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Can a computer have a sense of smell?

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Computers have had a tough time learning what the nose knows.

Engineers have been successful in creating sensors that detect specific smells. But when it comes to replicating the entire discriminating ability of a nose - well, that's nothing to sniff at.

But a Palo Alto entrepreneur believes it can be done.

Former Stanford visiting scholar Paul Rhodes, through his startup called Evolved Machines, is working on a process to reverse-engineer the brain with the hope of turning a machine into a dynamic sensing device that can sort a host of odors. Ultimately, Rhodes said, the research could lead to a device able to detect toxic material, spoiling food, disease and various degrees of sickness.

"We're trying to build a device that in a general way can be trained like a dog to tell you what's out there," Rhodes said.

By re-creating the neural circuitry of the brain, Rhodes believes he can go a step further than other smell-detection machines, which often are trained to sense a specific set of smells. Just as a brain can make sense of multiple odors, Rhodes said, Evolved Machines will be able to pick out overlapping odors, making the sensing work more dynamic and useful.

That has been the sticking point in the past because smells are rarely isolated; they exist among other odors. Trying to detect one can be a chore, especially when it's similar to another scent. And even one scent can register differently depending on its distance to the receptor.

"The real world is complex, and you have many different odorants," Rhodes said. "You have background smells, and it's not a small problem to have an olfactory sensor determine what's in a room. But that's what a mouse does effortlessly."

Rhodes believes that if he can re-create the brain makeup that enables mammals to detect odors, he can create a computer that has an evolved sense of smell, one that actually learns over time.

"The circuits reorganize themselves based on exposure to the sensory world - that's what happens in a brain in any person," Rhodes said.

The goal is to create a portable sensor that can be used in a variety of settings, said University of Illinois chemistry Professor Ken Suslick, who is providing the next-generation sensors for the finished device. The two expect to have a prototype available in the next couple of months.

Suslick said the finished device, which could be available in the next couple of years, perhaps for less than $1,000, could be used for a number of applications: airport security screening or at hospitals to detect lung cancer, bacteria, diabetes or the degree of a sickness. It could also be used in the food industry to quickly test products for freshness.

"This could be good for rapid detection of bacteria or freshness of meats or prepared foods," Suslick said. "How many people get food poisoning from potato salad? Ideally, it would tell you there is a higher bacteria count than you want to put in your mouth."

Steve Jurvetson, a partner with venture capital firm Draper Fisher Jurvetson, said if the process works, it could create numerous business opportunities.

"No one has solved this problem," said Jurvetson, who has not invested in Evolved Machines. "Whatever the market is, it's a fraction of its potential."

Part of the reason smell detection has been primitive so far is that the various technologies necessary haven't been easily available. One of the key components for Evolved Machines are new graphics-processing chips from Santa Clara's Nvidia, which manage the huge number of calculations necessary for smell detection. Rhodes has been an early tester of Nvidia's Tesla processors, which utilize 128 computing cores to manage the large number of parallel calculations necessary to mimic a brain. Essentially, the latest graphics chips give researchers the ability to work on machines that provide the performance of supercomputers.

"What's special about the graphics processing unit is in the type of counting Rhodes does. He has thousands and thousands of neurons, but when you break that into pieces, you can break that into smaller decisions," said Andy Keane, general manager of Nvidia's Tesla group. "The GPU works by handling all the decisions in parallel at the same time."

Suslick said that if all goes well, people might soon be able to have the power of a bloodhound at their fingertips.

"That's the goal, to have a handheld dog," Suslick said, "and one that won't bite you."

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