Underwater 'Not Great Total Run'

Underwater truly is the final frontier for military robots. It's a question of control: water's the worst medium for transmitting secure control signals between the 'bot and its human handler. That's why even "smart" underwater truly is the final frontier for military robots. It's a question of control: water's the worst medium for transmitting secure control signals between the 'bot and its human handler. That's why even "smart"

A Drop-Com Banker Who's Stuck in the Past

Five for Fighting 07/25/2008

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Astronaut Reiman
A cognitive scientist wants to employ M.C. Escher's bag of optical tricks to get your eyes to solve logic problems.

More specifically, he suggests that human beings can use their brain's visual processing ability to solve LSAT-style logic puzzles, simply by staring at images designed to get their eyes to compute. Because this form of visual processing feels so effortless, such problems might be much easier to solve than their written counterparts.

The key, said Mark Changizi, a former Caltech fellow and current cognitive science professor at Rensselaer Polytechnic Institute, is tapping into the incredible visual processing potential of our visual cortex — the half of our brains dedicated to converting reflected light into seeing. He compared the precociousness of that innate visual-processing capacity, which everyone has, to the "Rain Man"-style abilities displayed by some autistic people.

"Autistic people can't be any smarter than we are, but probably what they have is the ability to harness parts of their brain that we can," Changizi said. "What their amazing powers show is that we have these amazing powers. We totally underestimate the powers of computation that we use all the time."

In some ways, Changizi is taking the same approach to problem solving as some computer makers, who are starting to tap powerful graphics processing units for more general-purpose computing tasks. In Changizi's case, he's trying to allocate tasks to the brain's GPU that are normally assigned to the brain's CPU. What's more, he's using the brain's visual capabilities to process visual "software" (such as the images in this article) and produce useful outputs. It's a radical concept and one with few precedents in cognitive or computer science.

Here's how the system, published in the most recent issue of the journal Perception, works.

The diagram at the right shows the simplest "wires" in Changizi's system, representing 1 and 0.

By staring at the "1" box at the top of the left circuit, the entire circuit, including the bottom, appears to face towards you. Similarly, by staring at the "0" box, that entire circuit appears to face away from you. In this way, Changizi says, the circuits "transmit" a signal from the top to the bottom.

Starting from these simple building blocks, Changizi built visual operators for AND, NOT and OR by manipulating the transparency of certain lines and fields. These operators function on the same principle as the simpler wires. Take the image at the top of this article. It shows the permutations of the OR operator on the top and the AND operator on the bottom. By parsing the visuals at the top of each circuit, your eyes flip the bottom part either towards or away from you, giving you either a 0 or a 1 — the correct logical output of the binary operation.

With refinement, Changizi hopes this approach will open up the entire gamut of possible circuits.

"Once you have a NOT, AND and OR you could conceivably do any digital circuit computation," he said.

But the system isn't fool-proof. Even simple circuits can suffer from the Escher problem, as the 1s and 0s flip back and forth randomly the longer you stare at them. Changizi hopes that training his Rensselaer students on the system will make them better at this type of logic.

"We all have to learn how to read, so I'm going to be teaching courses where instead of digital logic notation, we teach this," he said. "Once kids are trained up on it, could they get much better at it than someone just walking in off the street?"

Changizi argues that if students could get fluent with the system, they'd have a distinct advantage over their peers in logical thinking. That's because visual perception feels effortless, even though our brains have to work hard to do it. Competing with his visual circuits isn't like doing math.

"It's a perceived walkthrough rather than a cognitive walkthrough," Changizi said. "You just stare at it."

Eventually, he hopes that the correct answer to digital circuit calculations will simply appear to our eyes, like the 3D picture emerging from a stereogram.

"The nicest case would be to stare at some stimulus and see the answer at once," he said.

Changizi knows that day is a long way off. Like the early work being done with DNA-based computation and quantum computing, his visual-processing system is still more proof of concept than a practical solution to computational problems.

But Changizi remains hopeful that his system will be more than a mere curiosity.

"We're fleshing out a whole new domain of computation," said Changizi.

WiSci 2.0: Alexis Madrigal's Twitter, Google Reader feed, and webpage; Wired Science on Facebook.