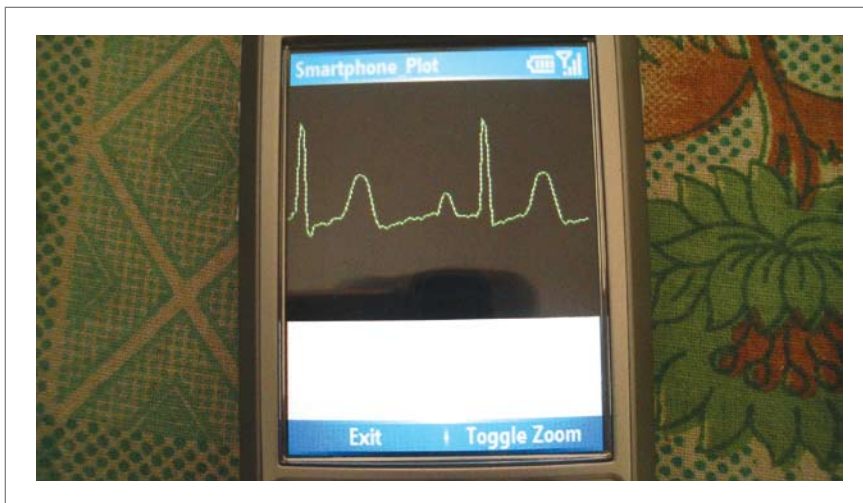
*Many people in the developing world live without easy access to medical care, especially in rural areas. When medical emergencies happen, crucial diagnostic equipment is rarely available and local health workers often lack the expertise to determine the appropriate treatment. A team of researchers at the International Institute of Information Technology in Hyderabad, India, is addressing this challenge by developing a low-cost, portable diagnostic system that can collect vital patient data and transmit it to doctors in other locations who can direct timely treatment and help save lives.*

The difference between surviving a heart attack and dying from it often depends on whether a patient can get immediate diagnosis and treatment. In rural India, where medical facilities and doctors are scarce, by the time a patient is transported to a regional clinic or hospital, it is often too late.

The kind of diagnostic technology that can be so crucial in these situations is expensive. For example, a low-end electrocardiogram (ECG) reader or pulse oximetry device costs about US\$400, more than the per capita annual income in rural India. A machine with a graphical display costs a few hundred dollars more.

In analyzing the problem of how this technology could be made less expensive and more widely available, Professor M. B. Srinivas of the International Institute of Information Technology (IIIT) in Hyderabad hit upon the idea of using mobile phones as the centerpiece of a low-cost diagnostic system that could monitor vital health parameters, record them in a database and send the data directly to a remote doctor's mobile phone.

"Mobile phones have a display, and they are widely used in India," says Srinivas. "We asked ourselves, can we exploit this display? A mobile phone also has commu-



*The initial prototype device collects ECG data. Pulse oximetry monitoring will be added to the next version.*

### Fast Facts

**Project:** Low-Cost Portable Medical Device

**Project Principal:**  
 Professor M. B. Srinivas, International Institute of Information Technology

**Web Site:**  
[http://iiit.ac.in/research/vlsi/MSR\\_DI.htm](http://iiit.ac.in/research/vlsi/MSR_DI.htm)

**Profile:**  
 This low-cost portable diagnostic system will monitor vital health parameters, record them in a database and send the data directly to a remote doctor's mobile phone. The system will collect ECG and pulse-oximetry data, with additional parameters such as diabetes monitoring to be added in future versions.

### 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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nications capability. It has a powerful processor, and it has memory.” He also realized that the Microsoft® Windows Mobile® software and its easy-to-program interfaces would make the display of ECG data easy and inexpensive.

With academic research funding and technology resources from the Microsoft Research Digital Inclusion Program, Srinivas is well on his way to creating the low-cost diagnostic system he envisioned. His solution involves creating an inexpensive device that collects the diagnostic data, digitizes it and transmits it via a mobile phone network or an Internet connection to any other device running the Microsoft Windows® operating system. Srinivas estimates that a device that takes both ECG and pulse oximetry readings can be produced for less than US\$100. It can be powered by electricity from a wall socket or by batteries.

If a village were to have even one such portable monitoring system, a heart attack victim could be diagnosed right away, and a doctor at a regional clinic or medical facility could direct a village health worker to provide the appropriate emergency care. Where a PC is available—such as at an Internet kiosk—the diagnostic data could be displayed directly on the monitor, saved to the PC’s hard drive and transmitted via the Internet.

*“Current-generation mobile phones are more powerful than Pentium-based computers just a few years ago. In case of an emergency, the mobile phone can become a personal diagnostic device that includes a person’s entire medical profile.”*

—Professor M. B. Srinivas,  
International Institute of Information Technology

Srinivas and his team of graduate students have successfully pilot-tested a prototype low-cost ECG system, which monitors the electrical activity of the heart. The hardware for pulse oximetry—which measures blood pressure as well as the amount of oxygen carried by the blood—will be ready in early 2008. The team will then integrate the two diagnostic components into a single unit that can connect to a mobile phone running Windows Mobile. The resulting system will be pilot-tested in villages in the Indian state of Andhra Pradesh in collaboration with Computer on Wheels, a nonprofit initiative dedicated to expanding Internet access in rural India.

Srinivas envisions that the system can be adapted for many other kinds of patient monitoring. Since embarking on the project, he has been approached by medical institutions in India that are seeking inexpensive diabetes monitoring as

well as monitoring for the risk factors of pregnancy, which can include diabetes and heart problems. Given the high incidence of diabetes in India, as well as the country’s high rates of maternal and infant mortality, successful dissemination of this technology could save many lives.

Following the initial positive pilot test results, Srinivas has also begun collaborating with a group of researchers at the University of Wisconsin in Madison, who are developing long-range Wi-Fi technology. Their joint project will adapt Srinivas’s diagnostic device to work over Wi-Fi, further extending its potential reach in India, where communications links include a patchwork of technologies ranging from broadband to landlines to mobile networks. The research collaborators intend to make the resulting system available through open licenses for public use.

Srinivas, who has spent years designing mobile technologies for health and education using personal digital assistants (PDAs), sees vast potential for expanding healthcare in developing countries through the application of mobile technologies. “Current-generation mobile phones are more powerful than Pentium-based computers just a few years ago,” he says. “In case of an emergency, the mobile phone can become a personal diagnostic device that includes a person’s entire medical profile.”

Srinivas sees a large role for such low-cost diagnostic systems in preventive care as well, particularly in village clinics, but even in villages that lack medical facilities but have an Internet kiosk. In fact, he sees vast potential for this technology in all parts of the world, including developed countries, where the high cost of diagnostic tests and the distance people live from test facilities are common obstacles to better health maintenance.

Srinivas credits Microsoft with having a deep understanding of how innovative and cost-effective technology solutions such as his can improve lives. “Microsoft can actually foresee the potential of this kind of project and the help it can bring to local communities,” he says. The help from Microsoft Research has also given a huge boost of confidence to Srinivas and his team. “The last two years have been a great period of time for us,” he says. “My team has had so much pride in doing this project. We have gained so much confidence because of the support that Microsoft Research gave us. It showed us that we can do anything in this world.”

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