Scientists work up a crab-powered computer

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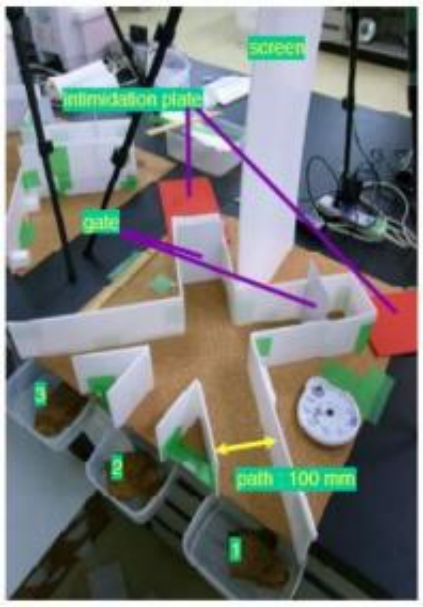

Implementation of AND gate by real soldier crabs. A or B represents input space for input x or y, respectively. The symbol 1, 2 and 3 represent output for NOT(x) AND y, x AND y, and x AND NOT(y), respectively. The experimental results of AND gate implemented by real soldier crabs. Image: arXiv:1204.1749v1

(Phys.org) -- A team of scientists from Japan and England have hit the high mark in exploring and testing unconventional forms of computation. They have built and tested a computer using crabs. This is a computer in which the information carriers are swarming creatures, namely, soldier crabs. In their paper, “Robust Soldier Crab Ball Gate,” authors Yukio-Pegio Gunji, Yuta Nishiyama, and Andrew Adamatzky describe what others are already referring to as the crab-puter.

The scientists were interested to see if they could adapt a previous model of unconventional computing, based on colliding billiard balls, to work with swarms of crabs.

“To expand the family of unconventional spatially extended computers, we studied the swarming behavior of soldier crabs Mictyris guinotae and found that compact propagating groups of crabs emerge and endure under noisy external stimulation. We speculated that swarms can behave similarly to billiard balls and thus implement basic circuits of collision-based computing,” they stated.

The researchers found that when two swarms of crabs collide, they merge and continue in a direction that is the sum of their velocities. Their reference to billiard balls is noteworthy, in that computer scientists E. Fredken and T. Toffoli in the 1980s -- explorations of unconventional forms of computing have been going on for some time -- set out to see if a computer built with billiard balls could work.

In an article explaining the earlier billiard-ball concept, *Technology Review* said, “The idea is that a channel would carry information encoded in the form of the presence or absence of billiard balls. This information is processed through gates in which the billiard balls either collide and emerge in a direction that is the result of the ballistics of the collision, or don’t collide and emerge with the same velocities.”

In this recent computer feat, the team constructed logic gates that exploit the swarming behavior of soldier crabs. They said that "We demonstrate that swarms of soldier crabs can implement logical gates when placed in a geometrically constrained environment." The swarms of soldier crabs herded through tunnels can form the AND, OR and NOT logic gates.

Working initially with simulated swarms, the authors found that the OR gate worked every time--this is the gate which combined one or two

swarms into one. The AND gate was more complicated, according to the *New Scientist*, which involved the combined swarm heading down one of three paths. The AND gate turned out to be less reliable.

Next, the team used using swarms of 40 crabs tested the logic gates for real. The swarms were placed at the entrances of the logic gates and encouraged to move by a shadow intended to convince the crabs that there was a predatory bird overhead. Results closely matched those of the simulation, suggesting that crab-powered computers were possible.

In their study, the authors include a parting note to assure that the crabs submitted to testing were not harmed, and that "the crabs were kept in comfortable condition." They also said that after all the experiments, the crabs were released to their natural habitats.

More information: Robust Soldier Crab Ball Gate, arXiv:1204.1749v1 [cs.ET] arxiv.org/abs/1204.1749

Abstract
Soldier crabs Mictyris guinotae exhibit pronounced swarming behaviour. The swarms of the crabs tolerant of perturbations. In computer models and laboratory experiments we demonstrate that swarms of soldier crabs can implement logical gates when placed in a geometrically constrained environment.