BioWall--An Electronic Tissue That Pulsates Like Skin

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Leonardo, Volume 37, Number 2, April 2004, pp. 103-104 (Article)

Published by The MIT Press

Fig. 3. Christophe Luxereau, *The Hand*, part of the series *Electrum Corpus*, 2001. (© Christophe Luxereau)

vector method of constructing a shape. Designing with virtual tools also changes one's vision of an object. In 3D, any creation of a form begins with a cube, its edges, points in space. The computer does not include/understand intuitive forms.

My next exhibition, *P = Mg FIAC* (2003), showed how the mind develops its knowledge about texture, from noise on the screen to the texture of an algorithm—how our brain understands the noise on the screen, a texture that we can neither feel nor smell, but that everyone knows exists, even if it has no tangible existence.

Working with computers is a way for me to question myself about the posthuman design, a cross between the analogic and numeric, between mechanical and organic. With a machine, I can imagine human-mechanic extensions (Fig. 3). Our body has to mutate in order to adapt to the present world, just as art is mutating because contemporary needs are far from the 19th-century vision of art. Exploring new possibilities means fabricating and developing new tools.

BioWall—An Electronic Tissue That Pulsates Like Skin

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The skin, the body's largest organ, performs vital functions. Its surface, covered in receptors, reacts to the faintest of signals from the outside world. It continually adapts its morphology, permeability and temperature to the body's needs, scarring automatically whenever it is attacked. The BioWall constitutes a major step towards the creation of intelligent, bio-inspired electronic tissues, capable of evolving, self-repairing, self-replicating and learning.

In its current form (see Fig. 4), the BioWall is a perfectly scalable surface of identical electronic modules, consisting of an input (a transparent touch-sensitive membrane), an output (an array of 8 × 8 tri-color LEDs) and a programmable computational unit (a Xilinx FPGA). The BioWall's surface combines the possibilities offered by the very latest information technology with the most instinctive of human gestures—touch. With thousands of different uses, it will facilitate dialogue with computers, with an automatic response removing the need for tedious human intervention: at the bank or post-office counter, in ticket and drink dispensers, gas pumps or telephone booths. It will also pave the way for chalk-less blackboards in offices and schools.

A more flexible version of the BioWall tissue will, in the future, act as an interactive garment, capable of adapting its appearance to changes in the environment, just like the skin of a chameleon. Eventually, reduced to the microscopic size of a silicon chip, the self-repairing electronic tissue will become widespread where dependability is paramount—in outer space, it will be an indispensable tool for automatic probes and, when molecular electronics begin to develop (and when infinitesimal circuits are made on an atomic scale), it will enable circuits to work

Fig. 4. The BioWatch application on the BioWall, 2002. (© Daniel Mange. Photo © Corine Sporer.) In the BioWatch application, the visitor can inject faults in the electronic substrate and observe the machine repairing itself.

even when their components are momentarily or permanently imperfect.

The current BioWall is a mosaic of 4,000 transparent electronic modules, which could be described as artificial molecules. Each of these enables the visitor to communicate with the surface, simply by touching it with a finger. The BioWall, exploiting the programmable logic distributed throughout its surface, calculates its new status and immediately displays the consequences of this contact (which can vary depending on the application). This extraordinary ability is demonstrated in several applications, most notably in the BioWatch, a giant self-healing timer inspired by multicellular biological organisms, and in a set of interactive implementations of cellular automata, ranging from the simple Life automaton, through self-replicating Loops, to the astoundingly complex Universal Constructor, designed by John von Neumann.

Through its ability to completely alter its structure and functionality, the BioWall is also an ideal platform for biologically inspired machines. This ability is illustrated in applications inspired by the process of Darwinian selection, where populations of electronic insects (such as ants or fireflies) are evolved to solve given problems and by the mechanism of learning, through the implementation of artificial neural networks. Recently on display at the ITU Telecom World 2003 exhibition in Geneva, Switzerland, the BioWall has since been moved back to the Swiss Federal Institute of Technology at Lausanne (EPFL), where it is used to prototype novel bio-inspired applications (see the web site <http://lslwww.epfl.ch/biowall> for a more complete description of the machine and of its applications).