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The Human Touch

Russell Gasser
School of Engineering, University of Warwick

Terry Thomas
School of Engineering, University of Warwick

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by Russell Gasser and Terry Thomas,
Development Technology Unit,
University of Warwick

Biting insects, inaccessible terrain, impenetrable bamboo thickets and thorn bushes. Mine clearance in Cambodia is a hot, sweaty business at the best of times. Because tripwires hidden in the undergrowth could trigger explosions, the vegetation has to be cleared by hand before mine detection can start. It is a tedious matter and can occupy two-thirds of a mine clearer's working day.

The next step, finding and digging out every piece of buried metal, is not any easier. In the dry season, the ground can be rock-hard and the deminers must move forward at a painstaking pace, probing with a prodder and digging with a small trowel. Only one in a thousand of the finds is likely to be explosive, but you cannot let your concentration slip for a moment. The majority of deminers who undertake this painstaking work are not experts but local people who have gone through a training course lasting two or three weeks.

Cambodia is not alone. Current estimates suggest there could be 25 million landmines buried worldwide. That is far fewer than was previously feared but still enough to contaminate one country in three and to kill or injure two thousand people every month, many of them children. Present methods of clearing land are slow, and mines can remain active for many years. Something should be done, but what?

"Military-driven technology is useless for clearing mines in villages and rice fields."

At first glance, the answer seems obvious: bring in super-fast robots, hook them up to remote sensors and control them from afar with computers. In countries such as Britain and the United States, that is pretty much what most scientists and engineers working on mine clearance technology have been doing. In a typical advanced research lab, you will see mine-like targets planted in giant sandboxes below computer-controlled positioning equipment. The researchers will be hunched over computers analyzing mine "signatures," detected remotely by ground, penetrating radar and polarimetric infrared cameras. By combining information from these sensors, the labs can obtain stunning images of buried objects.

It is all very impressive. Yet despite the large sums that have been spent on such projects, the results to date have been of no use to humanitarian deminers working in heavily mined countries, such as Cambodia, Mozambique, Angola and Afghanistan. What has gone wrong is that researchers have made detecting buried mines their goal. But priorities in real mine fields are quite different. Vegetation and tripwire clearance and discriminating between mines and scrap metal are the key problems. To pursue expensive technologies designed for finding mines in level lawns is to woefully misunderstand what deminers actually do.

Part of the problem is that almost all the lab research is driven by military needs. Generals may want to clear a safe passage through a mine field quickly at night or under enemy fire. In humanitarian demining, what matters most is not speed but the ability to completely clear the land so that it can be returned to the community. This means that potentially useful methods are often developed to meet the wrong objectives.

Self-monitoring prodder. Self-contained, no wires.
Photo c/o Russell Gasser

For example, the ability to detect explosives without laboriously having to excavate scrap metal could be a boon. One promising method uses neutron bombardment to detect the nitrogen in explosives. When nitrogen captures neutrons, gamma rays of a known energy are produced and can be detected. Another technique is "nuclear quadrupole resonance (NQR)," a form of nuclear magnetic resonance (NMR) that can detect chemical bonds specific to an explosive by the way atomic nuclei absorb radio waves. Unlike NMR, NQR uses the Earth's magnetic field instead of powerful magnets.

The problem is that research into such approaches has been aimed at making them as fast as possible for military use, almost regardless of cost. Humanitarian deminers require cheap and highly dependable tools, even if they are slow. And the notion that techniques such as NQR will be vital to clearing "plastic" mines has been overstated. Most so-called "plastic" mines actually contain a metal firing pin that sensitive metal detectors can now find. Only in a few well-defined zones, usually high-tech war zones, can a tiny number of special zero-metal mines evade detectors and have to be found by other methods such as prodding.

In any case, the extended timescale of research programs, which may not produce results for a decade, represents a major problem for the mine clearers. Afghanistan plans to clear all its potentially most productive and useful contaminated land by 2007. Some 4,000 deminers have already removed 850,000 mines, and mine clearance is now Afghanistan's biggest source of employment.

A common argument for replacing these human deminers with machines and software is that it will be less risky and more efficient. In fact, it is likely to be neither. New software is notoriously unreliable, and advanced electronics is out of place in many mined areas. Deminers in rural Angola have enough problems getting batteries for their metal detectors.

Besides, a skilled deminer looks and feels for suspicious objects simultaneously. They also listen for the sound of tools touching metal or plastic and make rapid decisions based on sparse information in unique situations. No machine, with or without batteries, can duplicate these skills. The fact is that human deminers are clearing land more safely than ever before. Accident rates are around one per 30 persons per year, and this statistic is declining.

While generously funded lab research has failed, simple pragmatic ideas developed in the field have yielded major improvements in humanitarian demining in recent years. For example, both commercial and NGOs have fitted mine-clearance tractors with agricultural flails to clear vegetation. Either the driver is protected by thick sheet steel or off-the-shelf remote controls enable driving from a safe distance. Similarly, home-made armored excavators are being used to sift through mined building rubble. Using the simple protective equipment now being manufactured in countries such as Cambodia, Pakistan and Zimbabwe, a deminer can sometimes walk away from an anti-personnel mine explosion with only scratches.

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All of these approaches are based on an intimate understanding of local needs and human resources that have so far evaded hi-tech research. We have seen a similar pattern emerge many times in the developing world in the past 20 years from agriculture and water supply to urban transport and rural telecommunications. Everyone wants mine clearance to be safer, faster and cheaper. Scientists could help by making their work more relevant, but deminers despair that this will never happen. Someone, somewhere must try to prove them wrong. ■

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Contact Information

Russell Gasser and Terry Thomas
Development Technology Unit
School of Engineering
University of Warwick
Coventry CV4-7AL, England
Tel: +44 1203 522305
Fax: +44 1203 418922
Mobile: +44 7931 733632
E-mail: esrpo@eng.warwick.ac.uk