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cyberPRINT: Toward an Architecture of Being

·I *hove conceived the project of enveloping you with your own discovery.*•
-Boullee to Nrwton [Fig 1]

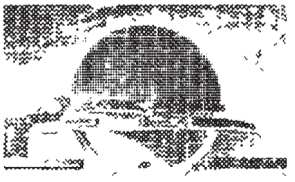

Figure 1: Pro1eC1 for Newton's *Cenotaph* 1783 Et,enne-Lou,s Bo~llee.

Introduction

Typically, cyberspace is thought of as the ultimate disembodiment. Many expound on cyberspatial opportunities related to freeing oneself of the body and materials. In these worlds, we become faceless and bodiless; orphaned from our tangible self. We are free to try on other selves and postures, experimenting and acting through other identities. We are also anonymous, losing our uniqueness and possibly *our* accountability.

Cyberprint provides a theoretical framework for exploring and inhabiting cyberspace with an identity. This identity is inextricably tied to the individual inhabitants because it germinates from their physiological signals. Our physical bodies inhale, they exhale, they beat, they sweat, they shiver. These functions are uncontrollable and necessary They are also unique to our own self. If we incorporate the fundamentals of physical being to establish virtual being, to give form and space to personal architectures and avatars, we create a personal signature, *a* cyberprint. The cyberprint also sustains beyond our dwelling, leaving an imprint of our physical place in time.

The ancient roman poet, Ovid, stated "In med'cine, as in life, until the mind has been prepared to see something, it will pass unnoticed as mvrsrble, as though it did not exist." (Binns). *Cyberpn·nr* attempts to bring this body architecture, the self atmosphere, to existence, making it visible and challenging our perceptions.

The question is then how do we reinterpret the elements of architecture (rhythm, light, texture, etc.) into a virtual world modified by and for our physiological being. We can begin by developing a language; naming the physiological data and designing the corresponding *values*. If *we* take a look at our bodies, they are constantly talking. Yet, we have only invented a few languages to communicate and understand what they are saying. We have learned to read some of the conscious messages such as postures, gestures, and sounds. The many untold stories lie in the involuntary actions of the body. Developing a language for the subconscious messages will offer communication *of* the self *on a* new level.

Traditions af Self-Portrayal

Throughout history, humans have developed culturally acceptable interpretations of the body and the subconscious self. These representations and performances, in turn, would teach us more about the body. Over 12,000 years ago, surgeons of the Paleolithic era performed trephination, a process where holes are cut in the patients' skull This was thought to release evil spirits that cause disease. Three thousand years ago, Egyptian rnorncrens removed the internal organs and filled the body with strong spices. They believed it was necessary to preserve the body for the soul to live on after death [Fig. 2].

Figure 2: Embalming, Kittredge, p. 20.

These practices served as investigations, teaching the cultures something more about the body, altering their perceptions, and thus.refining their practices. It was not until 14-0 years ago thatthe Medieval practice of bloodletting to purge the body of impurities was renounced [Fig. 3].

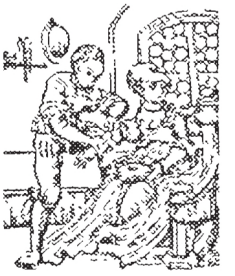

Figure 3: Bloodletting, Guinness, p. 104.

Physiological Data and Architectural Metaphors (language)

Today, we have an inmd1ble, at least perceived, understanding of the workings of the human body. However, the only linguists are those in the medical profession The language for organic structures (anatomy) is well formed through dissection, modeling, and imaging of the body with scans such as X-rays, CRTs, and thermography [Fig 4]

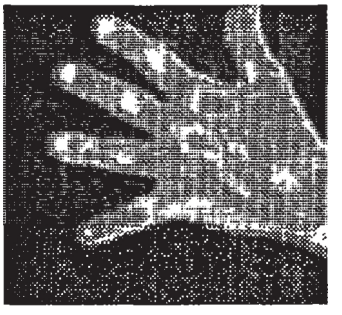

Figure 4: Thennography, Guinness, p.24.

The language for body functions and physiology, which are processes and states, are not as well developed. For example, during anesthesia, the anesthesiologist watches over 30 interrelated variables charted as a 2-D vvave-fonm data display [Fig. 5] to determine if a patient is stable and in the desired physiologic state. These human factors are continuously monitored and indude: Pulmonary Function, updated each breath (Tidal Volume, Respiratory Rate, Nitrous Oxide, Oxygen, Carbon Dioxide, and Airway Pressure), Cardiac Output, updated each heart beat (Stroke Volume, Heart Rate, Systolic Blood Pressure, Diastolic Blood Pressure, and Arterial Oxygen Saturation), Predicted Plasma, Brain, and Muscle Concentrations, updated every 2 seconds (Fentanyl, Propofol, Isoflurane, and Vecuronium), Fluid Changes (Blood Loss and Blood Infused), Urine Output, and Body Temperature.

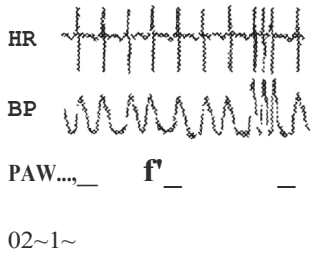

Figure *5:* Wave Form Diagram, Westenskow.

All of these variables are interrelated and constantly m flux. For example, when air is inhaled into the lungs, pressure is exerted on the heart due its close proximity. This pressure causes the volume of blood pumped by the heart to change with each beat. The current representation, which depicts them as isolated vanables, does not show these relationships. It also does not accommodate a real-time history or comparison against normative values, useful for monitoring trends.

The standard physiological data monitored by an anesthesiologist, coupled with brain activity, can be used as the language building blocks for Cyberprint. These vital signs cover all essential human functions: breathing, heart, and mental activity. When these systems are then coupled with time. a three-dimensional construct is created.

Breathing: The Respiratory System supplies oxygen and removes carbon dioxide. Airflows through a series of conduction passageways that branch out from one another. Inspiration, the movement of air into the lungs with elevation of the ribs and expiration, the movement of air out of the lungs, back into the atmosphere with fall of the ribs creates a rhythmic pattern. This rhythm is altered from internal and external forces such as stress and physical activity.

Heart: The Circulatory System provides a homeostatic environment for the cells of the body [Fig 6]. Blood continuously travels a closed, circular route through the heart, into arteries, then to capillaries, into veins, and back to the heart. The heart *is* the pump that provides the force necessary to keep this blood flowing. Changes in the blood volume may be brought about by emotional states (fear), environmental factors [temperature), physical activity, and other variables.

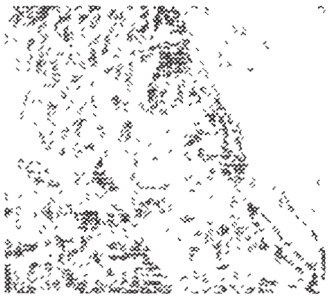

Figure6: Dendnuc (Fractal) Structure of Bra,n Cells, Bnggs, p. 125.

Mental Activity: The Central Nervous System is responsible for the integration and control of body functions [Fig 7]. Functions range from single activation and reflex control of skeletal muscle to complex functions of memory, abstract thought, association, and language. Throughout the body, nerves (somatic receptors) receive stimuli (change in the environment} and send the information to the central nervous system so it can react in a purposeful manner to changes in the external and internal environment. Exteroceptors are sensitive to changes in the body's external environment (pain, touch, temperature, pressure, hair movement). Interoceptors are sensitive to changes in the body's internal environment (stretching of muscles, the inner ear.etc.).

Figure7: Fractal Structure of the Circulatory System, Briggs, p. 127.

The body's organic structures are easily visualized because they already possess their own characteristic shapes. The language results from enhancing a given set of representations. In contrast, physiologic data has no particular form. Representation must be invented. This bnngs us back to the age old question of how *we* represent the self. This Is the design challenge of *Cyberprmt.*

The three systems initiate germination m form, co/0l, texture, light, and proximity. To create the cyberprint, a model for externalizing these three systems must be developed. The initial investigations utilized traditional architectural metaphors [f,gs. 8, 9]. The roof, that which provides shelter, is externalized from the respiratory rate, Variables of heart rate make up the walls, which are necessary for roof support [figs. 10-14]. The premise is two-fold. First. that everyone understands the basic requirements for a building. Second, if one system goes into failure, the others will follow due to their dependency, For example, if blood pressure begins to drop, the walls will collapse and the roof, breathing, will follow.

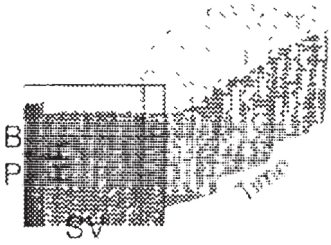

Figure 8: 3-D Wave Form Diagram

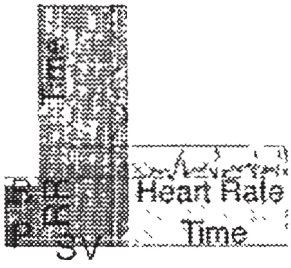

Figure 9: 3-DWave Form Diagram

Figure 1 0: 3-D Wave Form Diagram

Figure 11: 3-D Wave Fann Diagram

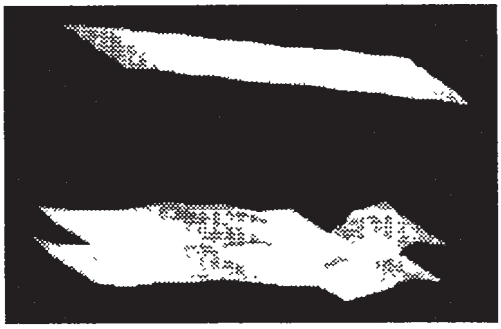

Figure 12: 3-D Wave Fann Diagram

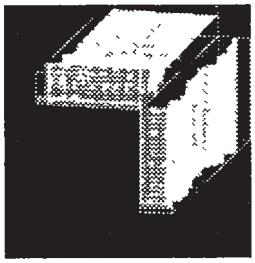

Figure 13: 3-D Wave Fonn Diagram

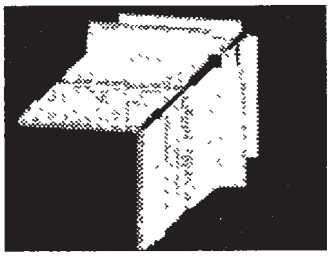

Figure 14: 3-D Wave Form Diagram

Another model for externalizing these three systems ls where each system is given an initial "cell." The cell has certain properties based on the system variables (heart rate, blood volume, etc) and can travel between ranges based on the present condition of the cell's variables. The cells are dependent on one another across the systems and will change in relation to each other lhis is known as cellular-automaton simulation [Fig. lS]. Cellular automatons are used to model the behavior of unpredictable systems. The behavior of the whole **i i** dependent on the interaction of the individual cells [Fig. 161 (Friedhoff, p 158).

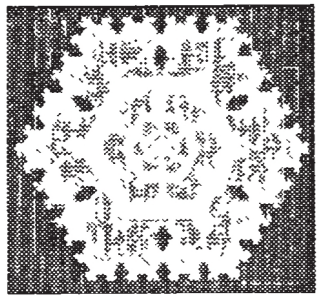

Figure 15: Snovvilake Cellular Automation, Fnedhoff, p. 158.

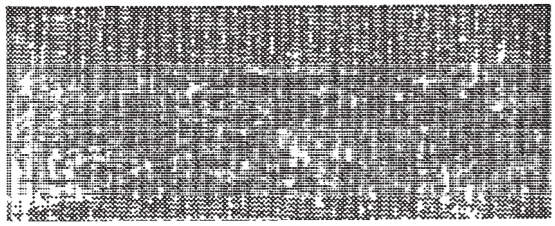

Figure 16: Gas Fractals, Bnggs, p.135.

Each cell would be capable of multidimensional representations of the system data: X, Y, Z coordinates in space, color and shape, nonnal size (historical average) and fluctuating size (real umel.speedand sound. The cell's capability is defined from nonnative values and deviations or ranges of values.All cells will be portrayed against a "normal" value. These norms are used to apply intelligence to the environment. If a system fulls outside the nonnal ranges, that particular cell's graphic representation goes to alert status by changing color intensity, speed, pitch, etc.

Cyberprint Environment(Design)

The language of representing the three systems creates a special mirror, a physiological based image of self. It provides a new medium, giving access to a part of the sett previously unknown. Through virtual dwelling, we can begin learning to read our body stories and come to know the rhythms of our involuntary actions.

This will provide a connection between the body and the environment that is currently lacking in virtual architecture. In traditional architecture, we understand our environment through our bodies. This indudes scale and memory of objects. From dassical times onward, architects used the body as the measure of all things [Fig. 17]. Size, proportion, placement, and texture of all built things are understood in relation to body size From 6'-8" door openings to pass through to 2-1/8" door handles to tum, we understand how the environment works by relation to our body. Our physical presence also leaves a memory in the environment [Fig.18]. We see it in the raised grain on the chair anns and seat, the worn dips in the stairs, and the fog of breath on the window.

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Figure 17: */deat Man,* teonarn ca vino. Rasmussen, p. 115.

Figure 18: Detail of lnqhsh walnut chair, Rasmussen, p. 179.

In cyberspace, there is no inhent scale, materiality, direction, or body. We lose the clues from objects as to if we wall through or tum to open with our hand. There is no wearing of surfaces through accommodation of bodies *(yberprintbrings* the body into virtual architecture, providing a new type of scale and reference to the body. Personal signatures or avatars and environments are created with an inherit reference to our physical bodies. The environment is now made by and for our body rhythms, We feel the fit within a virtual space made to accommodate them.

Through sustained inhabitation, *(yberprinr* allows our presence to create memories in the virtual environment. The repetition of variables will alter the environment, crystalizing an edge or extending a vista. Interaction among *(yberprint* will compound this affect, creating communal spaces.

Our individual *(yberprint* will also be influenced by existing *(yberprints.* Awareness of, or proximity to others will change our signature. This may be undesirable. In public settings, we make self-conscious efforts to control our presentation of self; we manage the impression we make on others. In a consensual virtual environment made up of *Cyberprints,* we may want to do the same. Filters can be introduced to alter our presentation of self; the *(yberprint* accessory. They may have the equivalency of self restrain, keeping us from communicating our true feelings. The filters may also be superficial, equivalent to lipstick and perfume.

Filters could also serve to interpret our physiological data differently, through new rules. They may focus a particular physiological aspect such as breathing, to be used for meditative purposes. Filters may also reinterpret our physiological data to represent other animate forms. We could try on other *(yberprints,* say that of a heavy smoker, or of a Doberman, to experience the virtual environment from a new perspective. This takes us full circle from the introduction, *whereCyberprints* is striving against the bodilessness and loss of self in virtual environments that allow for this play. However, *Cyberprint* and *(yberprint* filters now can give us this multiplicity of self with the inherent tactileness of the body in the environment.

Futures (Critique and Redesign)

The final images shown [Figures 19-26] were generated in real time with actual data of physiologic states using Microsoft Data Explorer software The forms (ground) are the actual data as it unfolds, the dancing of the body rftythms The background is the two-dimensional normative projection, warped by the weight of the undulating forms

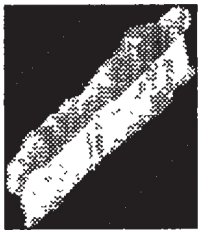

Figure 19: 3-0 Modeling of Physiological Data, Agutter.

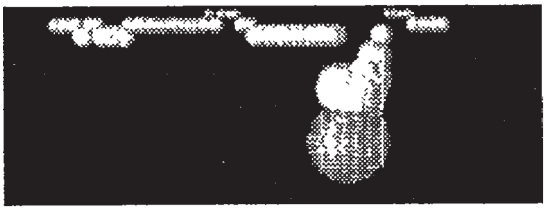

Figure 20: 3-D Modeling of Physiological Data, Agutter.

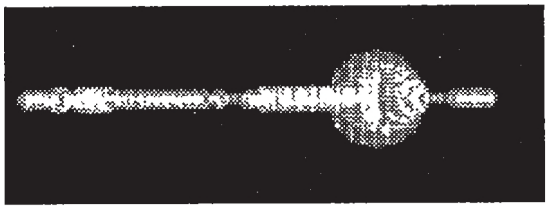

Figure 21: 3-D Modeling of Physiological Data, Agutter.

Figure 22: 3-D Modeling of Phys1olog1cal Data, Agutter.

Figure 23: 3-D Modeling of Phy;,olog,cal Data, Agutter.

(yberprintcreates a storhastk, fluid environmentthat originates from the data naturally generated by living individuals. It is a real time phenomenon, displayed in immersive or desktop digital environ-

ments. *Cyberprint* is still in an infantile state. This work requires interdisciplinaryresearch among usually isolated fields; architecture, music, computer science, and medicine. The challenge to date has not only been the interpretation of the ph~io!ogic data ,nto

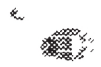

Figure 24: 3-D Modeling of Phys,oiog,cai Daia, Aguner.

Figuie 25: 3·D Modeling of Phys,olog,cal Data, Aguner.

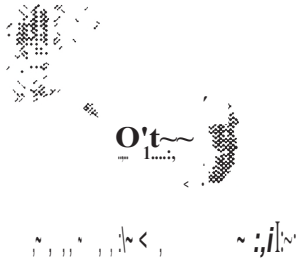

Figure 26: 3-D Modeling of Phys,olog,cal Data. Aguner

corresponding visual and aural representation, but also the design of the hardware that recognizes, captures, and transfonms the necessary information into digital output and the software that takes on this input data and manifest it in a fluid audio-visual expression.

Using Descanes'terms, we understand behavior as reaction to outside events. *(ybe, print* layers on this an architecture as reaction to behavior. Like Ovid's quotation, new technologies lead to new understandings of certain phenomena because they provide visualization tools. The invention and refinement of the microscope m the 1600's led to new understanding of body functions (Kittredge, p 21). Ptrhaps *Ctberprint* will also lead to new understandings and advance our perceptions, not only of architecture but of our selves.

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