The New York Times | http://nyti.ms/1HsMQ0X

SCIENCE

Relax, the Terminator Is Far Away

By **JOHN MARKOFF** MAY 25, 2015

In glossy sci-fi movies like "Ex Machina" and "Chappie," robots move with impressive — and frequently malevolent — dexterity. They appear to confirm the worst fears of prominent technologists and scientists like Elon Musk, Stephen Hawking and Bill Gates, who have all recently voiced alarm over the possible emergence of self-aware machines out to do harm to the human race.

"I don't understand why some people are not concerned," Mr. Gates said in an interview on Reddit.

"I think we should be very careful about artificial intelligence," Mr. Musk said during an interview at M.I.T. "If I had to guess at what our biggest existential threat is, it's probably that," he added. He has also said that artificial intelligence would "summon the demon."

And Mr. Hawking told the BBC that "the development of full artificial intelligence could spell the end of the human race."

Not so fast. Next month, the Defense Advanced Research Projects Agency, a Pentagon research arm, will hold the final competition in its Robotics Challenge in Pomona, Calif. With $2 million in prize money for the robot that performs best in a series of rescue-oriented tasks in under an hour, the event will offer what engineers refer to as the "ground truth" — a reality check on the state of the art in the field of mobile robotics.

A preview of their work suggests that nobody needs to worry about a Terminator creating havoc anytime soon. Given a year and a half to improve

their machines, the roboticists, who shared details about their work in interviews before the contest in June, appear to have made limited progress.

In the previous contest in Florida in December 2013, the robots, which were protected from falling by tethers, were glacially slow in accomplishing tasks such as opening doors and entering rooms, clearing debris, climbing ladders and driving through an obstacle course. (The robots had to be placed in the vehicles by human minders.)

Reporters who covered the event resorted to such analogies as “watching paint dry” and “watching grass grow.”

This year, the robots will have an hour to complete a set of eight tasks that would probably take a human less than 10 minutes. And the robots are likely to fail at many. This time they will compete without belays, so some falls may be inevitable. And they will still need help climbing into the driver’s seat of a rescue vehicle.

Twenty-five teams are expected to enter the competition. Most of their robots will be two-legged, but many will have four legs, several will have wheels, and one “transformer” is designed to roll on four legs or two. That robot, named Chimp by its designers at Carnegie Mellon University, will weigh 443 pounds.

None of the robots will be autonomous. Human operators will guide the machines via wireless networks that will occasionally slow to just a trickle of data, to simulate intermittent communications during a crisis. This will give an edge to machines that can act semi-autonomously, for example, automatically walking on uneven terrain or grabbing and turning a door handle to open a door. But the machines will remain largely helpless without human supervisors.

“The extraordinary thing that has happened in the last five years is that we have seemed to make extradorinary progress in machine perception,” said Gill Pratt, the Darpa program manager in charge of the Robotics Challenge.

Pattern recognition hardware and software has made it possible for computers to make dramatic progress in computer vision and speech understanding. In contrast, Dr. Pratt said, little headway has been made in

"cognition," the higher-level humanlike processes required for robot planning and true autonomy. As a result, both in the Darpa contest and in the field of robotics more broadly, there has been a re-emphasis on the idea of human-machine partnerships.

"It is extremely important to remember that the Darpa Robotics Challenge is about a team of humans and machines working together," he said. "Without the person, these machines could hardly do anything at all."

In fact, the steep challenge in making progress toward mobile robots that can mimic human capabilities is causing robotics researchers worldwide to rethink their goals. Now, instead of trying to build completely autonomous robots, many researchers have begun to think instead of creating ensembles of humans and robots, an approach they describe as co-robots or "cloud robotics."

Ken Goldberg, a University of California, Berkeley, roboticist, has called on the computing world to drop its obsession with singularity, the much-ballyhooed time when computers are predicted to surpass their human designers. Rather, he has proposed a concept he calls "multiplicity," with diverse groups of humans and machines solving problems through collaboration.

For decades, artificial-intelligence researchers have noted that the simplest tasks for humans, such as reaching into a pocket to retrieve a quarter, are the most challenging for machines.

"The intuitive idea is that the more money you spend on a robot, the more autonomy you will be able to design into it," said Rodney Brooks, an M.I.T. roboticist and co-founder two early companies, iRobot and Rethink Robotics. "The fact is actually the opposite is true: The cheaper the robot, the more autonomy it has."

For example, iRobot's Roomba robot is autonomous, but the vacuuming task it performs by wandering around rooms is extremely simple. By contrast, the company's Packbot is more expensive, designed for defusing bombs, and must be teleoperated or controlled wirelessly by people.

The first Darpa challenge more than a decade ago had a big effect on the

perception of robots. It also helped spark greater interest in the artificial intelligence and robotics industries.

During the initial Darpa challenge in 2004, none of the robotic vehicles was able to complete more than seven of the 150 miles that the course covered. However, during the 2005 challenge, a $2 million prize was claimed by a group of artificial-intelligence researchers from Stanford University whose vehicle defeated a Carnegie Mellon entrant in a tight race.

The contest led to Google's decision to begin a self-driving-car project, which in turn spurred the automotive industry to invest heavily in autonomous vehicle technology.

Developing a car to drive on an unobstructed road was a far simpler task than the current Darpa Robotics Challenge, which requires robots to drive and, while they're walking, navigate around obstacles, remove debris, use vision and grasp with dexterity, and perform tasks with tools.

"We had a relatively easy task," said Sebastian Thrun, a roboticist who led the Stanford team in 2005 and later started the Google self-driving-car project. "Today they're doing the hard stuff."

His view about the relationship between humans and robots has been shaped by the two contests. "I'm a big believer that technology progresses by complementing people rather than replacing them," he said.

Most of the Robotics Challenge teams receive university and corporate financing, and in some cases use a Darpa-funded, 6-foot-2 Atlas robot that weighs 380 pounds. (All of the competitors must design their own software and controls.)

But one team of hobbyists will bring a homegrown robot financed with credit cards and the help of family members.

"We're not a big company," said Karl Castleton, an assistant professor of computer science at Colorado Mesa University and the leader of Grit Robotics, which has constructed a robot that rolls slowly on four wheels. "We're just some guys who have a lot of love for what we're doing."

A version of this article appears in print on May 26, 2015, on page D2 of the New York edition with the headline: A Reality Check for A.I.