Artist Explorations of the Boundary between the Virtual and the Physical

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Abstract

This text surveys artistic exploration of the boundary between the physical and virtual electronic worlds and considers developments in the research world likely to be significant.

The last two decades have marked the ascendance of the virtual. Artists have rushed to create computer-mediated worlds. As our public and private lives are dominated by electronics, theorists suggest the physical world decreases in importance. For example, in **Being Digital**, Nicholas Negroponte suggests the focus has shifted from moving atoms to moving bits. Radical constructivists suggest our concepts of physical reality are so shaped by underlying narratives that we can't have access to an authentic "reality".

In recent years, however, some technological artists have begun to question these developments. They have become interested in the intersection of the physical and the virtual worlds, which some call "mixed-reality". For example, they have created events in which physical events shape what happens in the computer generated world. This paper briefly surveys this mixed reality art and identifies trends and underlying themes. It also identifies scientific and technological research that suggests the growing importance of this inter-penetration.. The paper is based on research from my book **Information Arts: Intersections of Art, Science, and Technology**. This paper can only offer a few examples of an enormous body of art works; please consult my web site for full categorized links to world wide artistic experimentation.

Note that the distinction between the physical and the virtual is not as clear cut as it might seem. Usually the virtual refers to electronically created worlds - images and sounds generated on screens and speakers through analog and digital synthesis and manipulation. The physical refers to the 3-d palpable world of bodies and things that take up space and can be touched. Yet, even the virtual world is created in the physical space of the phosphors of the screen and speaker cones and the movements of mice and keyboards are necessary for its creation. Also, the virtual existed long before digital technology - literature, art, drama, and cinema created artificial worlds that drew in audiences.

This text surveys art that explores several different categories of mutual influence: the electronic world's influence on both human and non-human physical realities and the converse.

I. Non-human physical world's influence on digital events: Several artists have created digital events based on sensing of the natural environment. For example, Project Taos's *Sensorium* presents a throbbing earth based on current worldwide seismic activity; Patrick Clancy's *Writing Machine* progressed based on sensing weather elements; my *Ocean Merge* presented a 3-D sound event based on the movements of the waves. Natalie Jerimjenko's *One Tree* project linked environmental sensor readings about air quality with the growth fate of digitally created trees which live in an artificial life environment. Shawn Brixey's work focuses on atomic level phenomenon - for example, *Instruments of Material Poetry* in which motion of subatomic particles are converted to sound events.

Monumental forces such as the weather and seismic activity confront the claim that the physical world is insignificant. Artists who create these events have many agendas, including acknowledging the power of the physical world, questioning the conventions used to represent these natural forces, asserting dominance over these forces by bringing them within the artist's control and using the non-linear flux of the events to orchestrate other events.

II Human physical actions influence on digital worlds: In this popular area of investigation, artists seek to find ways to link human actions (beyond mousing or keyboarding) with digital events . Examples include haptic and kinesthetic works that read motion in 3-d space, gestures, touch, and gaze. Some read more complex behaviors such as bicycling or surfing. And others read complex sociological aggregates of action such as movement of transit trains or traffic. Some such as VR oriented works require complex instrumentation while others try to interpret motion in free space, typically via video analysis.

Some examples of motion based events include: David Rokeby's *Very Nervous System,* which translated viewer motion into an electronic instrument; Monika Fleischmann's *Rigid Waves*, which linked image distortion to the closeness of the viewer's approach;; and George Legrady's *Tracings*, which revealed levels of imagery based on the way visitors positioned themselves.

Some examples of gesture, touch, and face reading works include: Pamela Z's conceptual sound works, which use her body as a midi instrument; Christa Sommerer & Laurent Mignonneau's *Intro-Act*, which use visitor actions to influence the evolution of artificial life forms living in their system; Thecla Schiphorst's *BodyMap,* in which the touch of the visitor controls video events; Seiko Mikami's *Molecular Clinic,* in which the gaze of the viewer affected the development of digitally projected artificial molecules; and the Plasm group's *Your Mug*, which attempted to link events to facial expression recognition.

Some examples of linking complex motion to digital events include: Jeffrey Shaw's *Legible City*, which let visitors ride a stationary bicycle to navigate an artificial city made of architectural sized letters; and my *TransitTime*, which linked digital sound and video to the real time movements of San Francisco transit trains.

What intrigues artists about these links between human actions and digital events? For some the physical world of motion and gesture allows for more complex investigation of the psychology of interactivity - for example translating physical qualities of near and far into psychological metaphors, or reading the quality of touch as an indicator of attitudes. For other artists breaking out of the standard interface can liberate the digital environment from its commercial and historical baggage.

The "promise" of these new physical interfaces is somewhat historically bound. The mouse itself was once considered revolutionary in the way it freed the user to use more expressive physical gestures than the keyboard. It is possible that as research into the new physical interfaces matures, they too may become conventional and their artistic interest will decrease.

III Activated Objects: Artists have created new kinds of activated objects in which physical manipulation results in changes in the electronic events. Often these installations explore several layers of interconnected physical and digital worlds.. Examples include Toshio Iwai's *Music Plays Images*,, in which a pianist's movements on the keys generated light which generated music when it bounced into another piano; Masaki Fujihata's *Global Interiors* and *Beyond Pages*, in which viewer manipulations of pages of a book causes physical (eg a light to go on) and virtual events (sounds, digital video of action behind a door); Perry Hoberman's *Timetable* and *System's Maintenance*, in which three inter-linked worlds (full size physical room, miniature physical room, and projected room) are affected by actions in the other versions of the room; and David Small & Tom White's *Steams of Consciousness*, in which letters projected on a pool of water are affected by viewer's moving their fingers through the water;

Artists are addressing several themes in this work: the surprise and violation of expectations that arises when conventionally inert objects are endowed with the hidden powers; the new possibilities of activated physical worlds; and play with constructivist questioning of the validity of assuming the objective nature of the physical reality. Outside the art world, researchers in fields of ubiquitous computing and tangible bits are working to expand the IT properties of objects.

IV Virtual world impact on the physical world: Artists are exploring arrangements where the influence goes the other way - the virtual world influencing the physical world. Control automation, telepresence, and robotics offer common examples in which electronic virtual worlds control machines acting in the physical world. Examples of artistic exploration of these concepts include Ken Goldberg's works such as the *Telegarden*, which web visitors could influence the movements of a garden-tending robotic arm; Rafael Lozano-Hemmer's works such as *Vectorial Elevation*, in which web visitors controlled the positioning of search lights over Mexico City; Survival Research Labs' *Lethal Experimentation*, in which web visitors could chose to launch potentially dangerous projectiles; and other artists visualizing the state of the network in concrete form.

Rapid prototyping (RP) offers another form of physical/virtual linkages. Computer designs in the electronic context are directly translated to instructions to machines which create corresponding physical objects for example by focusing laser beams on plastic vapor so that it solidifies to form the object. Artists are beginning to explore this capability. For example, the Cyberarts "Mind into Matter" show invited sculptors to send in designs which were then actualized into physical forms by a rapid prototyping machine.

Most tools and machines can be seen as aids in moving from the virtual to physical form. Sculpture and architecture are contexts for actualizing imagination in the physical world. New electronic and materials science developments can be seen as primarily shortening and easing the cycle.

V. Virtual world impact on human bodies: Artists are exploring the possibilities of the virtual world directly affecting human bodies. For example, in Stelarc's *Parasite*, distant viewers clicking on an abstract representation of the body are able to activate muscle stimulators.. In *Movotar* an artificial life controls the stimulators. In Arthur Elsenaar and Remko Scha's *Huge Harry*, an artificially intelligent entity gives a lecture illustrating human emotional response by controlling muscle stimulators placed on Scha's face. Stahl Stenslie and Kirk Woolford investigate the body/ electronic boundary in works such as *cyberSM* , in which viewers use stimsuits, containing both touch sensors and kinetic body vibrators, to send body sensations back and forth.

Artists are drawn by the twin poles of fascination and abhorrence. Do we really want to let the virtual world directly impact on our physical bodies? Do we have any choice?

VI Summary: We are at a stage of uncertainty about the physical world. The information economy, electronic media, and constructivist skepticism about physical reality reduce the importance of the physical.. These trends connect with the longing for escape from the limitations of flesh and matter which has been a long historical theme.

Subjugation of the physical and biological world is another active theme manifest in research. For example, ubiquitous computing hopes to activate and monitor everyday objects and architecture. Bionics and telemedicine hope to similarly interconnect the biological body with electronic infrastructure. Even more radically, bioengineering, bioinfomatics, and nanotechnology seek to understand and ultimately control the heart of physical reality. The distance between the virtual world of electronic representation and physical manifestation will be erased as researchers translate designs to actual cells and materials.

For some, these scenarios are nightmarish distortions to be resisted. For others they are part of the inevitable movement of history. Artists seek to interrogate this space by putting the physical and the virtual in contact with each other. What is special about the physical and biological world? What are the limits and opportunities of allowing the electronic and physical worlds to influence each other? The arts are an ideal place for this inquiry because of their simultaneous interest in the physical and the iconic. In a radical shift the everyday world of bodies and things will become the media of art.