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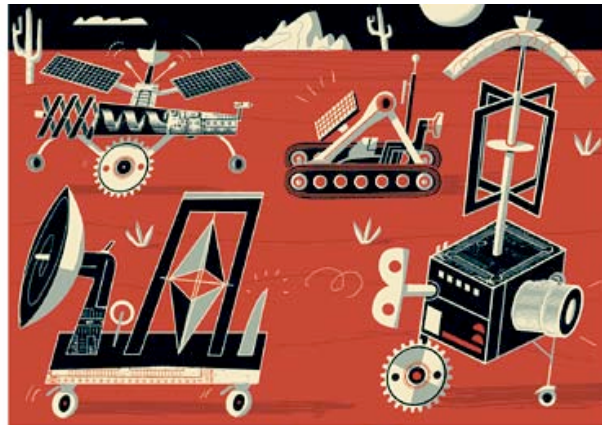
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MONITOR

Robots, start your engines

Mar 11th 2004
From The Economist print edition

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Innovation: Could a robot race funded by a military-research organisation help to advance the development of autonomous fighting vehicles?

AMONG government organisations, America's Defence Advanced Research Projects Agency (DARPA) has always been somewhat unusual. As the research arm of the Department of Defence, it is akin to a high-stakes venture capitalist, gambling large sums of money (its estimated 2004 budget is \$3 billion) on risky technologies that will probably fail, but could pay off in a big way. It has had some stupendous successes, such as the internet, the Saturn rocket and micro-electro-mechanical systems (tiny machines that work at the scale of a human cell). There have also been some resounding duds, such as the Total Information Awareness project, a Big Brotherish plan to spot terrorists by combing through databases of personal information, which was swiftly abandoned.

But what is arguably DARPA's most outlandish scheme yet will start rolling on March 13th, when a gaggle of strange-looking vehicles will line up in Barstow, California to make a wild run across 250 miles of scrub and desert. They will be heading, fittingly, towards Las Vegas, where gambling and high stakes are as common as hotel-buffet specials. DARPA calls this race the Grand Challenge. What makes the race so grand, and so much of a challenge? The lack of humans.

Not a single person is permitted to be at the wheel (or remote control) of any of the racing contraptions. Each machine in the contest must reach the finish line unaided, within ten hours, or die trying. The first vehicle to cross the finish line within the allotted time will win its human creators a cool \$1m—respectable winnings even in the luminescent, desert-bound gambling capital of the world.

The Grand Challenge is creative even by DARPA's standards. Normally, the agency takes its multibillion-dollar annual budget and allocates it to defence contractors, academic institutions and individual scientists who bring ideas to the agency or answer a request for

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proposals. As a result, those who usually get to play with DARPA money constitute a relatively small club. But that changed in 2000 when DARPA's congressional paymasters decided that, in addition to the normal procurement process for developing technological breakthroughs, it might make sense to devise special prizes to enable DARPA to reach out to a range of researchers wider than the usual suspects.

DARPA embraced the idea and quickly began to explore technologies that might be prize-worthy. After much discussion, Anthony Tether, DARPA's director, decided in 2002 that the first DARPA prize should challenge researchers to solve the stubborn problem of building land vehicles that navigate and drive themselves.

There were good reasons to do this. For one thing, Congress has decreed that by 2015, one-third of America's combat ground-vehicles must be autonomous. Furthermore, engineers and scientists have spent years, and millions of dollars, grappling with this problem without success. Driving through rough, unpredictable terrain requires machines with sensors and computational capabilities that no one has been able to devise. So DARPA's staff worked out the format for the competition, the prize money was put on the table and the Grand Challenge was born. "By having this race and awarding a prize of this size, we will bring out the people from the garages around the country and stimulate interest in this important field," Dr Tether said when he announced the prize.

That was the idea, at least: to fire up the enthusiasts, geeks and robot evangelists huddled away in the American hinterlands, and give them a shot at applying their collective genius to problems normally left to corporate giants such as Lockheed, General Dynamics and Boeing. But DARPA was far from certain that the citizen inventors were actually out there. "We would have been happy to field four or five vehicles in the race," says Jan Walker, a DARPA spokeswoman.

Enthusiasm, however, was not a problem. By early 2003, 106 teams had emerged from the ranks of university students, robot clubs and off-road-vehicle enthusiasts. Of these, 86 presented scientific papers containing the detailed technical specifications DARPA required, and 19 were accepted to participate in a four-day "qualification inspection and demonstration" (QID) to be held five days before the race. Another 26 entrants were judged "possibly acceptable". To quell grumbling among these teams, DARPA offered each one a visit before making a final decision. This offer was accepted by 19 teams, six of which made the cut. However, says Ms Walker, any or all of the teams could be wiped out in the QID.

Teams of every stripe have been formed, from Alaska to Lafayette, Louisiana. One group from Palos Verdes, California, consists mostly of high-school students, but is not to be underestimated, because many of the students' parents work in the aerospace industry. Another group, Team Phantasm, is based in St Louis and consists of an inveterate tinkerer and a semi-retired computer programmer who have big plans but shallow pockets. Despite meagre resources, the duo have devised a creative flower-petal design that will right their vehicle if it flips over during the race, in much the same way that an insect gets back on its feet when turned over.

Insiders suspect that three teams—from the California Institute of Technology, Carnegie Mellon University and Ohio State University (funded largely by Oshkosh Truck Corporation, a truck-maker)—have the best chance of robotic victory. But the leader of the Carnegie Mellon team, William "Red" Whittaker, a leading field-robotics expert, insists he is taking nothing for granted. "I think it would be presumptuous and pretentious to say that anyone would have better than a 50-50 chance to win," he says. There are too many variables, and "it's hard to appreciate what these races can do to the machinery."

Even if the delicate digital hardware running these machines keeps going, and even if they are the smartest roving robots this side of Mars, navigating through the scrub, dust and rock of the Mojave desert represents a complex challenge. The vehicles will use digital cameras, radar and sonar, married with sophisticated home-grown software,

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DARPA provides information on the Grand Challenge. Amongst the participants are Team Phantasm and a team led by William "Red" Whittaker at Carnegie Mellon University.

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to pick and ping their way through the desert. Two hours before the race begins, DARPA will provide the racers with a CD-ROM containing the locations of up to 1,000 waypoints to help teams map the course. But there will still be plenty of challenges. The Mojave is filled with cactus plants, boulders, ravines and ruts. "The vehicles can be repaired and refuelled," Dr Whittaker says with a grin, "as long as they do it themselves."

Who will win? Probably no one this time around, although the agency is more optimistic than it was a year ago that one of the teams might manage to claim the prize, according to Ms Walker. But even without an outright winner, there may be rewards of other kinds for those who compete. There are plenty of people in industry and the military who want to solve the autonomous-vehicle problem, says Ms Walker, and they will be watching the race closely.

Besides, says Dr Whittaker, the race is not really about the money. It is about doing something that's never been done before. "In the end, the best technology will win out, but this is really about the triumph of the human spirit," he says. Which is somewhat ironic, when you consider that the race is for robots only.

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