

ART AND LIFE: BIOCYBRID SYSTEMS AND THE REENGINEERING OF REALITY

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Ontological levels of creative reality and the reengineering of life provided by the BWAS– biocybrid wearable affective systems – configure the expanded sensorium and the health measures against the infirmity of landscapes, in biodiversity. Art and Technoscience combine developments in biomedical engineering in physiology and synaesthesia into the drama of life and the embodiments in Brazilian cultural rituals, urban space, domotics and ecology.



Figure 1. (a) The four stages in the development of the system for the classification of frogs' vocalizations. (b) A large screen for the manipulation of visual and sonic information.

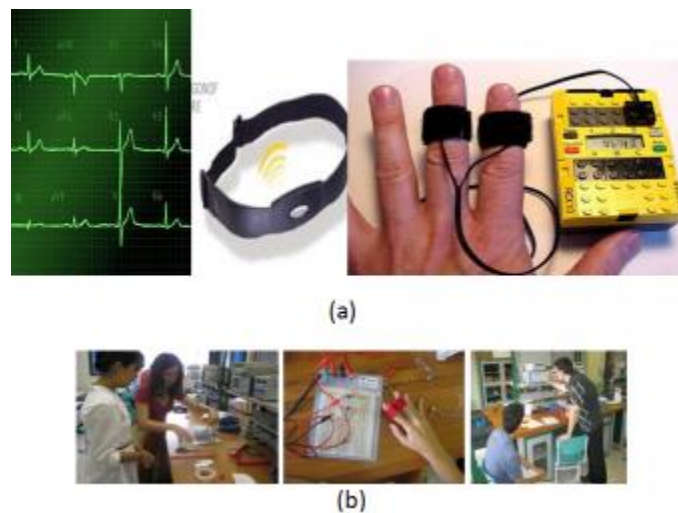


Figure 2. (a) Circuit sensors for the biocybrid condition. (b) Laboratory of instrumentation, where we develop the biosensor circuits. BWAS mobile wireless using non-invasive sensors for the body capture electrophysiological signals - galvanic skin resistance, breathing rates and heartbeats, which are treated and transmitted.



Figure 3. Traditional figures of Baianas (the old mother), in a Carnival dance, performed at Rio de Janeiro streets. Image provided by Maria Aparecida Donato, a post-doc researcher at LART.

1. Introduction - Biocybrid systems and the drama of life

Challenges of the world, increasingly technologically dependent, are faced by our biocybrid circuits of sensors, blurring the limits of the natural worlds and the engineered reality. Creative technological levels regarding body, landscape and the urban life of our biocybrid systems are provoking the end of the “nature itself” and the emergence and “the future engineered reality”. The Group of researchers at UnB Gama in the Biomedical Engineering Graduate Program and in the Laboratory of Research in Art and TechnoSciences – LART develops biocybrid systems for human existence in the continuum and symbiotic zone between body and flesh - cyberspace and data - and the hybrid properties of physical world. That continuum generates a biocybrid zone (Bio+cyber+hybrid). [1] We add biofeedback circuits of sensors, therefore, bio signals to the cybrid condition, pointed out by Anders in 1998, [2] and we investigate complex enactive systems of creative technologies which reinforce the *natural* history of artifacts, with cyber technologies and transparent interfaces ubiquitously mixed to phenomena of ecoscosmos life.

Biocybrid condition is the co-existence in the physical and cyber worlds connected by enactive interfaces allowing biosignals communication and affordances in the “narratives of life”. Anthropologically, we propose the affective wearable condition, resembling Picard’s investigation on affective computing. [3] We reinforce the liveness condition and the reengineering of our sense to be alive in every act through our biological signals. This approach is not new; we only gain creative levels for the understanding of our relationship human/environment in the remote theory of enactment, as in Aristotle's *Poetics*. [5] Enactive interfaces embodiments reinvent the drama of life by Aristotle and life is a complex act of being enacted to the environment by biosensors.

1.1. THE AFFECTIVE AESTHETICS

The body as part of an interactive system evokes the expansion of the aesthetic dimension in conceptual and body art with responses generated in symbiotic zones with programs within “hermeneutic operations,” dealing with biophysical laws, when code and facts are experienced in the intensity of the senses and the ability of data laws built into the system. In the field of *endophysics*, [4] Rössler’s interfaciology points out what the Performative Science is.

Reaffirming the origins of the discipline *Aesthetica*, postulated by the German philosopher *Baumgarten* in 1750, we propose embedded systems for synaesthetic experiences of biosynthetic bodies and the ability to perceive the world with the five bodily senses. Physiology and synaesthesia are the main topics for our microcircuits.

Biosynthetic interfaces integrating biocybrid systems are no longer machines, but complex systems, surpassing the human condition and limits of the mechanistic paradigm. We must delete this old classification and consider human/animals/environment as a complex, living organism. In 1997, we had already discussed, in the *Flesh Factor* list of Arts Electronica Memesis Symposia, [5] some theoretical aspects related to this development.

In the 1990s we started to postulate the interest of sciences on the human factor of technologies, increasingly growing to the spiritualism of their theoretical approach. We now propose the biosynthetic interfaces expanded to *biocybrid* systems and ecstasy. But in the earlier form, we had already started postulating the trance. Our projects described in Section 3 analyze rituals in the passage from trance to ecstasy. We consider the “sentences” of the body movements, called *parakinemas*, which come to existence due to stimuli, whose basic components appear also in the Brazilian culture’s rituals and myths.

In a general way, the point is to consider the myths and old ontologies close to the biocybrid systems, the reengineering of sensorium and the reengineering of nature.

2. Reengineering Nature – Biodiversity, Infirmary and Affectivity

Assuming the role pointed out by Louis Bec, we are engaged extremophiles, [7] working in the direction of a cultural and anthropological paradigm, and concerned with the planet’s health. In the same way of ontological levels of creative reality and mutual influences with environment information related to the James Gibson’s ecological perception theory (1986), [6] we investigate the ecosystem in its dynamical relations between human, animal, plants and landscapes.

The urgent attention to life in our country’s huge territory calls for the extremophile creative attitude, facing the effects of an endemic infection of tropical climates as well as the challenges of the biomes in the Amazon Forest. We consider the infirmity of the territory and the human invasion and destruction of the ecosystem self-organizing defense.

We will describe two of the types of research we conduct: *Sapio – biodiversity, infirmity and affective geography* (Dengue infirmity and health care) and *Frogs’ signatures: Pantanal Bioma in Amazonia Forest* (preservation of ecosystem and biological community).

2.1. SAPIO: BIODIVERSITY, INFIRMITY AND AFFECTIVE ECOSYSTEM

The System for the Acquisition and Processing of *Ovitrampas* Images (SAPIO) develops an automated tool for monitoring, fighting, and preventing *dengue* in creative extremophile actions regarding a human/environment/net, natural/artificial, remote/local and rural/urban structure in mutual contamination. Dengue ecological information analogous to the principle of the ouroboros mythic serpent, and self-regenerating emergent narratives about health care and dengue. Interfaces localize the *ovitrampas*,

special traps that collect the mosquito's eggs and reveal infestation tendencies allowing the prompt definition of control actions. The SAPIO project is aimed at obtaining and analyzing ovitrampas images, in order to automatically count the deposited eggs and to disseminate the collected information through the World Wide Web.

2.2. AFFECTIVE GEOGRAPHIES: INFIRMITY OF THE LANDSCAPES AND NEW ABSTRACTIONISM

Our Biocybrid cultural platform mixes people's life and behaviors to the natural physical environment, by using data collected mainly data from geography (GPS, Google Maps) and SIG regarding the infirmity of the landscapes. The processes are fundamentally different from photography and television used in Brazil, using tools such as data visualization, scientific methods of signal processing, web semantic and visualization of social nets, augmented reality and mobile devices using APIs for Google maps, Google earth, SMS, Blogs and Wiki Maps. Learning and teaching about the epidemic mixes experiences in the physical world and in the digital environment, with collaborations and reciprocity. The co-location in the virtual and physical environments makes virtual worlds reengineering physical world. They share the responsibility and affection to the landscape, meanwhile the Art History, in the domain of the new abstractionism is enhanced by signals processing, data visualization, satellites eyes, computer vision, and other synthetic systems. The CyberAdams and health care reengineer reality.

2.3. FROGS' SIGNATURES IN THE PANTANAL BIOME

In another line of research, we investigate the frogs' populations in the *Brazilian Pantanal* area, and explore the richness of information in the frogs' vocalizations. This sonic landscapes theme is the research focus of the PhD student André de Oliveira, enhanced by our investigations on data visualization and signal processing. The data visualization and sonification system in voice recognition and intelligent methods to analyze the properties extracted from the frogs in Pantanal Bioma are summarized in Figure 1 (a). The automatic system will provide to the biologists the classification of species and the number of frogs living in that remote bioma which will replace the old and analogic ones.

In developing the biocybrid system and the simulation of the human proximity using wearable art and biosensors to act and actualize, by immersive synthetic biofeedback interfaces the data landscape – large data screen or cave, exemplified in Figure 1 (b) – and the manipulation of visual and sonic information, in dialogues with the distant *Pantanal* Biome. Metaphorically, we propose the frogs' signatures and the human behavior dealing with laws and phenomena of the cosmos, by influencing life of nature inside the world as a living organism exchanging electrical potentials, heats, sounds and vibrations and the sense of presence being advanced by the technological apparatus and affective biofeedback for the responsibility of humans and a healthier territory.

3. Reengineering Senses – Biocybrid Systems and Expanded Sensorium

We develop microcircuits with sensors for the creative levels of performance and *coinaesthesia* – all the sense, to reaffirm the potential of affective aesthetics. Manufactured synthetic senses for enactions and synaesthesia [9] as filters for translating the intertwining of the body with the technological environment configure that perception as a laboratory phenomenon, as Krueger described in his "Redefining

Human". Microcircuits of wearable biosensors referenced in Maturana and Varela consider the interactions with the environment as sources of percepts, rather than mere representations and the body is involved in a neuropsychophysiological way, with mutual interactions with the whole environment. [8] Physiology and synaesthesia are the two topics for biofeedback

3.1. SYNTHETIC SENSORS AND THE OUROBORUS PERCEPTION: THE SEAMLESS AND ENDLESS AFFECTIVITY

The endless ouroboric principle of life, by Domingues, [2] with the mythic serpent eating its own tail and self-regenerating life, is expanded in wearable affective biocybrid systems. We invest in technological innovation regarding the miniaturization of hardware systems that have enabled the development of network sensor nodes, for interconnected wireless networks and assistive medical applications. According to Rocha, [11] these sensors have the ability to detect or measure some phenomenon of nature, processing and transmitting data or information to other sensors. In our artwork the circuit is built in an intelligent network inserted in a set of accessories, which coupled to bodies configure the Biocybrid Wearable Art System (BWAS), exemplified in Figure 2(a).

3.2. THE PERIPHERAL PERCEPTION: EXTRUSION OF EYES AND COUPLED VISION

What is vision now?

The recent anthropological biocybrid mobile condition amplifies the phenomenology of "being here" (Barthes), altered by the use of mobile cameras of cell phones, and the locative and geographic interfaces. We perceive with three eyes, and no more only coupled to the mechanical eye of the photographic camera. In January 2011, we discussed, in the SPIE conference, *virtual reality reengineering reality* session [1] and the inclusion of synthetic objects in physical concrete spaces by mixed and augmented reality and computer vision. The system reaffirms the post biological extrusion of human vision, by the act of seeing shared with the satellite eye in the sky and the handled eye of the mobile device, expanding the human perception. Tags in AR placed in a GPS (Global Positioning System) and the possibility of geodesic coordinates create a co-located event for human body. The neuropsychophysiological perception expanded by data signals processing, geotags and computer vision allows interventions in urban life, using mobile augmented reality (MAR). The ecological geolocated art event *Borges Fantastic Creatures in Buenos Aires' streets* insert Synthetic creatures in the city.). The earlier *14 Bis* biocybrid system, celebrated Brasilia's 50th birthday, in a public event where the plane, invented by the pioneer Santos Dumont invaded the sky. In the Domotics field, we use the BWAS in connection to a specific environment (home, office, hospital or other), and the relations between the inhabitants and the space, as well inhabitants, patients and doctors etc.. Regarding biomedical applications, the relationship of distance between individuals is a relevant factor in the recovery of some diseases. The certain distance from other people or objects, and the invisible bubble of space which is the "territory" is one of the major dimensions of modern society are the approaches to LART PhD student Tiago Franklin Lucena in his Project *Cidadepathia*.

3.3. TRANSPHYSIOLOGY OF PASSIONS: EXTREMITIES OF THE BIOCYBRID CONDITION AND RITUALS: FROM TRANCE TO ECSTASY

In the same attitude of creative extremophiles, we focus on the expanded sensorium in data visualization and biosignals, reconnecting the body and its physiology to the rituals. The concept and operational

principles: 1) the body's schemas based on Rudolf Laban's corporeal graphics or Labanotations; and (2) kinesthesia, always perceiving and processing data of human physiology and affective levels in scientific analyses of electric potentials and biofeedback using the BWAS. The kinesthetic Labanotation schema enhanced by the data visualization methods, in sensorial properties of synaesthetic biofeedback provide us the kinetography mixing the Kinemas, as a language of movement in a transphysiological dimension. Aspects of motion, electricity, graphic design, in data visualization and data sonification: body movements, translating graphics, gestures, postures, fragmentation, reinstatements, dynamics, internal-external connections and motor schemes, dealing with gestures, rhythms, not only at each stage of the movement, but also in consideration of what affects you, the environment and the coupled interior and affection in the flows of life with affective wearable sensors. The resulting concept fundamentals the transphysiology of the Ecstasy is rooted in the concept of the Transphysiology of Passions and Trance, proposed by the supervisor of this research, Diana Domingues and discussed in the post doctoral research by Donato Cida / CNPq. The body's electrical potentials rising from ecstasy in Brazilian rituals such as the carnival and Afro-Brazilian religions as Candomblé and the shamanic trance differs of the ecstasy states. In the ceremonies that involve embodiments in deep levels of unconsciousness, the ecstasy and their sensations, emotions and thoughts, attempt the condition of transcendence, embedded in mediunic state. The internal excitations of the nerves and sensorial apparatus caused by the impression of the senses are translated in its transphysiology, where the sensorial and affective presence is measured. Laban's paradigm postulate that human movements are always composed of the same elements, whether in art, at work, rituals than in everyday life. Consequently, we search for a method with emphasis on the psychological and physiological aspects that lead human beings and electrical biopotential of a body, which in their combination produce states, qualities, actions and parallel motion feature psychic actions present in our actions – recognition in the form of rhythms and structures – the *poiesis* of a bio-cyber body.

References and Notes:

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