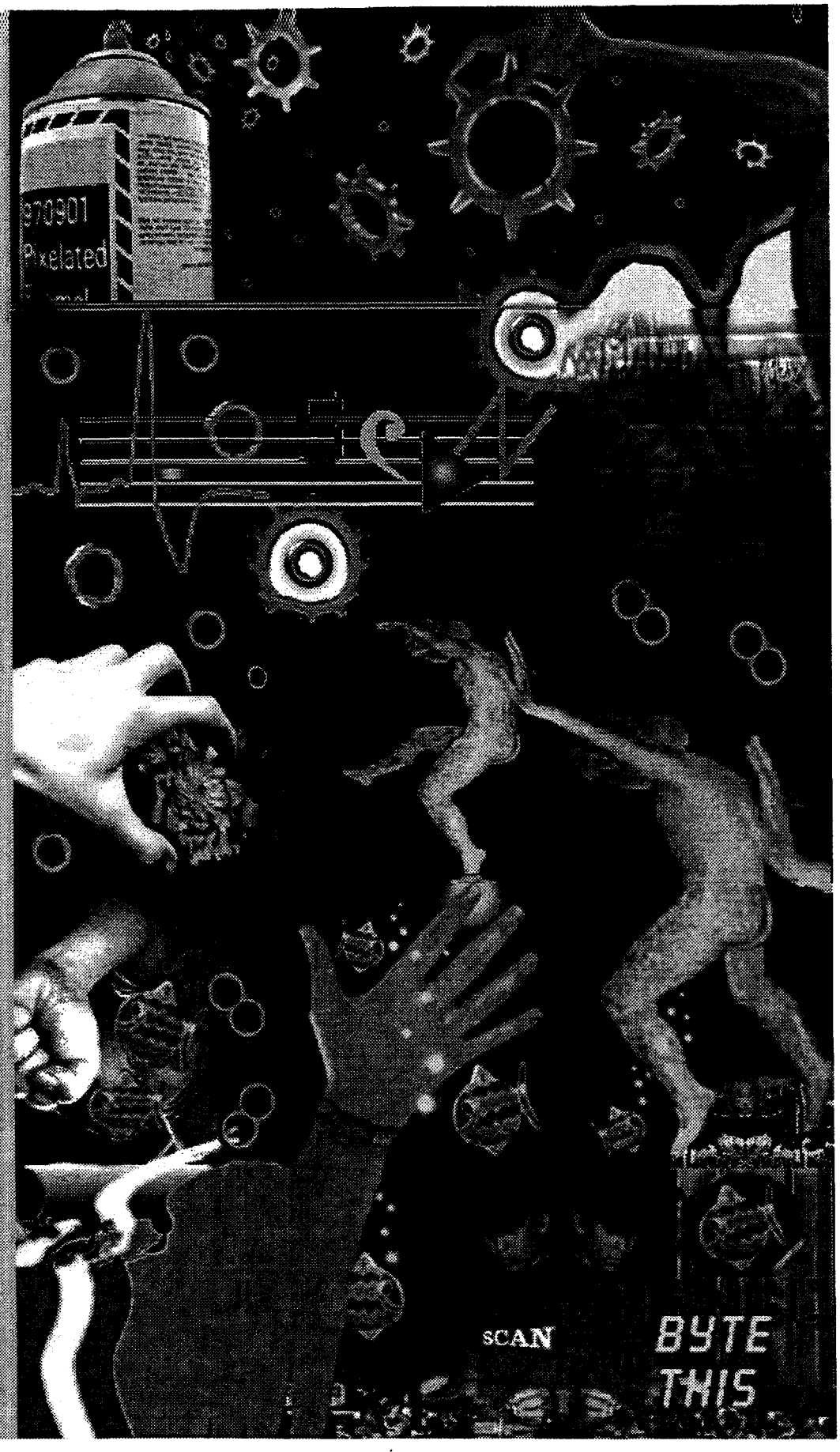
SCAN 97

The 17th Annual Symposium on Small Computers in the Arts
November 7-9, 1997



The Franklin Institute Science Museum
Philadelphia, Pennsylvania

SCAN '97

Friday, November 7th Steams Auditorium

8:30 Registration
9 Opening Remarks • Tom Porett
9:15 Apple: The Creative Edge • David Hays
10:15 Super Computers In The Arts • Laura Giannitrapani

11 - 12:30 Lunch Time

12:30 MetaCreations • Matt Douglas
2 Metaphorium, Cati Laporte • Doreé Duncan Seligmann
2:45 The First Wave: Art That Is Defining The Pallet Of The Web • George Thompson
3:30 Art Museums Online • Dr. Stella Russell & Charles Boehme
4:15 A Simulation To Train Medical Students... • Arne Joensson

5 - 6:30ish pm Suppertime! *(see restaurant list)*

6:30ish - 8pm First Friday & SCAN '97 Art Exhibition Opening
Silicon Gallery 139 North Third Street

8pm American Music Theater Festival's Crosswaves '97
Thinning Of The Veil &The Digital Gallery
Jaron Lanier & Rebecca Stenn
Whyy Forum Theater 150 North 6th Street Tickets $12.50 & $10.

Saturday, November 8th Steams Auditorium

9:30 Classical Art Meets Modern Day Deadlines • Kevin Gallup
10:15 The Theater Of The Brain • Rob Fisher
11 Sculptural Form & Space And Boolean Algebra • Timothy Duffield
11:45 A Multimedia Presentation On Mixing Digital And Traditional Media • Jeff Otto

12:30 - 1:30 Lunch Time

1:30 Grammatron: Hypertext Fiction On The Web • MARK AMERIKA
2:15 Artistic Collaborative And Educational Possibilities...Multimedia-Dance • A. William Smith
3 Minute Variations • Lawrence Fritts
4 LiSa: Using Motion Sensing ... In Performance • Richard Povall
4:45 Lyrrus's G-Vox Guitar 101 Interactive CD-Rom • Bill Purse

5:30 - 8pm Suppertime!

8 - 10pm Scan '97 • Saturday Evening Performances • Steams Auditorium

Sunday, November 9th Musser Choices Forum

10 Computer Aided Design For Handmade Sculpture • Rod Mccormick
10:45 Creating Digital Sculpture • Bruce Wands & Peter Terezakis
11:30 Projects • Robert Michael Smith

12:15 - 1:30 Lunch Time

1:30 Video Opera Jesus' Daughter • Burton Beerman, Celesta Haraszti
2:30 americAmiracle: Creation Of An Enhanced CD • Tom Porett
3:15 Digital Prints Of Decaying Flora • Steven Berkowitz

4 Closing Comments Dick Moberg
End Of Conference Scan '97

SCAN:

Symposium:

Dick Moberg, Founder & President
Mark Scott, Vice President
Misako Scott, Symposium Coordinator
Ranjit Bhatnagar, Proceedings Editor
Rick Decoyte & Tom Porett, Art Exhibition Curators
Steve Berkowitz & Brian Souder, Music Program & Performance Coordinators

Franklin Institute Liaison:

Our guy, Ed Wagner

Technical Staff:

Steve Beuret, Dick Moberg, Tom Porett, Brian Souder, Steve Berkowitz,
Mark Scott, Ken Kramar, Ranjit Bhatnagar.

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Welcome to Philadelphia, and SCAN '97!

and

The Franklin Institute Science Museum

20th Street & Benjamin Franklin Parkway
Philadelphia, PA 19103
215 • 448 1200
email: webteam@sln.fi.edu
http://sln.fi.edu

What's at the
Franklin Institute?

The Feature Exhibit: The Robot Zoo

Machinery in the robot animals simulates the body parts of the real animals. Muscles become pistons, and brains become computers. Three of the exhibit interactives are powered by powerful Silicon Graphics workstations. Use real-time color image processing to change the chameleon's color. Interact with a three-dimensional rhino in a virtual reality environment. Propel a digital squid using computational fluid dynamics. Engineering becomes fun in "The Robot Zoo."

The Tuttleman Omniverse Theater : Alaska, Spirit of the Wild

Visit one of the world's most fascinating ecosystems, brought to Philadelphia on the four-story high screen of the Tuttleman Omniverse Theater. See Arctic sand dunes, humpback whales, sea otters, and more.

Planetarium - Mars, 4th Rock From the Sun

THE SMALL COMPUTERS IN THE ARTS NETWORK

Presents:

SCAN '97

The Franklin Institute Science Museum
November 3rd - 5th, 1995 Philadelphia, PA

After 17 years we have finally decided to drop the annual theme and concentrate on what's important Computer Technology and it's unique relationship to The Visual Arts, Music, Dance and Performance Art.
Small Computers in the Arts Network, (SCAN), is a national network of approx. 1500 visual and per - forming artists for whom the use of the personal computer is integral. The SCAN Symposium is not a vendor's trade show, and products are demonstrated by invitation

The17th Annual Symposium on Small Computers in the Arts

is Sponsored by:

The Small Computers in the Arts Network

and

The Franklin Institute Science Museum

With Very Special Thanks to:

Ed Wagner & the Franklin Institute Staff
Bob Kuss, (Franklin Institute T-1 Guru)
Rick Decoyte and Michal Smith at the Silicon Gallery
David Hays & Apple Computer, Inc.
Ranjit Bhatnagar, Dick Moberg,
Bob Helms, (concert sound technician)
The American Music Theater Festival
Valerie Castleman & New York SIGGRAPH
Ed &The BPM Group

Meet some of SCAN's new best friends:

The American Music Theater Festival

123 South Broad Street 18th floor, Philadelphia, PA 19109
215 • 893 1570
http://www.libertynet.org~amtf
***brings us Jaron Lanier's lectcert* The Thinning of the Veil**

Founded in Philadelphia in 1984 with the mission of developing and producing new music theater in all of its forms. In 13 years, AMTF has built a national reputation for its innovative world premiers and commitment to emerging artists. Both *Time* magazine and *The New York Times* have praised AMTF as America's leading showcase for new and exciting music theater.

The Segewick Cultural Center and Theater

7141 Germantown Avenue Philadelphia, PA 19119
215 • 248 9229
brings us MARK AMERIKA:

Mark Amerika's appearence at SCAN is presented in conjunction with the Hyper-X Workshop. The Hyper-X Workshop is dedicated to creating new Web-based works developed from collaborations between artists, writers, musicians, dancers, and performance artists. The Hyper-X Workshop conducts residencies and performances at the Sedgwick Theater.

PANMA

Philadelphia Area New Media Association
Ric Kolenda, President
215 • 487-2200
http://panma.org

The Philadelphia Area New Media Association is a member organization with the goal of promoting a professionally and socially friendly environment for new media professionals and employers in the area. PANMA succeeds by offering monthly meetings that range from informal get togethers at interesting taverns and cafes to educational seminars featuring panels populated by industry leaders. PANMA members, primarily Internet design and multimedia production professionals, can take advantage of networking opportunities to find colleagues, partners, employees and employers. "PANMA tries to bring together all of the diverse groups and individuals involved in designing, programming and publishing interactivity." according to Ric Kolenda, PANMA president. By hosting events and garnering publicity, PANMA helps to shape the global reputation of its region.

Call 215-487-2200 for event information. Schedules for Philadelphia Cybersuds and PANMA events are accessible at http://panma.org. Anyone interested in joining can do so at that location.

SCAN '97

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Friday, November 7th, STEARNS AUDITORIUM

8:30
REGISTRATION
9: - 9:15
OPENING REMARKS
Tom Porett

9:15 - 10:15
APPLE: THE CREATIVE EDGE

David Hays, Apple Higher Education Sales Agent • hays@etany.com www.etany.com

Apple Computer continues to innovate and improve the way computers are used in the arts. Dedicated to the needs of creative users, the Power Macintosh platform is the industry leader in content creation. Enjoy a quick introduction to Quicktime 3.0, Quicktime VR, QuickDraw 3D, as well as the future of the Macintosh operating system and the power of PowerPC architecture.

David L. Hays, Account Manager
Educational Technology Associates
Authorized Apple Education Sales Agent
48 Mall Drive
Commack, NY 11725
800-735-1775

Home office: (215)-991-6567
Apple Home Page: http://www.apple.com
Apple Higher Education home page : http://hed.info.apple.com
Apple Support & Product Information: http://www.info.apple.com
Apple TechInfo: http://til.info.apple.com/til/

10:15 - 11
SUPER COMPUTERS IN THE ARTS, NETWORKED

Laura Giannitrapani • laura@bu.edu http://www.bu.edu/SCV

Have you ever wondered how your artwork would look and evolve if your resources included a high-bandwidth network, an Immersadesk (or a number of them around the world connected by this high performance network), and a supercomputer? We will discuss how artists can utilize these resources and their capabilities to expand their work.

***Laura Giannitrapani** has worked in computer graphics since 1979. Interests include 3D modeling and animation and scien - tific visualization. Currently, she is the Manager of Graphics Consulting for the Office of Information Technology's Scientific Computing and Visualization Group at Boston University. Laura is also a Teaching Associate in the School for the Arts at Boston University and teaches 3D design and animation using computer graphics. Laura received a BFA in Communication Arts and Design from Virginia Commonwealth University in 1980 and an MFA in Graphic Design from Boston University in 1987.*

11 - 12:30 LUNCH TIME ***Lunch at 11!?*** From Ed, Franklin Institute Liaison:

***** *Bad news, good news - on Friday, the museum booked a school show in Stearns, so here's the deal: the show is from 11:15 - 12:15, so we'll need to make lunch at that time and stick to it. If anyone wants to stay for the show, they're more than welcome!* ***And, as a perk,*** *every attendee that day will get a* ***free Omni pass that is good until the end of the year.*** Not a bad deal ... OK - let's do it! *Bring yourself back a big coffee.*

(Please see restaurant suggestions - back cover)

12:30 - 2

METACREATIONS

Matt Douglas

Painter 5 empowers creativity with the broadest set of features of any art creation program. From Natural-Media simulation to super-natural tools, Painter 5 incorporates sophisticated technology that gives you the power to create looks you can't get anywhere else.

Introducing **Infini-D 4,** the amazing new version of MetaCreations' award-winning 3D animation software for video. New Infini-D 4 gives you an unprecedented combination of video integration, 3D animation power, high-end special effects and a responsive, intuitive working environment. It's the ideal choice for corporate and broadcast video, CD-ROMs and more

Bryce 2 is ideal for anyone who wants to create 3D images but has been intimidated by the cost of 3D applications and the hardware required to run them. Bryce breaks the price barrier, bringing 3D capabilities to the desktop. Bryce is perfect for both 3D enthusiasts and digital imagers exploring 3D for the first time. Both can use presets for immediate results or create custom 3D images with full control over terrain, as much sophistication or complexity as users desire.

2 - 2:45

METAPHORIUM

Cati LaPorte, Doreé Duncan Seligmann • *http://www.multimedia.bell-labs.com/metaphorium/*

We are exploring the use of visual imagery which simultaneously provides the content and control of web-based interactive services. We describe four unconventional web-based services we have implemented for: messaging, a bulletin board, broadcast messages, and browsing through a set of hyperlinked objects. We implement each service using a real-world metaphor which serves as the basis for the visual presentation as well as the service itself; thus form and function are tightly coupled. The use of universal imagery eliminates the need for wordy explanations and hence increases accessibility to an international audience. During the course of development, we devised techniques to enhance the shared experiences of the visitors to our sites, including automatically generated 2D animations. These approaches can be applied to a variety of web-sites and are also described.

Cati Laporte *For SCAN '94, Manhattan artist (Cati LaPorte, aka FIRE) explained why she made and sold outlaw postage stamps featuring Dr. Kevorkian, Lorena Bobbitt and Ford Bronco & DNA to name just a few. At SCAN '95, she showed us her web site called Almanac of Disasters. This year, she & Doreé Seligmann will give us a tour of their work at Bell Labs.*

2:45 - 3:30

THE FIRST WAVE: ART THAT IS DEFINING THE PALLET OF THE WEB

George Thompson • ***thompson@jcccnet.johnco.cc.ks.us***

The first wave of art which successfully uses the pallet of the Internet for its expressive potential has arrived. In works such as "The Place," "Electronic Alchemy" and "The Spleen" artists have published projects which have investigated the essential properties inherent to this medium. To understand what defines these works as distinctive this illustrated talk will examine the strategies, techniques and tools that inform them. The concepts of non-linearity, interactivity, didacticism, provocation and intimacy will be shown to be their common hallmarks and the foundation of a new aesthetic, which is defining the pallet of the Web.

George Thompson's *investigation into the ontology of the Internet has resulted in his publishing "Electronic Alchemy," in con - junction with the Nelson-Atkins Museum of Art, in 1997. The work is a continuation of his use of the digital medium for the creation of time-based art, which began in 1985. When not in the studio, he devotes his time to the education of artists and musicians as the Director of the Visual Arts and Music Program at Johnson County Community College, in the greater Kansas City area.*

3:30 - 4:15

ART MUSEUMS ONLINE

Dr. Stella Russell & Charles Boehme

More than 350 art museums internationally are now online, while visual artists and galleries number in the thousands in cyberspace. Essential internet terms are defined and some servicers are listed including World Wide Web. Almost all 350 museums post contact information via address, phone and fax, hours of admission, membership information, current and pending exhibitions and museum store inventory, art classes and film schedules if offered. A few museums provide browsing through permanent and special exhibitions. Some furnish press kit info and special services like research libraries. APPENDIX lists 150+ online museums. BIBLIOGRAPHY includes most 1994-1997 articles (periodicals) that deal with art and museums online.

***Stella Russell** has taught for more than 20 years at SUNY (State university of New York) Nassau Community College, won dozens of awards, including the SUNY Chancellor's highest teaching honor, participated in art exhibitions, articles written, service as Art Chairman, lecture tours, is a recognized authority as an airbrush artist, and hostessed a long-running and cel - ebrated Art Salon. Her solo show of computer graphics at the Fine Arts Museum of Long Island was favorably reviewed in The New York Times . She recently received her second Master's degree from the New York Institute of Technology in the field of communication arts. She has produced six videotapes on new art images and techniques. She has been invited to lecture on computer art at the University of Miami,and Vincennes University, Indiana, among others, and all the while she is record - ing this new phenomenon in a book* The Image Revolution In Computer Graphics.

4:15 - 5

A SIMULATION TO TRAIN MEDICAL STUDENTS IN THE DELIVERY OF LUMBAR PUNCTURE AND SPINAL ANESTHESIA USING INTERACTIVE 3D GRAPHICS AND HAPTIC RENDERING

Arne Joensson

The objective of this thesis is to develop a training simulation, using 3D graphics and a force feedback device, to teach medical students to perform the complex task of spinal taps and spinal anesthesia.

The simulation can introduce medical students and residents to the task of needle insertion into the lower back of a patient, avoiding of the normal stress of the real world environment.
The simulation will consist of two modes; an exploration mode for interactive exploration of the region of interest, including database access, and a simulation mode for process training. Each mode allows for interaction through force feedback devices. The use of force feedback technology is of importance to the simulation, because it is a substantial part of the real task. The practitioner must rely only on feel and some indirect visual cues during the actual performance. Criteria for success or failure in the simulation are completion time and the accuracy of the pass.

***Arne Joensson** studied Industrial Design at the Hochschule für Bildende Künste (HfBK) in Braunschweig in 1987. After grad - uating in 1994, he and a few collegues took on a project developing a graphic user interface to dispatch MAGLEV (high speed magnetic) trains. This was a team effort, where the other two members conceptualized the furniture and building for a pro - jected central control station for the TRANSRAPID. Hearing about the MID program at the University of the Arts in Philadelphia, he decided that this was the opportunity to pursue his interests in interface design, 3D modeling and New Media. Once there, he became interested in the development of virtual environments.*

5 - 6:30-ish pm Suppertime!

may we suggest:

an area rich in restaurants and eateries in the FIRST FRIDAY GALLERY SECTION of Olde City, where our own **Art Show at Silicon Gallery** *is situated. Located within the most historic square mile in the USA, Old City Philadelphia, once a busy waterfront district, is now a thriving art community with theaters, dance companies, art galleries and restaurants.*

Brazils Restaurant and Nightspot
112 Chestnut Street
215-412 1700
Brazilian Cuisine, Live Music

Café Sorella
Martini Bar
314 N 4th Street
215-592 7075
Fresh seafood and poultry restaurant

DiNardo's Famous Crabs
312 Race Street
215-925 5115
Guess what they specialize in?

Jake and Olivers House of Brews
22 S. 3rd Street
215-627 4825
60 Microbrews on-tap, food and dance. serve beer)

Old City Coffee
221 Church Street
215-629 9292
Fresh roasted coffee and snacks

Philadelphia Fish & Company
207 Chestnut Street
215-625 8605
A neat place for fish

Ristorante Panorama
Penns View Inn, Front & Market
215-922 7800
Italian food - best wine bar in Phila.

Serano
20 S 2nd Street
215-928 0770
Inventive cuisine
Acoustic Café upstairs

Brick House Café
141 N 3rd Street
Coffee and great foccachia sandwiches

City Tavern

138 S 2nd Street
215-413 1443
Colonial Tavern

The Five Spot
5 South Bank Street
215-574 0070
Cocktail lounge, Supperclub and Jazz

Mexican Post Restaurant and Bar
104 Chestnut Street
215-923 5233
Good inexpensive Mexican Food

Old Original Bookbinders
125 Walnut Street
215-925 7027
Lobsters, fresh fish and steak

Quarry Street Café
147 N 3rd Street
215-413 1360
Coffee house, bookstore, gallery

Rococo
123 Chestnut Street
215-629 1100
Very trendy place in Phila.

Society Hill Hotel
3rd & Chestnut Streets
215-925 1919
Jazz & food

Café Pazzo
51 N 3rd Street
215-629 5878
Café, gourmet deli, pastries

Continental Restaurant and

138 Market Street
215-923 6069
Trendy martini bar and tapas style

Gargoyles Restaurant and Pub
278 Vine Street
215-627 9706
Good cheap eats with Creole flair

Mulberry Market
236 Arch Street
215-592 8022
Casual deli/small restaurant (they

Pasta Blitz
212 Walnut Street
215-238 0499
Could this be a pasta place?

Ristorante Ghiottone
130 N 3rd Street
VERY popular BYO

Sassafras
48 S 2nd Street
215-925 2317
Bar and restaurant

Sugar Mom's
225 Church Street
215-925 8219
Cheap eats, real ale

Warmdaddy's
Front & Market
215 627 2500
Blues and food

Friday, November 7th

6:30-ish — 8pm

SCAN '97 ART EXHIBITION OPENING

Silicon Gallery 139 North Third Street

SCAN's annual art show at SILICON GALLERYone of the few in the region to showcase computer art. SCAN attendees will be treated to *First Friday,* an event in which this cluster of galleries in our "gallery row" open their shows concurrently and SCAN puts you there!

About this year's show

— from the Silicon Gallery

"This nationwide group was one of the first to see the potential for computers in the arts. The depth of the collective knowledge of the SCAN artists and technicians using of computers in the arts is remark - able. The conference itself and events surrounding it capture the wide range of work being done by artists with computers today.

Computer hardware and software has developed exponentially since the conference inception but the participants dedication to pushing the frontiers of artwork with the computer tools available has not changed. Silicon Gallery is hosting the visual arts portion of this conference in their SCAN 97 show (November 7th - 30th) The work was independently curated by Tom Porett of the University of the Arts and represents the full scope of 2-D, 3-D, video and multimedia work.

Among the three dimensional work there is jewelry from Lori Kraus and Guy Marsdens random number machines that look like equipment you would find in Frankenstein's laboratory. Leslie Farbers lively quilts use the computer as the design tool to produce beautiful fabric wall hangings. Elona Van Gent has produced delicate copper, steel and aluminum sculptures which look like science fiction plants and ani - mals. Pat Baldwin uses a wide variety of computer software to produce exquisite, miniature handmade books. Tom Krepcios stained glass uses a conventional material with very modern imagery.

Among the two dimensional work Richard Helmick uses a conventional architectural plotter to produce his large monochrome images. Jeannie Pearce photographs old architectural implements and tools and then works on the digital images to produce striking, almost abstract images. Kristine Bouyoucos bril - liantly colored panels scarcely look as if they have had anything to do with a computer. Likewise Christina McPhees large landscapes seem a long way away from anything digital.

In the video portion there is an exciting virtual subway world created by Muriel Magenta and Michael Udow, there are websites and interactive CD's on a variety of topics.

The maturity and depth of this show indicate how the computer can be used productively as a tool to pro - duce a wide range of artwork without interfering with the vision."

Artists Exhibiting at SCAN '97 Silicon Gallery

Pat Baldwin • Bisbee, AZ
The Oath 2.5 x 2.25" 1997 miniature book
Queen MAB 2.25" cube 1997miniature book

Kristine Bouyoucos • Pittsford, NY
Seasons • 32 x 35" Inkjet print 1997
Cityscape • 15 x 17" Inkjet print 1997

Denise Carey • Oroville CA
'Day Lily • 29.75 x 23" collage on canvas 1997

Matt Dibble • Arlington VA 22205
Spokesmodel • Video Installation

Lori Glessner • Philadelphia PA
The Past 9 x 22" computer manipulated photography
Iris Print 1997
A Tree 6 x 22" computer manipulated photography
Iris Print 1997

Robert Hakalski • Philadelphia, Pa
Biello Head • 35 x 46" Iris Print 1997

Lori Kraus • Philadelphia, Pa
Flexible Bracelett #9B 5.25 x5.25 x.25"
Silicon Rubber and Titanium 1997
Navel Ring 4 x 3.5 x 4"
Silicon Rubber and ABS Plastic 1995

Muriel Magenta • New York City, NY
Token City • Video - 3-D animation

Christine McPhee • Kansas City MO
Ring of Fire Punta Variations II
41 x 29" digital chine colle monotype 1996
Ring of Fire Punta Variations XX(?)
41 x 29" digital chine colle monotype 1996

Pat Swain • New York City NY
Sacrificial Pear • 8 x 8.9" Iris Print 1997
Evolved Pea • 8 x 8.9" Iris Print 1997

Bill Tinker • New York City, NY
A Journey to Krun • 24 x 36" digital collage 1997

Ronaldo Kiel • Brooklyn, NY
Cityshore • Video
(Manhattans crowded loneliness) 1995 - 97

Ann Phelan • Elicott City MD
Shoe Reliquary II/VII • scanned assemblage
Veronica Becoming St.V. IV/XII • computer painting C-print

Steve Berkowitz • New York, NY
"Artifact / Reflection Series, Violet Bridge",

Valerie Burke • Streamwood, IL
Reflections While Flying over the Yukon
Nest' • 6.5 x7.5" Ink Jet Print 1997
16 x20" Shadow box construction 1997

Mark Carroll Nashville TN
Holocene Sky Earth Ai r• interactive CD

Leslie Farber • Demarest NJ
Early Indoctrination
30 x 29" Computer image transfer to
fabric, dye, paint and pastel
Fragility
32 x 40" Computer image transfer to
fabric, dye, paint and pastel

Richard Helmick • Columbia MD
Trees 29 x 26" digital pen plotter drawing 1997
Woman at a Window 18 x 35" digital pen plotter drawing 1997

Tom Krepcio • Charlotte NC
Quotation #2 Blake • 14 x 18" painted leaded glass 1996
Three Figures • 16.25 x 9" multilayer leaded glass 1994

Guy Marsden • Oakland CA
Digital Numeric Relevator
2 sculptures acrylic and electronics 1997

Jeannie Pearce • Wynnewood PA
Rope • 16 x 20" Iris Print 1996
Mask • 16 x 20" Iris Print 1996

George Thompson • Overland Park, Kansas
Electronic Alchemy • Interactive Internet art work 1997

Elona Van Gent • Grand Rapids MI
Reap What You Sow • 18 x 56 x 56" Copper and Bronze 1997
Pistil • 42 x 26 x 18" Aluminum and Copper 1997

Harvey Goldman • Westport MA
My Toes Is • 16 x 20" Iris Print 1997
Foot • 16 x 20" Iris Print 1997

Saturday, November 8th STEARNS AUDITORIUM

9:30 - 10:15

CLASSICAL ART MEETS MODERN DAY DEADLINES

Kevin Gallup • *gallup@vt.edu* • *http://www.odu.edu/~instadv/*

Kevin will discuss the process of building a lion sculpture for Old Dominion University. The lion was first digitized using a 3d digitizer then the lion was manipulated on the computer. The armature was built using autocad to plot out sections of the lion as a wire frame model. The next step was to spray foam on the armature which then was sculpted to get the fine details, molds were made then wax copies then the bronze. The lion is 10 ft long and about 6 ft tall at the main. The use of the computer enabled Kevin to do this in less than 3 months. This is the school icon for Old Dominion University.

***Kevin Gallup**, currently adjunct faculty at Old Dominion University, recently set up a ceramic shell bronze casting foundry at ODU, and is exploring new techniques in casting, especially with CAD & 3D Digitizing.*

10:15 - 11

THE THEATER OF THE BRAIN

Rob Fisher • *Glenunion@aol.com*

What would it be like to be inside the brain as it processes information? What would we learn by observing firsthand how the brain functions? What if we could for a few moments play at being a brain, each of us taking the part of individual neurons, working together to solve problems? Such is the novel approach of a new project entitled "Tracking the Human Brain" which will transform science center planetariums into new learning environments. The new planetarium show will combine immersive and interactive techniques to create a "theater of the brain". Above the audience on the planetarium dome will be projected a giant image of the brain with pulsating neurons that correspond to the seating arrangement of the audience. The most innovative aspect of the show casts each audience member in the role of a neuron. Using the interactive system, the audience must work together to solve a variety of entertaining problems and tasks and in the process will learn how the brain functions.

***Rob Fisher**, Senior Research Artist, Carnegie Mellon University produces large-scale Environmental Sculpture, and is pre-eminent among computer sculptors.*

11 - 11:45

SCULPTURAL FORM & SPACE AND BOOLEAN ALGEBRA

Timothy Duffield • *timd@netaxs.com*

English mathematician and logician, George Boole suggested that logic is mathematics restricted to the two quantities, 0 and 1. The sculptor's form and space can be seen as Boolean values: form and not-form, space and not-space, 1 and 0, true and false. This presentation will examine the potential for a software, on screen contribution to the creation of cast sculpture. For this contribution actually to result in a tangible object, computer controlled machinery has to come into play. This aspect will be referred to, but not examined in depth. The presentation will be, in the main, a theoretical exploration of potential.

***Timothy Duffield** has completed large public sculpture commissions in Pennsylvania, New York, New Jersey, Connecticut, Georgia, Nebraska, Delaware and Louisiana. Most recently, he has begun to experiment with the computer control of sculpture manufacturing processes, in particular, the cutting of granite. He is one of the co-founders of the Computers and Sculpture Forum of the International Sculpture Center and he publishes a newsletter, The Platform, for sculptors who use the computer.*

11:45 - 12:30

A MULTIMEDIA PRESENTATION ON MIXING DIGITAL AND TRADITIONAL MEDIA.

Jeff Otto • *jeffotto@tcnj.edu*

A College of New Jersey FIRSL summer stipend awarded to Jeff Otto for the proposal, "Altars and Icons -Virtual and Reality". The award funded 3 weeks of travel in Germany, Switzerland, Italy and France, where altars, tombs and other architectural devices were sketched and photographed. This was the source for a new body of artwork, 12 visuals to be presented in the fall of 1997. These are the works and experiences of an artist/musician who combines computers, computer graphics with traditional techniques and materials as his chosen media since 1985. The artwork will be presented in a multimedia presentation that showcases the 12 new works as well as additional experimental abstract images and an original musical composition created with Jean-Claude Moussaly of the University of Geneva's MIRAlab facility during a visit to Jean Mounir's chalet for a meeting with Swiss 3D artist Stephen Leger.

***Jeff Otto** is a Professor of Computer Graphics and Coorinator of the Computer Graphics Area at The College of New Jersey (formerly Trenton State College). He's also is a member of a coop gallery and freelance digital illustrator. The visual arts are not his only creative outlet. A self-taught musician, Jeff has been playing guitar for 30 years. For the past 18 years he has been composing music, both traditionally and digitally. He has logged over a dozen sessions at Red Rock Recording in Saylorsburg, PA with engineer producer Kent Heckman. His fine art can be seen in the Artists' Gallery, Lambertville, NJ and select shows at the Silicon Gallery in Philadelphia, PA.*

*12:30 - 1:30 **LUNCH TIME***

1:30 - 2:15

GRAMMATRON: HYPERTEXT FICTION ON THE WEB

MARK AMERIKA • *www.grammatron.com*

Grammatron is an intricate matrix of 1,000 screens of text that have been woven together with 1,700 links, sometimes accompanied by animated graphics or an original soundtrack and is freely accessible on the Web.
A truncated version of journalist Mirapaul's description of the plot:

Golam embarks on a journey to the city of Prague-23 to reconnect with a former lover, Cynthia Kitchen, who now is an employee of a huge corporation that is striving to control the market for "it" all. Or maybe not. Prague-23 is revealed to be a simulated city, created by the application Prog-23. Or, maybe not.

***MARK AMERIKA** author of* The Kafka Chronicles *and* Sexual Blood, *founder and publisher of* Alt-X *has participated in:*
Ars Electronica 1997International Biennial of Film+Architecture 1997
ISEA 1997M.I.T. Media Lab "Portraits In Cyberspace" 1995

2:15 - 3

ARTISTIC COLLABORATIVE AND EDUCATIONAL POSSIBILITIES USING INTERACTIVE MULTIMEDIA-DANCE

A. William Smith • *smith.1952@osu.edu*

Dr. Smith has created software that allows a user to simulate a dance performance in the virtual space of the computer environment. The user controls the choices of stage color, cyclorama color, backdrop painting or foreground set, rear-projection video, sound, and most importantly—the number of dancers, their placement on stage, their size, and their dance phrases. In short, the computer user customizes the aesthetic experience to match her or his needs at the moment. Because he's facile in the various arts of dance, music, and painting, he has provided enough samples in a prototype for there to be more combinations than 2.57 times ten to the sixteenth power. This is appropriate in a world of individual freedom and choice. The prototype entitled *Natural Trips* was premiered at the Arts and Technology conference at New London in Winter '97 and an updated version shown internationally at DanceOn '97 (Hong Kong) in the summer. He will show how various artists can use the IM-D software to see their work in new ways and to allow virtual collaboration. With this collaboration, a computer user can create a unique "program" where the appropriate credits are listed for contributors of the various media. Hence, one person at one part of the globe could have created the dance; another, the music; another, the backdrop; and so forth, and the user can experience a new fusion of creativity.

***A. William Smith, PhD**, Ohio State University*

3 - 3:45 *Panel: New Computer Music For The Millenium: Cinema For The Ears*

MINUTE VARIATIONS

Lawrence Fritts • *lawrence-fritts@uiowa.edu*

Minute Variations is based on a one-minute spoken text by Chris Mann. After its opening statement in its original form, material from this theme undergoes four one-minute variations. In the first three variations of the theme, both overt and minute variations of pitch and timbre is accompanied by ever more dramatic transformations that turn the voice into a quasi-percussion ensemble. During the third variation, these percussion sounds are gradually transformed back into speech sounds that percussively accompany a voice that is beginning to learn how to sing. The fourth variation consists only of the singing voice, as soloist, then choir.

***Lawrence Fritts** is Director of the Electronic Music Studios and Assistant Professor of Composition at The University of Iowa. He received his Ph.D. in Composition from The University of Chicago, where he studied with Shulamit Ran, Ralph Shapey, and John Eaton. His electronic works have been performed and broadcast in the US and Europe. His writings on music and mathematics appear in Music Theory Spectrum and Abstracts of the American Mathematical Society.*

FAMILY STORIES, Part I

Laurie Hollander • *laurie@silvertone.princeton.edu*

Family Stories is part of a newly burgeoning genre in computer music which some call *Cinema of the Ear.* In this work, the spoken word serves as both narration and the genesis of many musical sounds in the piece along with high associative ambient and found sounds. Fragments of ethnic music - klezmer and early blues - serve as iconic memories, locating the piece in history and place - pre-WWI Atlanta, site of the mother's birth, the death of her mother and the lynching of a Jewish man and countless African-Americans.

Written by Anna Rubin ***Anna Rubin & Laurie Hollander, co-composers***

3:45 - 4:30

LISA: USING MOTION SENSING AND REALTIME SOUND SAMPLING SYSTEMS IN PERFORMANCE.

Richard Povall. • *Richard.Povall@oberlin.edu website: http://timara.con.oberlin.edu/~RPovall/RPHome.html*

This presentation profiles a remarkable piece of software recently developed at STEIM in Amsterdam. LiSa is a realtime audio sampling system utilizing the native audio processing capabilities of the Power Macintosh to capture, replay, and process multiple channels of digital audio in realtime. The system gives the composer/performer tremendous power in a realtime domain, and provides an extraordinary pallette based on realtime input or from pre-recorded sound sources. Difficult to tame, LiSa can be the performer's dream - and his/her worst nightmare. This presentation also profiles my use of LiSa in conjunction with a realtime motion sensing system also developed at STEIM.

***Richard Povall** is a composer, video artist, and educator, currently Assoc. Prof. of Music, and Chair of TIMARA at the Oberlin Conservatory of Music (USA) and a Visiting Researcher at the University of Plymouth (UK). From 1992-94 he was Research Fellow in New Performance Media at Dartington College of Arts in England. From 1990 - 1994 he was on the faculty of the iEAR Studios at Rensselaer Polytechnic Institute. Povall has been involved in computers and music for almost 20 years, and with video for more than 10 years. His recent work concentrates on small-scale and solo work using a variety of interactive devices, and on the creation of experimental interactive environments. His work is shown widely, and distributed through Frog Peak Music (www.sover.net/~fpeak).*

4:30 - 5:15

LYRRUS'S G-VOX GUITAR 101 INTERACTIVE CD-ROM

Bill Purse • *MaestroBP@aol.com*

Have you ever wanted to learn to play the guitar? Incredible graphics and exciting onscreen video put you in the interactive classroom of the future. Learn the right way to sit, hold the guitar, strike the strings and more. The Guitar 101 sampler includes the internationally acclaimed G-VOX Riffs software so you can practice exercises and follow along on the computer screen, note by note, fret by fret.

***Bill Purse**, 7 year consultant for G-VOX, is Chair of the Music Technology Department at Duquesne University, and has studied privately with Joe Negri, Vic Juris, Howard Massey (FM Synthesis), and Pat Martino. Purse received an EDUCOM grant for study with Dr. Carol Lennox in the area of multi-media development in 1990. He was instrumental in the development of two new majors at Duquesne University; Music Technology and Sound Recording Technology. As the author of Bach Chorales for Guitar (Mel Bay Publications), and The Duquesne University Guitar Method (Lyrrus/G-Vox), Bill has pioneered the utilization of interactive CD-ROM, MIDI files, hard disk recording, and music score publication. He has specialized in developing an accelerated course for mastering music notation software, The Finale Primer (Miller Freeman Publications). Purse has integrated Macintosh music technology software into all areas of his classroom and private teaching at Duquesne University.*

SCAN '97
Saturday Evening Performances

Stearns Auditorium 8 pm - 10 pm

The Appalling Steve Berkowitz, Master of Ceremonies

Dan Trueman & Curtis Bahn
Improvisation

For the last couple of years as neighbors, we have hauled racks of equipment back and forth regularly to play, frequently asking other musicians to join us. In our improvisations, we try to create interesting musical environments and then have conversations there, inviting others in to listen. When we perform, we prefer to start before anyone arrives and to finish after they leave. Our performance interfaces combine musical notation, mixing of composed sounds on disk, control of external MIDI devices, and interactive compositional structures. Our improvisation tonight reflects the current arrangement of our gadget-filled "living room.

Curtis Bahn *received his BA from Indiana University where he studied improvisation with David Baker, and string-bass with Stuart Sankey and Edgar Meyer. Recently finishing his Ph.D. in music composition at Princeton University with Paul Lansky, Paul Koonce and Steve Mackey, Curtis is now Professor of computer music performance and composition in the Integrated Electronic Arts program at Rensselaer Polytechnic (iEAR).*

Dan Trueman *(dan@music.princeton.edu), plays electric violin and composes. He has studied classical violin with Irene Lawton, jazz with Pat Harbison, and the Norwegian hardanger fiddle with Loretta Kelley and Hauk Buen. His interests in computer music include interface/instrument design for performance and composition, and signal processing. He studied physics at Carleton College, composition at the College-Conservatory of Music in Cincinnati with Brad Garton and Allen Sapp, and is now a doctoral candidate in composition at Princeton University where he works with Paul Lansky and Steve Mackey.*

Zack Browning, Composer Gabriel Kastelle, Violinist
Sole Injection

Sole Injection for amplified violin and computer-generated tape was written during the summer of 1996 and commissioned by Carbondale Community Arts for performance at Arts in Celebration '96. This composition is the fifth in a series of works by the composer which uses the magic square of the sun as a compositional model. A magic square consists of a series of numbers arranged so that the sum of each row, column, and diagonal is the same amount. Eleven different routes through the square (the middle nine each having a duration of 55.5 seconds) are mapped onto a musical structure based upon the magic square. The unique position of each number within the square is paralleled in the score by a particular musical style, rhythm, density, and orchestration. The musical energy created by this structure is designed to produce a physical as well as aural experience for the listener. The tape was produced using GACSS (Genetic Algorithms in Composition and Sound Synthesis) which is an original computer music software package developed by Benjamin Grosser.

Genetic Algorithms in Composition and Sound Synthesis (GACSS)
GACSS utilizes a Genetic Algorithm (GA), a search procedure patterned after the workings of natural genetics (survival of the fittest), as a control structure for sound synthesis and compositional parameters.

Zack Browning *(zbrownin@uiuc.edu)is a Professor of Music Composition and Theory at the University of Illinois. He received his Doctorate from the University of Illinois. Active as a composer, conductor, and performer, Browning has played trumpet with the Atlanta Symphony Orchestra and served as co-director of the Atlanta New Music Ensemble. He was Visiting Artist for the North Carolina Arts Council. He has received grants from Meet The Composer, National Endowment for the Arts, ASCAP, and the Georgia, Illinois and North Carolina Arts Councils. His composition* In Time *received first prize in the Arts '96 Midwest Composers Competition and Honorable Mention in the International New Music Composers Competition. Recently Mr. Browning was awarded an Arnold 0. Beckman Research Award from the University of Illinois for his work in computer music composition.*

Aergo ~ Bill & Lynn Purse

The Faculty Plugs In

"Music and its emotion cannot exist in computer chips but can only be found in the expression and creativity of the human heart."
(updated Confucian proverb).

Bill and Lynn Purse, (MaestroBP@aol.com), founding members of Aergo, have recorded and performed with electronic instruments throughout the planet. They bring their philosophy of IMOM (In Music Out Music) to their electronic performances and seek to create music that is both artistically expressive and emotionally satisfying. They will present both their music and their approach to electronic performance in a concert that will utilize a laptop computer, sampling/looping devices, physical modeling, and a wide variety of MIDI controllers for keyboard, guitar, wind, voice and percussion.

***Bill Purse** (see G-VOX, presentation, Sat urday afternoon)*
***Lynn Purse** is a faculty member in Music Synthesis at Duquesne University, where she manages the Music Technology Labs and directs Paradigm, an electronic performance ensemble that she founded. Ms. Purse is an active performer and recording artist, and specializes in electronic keyboards, wind controller, and voice.. Performing as a keyboardist with Mother Mallard, one of the world's first synthesizer ensembles, she has appeared in concerts in New York at Lincoln Center, Town Hall, London's Barbican Center and the Tivoli Concert Hall in Copenhagen., and recorded on the Mother Mallard CD "The Continuing Story of Counterpoint, Parts 1-4 + 8". The author of "Exploring Sound, Creating Music: A Guide for Young Composers", Ms. Purse is also a composer and arranger for the Carden Keyboard Method Series where she specializes in writing for electronic keyboard ensembles; her keyboard ensemble compositions are performed regularly in concert programs throughout the country.*

Burton Beerman
composer, electric clarinet
electric indian flute

Celesta Haraszti
choreographer, dancer

Ancient Castles
Primal Landscapes
Meditations

ANCIENT CASTLES uses 2-3 laser beams as a three-dimensional trigger environment in which the dancer can control computer music events. The output of the laser beam is placed into a notebook computer via a MIDI cable. Once in this medium, the movement of the dancer is integrated into a C program with music sound and effects modules. As she moves within the laser space, she sends continually changing data to the C program, which responds with an appropriate musical gesture. In addition, she will be wearing a BODY GLOVE with sensors distributed around the body, on arms, legs and the torso, recording her movements and steering digitized images of the dancer and surround her, creating a virtual interactive stage set.
PRIMAL LANDSCAPES for electric Indian flute and computer generated samples.
MEDITATIONS for electric clarinet, dancer, and interactive computer. The computer-generated sounds interactively follow the lead of the electric clarinet.

***Burton Beerman**, (bbeerma@opie.bgsu.edu) Composer/ Clarinetist/ Video Artist, Burton Beerman, is amongst the pioneers of electroa - coustic composition; straddling both worlds of acoustic and electronic music and is particularly recognized for the graceful integration of both worlds. His compositions have been widely performed by chamber ensembles, orchestras and soloists throughout the United States, Europe, Australia, Mexico and Japan. The video opera version of this large work was selected as one of twenty works to be featured in a series of European video concerts in 1997 initiated in Switzerland and Rome endorsed by UNESCO.*
***Celesta Haraszti**, began her dance training in Budapest, Hungary and later received her Master of Fine Arts in Dance/Choreography from the University of Utah. She has been acknowledged as "one of the leading soloists of the avante-garde dance world..." by the Cleveland Plain Dealer. Having firmly established herself as an undaunted collaborator with many internationally-known composers and directors of multimedia productions, she has performed and created over 40 works. Since 1982 she has toured as a member of the Electric Arts Duo ensemble performing throughout the United States, Canada, and Europe. In 1994, Celesta established the VIRTUAL MEDIA FOUNDATION, a non-profit organization to encourage the development of artistic works that concern themselves with humanistic social issues that are consciousness raising.*

Sunday, November 9th Musser Choices Forum

10 - 10:45

COMPUTER AIDED DESIGN FOR HANDMADE SCULPTURE

Rod McCormick

Rod McCormick designs his work using a venerable Mac IIsi computer. His works involves creating forms with 3D modeling prigrmans and unfolding them into flat patterns for welded and hammered sheet metal. He will show slides of his work and work process, and will talk about available software including Form Z, Vellum 3D, AutoCad for the Macintosh, and Touch 3D.

Rod McCormick, *Sculptor, Metalsmith, Chair Crafts Dept., UArts, Phila, PA transforms perforated sheet metal used for speaker covers on boom boxes and other screening into sculptures with radiant moiré patterns created by overlapping, perforated sheets.*

10:45 - 11:30

CREATING DIGITAL SCULPTURE

Bruce Wands • *BRUCEWANDS@aol.com* **Peter Terezakis** • *petert@interport.net*

This presentation will describe the process of creating physical sculptures from digital files. By using the software ARTCAM, one can take a digital image, convert it into a gray scale file and then have a computer controlled milling machine carve the sculpture out of wood, wax or plastic. The process will be described from concept to finished sculpture. In addition to reviewing the software and the hardware used, the aesthetic issues of this artform will also be discussed

Bruce Wandsis *Chair of the Computer Art Department, School of Visual Arts, NYC, NY.*
Peter Terezakis *is an Instructor of Electrical Engineering for Artists, Digital Sculpture, and Advanced Computer Systems, School of Visual Arts, NY C, NY*

11:30 - 12:15

PROJECTS

Robert Michael Smith • *Website for the International Sculpture Center* • *http://www.sculpture.org*

First on-line sculpture class including slides of CAD/CAM sculpture works produced by 17 students throught the U.S. including one from Canada.

Multimedia VRML experimental projects

Multimedia CD-E projects

Virtual sculptures projected into room without computer monitor. I will also submit one of these new virtual sculpture projections to the SCAN Computer Art Exhibition at Silicon Gallery.

Robert Michael Smith *is a sculptor and 3D Computer Artist. He currently teaches at the Sculpture Center, New School for Social Research, and Pratt Institute in New York City. Smith is an active member of artweb, the largest website for art exhibitions, resources and research projects of new media for the Web. He is also very active with the Computers and Sculpture Forum, and the International Sculpture Center. His sculptures have been exhibited extensively in the U.S. and abroad.*

12 :15- 1:30 ***LUNCH TIME***

1:30 - 2:30

VIDEO OPERA *JESUS' DAUGHTER*

Burton Beerman, Celesta Haraszti • *beerma@opie.bgsu.edu*

The video opera JESUS' DAUGHTER is a video adaptation of an original intermedia opera-ballet with real-time virtual reality video and musical environments that integrated computer technology, theater, dance, electroacoustic music and virtual "hyper-instruments." This work in both its video and real-time performance versions links art with a critical social issue of our time, violence against women and children, universally exploring the themes of denial, trust, betrayal and perceptions of truth.

In the real-time version, a Virtual Dancer is created through motion capture and computer animation using the Amiga platform software MANDALA. The movements of the dancer sends gates and triggers that control computer music modules and projected video animations. Considering the story's subtext, the Virtual Dancer navigates through the confused state of her mind and this collage of visual ideas is projected onto five large, white sails constructed of special super absorbent fabric that also evolve and change into abstract shapes by slowly pulling on the battens.

The Virtual orchestra is composed of multiple computer music modules and the electric clarinet, which functions as conductor for this symphony of computer music modules and large vocal samples. The single live vocalist is not only complimented by the large vocal samples, but also both the singer and dancer sometimes use a rhythmic, rap-like singing style, resulting in a driving, energetic contrapuntal texture, giving mesmerizing vocal quartets and duets of live and computer generated vocal voices.

Burton Beerman: *Composer Librettist, Video Artist, And Producer* • ***Celesta Haraszti:*** *Dancer/Choreographer*
Tina Bunce: *Mezzo-Soprano* • ***Paul Lopez:*** *Camera And Digital Editing*

2:30 - 3:15

americAmiracle: CREATION OF AN ENHANCED CD

Tom Porett • *tporett@netaxs.com* • *WWW Site Specific Art Work - theBeautiful: http://www.op.net/~tporett*

The two most common forms of compact disk formats are the audio CD and the computer based CD ROM, but there exists a hybrid form that contains both conventional audio tracks and has an additional capability of holding interactive digital multimedia content.

"americAmiracle" is a personal art project that makes use of this cross media/cross platform format. In my talk I will describe the conceptual development of the piece as well as the technical steps used to create the Enhanced CD format.

From the conceptual standpoint the piece is a compacted retrospective of work that combine several multi-image pieces that date back to the late 1960's and on through the 1990's with digital multimedia forms. The audio only portion of the disc contains 15 tracks culled from original electronic compositions that were part several multimedia pieces. The interactive element of the CD consists of still images that have been combined into Quicktime movies that are selected through a basic menu.

The content of the works stem from my lifelong concern with the politics, cultural spectrum and fashion of the USA in the later part of the 20th century.

Tom Porett *is Director of Electronic Media, The University of the Arts, Philadelphia and sits on the Board of Directors, Small Computers in the Arts Network. His work has been exhibited at the Painted Bride Art Center, Philadelphia; Institute of Contemporary Art, Philadelphia; ARTIFICES, Paris; Digital Image - Digital Photography, Dallas; SIGGRAPH Art Show, 1982, '83, '85, '86, '87, '91; Fashion Institute of Technology, NY; IBM Gallery, NY; Electra Exhibition, Musée d'Art Moderne, Paris; PIXIM, Paris. Tom received the Guggenheim Fellowship - Photography 1971, UArts Venture Fund Grants (4)*

3:15 - 4

DIGITAL PRINTS OF DECAYING FLORA

Steven Berkowitz • *berk3@mail.idt.edu*

The installation piece*Decay 12/30* is composed of two large scale arrays of digital inkjet prints and has been placed in the Digital Gallery in the lobby of WHYY NPR Radio / PBS Television in Philadelphia. This is in conjunction with the American Theater Music Festival hosting the Virtual Reality performance by Jaron Lanier.

The piece is a comparative study of the initial and subsequent conditions of flowers as they decay, displayed as two arrays of large scale digital prints. The idea of death and regeneration is a central theme. The two definitions of the word artifact - as a change in structure caused by death, and change in appearance caused by processing - are incorporated in the piece through the choice of subject and the use of technology to create the images.

An additional piece from the *Artifact / Reflection Series* is on display at Silicon Gallery and investigates similar topics in a different format.

***Steven Berkowitz** is an Assistant Professor at Temple University / Tyler School of Art where he teaches photography, digital imaging, and design. He began the computer art curriculum there in 1983 after having developed basic image processing on mainframes and minicomputers through the 70"s. He now has his own company Lateral Imaging Digital Studios based in New York City.*

Decay 12/30 *is on display in the Digital Gallery in the lobby of WHYY NPR Radio / PBS Television in Philadelphia in con - junction with the American Theater Music Festival hosting the Virtual Reality performance by Jaron Lanier.*

CLOSING COMMENTS

Dick Moberg

END OF CONFERENCE

SCAN '97

SCAN 97

The 17th Annual Symposium on Small Computers in the Arts
November 7-9, 1997

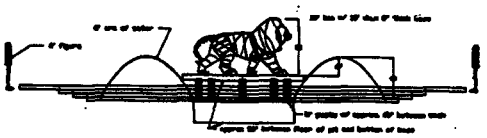
PAPERS

The Franklin Institute Science Museum
Philadelphia, Pennsylvania

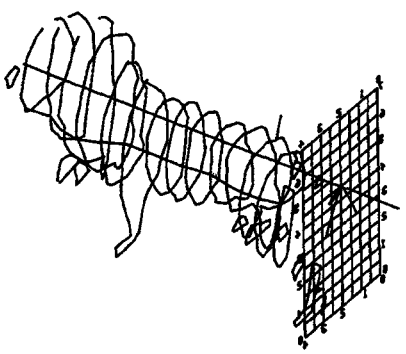
Classical Art Meets Modern Day Deadlines

Kevin Gallup
Old Dominion University Adjunct Faculty
Ronni Glaser
MFA Candidate, Old Dominion University

The challenges facing today's artists are far more complex than those found just a few years ago. Today's artist must be a businessperson. Artists must know how to market and promote themselves. They must be able to bill accurately, budget and give estimates. The small computer has become a valuable tool in facing these challenges. We have programs to help us budget, keep records, and even bill our clients. The Internet has opened up a new world of marketing and promotion to us. In business we are more efficient then ever before. However out of old challenges new challenges arise.



The world is moving faster. Artists can no longer afford the luxury of working at their own pace. Commissions that were once completed in a deadline of years are now expected in a matter of months. Why is this happening? There are of course numerous reasons. Technology has increased the pace of business. Information moves faster and this in turn increases productivity. One example of this concerning artists today are federal buildings. One percent of all budgets for federal buildings must go toward public art, by law. Buildings that once took upwards of three years to complete now take anywhere from six months to one year. Today's artist must keep up! More and more who can attain a commission will depend on one thing at that is, who can get the job done on time and within the budget given. We as artists must learn to define ourselves with two words, Flexible Accumulation. The more flexible we are the more we will accumulate. The question is how do we do this without compromising our work? How does today's artist create "classical" art in a compressed time period? The answer is, by adapting how we create that art. By looking at and dissecting the steps it takes to create art we can see where technology will aid us.



Take for instance "traditional" sculpture on a monumental scale. These types of commissions are known to take years to complete. How many of us have read about artists spending months on small details? This gives us the impression that it is the modeling that takes the most time. This however is not true. Often the months it takes working

out little details are due largely to errors made before modeling ever takes place. It is the armature that takes the most time and it is the armature that must be the most accurate. This is where the computer will allow for flexibility. By generating our armature on computer we can be accurate in one quarter the time that traditional methods would take. An example of this utilization was recently demonstrated at Old Dominion University. Five artists with diverse backgrounds in sculpture were selected to create a twice life sized representation of the University's mascot, a lion or monarch, as it is called, in cast bronze. The commission was originally slated to begin work in April of '97. Between April and August bureaucratic processes delayed production. These included twice changing the actual size of the sculpture. The second size change occurred after the armature had actually been partially constructed. Had the artists been using traditional methods, this sort of change would have meant starting from scratch. The recovery time would have put the commission months behind schedule. By using certain 3D digitizing techniques on the computer we were able to make the required modifications in one day.

Full-scale production began the first week of August. The University had scheduled the sculpture to be unveiled October 17th during a weekend of on-campus events. This left the group only two and a half months to complete the sculpture, which measured over six feet in height and ten feet in length. Because of the time saved building an accurate armature, the group was able to pool individual skills and proceed with no further delays. Traditional modeling techniques were employed to create the expression and over all appearance of the animal. As modeling was completed we began pulling molds for the casting process. With only three weeks until the unveiling the group split itself into two shifts, working around the clock up to the very moment in which the University took the sculpture to it's pedestal to be dedicated. As rigorous as this may seem it is only a matter of time before this sort of compressed deadline becomes the status quo. Flexible Accumulation is the way in which we as artists must continue to meet such challenges head on because technology and the rest of the world we live in won't stop there. In the end the business world is a mirror image of the natural world. Adapt or become extinct.

Special thanks to Michael Hughes, Tod Anderson, Nora White, and Steve Marder who worked incredible hours just because it was a really cool project.

Computer Aided Design for Handmade Sculpture

Rod McCormick

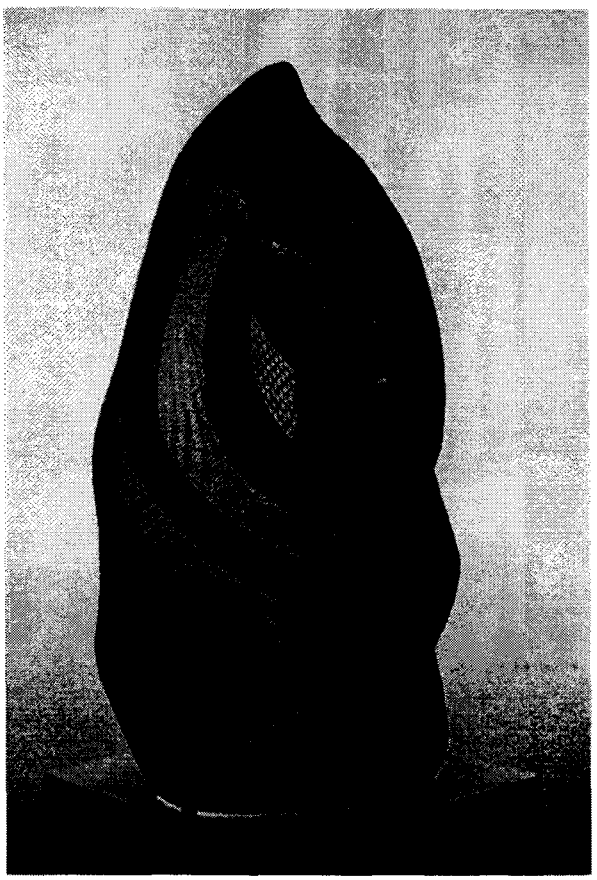


figure 1 *Infundibulum,* 1996, steel, paint, electrical components, quartz-halogen bulb, 36" x 20" x 18". This sculpture by the author was designed in form•Z and executed from patterns created by form•Z's unfold tool.

I work in welded and hammered sheet metal. Using 3D modeling programs, I create forms and unfold them into flat patterns. I print the patterns out full size by tiling them to an inexpensive printer, my Personal LaserWriter LS. I tape the 8 1/2" x 11" pages together and cut out the patterns. I am then ready to trace the patterns onto metal and take the digital model into the real world. For the advanced computer user, this paper may offer some ideas about low-cost alternatives to expensive methods of rapid proto-typing such as stereo lithography or output to a computer-controlled milling machine. For the neophyte, I can share my experience with working on a limited budget. I will gloss over certain basic terms and concepts; I recommend that a beginner acquire an inexpensive piece of 3D software and play around with it and work through the tutorial.

I am something of a Luddite. The majority of my studio time is spent with tools and processes which pre-date the Industrial Revolution. The fact that I am presenting at a computer conference is perhaps the sounding of a death knell for organizations like SCAN. If computers continue to become more and more ubiquitous, then the idea of a society focused on computers will become more and more absurd. Before the age of two, my daughter could turn on the computer and access her software. Her pre-Kindergarten classroom had two Pentium-processor multimedia computers. For her, computers are nothing special, just part of her environment and one tool among many. Now six years old, she much prefers crayons, markers, scissors, and paste for her art-making. Do you use a PDA (personal digital assistant), or are you content with a Daytimer calendar book and little pads of paper?

If computers are affordable, easy to learn/use, and either save me time or expand my capabilities, then they are of interest to me as an individual making sculpture. By my criteria

I got involved a bit prematurely. I also teach, however, and I owe it to my students to maintain some level of computer literacy. I teach metalsmithing in the Crafts Department at the University of the Arts here in Philadelphia. The school is heavily invested in computers, but the students who choose to major in Crafts seldom have much computer experience or interest. But that is changing, and almost certainly my daughters' generation will take computers for granted. I'll still be teaching when my daughters are college age, so I've chosen to get on the technology treadmill in the hope that doing so will help me to maintain my relevance.

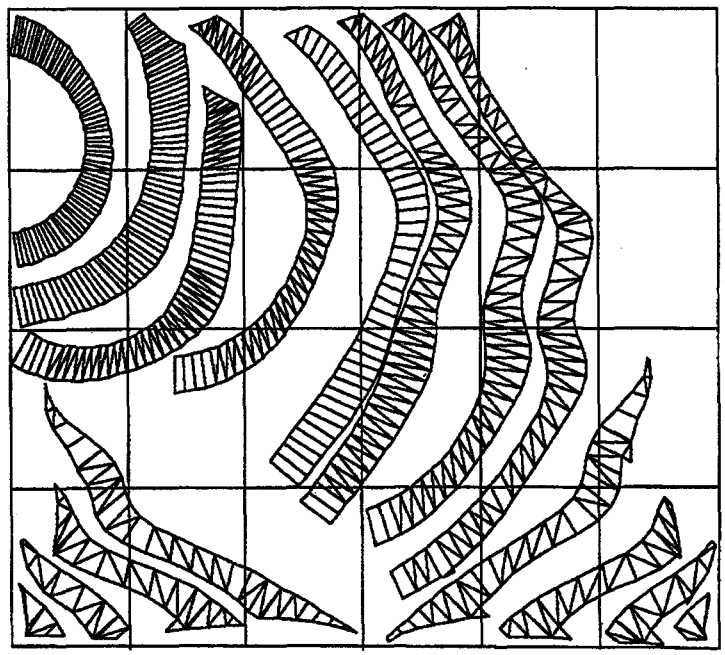


figure 2 A group of patterns for *Infundibulum*. The 8 1/2" x 11" grid shows the patterns arranged for printing to an inexpensive printer.

Flat Patterns for Sheet Metal Work

There is a long history of generating flat patterns for sheet metal work. There methods for creating patterns for cones, truncated cones, cones and cylinders cut at oblique angles, intersecting cylinders, domes, "lathed" or revolved forms, etc. Picture a steam locomotive or walk around Philadelphia looking at the upper parts of old churches and other buildings. I found myself spending days developing patterns with graph paper and a pocket calculator. (True to my non-early adopter tendencies, I didn't buy a pocket calculator when they first came out and cost $300, I waited until a bank gave me one for free.) At SCAN and International Sculpture Center conferences I was intrigued to see what some sculptors were able to do with computer workstations which cost as much as a house. It was obvious that the technology to aid my work process existed, and it seemed likely that the right hardware and software would someday exist and be within my financial reach. As I waited for technological trickle-down, I started reading computer magazines and pumping for information any techies I happened across.

The Search for Capable Software

In the Fall of 1991 I bought my first computer, a Macintosh IIsi. The first software programs I bought were Claris CAD (a 2D CAD program) and Silicon Beach Super 3D™. Super 3D™ was later bought by Aldus; both programs are now extinct. I liked them. Craftspeople have a great love for the obsolete but still useful. Super 3D™ was a capable enough modeler; I was able to create forms which I wanted to build in real life. Though Super 3D™ lacked the exact features which I needed to get information to build, I found that there were ways to creatively abuse the software. Super 3D™ lacked a cross-section tool. I found that by setting the camera depth of field to zero I could move a flat plane of vision through a form and see what in effect was an approximate cross-section. Using the mouse I could draw 2D cross-sections by tracing the screen image. By exporting the 2D cross-sections as pict files to Claris CAD, I could print them out. Claris CAD had a feature which divided up (or "tiled") a full size drawing to be printed out on 8 1/2" x 11" pages. My printer will handle 67 lb. cover stock if I hand feed the sheets, so I can get a template durable enough for shop use. I bent 1/8" wire to match the templates. By spacing my cross-sections every 4" I was able to prop

the cross-sections on my welding table and bend wire to connect the cross-sections. Other possibilities would be to cut the cross-sections out of thicker material (foam, plywood, etc.) and stack them. I found that a combination of commands would allow me to unfold a form. "Ungroup" broke a form up into individual facets. I could select an individual polygon and copy it to the clipboard. I could then change working planes and by using "command + option + P" paste the polygon (minus its 3D location information) into the work plane. By pasting all of the polygons flat into the same working plane, I could assemble flat patterns and export them to Claris CAD. Unfortunately, this method proved to be rather rough; segments which should have been identical in length wound up different. One segment might measure 4" and a matching segment 4.25". For me, this was too much of a gap to fill in with welding. At this point I chose to give up on Super 3D™, so I don't know if the inaccuracies were due to Super 3D™ itself, exporting as a pict, or both. I suspect that it was the pict format which lacked accuracy; both programs I was using lacked any other usable import/export capabilities. It is possible that by using a graphic translator such as Kandu Software's CADMOVER® I could have gotten useful information out of Super 3D™ into a CAD program. My point in detailing this history is that software which at first glance does not appear to offer the features you desire may still yield results once you become familiar with the program. I figured out these methods by reading the manual several times, and by trial and error. In contrast, I spoke with an experienced user, one who had been a beta tester for Super 3D™, and he was not able to provide me with a method to achieve an unfolded pattern. Even the simplest program is complicated enough that users will become truly facile only with those features which are relevant to their own work. I found it was up to me to ferret out those obscure methods which I needed. Super 3D™ also had some interesting features. It had an animation feature which you could set up to automatically make a movie by repeatedly rotating the view a certain number of degrees on any or all axes. It would take a couple of hours to make the movie, but you could then see the form you'd created spin or tumble about in real time. For understanding a 3D form within the 2D computer screen, this was a real boon, and it compensated for the computer's lack of speed and processing power. Though the form wasn't rotated "live", for my purposes it was effectively rotated in real time.

2D CAD for 3D Forms

For a series of symmetrical revolved or "lathed" forms, I found that a 2D CAD program was sufficient. I'll describe my work process. My purpose is to describe a situation where 2D CAD is an aid for 3D work, thus I'll describe my methods only briefly and without illustrations. The method is straightforward. Let's say that I have drawn the side view of an onion-shaped dome. Let's say that I divide the line depicting the profile into twenty 1/2" segments. Thus I'll have a curved line ten inches long with twenty vertices. If I draw horizontal lines from each vertex across the shape from right profile to left profile, I will have twenty parallel lines. If I imagine the dome as being made up of twenty stacked circles, then each of those parallel lines will correspond to the diameter of a circle. p times the diameter gives the circumference of a circle. Lets say that I want to divide the surface into a number of sections, say eight (picture the seams on a beach ball or cutting up an orange into sections). I can measure each diameter, and put the measures into a spreadsheet to multiply the diameters by p and then divide them by eight. In the 2D CAD program I can draw a straight vertical line ten inches long. From my spreadsheet results I create 20 horizontal lines. At half inch increments, I center my lines in order along the vertical line. By drawing a line along the endpoints of the horizontal lines connect-the-dots fashion, I create the outline of a flat pattern. If I cut out eight of these patterns and join them edge to edge I will have my dome. There are books covering layout and calculation of flat patterns for sheet metal work, and using the computer for drafting and spreadsheet calculation is a time saver.

Again, I stress appropriate technology — simple means may be the most cost effective ones.

Two Currently vailable High End 3D Modelers

For irregular or complex forms, I still needed a 3D modeler. I purchased AutoCAD Release 12 for the Macintosh. As a teacher, I could purchase an academic version for $200. At that price, I could put up with the awkward interface and the steep learning curve. Autodesk has not upgraded AutoCAD for the Mac to keep up with the Windows version, but the Mac version of release 12 is still available. AutoCAD can explode a form into separate polygons. To build a flat pattern, I use its align tool. First I draw a square in a convenient working plane. I then select the polygons or facets one by one, moving them into alignment with the drawn square. Once the facets are all in one plane, I assemble them into groups and I have my flat patterns to print out. With AutoCAD you can do almost anything if you have the patience. It is possible to create a script to put together a slide show similar to Super 3D™'s movie-animation feature. There is third-party software for unfolding forms for sheet metal fabrication . This software is DOS or Windows, and is intended for ventilation ductwork, etc. The cost of purchasing new equipment as well as the fear that the software would be too technical or inflexible kept me from looking into those options.

The software with the reputation of being the premier 3D modeler for the Mac is Autodessys' form•Z. It is priced at $1,495, and even with a hefty academic discount its cost was still intimidating to me. An evaluation version was available for $149 (with the software good for 30 days and the $149 applied to purchase of the full version if purchased before the expiration date). I took the plunge and form•Z is now my modeler of choice. It has many capabilities, and its complexity does give it a steep learning curve, but it is much easier to learn and use than AutoCAD. Running it on the same computer as I used for Super 3D™, I was amazed at how comparatively peppy it was. At the time I had 5 MB of RAM and form•Z ran quite well with that restricted amount. In comparison, AutoCAD's advanced solids modeling tools wouldn't run at all with that amount of RAM. The manual and tutorial for form•Z are excellent. The tutorial has one turn on form•Z's tools one by one, so one gets used to the bewildering array of options gradually. And form•Z has an unfold tool! You select the unfold tool, mouse click on an object to unfold and almost instantly you have a flat pattern. For a complex form unfolding gives you quite a mess, polygons connected every which way and separate polygons scattered about. (When unfolding, form•Z will not overlap the polygons. Convex areas will unfold without overlaps, but concave areas cannot. form•Z places the problematic polygons to the side.) For complex forms, the best practice is to first divide the form up into manageable sections. The instantaneous nature of the unfolding is a bit disorienting. It is hard to tell what matches up with what. Manually unfolding the AutoCAD models was laborious, but I understood the patterns. I find that with form•Z that I must color-code groups of polygons so that I can tell front from back and what lines up with what; and the color coding itself is laborious. form•Z will also automatically include tabs which can be helpful in assembling a physical model.

Using the Programs

As a sculptor, I find that I relate to the modeling programs almost as if they are physical materials. They have different characteristics, and they respond in different ways to my attempts to manipulate forms. Just as pushing around a lump of clay can help me develop and refine an idea, pushing the pixels around affects my thinking. Of particular interest to me are times when results are unexpected. Pushing a piece of clay around, you don't get

anything that is very far from your intentions. Using and combining some of the powerful modeling features, you can make a mistake and come up with something quite bizarre, but perfectly detailed and consistent. I came to the computer with rather pedestrian aims, to be able to better design and manufacture sheet metal forms. But the forms themselves are different from what I would otherwise have made. These programs can be a source of inspiration.

Using Additional 3D Software with Crafts Students

Having had some success in using a computer in my own work, I requested a computer to use with my students in the jewelry/metalsmithing studio. I was able to get a Power Macintosh 7200/80, budget priced but adequate for my purposes. I use this computer one-on-one with my students or for impromptu sessions during class. As students don't have access to this computer outside of class time, we purchased some software available in other school computer labs. Vellum 3D is a useful piece of software with many good features. Made by Ashlar, Inc., the same people who developed Claris CAD, it is intuitive and easy to use. It has a modest set of 3D tools, and it lacks the capability to display any kind of shading. Being limited to wireframe views, Vellum 3D is harder to visualize with. The models you create are made of lines placed in 3D space. You thus lack any sense of surface; you create forms but its as if you could put your hand right through them. For some requirements, Vellum 3D would be ideal. If you are a woodworker and you need to do top, front, side, and perspective views and measured shop drawings for a piece of furniture, Vellum would do the job very well. In form•Z drafting features are in a drafting environment separate from the modeling environment. Though the two form•Z environments are totally compatible, one must export objects from one environment to the other. For projects where one needs to dimension lines and angles, Vellum is tough to beat. I have not found a way to unfold flat patterns in Vellum; since the program does not create surfaces I suspect there is just no straightforward way to do that. Ashlar has promised Vellum Solids, an add-on module to Vellum, so the kind of features I am interested in may be part of Vellum in the future.

Also for my school computer I've bought a piece of software which is inexpensive and exciting. It is Microspot's 3D World™. It is fast, and extremely easy to use. The current version costs $149. I use it to introduce students to 3D modeling concepts. It is based on Apple's QuickDraw 3D and 3DMF (3D metafile format) and runs only on a Power Mac. Even on an inexpensive machine, one can rotate a shaded object and see it move in real time. To have a student play around with it without getting bogged down is useful; they can get a sense of what is possible and quickly pick up some general skills. It would also be good as a visualization tool, a quick way to rough out forms or troll for ideas. It might also be worthwhile to create models in other programs and import them into 3D World™ to move them around and see what they look like. It has recently been upgraded to version 2.5 and is complimented by Designer, a package of plug-ins. If new features such as Boolean Functions, dimensioning, DXF import/export, and vertex editing are up to the standards of the previous version, then 3D World™ might well satisfy someone looking for one simple, totally functional program.

An application which looks promising is Touch-3D by Lundstrom Design of Stockholm, Sweden. Touch-3D's main feature is an unfold tool for 3D models. It also includes an idiosyncratic but capable set of modeling tools. I've downloaded a demo version from the firm's web site, and based on a quick perusing, I like the software very much. It is exactly the kind of software I had hoped for but had concluded was way too nichey to ever exist. I imported a model from form•Z in DXF format. The model imported without a hitch and Touch-3D unfolded it successfully. In Touch-3D one has more control over the unfolding

process, so it might be especially useful for very complex models. For those with simple modeling needs or those who want to avoid a long learning curve, Touch-3D would fill the bill. At $395 it is affordable. Touch-3D would also combine nicely with a simple program such as 3D World™.

Hardware Recommendations

I do not need a photo-realistically rendered picture of my 3D models. For my purposes I create a sketchy digital maquette. As long as I can understand the form, a quick rendering is sufficient. It is the pretty pictures which require the processing muscle and memory. I am still content with my first computer, the Mac IIsi. I've added a FPU (floating point unit) math co-processor, a card which costs around $100 or $200. When memory prices came way down, I replaced RAM and now have 17MB. I don't spend a lot of time in front of the computer, so the slow machine doesn't frustrate me. When the computer takes three minutes to process a command, I compare it to sitting down for three hours with graph paper and a calculator, so the machine still seems fast to me. I also like to show a profit at the end of the year, so I weigh hardware purchases against other uses of the money. My TIG welder cost a couple of thousand dollars. A new welder costs about the same and has the same if not identical capabilities. My computer equipment cost me thousands of dollars and is now worth a few hundred and is a doorstop compared to the capabilities of a new machine. With software at least you can maintain your investment by purchasing the upgrade. My advice is to spend the most on the components which depreciate the slowest. If I were purchasing today, I would first set a budget. I would then select first software, then a 17 inch monitor, 32 or 64MB of RAM, and a printer. I would tally up the costs and see if I had anything left for a new or used computer. To economize, I would first buy less RAM (making sure that I could add more RAM in the future without throwing away the initial RAM). After that I would settle for a 15 inch monitor. A big monitor is much nicer to work with. If you later purchase a second monitor, both can be hooked up at the same time. You could devote one monitor totally to the modeling environment, and use the smaller monitor for prompt windows or other purposes. This doesn't mean that I don't lust after new equipment. A recent review of form•Z reports that a hardware accelerator, Newer Technology Inc.'s RenderPIX PCI/500, allowed the reviewer to use form•Z's implicit surfaces feature to sculpt a face while viewing a shaded rendering.[1] Right now I can't afford to invest in so much new hardware. When I do it will be for the ability to better visualize within the 3D environment represented in the 2D computer screen. I've heard plenty of people lament that they bought a new computer just a little too soon. I've never heard anyone brag that they bought just before prices dropped or new technology was introduced.

Conclusion

With the current availability of hardware and software, computer aided sculpture is within the reach of individuals with modest resources. Almost everyone should be able to find something to fit their needs and budget.

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[1] Sean Wagstaff, *form•Z RenderZone: Model of 3-D excellence,* MacWEEK, 05.05.97, Volume 11, Number 18.

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2011 Riverside Drive
Columbus, Ohio 43221
TEL: (614) 488-8838
www.formZ.com

3D World™
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The Mixing of Digital and Traditional Media and The "Altars and Icons - Virtual and Reality" Project.

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Introduction

In the beginning as a painter and illustrator, at first working in pen and ink (for architectural renderings), then in rubylith film (for screen printing), I used specific mediums for specific reasons. The first eight years of my professional art life were spent working this way. In the early 80's I was creating stage props and graphics for multimedia presentations in the days before Persuasion and Director, where the mixing of traditional media was almost a necessity. I was also making good old fashion slide shows with audio cassette tape soundtracks, mixed and faded live during the presentations. These sales meeting extravaganzas for clients Ryder Truck Rental and Consolidated Freightways were truly multi and mixed media events and sparked my interest towards mixing more than just the visual art media. Then in early 1986 I started to mix media, airbrush acrylics with INTs and ruling pens for magazine illustrations. This mixing opened my eyes to new possibilities in the studio. In 1986 when I started working in computer graphics I realized the opportunities digital media offered to the creative process, alterations in work and even the delivery of art to the client. At that time in Philadelphia not many art directors were using computers, let alone computer graphic illustrators. Most reactions to my portfolio had more to do with media than the actual portfolio content. Output was also a problem, art directors found that using computer graphics also complicated the production process. Color output was limited, 4x5 transparencies were really about the only option for quality output. I continued to work in traditional media while looking for ways to give art directors what they wanted while giving them what I wanted.

Traditional and Digital Visual Art

While earning my MFA at Marywood University I would create a body of work that would be my new portfolio, creating digital paintings and mixed media pieces that might walk the line between fine art and illustration. My hopes were to create computer graphics that might be acceptable to both galleries and art directors. Over a four year period I alternated and mixed traditional and digital media, experimenting, scanning drawings and photographs, tracing drawings on my digitizing tablet, using video frame grabs as underpaintings then taken to image processing programs. I would output to b/w dot matrix and laser printers on drawing or watercolor paper. I would color traditionally with color pencils , acrylics and watercolors. As digital output improved I would also try new printing techniques and media. The following are ways that I have found to work successfully when

mixing traditional and digital media. It is my intention to share these techniques so that others can experiment and perhaps find some missing links to their own investigations.

Dot matrix print on watercolor paper with watercolor washes

With the help of a pair of pliers, a Panasonic KX1080i can be enabled to accept 90lb watercolor paper, Strathmore 1 ply rag bristol and an assortment of drawing papers. Unfortunately after custom alterations the printer may never be the same. Paper has to be hand held through the entire print cycle which can take up to 20 minutes for a 9x12" sheet. Not every print turns out to be usable, some may streak, some may miss a line. Some dot matrix prints are able to withstand waterbased media without washing out or running. The print should rest for a few hours, then soaked in water for a few minutes and stretched on a board with gummed packing tape, as is traditionally done for stretching watercolor paper. Watercolor and color pencil can now be added.. The dot matrix under print gives a geometric crosshatch type of appearance. This works well with a looser drawing style and painting technique. These should be framed under glass.

The Planet Drum series were based on drawings made at a performance of Mickey Hart's (Grateful Dead percussionist) Planet Drum tour at the Keswick Theater in Glenside, PA. These drawings done at the show, were traced on a digitizing tablet. Some textural and compositional additions were made, then printed on a dot matrix printer and painted with watercolors and color pencils. The works in the series are portraits of Zakir Hussain, Babatunde Olatunje, a kneeling Mickey Hart, a seated drummer and a hand drummer.

Zoomer prints and with waterbased paint mediums

The Zoomer printer, carbon based toner copier can be used for larger output up to 18 x 24". The major drawback is the streaking that sometimes occurs in the art, similar to the problems of the dot matrix printer, a number of prints may be needed before a usable print is achieved. Rice paper, pastel paper, rag bristol and drawing paper can be used with the Zoomer printer. The rice paper and the drawing paper usually gives the most consistent prints. Watercolors and acrylics work well when the print is stretched. Color pencils worked well on paper with a slight tooth. Aquaelle pencils can be worked with a wet brush. Caution should be taken not burnish too hard with the pencil as the halftone toner dots can be rubbed off of the paper. For a presentation without glass, 4-5 layers of Crystal Clear acrylic spray should follow, then finish with a brushed on coat of polyurethane.

The Loistone Altar, An African Altar and The Queen Alyssa Altar are all from my first body of work dealing the theme of altars and icons. All starts with photographs of models that were worked in Photoshop and Painter softwares. Paint, found objects and gold leaf adorn the prints mounted on sculptures constructed from old furniture wood and found objects.

Color prints with acrylic glazes and antique finishes

Digital color output in the 80's and early 90's was horribly fugitive. Early Howtek wax thermal prints faded so fast they could be considered performance pieces. By coating with crystal clear spray first (up to 10 light coats) acrylic glazes can be added to these prints Unfortunately the prints will still fade. The Tektronix Phaser thermal prints prove a bit

more successful. Prints can be sprayed with crystal clear acrylic spray and Blair marker fixative. The latter for its UV protection. Large scale bubble jet prints can be sprayed and sealed with polyurethane and acrylic mediums. These will accept glazes of acrylics for an aged look if properly sealed. To age further, 3D sculptures using old wood and furniture pieces can be created to frame or encase the prints. Iris prints and Fiery prints are the best color output for this technique. before my very eyes. It is of the utmost importance to seal Iris and ink jet prints well when working with water base media. A minimum of 4-5 coats of acrylic clear spray is necessary before any water base medium is applied.

Crackle finishes are an excellent way to add an aged look to prints. The lesser expensive finishes found in many craft stores work to an extent, unfortunately the cracks can be of grand canyon proportion. By the time they are aged with raw umber or sienna oil paints, the cracks can look like a giraffe's pattern covering the work. Oil based varnish applied directly to unsealed works can stain and deteriorate the paper. Somewhat successful is an oilbased varnish spray applied to an Iris, ink jet or fiery print after acrylic clear spray is applied. Then a coat of water base polyurethane can be brushed on with a soft brush. When dried this produces small spider web type cracks. Another option for crackle finishes is a 50% hide glue/50% water solution applied by brush over a acrylic clear spray first coat. Then when dry (but still slightly tacky) a water base polyurethane coat is applied with a soft wash brush. The thinner the second coat, the finer the cracks. Getting the thin coat is the trick. A sable wash brush is good but can be thick depending on climate conditions. The hide glue/ polyurethane sometimes works better when applied with an airbrush. A respirator mask should be worn to avoid the inhaling of spray particles. It is important not to spray any of the coatings in the same room as a computer and should be done with plenty of ventilation. Paint Magic, a more expensive 2 part finish gives a consistency in crack depth and width, while maintaining random qualities in crack direction. When dried this is rubbed with raw umber oil paint and buffed off. After setting a few days it is sealed with an oil based varnish. If care is taken this method does not affect the print. It is sealed with an oil based varnish. The result is good with all the advantages of digital media plus the added surface textures of a traditional medium. Prints can be glued or mounted to sculptures or boards using acrylic medium as the adhesive and first top coat seal. Print output such as the Fiery print, the Zoomer print and the laser print should be on a quality paper such as Strathmore acid free drawing paper or a 100% cotton or rag charcoal paper.

Altars and Icons Virtual and Reality. Based on photographs taken on location in Germany, Switzerland, Italy and France, this new body of work is an extension of those early altars. Funded by a FIRSL award from The College of New Jersey. Three weeks were spent traveling and studying altars in cathedral and churches, ruins and architectural devices. The combination of high tech and low tech, digital and traditional media allow me to explore the latest in computer graphic technology while staying in touch with the media that started it all.

Traditional and Digital Music

I have been combining digital and traditional in the music studio since the mid 80's. As a self taught musician for over 30 years, I have played in bands, worked solo and created studio pieces. It was these studio pieces that leaned me toward digital music as a way to add something extra to my traditional based music. Drum machines and synthesizers accompanied my acoustic and electric guitars. An early version of "Take a Holiday" was recorded using a guitar, bass Linn Drum machine and a $50 Casio keyboard direct lined into the mixing board. Digital effects were added yet it still sounded like a $50 Casio, but this opened my mind to new possibilities. In 1990 I looked at my music again, then at my mixed

media art, then back at my music and realized that I needed to blend (like my visual art) my musical media better. "Howling at the Moon" would be the starting point. A digital drum was used in the studio as basic rhythm tracks were laid down. A rough mix was made and a tape was taken home to other musicians to jam along with. Later a conga player was brought in to play with the digital drum. The machine quality was gone, at least to my ears. Digital effects and synthesized sounds were also added. The sound of a band with minimal players and total control. A number of projects followed. My latest project has taken this further. The digital music would be on the rhythm side, but now by programming the drums and assigning different sounds to the different rhythms, I was adding instruments not available to me in the traditional world. After rehearsing with the Blue Monks, the band of musicians I play with on a weekly basis, we went into Red Rock Recording, a state of the art digital recording studio. I would lay down the rhythm guitar along with a drum program. Then the band would all play along with that as a guide. Congas, bongos, triangle, agogo, guitars, bass and vocals. The feel of a live band was present and it was the digital music that held it together allowing room for improvisation over the steady beat. The songs were digitally edited and mixed down to a CD-R.

The presentation for SCAN'97 is the first time I have combined my art and music into one project on the computer. It is the starting point for projects to come.

"Altars and Icons - Virtual and Reality"

In the spring of 1996 The College of New Jersey (where I am a professor and coordinator of the computer graphics program) presented me with a FIRSL award for my proposal titled "Altars and Icons - Virtual and Reality". The award funded 3 weeks of travel in Germany, Switzerland, Italy and France, where I studied, sketched and photographed, altars, tombs and other architectural devices. These would be the source for a new body of artwork, 12 pieces to be presented in the fall of 1997. While in Switzerland I met with Jean-Claude Moussaly, an SGI research assistant at the University of Geneva's MIRAlab computer graphics facility. Moussaly and myself have collaborated in the past on both visual and musical artistic projects. Portions of this arrangement were recorded (on location sitting on a picnic table about 500 meters downhill from a glacier) on a walkman tape deck. The finished version was recorded with my band, the Blue Monks at Red Rock Recording.

The 12 works are finished, some as prints, some as mixed media assemblages. The works are presented in a multimedia presentation that showcases the 12 works as well as additional experimental abstract images and the original musical composition, "If the Saints Let You In".

from DIGITAL BEING:
THE VIRTUAL ARTIST IN CYBERSPACE

Mark Amerika

SURF-SAMPLE-MANIPULATE, PSEUDO-AUTOBIOGRAPHY, WORK-IN-PROGRESS...

"Now, as art becomes less art, it takes on philosophy's early role as critique of life. As a result of this movement out of art and back into everyday life, art itself becomes integrated into the workings of everyday life by situating itself in corporations, universities, governments and the vast electrosphere that houses the pluralistic cultures they thrive on. So it's now possible to reject the print-centric, paternal paradigm of a distanced, objectifying, linear and perspectival vision. In the age of network cultures, the eye touches rather than sees. It immerses itself in the tactile sense it feels when caught in the heat of the meaning-making process. This meaning-making process, which manifests itself as kind of electronic media event one is responsible for having created themselves as a result of having become a cyborg-narrator or avatar-presence in the simulated worlds of cyberspace, is actually part of a greater desire to become part of a socio-cultural mosaic."

Or so says Abe Golam[2], who, having moved around the various immersive environments created by the GRAMMATRON[3] program, eventually finds himself entering the sim-city called Prague-23.

Prague-23, one of the main locations for the story to take place in, is loosely modeled after various dream-cities pursued by artists like Walter Benjamin, Franz Kafka, Arno Schmidt, Federico Fellini, Jean-Luc Godard, Italo Calvino, James Joyce and the "psychogeographical" foundations of Situationism. Most of the screens that the navigator encounters when moving through Prague-23 are made up of sampled data from an unspecified number of cross-disciplinary sources. This occurs as a result of having employed an ongoing creative principle I've practiced in my novels called "surf-sample-

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[2] Golam continues: "This desire to pull from, yet reintegrate into, the cultural mosaic of life is religious in orientation but once again presents itself as narratological discourse. Its self-reflective writing strategy crosses a dangerous border, the place where "I" explodes into I. This new I, the role played by femininity as a utopian gesture toward the readymade, is capable of sprouting monstrous erections of difference that when dressed in the oil of promiscuity, enable the new I to obliterate that initial desire into something like essence. But this essence is cleverly concealed inside a body of work that refuses to submit to the spiritual subversion that takes place within my organically-grown system.

"I am everyone. God is the Devil.

"The I doesn't speak for the egotistical me. It is the subject of my madness, my obsession with putting out fires. With dispossessing the natural."

[3] GRAMMATRON 1.0, located at www.grammatron.com, was released on the World Wide Web on June 26, 1997.

manipulate". This "surf-sample-manipulate" practice, when broken down to its root meaning, is really nothing more than the latest manifestation of the Modernist desire to mix the elements from "the real world" with contemporary phenomena materializing in "the art world" -- a desire Modernism pursued by bringing the art of collage into its formal mix of aesthetic devices.

Whereas collage itself has been around since we've been able to historicize art in culture, the technique was first used as a radical formal device in painting by the cubists. Picasso and Braque, looking to move beyond the problems presented by analytic cubism, were hoping to challenge the illusionistic preference of all painterly art coming out at the beginning of the century and so began incorporating found objects into their paintings.[4] As mentioned earlier, it was shortly after cubism came into art's historical current that Marinetti, Duchamp and Schwitters, to name a few, all began appropriating objects from the material world in order to better explore *the idea* of painting in the modern world. Eventually these ideas, which were part of an overall shift in 20th century art to move the subject matter of art away from nature and into the culture itself, flourished in the post-Pollack work of artists like Robert Rauschenberg whose "combines" took us into a categorical no-man's-land where ontological chaos and the seductive application of pop-culture imagery and brand-name identity onto the fetishized art-object, subtly pointed toward the move beyond material postmodernism and the eventual entry of the (virtual) Avant-Pop.[5]

But as all valuable tools and formal innovations eventually risk losing their potential liberatory power by getting absorbed into a cultural tide that insists on the continual proliferation of new consumer-friendly processes, so the art of collage, which reached its apex in material postmodernism, must also now look for alternative spaces to exhibit its radical recombinations of anti-aesthetic drift. Whereas the use of extra-material from the detritus of everyday life has become almost commonplace in the garage-sale poetics of the contemporary art world, the ability to convert much of our contemporary cultural work into easily manipualble binary code, sets up a new environment from which to engender new contexts of meaning and, if possible, create para-media constructs that assault the banal production values inherent in mainstream culture.

The GRAMMATRON strategy of "surf-sample-manipulate" (i.e., to surf the net, sample data and then change that data to meet the specific needs of the narrative) works on two fronts: one, the so-called "creative content," that is, the text, images, music, and graphics are many times sampled from other sources and digitally-manipulated so that they become "original" constructions that are immediately exported into the storyworld as supplementary data and, two: the so-called "source code" itself is many times appropriated from other designs floating around the Net and eventually integrated into the screen's behind-the-scenes compositional structure. The great thing about the Net is that if you see

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[4] For a very readable account of the use of collage by the cubists and its interconnectness with Eisenstein's introduction of the practice of montage and how, toward the latter part of this century, literary critics have begun employing both collage and montage as formal devices to better present their critical theories, see Gregory Ulmer's "The Object of Post-Criticism" in The Anti-Aesthetic (Port Townsend: Bay Press, 1983), p. 83-110.

[5] For an extensive survey of the Avant-Pop cultural phenomenon and how it inmixes both the avant-garde art and writing practices of the beginning of 20th Century with the digital pop culture that permeates our contemporary culture, go to the Alt-X Online Publishing Network (www.altx.com), an artist-run network that I founded in 1993.

something you like, whether that be "content" or "source code,"[6] many times you can just download the entire document and manipulate it to your needs. I see this as first an anti-aesthetic gesture, similar to the one Duchamp showed us with his Readymades, but I also see it as what Derrida might call a "signature-effect" that brands the ephemeral creator's imprint on the "material" "at hand" (the "bytes" "at hand"). In Hypertextual Consciousness[7], I refer to this process as a kind of pseudo-autobiographical becoming, that is, a process by which the cyborg-narrator, teleporting themselves into cyberspace and accessing various fragments of everyday digital life, begins selecting whatever data they wish to download into their operating systems only to then filter it through a personalized collage-methodology that essentially does what it will with the data, integrating its binary code into their ongoing ungoing narrative discourse which, masquerading itself as a "work-in-progress," continually experiments with its ability to "manipulate" symbolic space in ways that will purge the narrator of any conventional portrayal of "subjectivity" and, instead, render into vision the object-oriented matrix of cultural tendencies now developing as a result of the convergence of technology and (anti-)aesthetic practice.

Moving beyond conventional "subjectivity" while immersing oneself in the sim-city of Prague-23 is what Abe Golam's ultimate adventure is all about. From the moment he enters Prague-23, this playful manipulation of who he and the other people actually *are* in these unfolding "scenes of writing" becomes one of the main themes floating throughout the narrative. One of the entry points into Prague-23 reads:

> Golam adjusted the VR socket cables and shifted his body inside the coffin-like teleportation unit ready to discharge himself into the vast realm of the electrosphere and its immersive chaos.

and by clicking on "the coffin-like teleportation unit" the navigator is sent to this next screen:

> Once the data was entered into the interiorized console, Golam issued the connect-command and just as he was being teleported out of his home-studio into the nether regions of pseudo-Utopia, he thought he heard Cynthia's voice say
>
> *Have a nice trip Abe and I'll see you at the border...*

Her intrusion at this instant of teleportation immediately introduces the possibility of her now controlling the story and the shift into what becomes a more immersive narrative space (still all words and graphics) that will take the "reader" through various arcades, rooms, hallways, sexual circuitry and dream-sequences. It's a world that the present day Web can only approximate either via textual development[8] or basic 3-D object-manipulation[9].

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6 It wouldn't be entirely suspect to suggest that "content" and "source code" are one and the same thing, since as far as the Web goes, one cannot simply exist without the other.

7 Hypertextual Consciousness, Mark Amerika, www.altx.com/hyperx.html

8 As a fictional construct, GRAMMATRON, besides aligning itself with the avant-garde lineage of writers like Rimbaud, Lautreamont, Apollinaire, Henry Miller, Artuad, Burroughs, and the Postmodernists mentioned earlier, is a textual literalization of some of the "virtual worlds" forecast by writers like William Gibson and Neal Stephenson, both of whose fictional universes have served as "idea-engines" helping power the development of both "cyberspace" and the "metaverse." In GRAMMATRON this cyberversification sustains itself in what Golam calls "the electrosphere," which is already used in the mainstream culture, most notably as one of the

Golam, who is now being ushered through Prague-23 by the avatar-guide called Ms. A, is soon enveloped by a variety of textually-transmitted, multi-sensory experiences:

> The city moved like a cognitive abstraction devised by some hip, chaos-bound physicist with an artist's eye for program design. There was an aura of mysticism that filled the atmosphere. Golam had the feeling that he was surrounded by sexual algorithms that communicated with the pulsation inside his pants.

Soon he is lead into a series of arcades full of rooms with names like PROLIFERATION, BLOODRUSH and SUCKY FLESH. The rooms are filled with psychotropic media constructs whose avatars can instantaneously become sensual, aggressive, interactive and critical:

> One man, who stood out from the others since he was older and dressed in a conventional grey suit draped with a large overcoat, came up to Golam and smiled at him as if they had been best friends all their lives. Golam thought he looked familiar but the peripheral data that circulated on the strange man's digital margins was fuzzy, as if he were about to dematerialize into one of the countless invisible avatars.

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section headings to *Wired* magazine (who Gibson and Stephenson are both contributing writers of). My own narrative fixations rely more on the same kind of language games and metafictional strategies employed by the avant-garde postmodernists of the 60s and 70s and less on the conventional formulations of plot and characterization associated with the sci-fi/cyberpunk genres (unfortunately this is not the place to discuss how I see most of the writing coming out of the sci-fi/c-p genre as further encouraging the routinization of our present-day thinking about the implications of the new technology despite their avowed "anti-corporate" themes). Nonetheless, there can be no question that it was writers like Gibson, Stephenson, Pat Cadigan, John Shirley and Bruce Sterling who first saw value in integrating the evolution of network culture into their stories and that they are still actively using the textual universe to try and imagine what a more immersive, 3-D story-environment might be like (for an informative "recap" of some of the earlier achievements of the cyberpunk phenomenon in the 1980's, see Larry McCaffery's *Storming The Reality Studio: A Casebook For Postmodern Science Fiction* (Duke University Press: 1991).

9 Prague-23 can be read as a narrative script outlining one possible strategy for developing a more immersive virtual reality story-environment. Unfortunately, clicking on words or graphics so as to shift through the fictionally-portrayed electrosphere in P-23 relies on the WIMP (windows, icons, menus, and pointing device) GUI (graphical user interface). Even GRAMMATRON's opening "Interfacing" section, which I've stated is an experiment in creating a new narrative inter-face (between the user and the program), still relies on WIMP GUIs. What's really needed to take GRAMMATRON into its next phase of development is what you might call a Post-WIMP GUI. Whereas the "user-friendly" point-and-click environment of most hypertext is fine for graphically-enhanced textual universes, if we really want to create more dynamic, sensual spaces like some of the ones described in the Prague-23 section of GRAMMATRON, then we need to move beyond the WIMP interfaces we are stuck with today and which are still an intermediary between what the navigator wants to do and how they can do it (for a very concise summation of the current state of (post)WIMP GUI developments, see Andries Van Dam's "Post-WIMP User Interfaces" in *Communications of the ACM*, February 1997, p. 63-67).

A more fluid narrative environment requires something more elaborate than 2D widgets like frames, hotlinked words and animated icons. And yet recent developments in advanced 3-D software created especially for the network, though ambitious and at times exciting, hardly provide for the kind of voice-recognition, fully realizeable, teledildonic, virtual sex experiences outlined in parts of the Prague-23 section of GRAMMATRON.

Here the navigator can take two routes, either clicking on "One man" or "invisible avatars". By clicking on "invisible avatars" we get:

> The man's presence reminded Golam that avatar-invisibility was popular among a certain sect of reality hackers that referred to themselves as The Tribe of Not There. They had created a program that essentially made their presence felt but unaccounted for. Some estimates had put this estranged silent majority of anti-imagists in the millions. Golam himself had tried to become an anti-imagist by way of an active voluntary simplicity that would also keep him out of the magnetic-like pull of the electrosphere and its total dependency on digicash paracurrencies -- but this part of his life was short-lived and once he met Cynthia, her energy and devotion to being a part of the so-called Real World kept him tuned to the daily grinder.

And so he/you-too, caught in the so-called Real World of electrospherical currencies, have to choose again between a forking path and, by choosing to click on "Golam himself has tried to become an anti-imagist," bring up the following screen:

> By becoming an anti-imagist, Golam was moving away from the graven image of himself as persona non-grata to a new form of independency he called persona non-gravitas. He devised a way to levitate his thoughts into a meditational state that would become attached to the living nature that surrounded him. Floating in the heavens of his creative imagination, beyond even the final moment of his life on an Earth already shredded in atmospheric apocalpyse, Golam would contemplate his role in the world and the more he focused his thought on himself, the more he vanished, the more he disappeared. But the battle over God was more than a disappearing act. And his survival, rigged by the electrosphere's digicash synchronicty with all creation, forced him to dream of greater specatacles.

If we click on "to dream of greater spectacles" we get:

> Ms. A grabbed hold of Golam's avatar and shuttled it down the boulevard past word junkies, complex memory digressions, and variegations of preprogrammed riverrun thoughts seeping out of static figures whose idle time had automatically closed their connections.

Depending on where you click, you may find yourself in foreign film speaking only the sub-titles or, if you're not careful, being bodily absorbed by a pack a raving tongues with endless strands of soft hair growing out of them. As Ms. A, your/Golam's guide is there to constantly remind you:

> "Please, don't give in too fast. You need to be more in control when you enter the city. You need to be able to resist these simple temptations. There are so many programmed sexdroids out there you'll lose yourself in an instant. It can happen that fast. They are waiting to eat you alive."

And by clicking on "[t[hey're waiting to eat you alive" you find out that:

> "I understand your urges Golam. I have them myself. They're programmed. Written in. What you have to worry about is what's written out. Your surge is worth something. And the last thing you need is to get infected by some sexdroid virus ready to corrupt your hard-earned data."

Eventually the navigator is routed through many fluid environments that together compose the sim-city Prague-23. There is The Sector, The Jewish Ghetto, The Halls of Cyberspace

Development, long journeys into the emptiness of a black night. But is there a plot? At one point Cynthia's avatar-Other, says to Golam:

> "Once they have access to **Nanoscript**," Ms. A continued, "they can learn to better process their own experience in ways they had never imagined. Some of them would get so caught up in the process that they would start to see their lives going through radical changes. It would be the end of corpo-slave culture and the beginning of a whole new operational mode of being. Digital Being is what you call it, right?"

But who are "they" in this context? Could it be related to the various memos that float throughout the narrative? One of the screens is called "dream memo" and reads:

> MEMO
>
> FROM: PTEDEPE
>
> TO: IN-TELL PROG-23 GROUP
>
> We need to explore the dream-apparatus embedded in **Nanoscript**. Though formal analysis of its potential usage has circulated, it is now clear that no one has successfully integrated the Eternal Mind's transformation into a liveable narrative reality. The only known resource for the development of **Nanoscript** is an avatar who goes by the code-name **Golem**. Once we use our significant resources to absorb Golem's enterprise, we can then hope then to continue developing **Nanoscript** so that we may have universal access to the endopsychic automatism of the group-psyche.
>
> Another reason for us to pursue the eventual acquisition of **Nanoscript** is so that we will be able to guide the GRAMMATRON program's design along profitable directions, and to estimate what resources are both required and justifiable for development. We are the only global concern in a position to do this and as one of the alien agents was recently quoted as saying, "kill their spirit and the rest will follow."
>
> If we don't act immediately, then individual entrepreneurs taking a gamble on **Nanoscript** stand to make a substantial profit and can then use ideas from the vaporstream to develop even greater business plans.
>
> This is crucial to our overall diversification strategy and all participants should have some notion of where they fit into the grand scheme.

Already the entry into Prague-23 shows the hypertext itself to be less "sexy" than GTRON's opening "Interfacing" section (what happened to all of the animated gifs, the streaming audio, the multitude of hyperlinks?), but there are still multiple paths to take, although what is implied by the various tones beginning to evolve in this new space is that each link is now structured with both more value and more narrative potential. In fact, two things happen once the navigator enters Prague-23: first, they will never go back into that initial whirl of hypertext links that immediately followed the "Interfacing" section and introduced them to much of the meta-linguistic vocabulary that drives the narrative's syntactical score, and second, they will never again go to the same screen twice (which is totally possible before entering Prague-23).

This immediately suggests that although the GRAMMATRON narrative has integrated all kinds of hypermedia pyrotechics and complex hypertextual linking structures into its compositional environment, the musicality of the piece's overall movement is actually linear. If one looks closely, they will see that there are four sections to GRAMMATRON: the opening "Interfacing" sequence, the linguistic metafiction of Golam's **Digital Being**, Prague-23, and a fourth, as yet created section called Genesis Rising[10].

And yet the fluidity with which the navigator passes through these various narrative interzones and the multitude of link-options available throughout the navigation, suggests that the narrative experience is actually multi-linear, which it is too. It is both linear *and* multi-linear. All of our reading experience is linear, even that which we may call multi-track or multi-digressionary. True, your routing through the GTRON structure will be different than anyone else's, but in the end, you will have taken a path that can only be called linear. Why is that?

The main reason is because we are still stuck with what you might call lines of code. These lines of code are what drive the writing technology no matter what tools it uses to transmit itself. In fact, GRAMMATRON goes out of its way, through elaborate meta-puns, like the ones associated with **Nanoscript** and **Digital Being**, to show how writing has always played *the* crucial role in that always already "staged production" we call The Evolution of Consciousness. Whether we're writing a book, writing a hypertext, writing code, or just writing everything off, "the bottom line" is that writing itself is the ultimate technology of all, and that no matter what theory of creation you align yourself with, as Golam says, "it's in the script."

The key question then becomes: yes, but who's writing it?

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10 The construction of Genesis Rising in the GRAMMATRON matrix will require state-of-the-art VRML software that enables collaborative "world-building" wherein the narrative becomes not only an active R&D platform for 3-D story development but also attains additional richness by opening itself up to a global social environment. Visitors to Genesis Rising will not only take part in the work-in-progress, their very presence and interaction within the computer-supported, collaborative play environment itself will supplement much of the narrative action the story depends on for its own development *as* storyworld.

A primitive version of this idea existed at Brown University when Tom Meyer imported the historic Hypertext Hotel, a collaborative fiction developed by the students in Robert Coover's experimental hyperfiction workshop starting in 1991, into a WWW-MOO system that not only maintained the integrity of the Hotel's elaborate link structure, but opened up each writing space so that it became "a room" for social interactivity. The actual interface, as Meyer himself notes, was "quite primitive, since the software was designed to work through line-mode telnet" (for a technical description of how Meyer created his networked collaborative hypermedia system, see his "WAXweb: a MOO-based collaborative hypermedia system for WWW" in *Computer Networks and ISDN Systems 28*, 1995).

The plan for Genesis Rising is to both maintain the integrity of the narrative sensibility while evolving more visually rich and fluidly interactive spaces for the various participants to port themselves through.

Artistic, Collaborative, and Educational Possibilities Using Interactive Multimedia-Dance Software

A. William Smith

We live in an age that empowers the individual to express herself or himself. Further, we live in an age where for economic reasons one often needs to specialize. As well, because this age is one where learning is continual because information is constantly being produced and made available, or technology is reflecting or driving change, we often collaborate. These three aspects of society form the context for the software application *Interactive Multimedia-Dance*. *Interactive Multimedia-Dance* allows a computer user to manipulate media that was created by others and is made available in the spirit of collaboration, or the user can input her/his own media if desired.

cultural context: individual freedom resonates everywhere

In this information age, we can access data that formerly was only accessible at a site that we had to physically visit. Now in dance we can purchase CD-ROMs that give us, for instance, the Dance Collection of the New York Public Library at our fingertips (Jourdain 1994). Moreover, the dance world is gaining increasing awareness that information related to dance is available on the internet (Calcari 1997, Edsall 1996, Gallagher 1996, Heilmann 1997, Henry 1994, Williams 1995, Williams 1996). With freedom to own a computer and web software or purchasing power to have someone maintain a site, an individual can even mount performances for web surfers to experience if they wish.

One such performance occurred 8 PM Thursday 4 September 1997 called Sarah Morrison's Leaping Into the NET! A person needed to download software at <www.MorrisonDance.com> without cost before the broadcast. The web performance was to be available in early October at the same address (but at October 11 it was not). The 'live physical' component cost $12 general admission and one had to witness it at the Cleveland Public Theatre at 6415 Detroit Ave. The experience of the dance via a monitor and that within the theatre were different, obviously, but for the latter, one had to be at a designated place at a designated time. For the latter, the individual had to conform to someone else's agenda in order to have the intended aesthetic experience. In both web and live performances, the audiences did not have much, if any, ability to alter the outcome of the event. Both audiences were relatively passive and witnessed a product whose process they did not participate in.

In contrast to a live internet broadcast, Richard Lord maintains a website <http://www.bigroom.co.uk/> where one can view several dances. One has choices of what movies to watch and when to watch them, however one does not have the freedom to affect the aesthetic outcome. The movies composing the dance experience were created days, weeks, or months before viewed, that is, the user's mood may change, but not the artistic product.

Having an opportunity to have an aesthetic experience that facilitates a person's own schedule such a website, CD, or dance software can be seen as positive. It can expose

dance artists to broader audiences, certainly one that is no longer local. Some fear, however, that such situations will negatively affect attendance at live performances (Mattingly 1997). It is too early to tell, and it is clear to see that things change. There was a time when social dancing was popular, but who out there has recently performed a one-step or maxixe that was the rage in the Ragtime Era? Society has changed much during the 20th century.

Another website at Dance Online allows its virtual audience to determine the order and start times of four events meant to be part of a single work, *3E: A Dance for Limited Space and Bandwidth*. The interactive work is composed of four areas, hallway, kitchen, bathroom, and living room. One can click to cause short (estimated 3 seconds) repeating dance clips that are small (estimated100 pixels by 40). *3E* is located at <http://danceonline.com/feat/3e/index1.html>.

Regardless of the ability to interact with a website, so far, a user is limited to the capabilities of media transmitted through tiny wires. This means that movies can't be big or can't be long, frames are dropped, the resolution and amount of colors is limited, and the user is dependent on the amount of internet traffic and other conditions that make such a venue lackluster.

At another website <http://www.art.net/~troika/slasharts.html> the artists define themselves as multidisciplinary e.g. "painter/poet/composer/x and so on." A web surfer can feel part of a ritual of time passing as a new shape appears at the website everyday, one that will be eventually incorporated into a movie that can be downloaded. The expression of movement appearing at <http://www.art.net/~troika/salon.html> suggests that a collaboration is desirable for the realization of these ideas (*Yearbody for Solo Dancer and Internet* [Java required!], Choreography: Dawn Stoppiello, Webography: Mark Coniglio).

That it is generally a team that produces an artistic product in dance is seen everywhere, not just on the web. "Collaboration implies a synthesis of ideas, a synergistic integration of elements, in which the total effect is greater than the sum of the individual effects (C. Smith 1997)." For just about any performance one will find a publicity manager, a costumer, a lighting designer, musicians or a sound manager, choreographers, dancers, and so on. Even CD-ROMs related to dance are often team efforts where various people contribute their skills (Bastien 1996, Feck 1996, Maletic 1996).

With the freedom that we experience, it is natural for that freedom to be translated in dance as new forms of expression. Even in traditional mainstage dance, Jowitt recognized that hybrids have been popular in the 1990s (Jowitt 1995). Moreover, fusions appear in many new dance performances (Kozel 1994, Lomax 1997).

Choreographers using a computer to realize movement ideas is a utilization of the power that machines have given to imagination's freedom. Some artists use devices to bring things outside of the computer into the computer space, such as Schiphorst and the *Flock of Birds* motion capture system (Schibsted 1996). In another application of technology, Bradford applies artificial intelligence within his software for dance creation (Bradford 1995). A new software called *Jack* for human animation is soon to be released (Shapley 1997). Almost everyone is aware that one of the major modern choreographers of the 20th century, Merce Cunningham uses *LifeForms* software in his process of creation (Cunningham 1996, Stenn 1996).

Even dance educators see that interactive multimedia has benefits (Fisher-Stitt 1996, Kane 1996, Manning 1996).

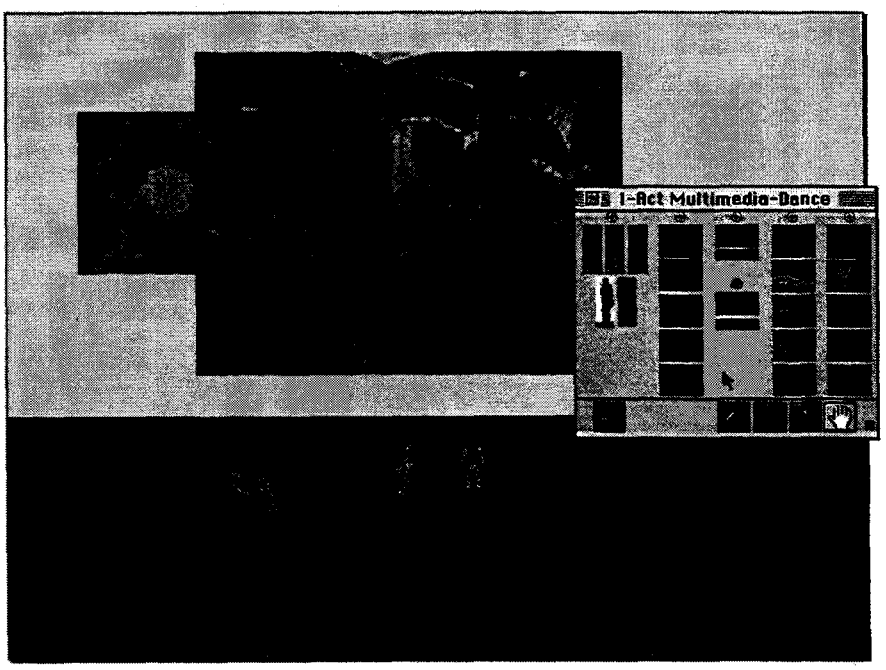
Lloyd-Jones raises an interesting issue with an article about reading dance notation as virtual rehearsal (Lloyd-Jones 1997). If one can rehearse without physically being in a studio, then

why can't dance activities such as producing a concert, structuring a dance, or creating any single contributory medium of a multimedia event also occur outside a studio or theatre? With a desk computer or one that is portable, this is possible.

Interactive Multimedia-Dance

I have created a software application that allows a user to simulate a dance performance in the virtual space of the computer environment. I am not even sure that "simulate" is an appropriate word choice, because I don't believe that an artistic creation on the computer has to refer to something.

Regardless of the philosophical issues, the user controls the choices of stage color, cyclorama color, backdrop painting or foreground set, rear-projection video, sound, and most importantly in the dance world—the number of dancers, their placement on stage, their size, and their dance phrases. In short, the computer user customizes the aesthetic experience to match her or his needs at the moment, and does this by using a media palette with a toolbar. [See example 1 that is one instance of over 20,000,000,000,000,000 possibilities. The media palette can be made to disappear.]



Example 1

Because I dabble in the various arts of dance, music, and painting, I have been able to provide with no copyright problem enough samples in a prototype for there to be more than 2.57 times ten to the sixteenth power artistic combinations. This is appropriate in a world of individual freedom and choice. The prototype entitled *Natural Trips* was premiered at the *6th Arts and Technology* Conference (New London, CT) in winter, 1997 and an updated version was shown internationally at *DanceOn '97* (Hong Kong) in summer, 1997 (Smith Mar. 1997, Smith Aug. 1997).

When various artists contribute media for the user to select, a form of virtual collaboration can occur. Conceptually, the software can be seen as requiring a computer user to complete

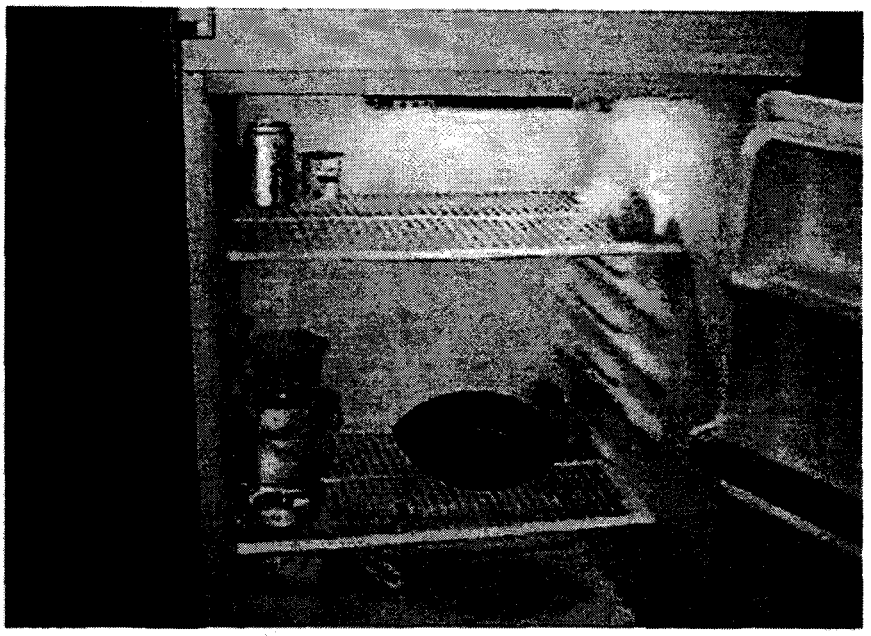
the collaborative team. Within this collaboration, after choosing various media for a virtual performance, a computer user can create a unique virtual program where the appropriate credits are listed for contributors of the various media, for example, Yacov Sharir for the dance, Kuan Chang for the backdrop artwork, and Susan Chess for the music. This program pops up in a window when the appropriate hotspot is activated and can even be printed. Hence, one person at one part of the globe could have created the dance; another, the music; another, the backdrop; and so forth, and the user can experience a new fusion of creativity. The user's name too can also appear on the program.

As part of the cultural context established in the first part of the paper, I believe the aesthetic experience arising from the *Interactive Multimedia-Dance* can occur at the user's choice of time and space. The user has an incredible numer of choices within the experience, more than just a few that are possible now at a website, so the idea resonates with enlarged personal freedom. Because the delivery is not through the wires of the internet, added benefits are that movies can be larger, longer, and without dropped frames.

Various artists can use the interactive software to see their work in new ways. I originally had a generalized contemporary audience member in mind when I conceived the idea for the software, but have since realized that artists can see their works in new contexts, allowing for growth in ideas. For instance, a painter's small (12" x 12") painting can be monumental as a backdrop to tiny moving figures in an *Interactive Multimedia-Dance* virtual production, allowing the painting to be seen in a way never before conceived by the artist.

That a virtual production might lead to a live physical production is a real possibility. Potential exists for students or professionals to try out many possibilities before moving into the theatre.

People can create human-figure movement-based works and, as well, can enter in their own media. This provides an excellent way to develop artistic decision-making. At one experiment at Douglas Middle School at Columbus, Ohio on September 17, facilitated by Sharon Unrau, three teams of two were given a quicktake camera and asked to take two pictures to be imported into the media pallet, and then to find the combination of media that best expressed their team. The picture by one team of a football in a refrigerator is refreshing, don't you think? [see example 2] When that image is placed as a backdrop, to the sounds of drums and other choices of the team, it was indeed a unique and vital expression. I was told that they talked about the experience at other times, so I believe it was memorable.



Example 2

The work premiered in the 17th Annual Symposium on Small Computers in the Arts (November 1997) contains media from many contributors whose ages and professional development vary.

Summary

The software *Interactive Multimedia-Dance* can facilitate artistic, collaborative, and educational growth. Those who desire to be more active in the shaping of their own aesthetic expression will appreciate the software Interactive Multimedia-Dance. The very act of using the software if choosing media created by others is collaborative. Development of conceptual planning and realization of intent allows the software to facilitate high-level organizational skills. The software itself is an expression of the age we live in for a dynamic people to express their moments.

Hardware Requirements

A computer (Macintosh Operating System or Windows-based) that is optimized for multimedia is required. High MHz (greater than 180) and RAM (64 Mb) are recommended.

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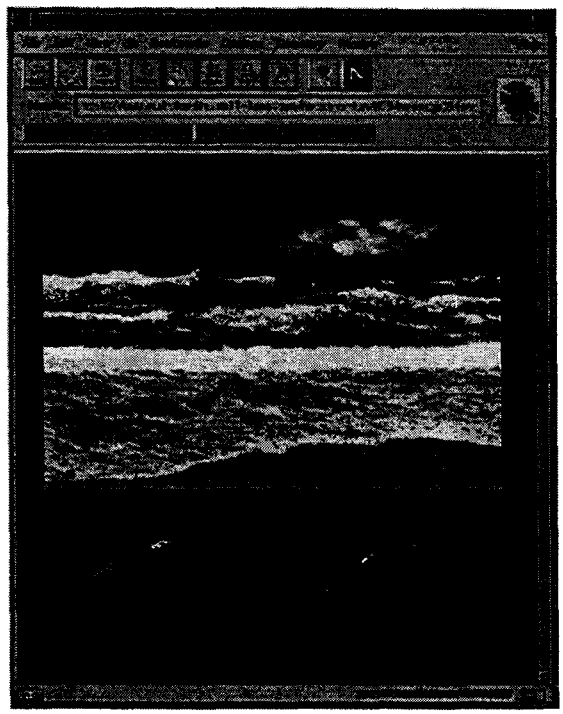
Metaphorium:

Digital Metaphor as a Shared Experience on the WWW

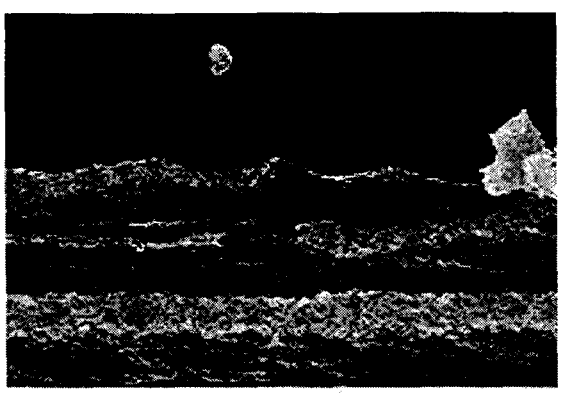
http://www.multimedia.bell-labs.com/metaphorium/

Cati Laporte
Dorée Duncan Seligmann
Bell Labs
4G-608
101 Crawfords Corner Road
Holmdel, NJ 07733
metaphorium@bell-labs.com

MessageInABottle



A messaging system with several unusual characteristics... Our system consists of a message pool into which users may at any time add messages. A server determines when a particular user has access to a specific message. Messages are not addressed to anyone in particular; a server determines to which users different messages are accessible. A user, after connecting to the service, may or may not have a message to read. Once retrieved, a message can be discarded or edited, appended to, and then put back into the pool. Thus, messages are written with no assurance that they will ever be read, and if read, their authors may never see the responses to their own messages. Our virtual environment consists of a large unchartered sea spotted with many islands. The sea is sometimes rough, and the currents are strong. Many of the islands are uninhabited. The sea is transporting glass bottles



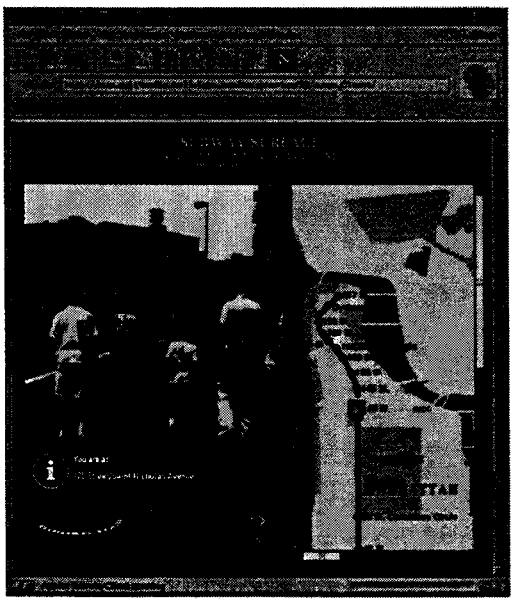
containing messages. Visitors land on an island, whereabouts unknown, out of their control. Their only form of communication is to place a message in a bottle and then throw it into the sea. Where it goes, and whether or not it can be retrieved is determined by the conditions of the sea. At the same time, if, by chance, a bottle passes by the island, anyone there can retrieve it and then: read the message, destroy it, add to it, and throw it back into the sea. Some bottles may spend days, months, in the sea without being found, while others may be found right away. Again, a message

writer has no guarantee that his or her message will ever be read. Even if it is read and responded to he or she may never know. The association of a bottle with a location simply provides a real-world metaphor for the mechanism of messaging which enables the server to procedurally determine whether or not a message is accessible to a particular user. It is unlikely that you will will visit the same island twice, or under the same conditions. Similarly, the paper on which a message is written is unlikely to be the same...

SandTypewriter/SkyWriter

Surrounding the virtual sea where messages in bottles are sent is a virtual coastline where two forms of communication are supported: bulletin board postings and broadcast messages. SandTypewriter/SkyWriter explores temporal messages on the Web. Visitors to the site are placed at random locations along the coastline and can explore the coastline by moving left and right. Below there are messages etched in the sand, above, skywriting. Visitors can use the sand typewriter to leave a message in any blank area on the shore, or the sky writer to create a broadcast message in the sky. However, every message entered has a random but finite lifespan, and eventually sand messages are washed away by waves while sky messages fade with time. With these fleeting communications we are exploring one method of temporal representation on the Web. Most other information on the Web stays there virtually forever once it's been written, but SandTypewriter/SkyWriter is a Web messaging service from which documents disappear. There is no guarantee of persistence of information, in fact there is a guarantee against it. You do not need to guess how long a message has been sitting in this system or whether it is any longer relevant, the age of the data is implicit in its availability. Only fresh data is served on our beach.

Subway Surface



SubwaySurface, a virtual gallery where the browsing technique is the theme of the exhibition, and basis for the virtual environment. In fact, the art itself was created in conjunction with the browsing mechanism. Visitors to the site travel (virtually) on the A-Line of the New York Subway system. They can select which station to go to. Upon arrival at a station they are presented with one or more photographs taken of the street scenes outside that particular station. This form of browsing is implemented through interaction with a map on which a subway car travels. Once the site is visited, music begins to play immediately while the rather large subway map is loaded in. Appropriate to the theme of this exhibition, a version of "Take The A-Train " is played. Travel is initiated by selecting a subway stations which causes the current photograph to disappear. During travel, as the next image is being downloaded, the subway car makes it way to the next station on the map, the Information Sign is changed to indicate the to and from stations, Generic representations of other people (representing

the other people visiting the site) populate the car. Thus, users travel virtually, to experience a view of the real world.

Photos by Alvaro Muñoz.1996

ART and ARTISTS on the WWW with a FOCUS on ART MUSEUMS

Stella Pandell Russell, Ph.D.

ABSTRACT: Online in **CYBERSPACE** are thousands of art galleries and visual artists, while more than 350 art museums can be accessed internationally. All post such information as addresses, phone numbers, faxes, e-mail sites, and some specialized services. Museums, galleries, and art agents add their hours of admission, or contact. Most museums also post membership information, current and pending shows and often include the kinds of things offered by their gift shops. Some supply art classes and film schedules. A few provide browsing through permanent and special shows. Others furnish press-kit info. and unique services such as research libraries. The **APPENDIX** lists more than 150 major museums, many with their web sites. The **BIBLIOGRAPHY** includes almost all 1994-1997 periodicals, dealing with art, artists, and museums **online**.

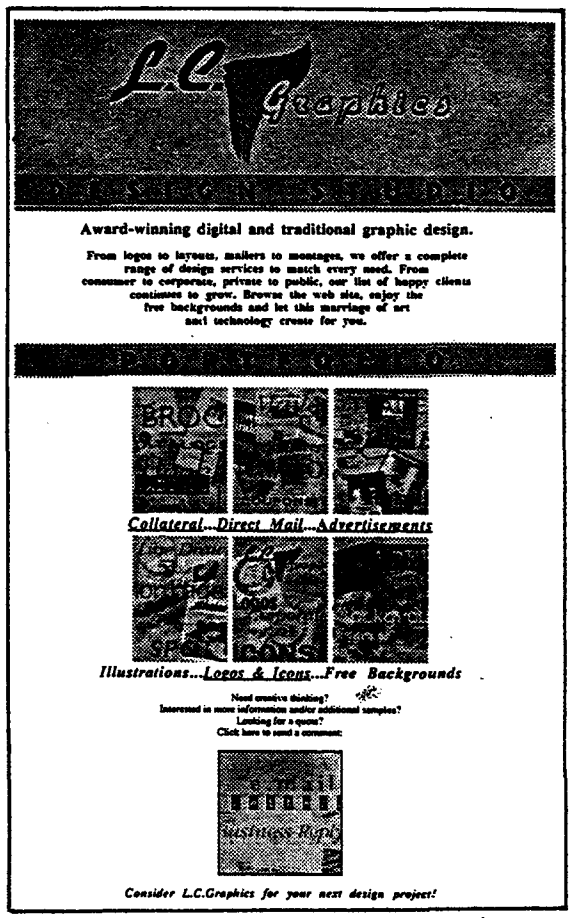


Figure 1. Web-page: L.C.GRAPHICS

The art world went **online** back in 1994-1995, using no more sophisticated equipment than a computer and a modem. This new electronic world briskly consolidated into numerous sites with art in some ways leading the pack. Prime attractions today remain art for sale and art for collectors... much of it only available online...the visual and performing arts and artists on disk and online, the Bulletin Board Chat Fest (online conferences coming from museum sites), architecture, art history, art therapy, body art, archaeology, ceramics, art courses, art journals, graphic arts, festivals, pictures, photography, products, publications and textiles. You name it... You'll find it!

The arts keep expanding with more and more listings. By 1997, touring the museums of the world via the **Internet** and **World Wide Web**... today's focus ... has become as easy as channel surfing on television. A majority of the new sites can be found on **WWW,** the portion of the Internet built on hypertext technology and the closest thing to that over-used term ***Information Superhighway.*** America **On Line**, perhaps heading the list (and their many competitors, **WorldNetATT, Prodigy, CompuServe, Yahoo, NetFirst, TrekNet,** and the **WebMuseum Network,** etc, etc.) all charge nominal monthly fees but the **WWW** is still free.

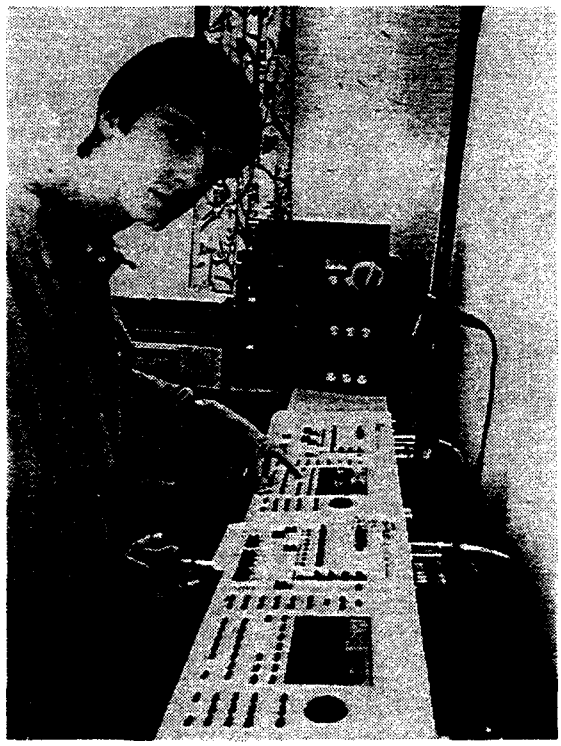
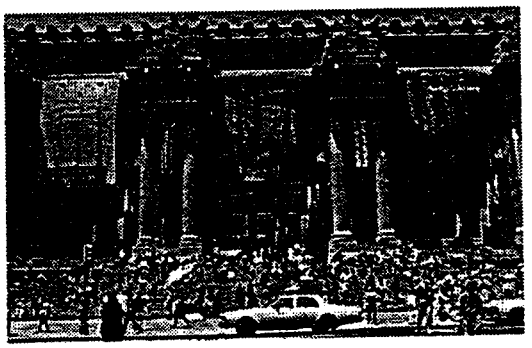


Fig. 2 Bewildering Music, Inc.
3-1 Park Plaza, No.162
Old Brookville,N.Y.11545
e-mail: bminc@aol.com
HTTP://MEMBERS.AOL.COM

Just what is this visual medium, the World Wide Web? The Web is a collection of electronic cross-connections that make it possible to communicate with other computers; part of a larger network called the **Internet** and to many of the online servicers is what the automobile is to a highway. **WWW,** the Internet's primary medium for computer inter-communication, is the major factor shaping today's Internet. Take a look at a typical page from **WWW**, and read up on the terminology. No need to follow the intricacies of its connections to the Web. Enough to say that a two-stage process permits online servicers like **AOL** to access a **URL,** a Uniform Resource Locator (Web address) for the viewer. The Web combines text, graphics, sound and video from all over the world collated on one screen with point and click convenience.

For the art collector, purchasing online is a wholly new phenomenon. Not only is it possible for a patron to surf world art online, but much of what can be viewed may be specifically designed for an Internet website and may be only available for purchase through the interactive capabilities of the Internet. The **Artcom Collector's Corner** in Illinois is one of many sites that offers information about upcoming international art and antique expositions all over the world. It's certainly a lot easier to sit in front of a computer and modem-connected telephone to make art choices instead of traveling overseas! On the other hand, it takes a real leap of faith to collect **online** art created at a website. This art is not only to be viewed online, but must be completely accessible to the public, who, taking advantage of the interactive capabilities of the Internet, can also contribute to the work. How will the art world accommodate to such changing parameters of art? And, who owns the work? Will an art museum ever exhibit it?

Accessing the world's greatest art treasures exhibited in museums internationally is a mouse-click away on the Internet (or on the CD ROMs generally available through most major museums). The doors to their art galleries need never be closed. The viewer selects the visiting hours and the specific collections to study; and the viewer determines which tours to take, while always controlling the pace of navigation. Browsers can find hours of enjoyment with full screen representations of art, video and slide shows, audio clips and more.



THE METROPOLITAN MUSEUM OF ART

NEW YORK

1000 Fifth Avenue
New York, New York
10028

The Metropolitan Museum of Art is one of the largest and finest art museums in the world. Its collections include more than two million works of art -- several hundred thousand of which are on view at any given time -- spanning more than 5,000 years of world culture, from prehistory to the present.

This site is designed to give visitors an overview of the collections on display in the Museum's galleries. Also available are a Floor Plan, which includes information on services for visitors, and the Calendar, which offers a detailed current listing of special exhibitions, concerts, lectures, films, and other Museum activities, and the Gift and Book Shop, with over 100 of our best-selling items available. The Metropolitan Museum of Art Guide, an illustrated handbook that is for sale in all of the Museum's shops, provides more information about the collections.

Welcome! Please use the button bar below to navigate this site.

If you have any comments about our site please contact us at webmaster@metmuseum.org

* Home * Membership * Calendar * Collections * Info * News * Shop * Education * FAQ

Home Membership Calendar Collections Info News Shop Education FAQ

Figure 3. The Metropolitan Museum of Art - Website

What's available at this point for the museum art lover? 350+ museums worldwide, many more galleries and thousands of artists have joined the rush for cyberspace. Museum websites post contact information such as addresses, phone and fax numbers, hours of operation and admission policies. Some list current and pending shows and special offerings like film schedules, museum shop inventories, and museum art classes. World-famous museums like the Metropolitan Museum of Art in New York permit browsers to visit some of their galleries, and observe shows that may change monthly. Frequently, artworks may be selected to view and discuss.

The Whitney Museum of American Art in NYC (and many European museums) offer links with other museum sites, a few of which provide Seminar-Discussions with Museum Curators and an opportunity to inspect grand collections of art or an occasional Virtual exhibit. For those who enjoy art but hate foot-numbing expeditions through exhibition-packed and people-overflowing halls, get online! Museums around the world are opening their doors to virtual visitors. Online museums (See **APPENDIX**) reach a global audience, as with the **University of California Museum of Paleontology** who sends more than 6000 files daily to online visitors. The Fine Arts Museums of San Francisco site, has 65000 works of art in a digital database, the largest collection of searchable art on the Web. So far, half their collection is online with the rest on the way. A virtual tour can move from ancient Assyrian wall reliefs to Picasso and everything in-between, thanks to clickable floor plans.

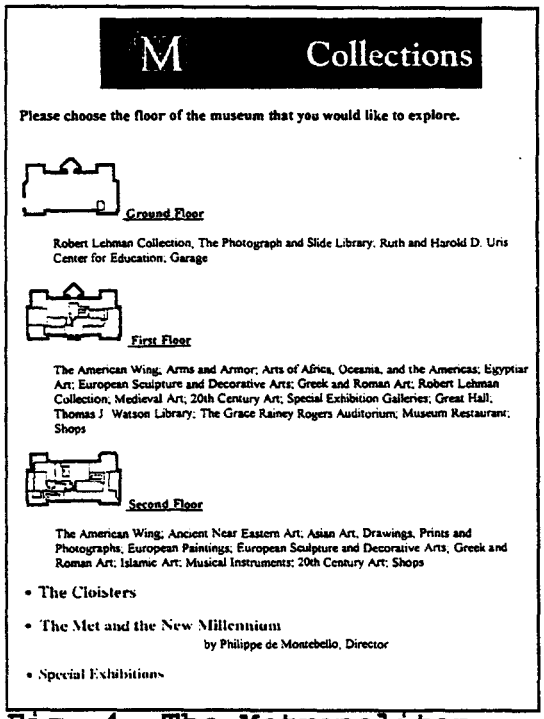


Fig. 4 The Metropolitan Museum of Art - Floorplan

The **Smithsonian** has all six of their art museums' assets at your fingertips. The **Musei Vaticani** tours cover much of their celebrated collection. New York's **Dia Center for the Arts** provides up to the minute contemporary art. You might begin museum browsing with the Virtual Library *Museums*:

A first stop might be **EXPO**, which takes **Internet** visitors through four exhibits based on Library of Congress holdings: 1) Rome Reborn (200 images from the Vatican Library) 2) The Soviet Archive Exhibit (earlier secret documents) 3) 1492, An Ongoing Voyage (1492-1600) 4) Scrolls from the Dead Sea

LeWebLouvre won a Best of the Web Award in 1994, showing: Impressionist Art, Medieval Art

In conclusion, many museums, other than the Louvre and the Metropolitan Museum of Art in NYC, the San Francisco Museum of Modern Art, the Smithsonian Institute in D.C. and the Hermitage in Leningrad offer both CD ROMs and web-tours... all of them interactive and some of them extensive. Galleries, museums, and a lengthy list of other exhibitors on the WEB can all be found in the Appendix below. All artists who produce suitable online sites can expect to reach millions of people, spending little or no money to do so. But, in fact at this stage of the online game, the most successful art, artists and museums around the world will surely be those which provide the best access to the most information online.

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APPENDIX

Ancient Near Eastern Art;Michael Carlos Museum of Emory (Atlanta) http://www.
Ancient Egyptian Art (Brooklyn Museum of Art)
Andy Warhol Museum
Anthology
Ariadne (Hellenic Arts- National Greek Center)
Arizona State University (ASU)
Art Museums http://www.treknet.net/net/htal/cultural/museum.htal
Art Deco (Erte)
Art Institute of Chicago http://wwwartic.edu/aic/firstpage.html
Art and Museums http://www.vol.it.it/UK/EN/ARTE
Arthur Sackler Gallery (Smithsonian) http:www.si.edu/asia
Arts:Humanities
ArtServe
Basle Museum (Geneva, Switzerland) http://wwwswissart.ch/museums.htlm
Bodleian Library http://www.bodley.ox.ac.uk/
Brooklyn Museum of Art http://www.brooklynart.org
Carleton University Art Gallery
Carnegie Museum of Art http://www.clpgh.org/cma
Cincinnati Art Museum http://www.cincinnatiart museum.com

Cleveland Museum of Art http://www.clemusart.com/
Contemporary Arts Museum, Houston http://www.camh.org
Costume Site
Dallas Museum of Art http://www.unt.edu/dfw.dma/www/dma.htm
Department of Classics (State University of Mississippi)
Doon Heritage Crossroads
El Museo del Barrio http://www.elmuseo.org
Fine Arts Forum (State University of Mississippi)
First Nations Art (Canada)
Folk Art from the Global (Recycled,Reseen) Art Resources
Ford's Theatre National Historic Site Museum
Frederick R. Weisman Art Museum (University of Minnesota)
Freer Gallery (Smithsonian) http:www.si.edu/asia
Galleria degli Uffizi (Cont'd) http://www.televisualit/uffizi
Galleria degli Uffizi (Florence, Italy) http ://www.uffizi.firenze.it
Glenbow Museum http://www.glenbow.org
Guggenheim Museum http:www.guggenheim.org/
Hampshire County Museum
Harvard University Art Museum http://www.harvard.edu
High Museum of Art (Atlanta) http://www.high.org
Hirschhorn Museum and Sculpture Garden http://www.si.edu/hirschhorn/
Hudson's Bay Company
Institute of Physics in Naples
Jan's Favorite K-12
Jerusalem Mosaic
Jewish Museum http://www.jewishmuseum.org
Jon and Mabel Ringling Museum of Art http://www.ringling.org
Julie Heller Gallery
Krannert Art Museum (Univeristy of Illinois-Urbana)
Kyoto National Museum (Japan)
Lausanne Museum (Switzerland) http://wwwswissart.ch/museums.htlm
Leonardo da Vinci Museum
London Natural History Museum http://www.nhml.ac.uk/
London Transport Museum
Lore Degenstein Gallery (Susquehana University)
Los Angeles County Museum of Art http://www.lacma.org/
Metropolitan Museum of Art http://www.metropolitan.org
Mid-American All-Indian Center Museum (Wichita, Kansas) http://www2.southwind
Mid-American (Cont'd) .net/"icm/museum.htal
Minneapolis Institute of Art http://www.artsMIA.org/
Montreal Museum of Fine Arts http://www.mmfa.qc.ca/
MS @ Oxford
Musee du Louvre (Paris Pages) http://www.at.com.net/louvre
Musee d'Orsay http://www.musee-orsay.fr:8081/ORSAY/HTML.NSF/BY+Filename
Museum of Rhode Islanmd (Cont'd) .html
Museum of American Folk Art http://www.folkartmuse.org
Museum of Fine Arts, Boston http://www.mfa.org
Museum of Art of Rhode Island School of Design http:///www.risd. edu /museum
Museum of Southern University
Museum of New Zealand
Museum of St. Petersburg
Museum of the Ancient Americas
Museum of Modern Art (NYC) http://www.moma.org
Nassau County Museum of Art http://www.liglobal.com/t_i
Nassau County Museum of Art (Cont'd) /attractions/mseums/ncma
National Gallery of Canada http://national.gallery.ca/
National Museum of American Art (NMAA) http://www.nmaa.si.edu
National Gallery of Art, D.C. http://www.nga.org
National Portrait Gallery http://www.npg.si.edu
National Museum of Women in the Arts http://www.nmwa.org
New Museum of Contemporary Art
New Orleans Net
North Carolina Museum of Art (NCMA)
Parrish Art Museum http://thehamptons.com/museum/

Planet Earth; Images Section
Prado Museum (Madrid, Spain) http://museoprado.mcw.es
Redwood (Cont'd) /csd/collections/redw,html
Redwood National Park Museum Collection of Art http://www.nps. gov/crwebl
Rice/Polak Gallery
Rijksmuseum (Amsterdam) http://www.nl/rijksmuseum/home.htal
Sagamore Hill National Historic Site http://www.cr.nps.gov/csd/collections/
Saint-Gaudens National Historic Site
Salvador Dali Museum http://www.webcoast.com/Dali
San Diego Museum of Art(SDMA) http://www.sddt.com/sdma.htal
San Francisco Museum of Modern Art (SFMOMA) http://www.sfmoma.org
Science Center Tietomaa
Singapore Art and History Museum http://www.museum.org.sg/sam/sam.html
Smithsonian Institute http://www.si.edu
South Bristol School (SBS) Museum
Spencer Museum of Art http://www.ukans.edu/\sma/
Stedelijk Museum of Modern Art
Tate Geological Museum (Caspar College) http://cy-mac.wek.com.ac.uk/art.htal
Thais; 1200 Years of Italian Sculpture
Tokugawa Art Museum http://www.cjn.jp/tokugawa/index.html
Universes in Universe (trilingual link)
University of California (Cont'd) uampfa.berkely.edu
University of California:Berkely Art Museum (Berkely, Cal) http://www.
Victoria and Albert Museum http://www.vam.ac.uk/
Walker Art Center http:www.walkerart.org
Weiner's World
Whitney Museum of American Art http://www.echonyc.com/whitney
World Wide Arts Resources http://www.com
Yale Center for British Art

Audience Interactivity: A Case Study in Three Perspectives Including Remarks About a Future Production

Rob Fisher, Paul Vanouse, Roger Dannenberg and Jeff Christensen
The STUDIO for Creative Inquiry
Carnegie Mellon University

Summary

Audience interactivity was a primary element of a major planetarium production about cell biology entitled "Journey into the Living Cell." The artist/authors were directly involved with the design of the production from concept to realization. Rob Fisher was the Project, Artistic and Technical Director. Paul Vanouse was Assistant Director responsible for the design and production of the interactive visual portions of the show. Roger Dannenberg directed the interactive audio portions and was responsible for the interactive audio system with the assistance of Jeff Christensen. The following paper provides background about the production and our varied perspectives on the use of the innovative interactive system. In addition, a future production currently pending approval of an NSF grant will be described. This new show about the brain builds upon the experiences gained in the cell project and sheds light on features of audience interactivity that point to some startling conclusions about group behavior.

Background

"Journey Into the Living Cell" was an interdisciplinary collaboration utilizing a planetarium for a new type of science education. "Journey..." was a major collaborative effort involving scientists from Carnegie Mellon's Center for Light Microscope Imaging and Biotechnology, artists from the STUDIO for Creative Inquiry, and educators from Pittsburgh's Carnegie Science Center. Similar persons and organizations within Pittsburgh and across the nation were also involved as collaborators, advisors and contributors to the immense set of visual imagery used in the production. The show is a forty minute interactive multimedia presentation on Cell Biology incorporating cutting edge technology that created the Group Immersive Visualization Environment (GIVE).

Educational Goals

The educational aims of the project were to allow large numbers of elementary and secondary school students and non-experts in the general public to experience interactive simulations of scientific phenomena. Specifically, students were enabled to explore the structure and several functions of the living cell. The cognitive goals of the show included teaching the audience biological principles, most importantly: the dynamic, 3D nature and structure of the cell; the cooperative interaction of its component organelles; and the central dogma of DNA and cellular reproduction. The project challenged audiences to correct misconceptions they may have had about the cell, biology, and the practice of science.

The Group Immersive Visualization Environment

A vast challenge for educators and artists alike is the integration of content and form. The planetarium became an analog of the cell, often covered in dense cytoskeletal fibers as if the audience were deep inside the cell. A strategy was developed that allowed for a more participatory learning—interactivity—utilizing various educational models for its interface. The interactive components of the show functioned like laboratory classes in science curricula, actively reinforcing key concepts following initial presentation of material. Some exercises utilized audience navigation and scaling of materials, in a manner analogous to microscopy. Other interactive lessons required audiences to add materials to the cellular environment as in an experiment to demonstrate ATP synthesis and cellular equilibrium.

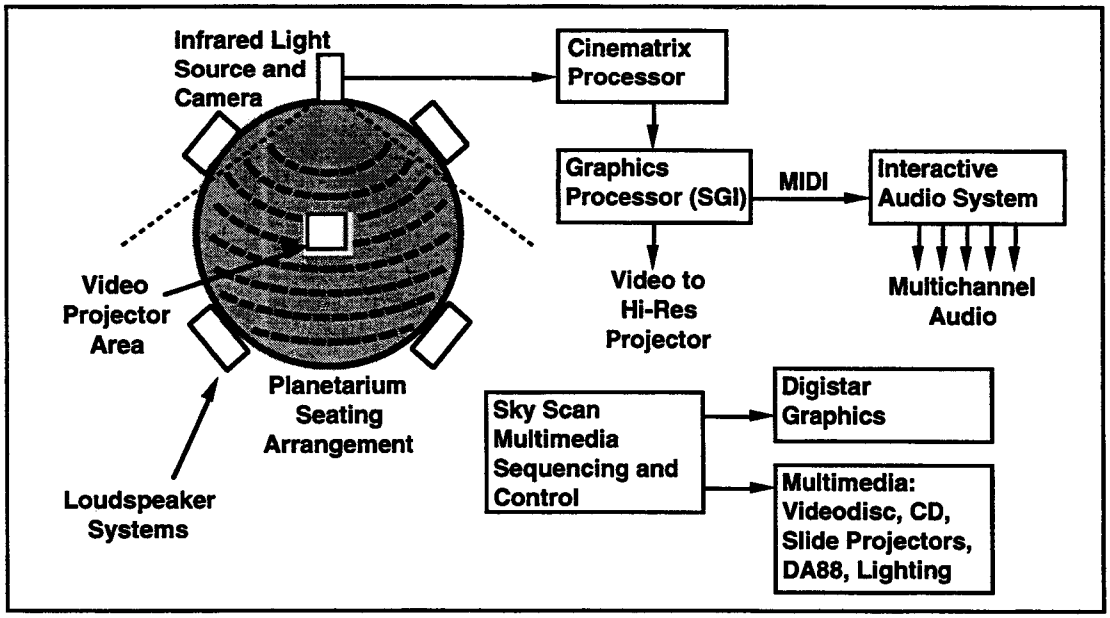

Figure 1. The planetarium (circular structure at left) with centrally located video projectors and surrounding loudspeaker systems. The infrared light source and camera system detects light reflected from audience-held paddles. The image is processed by the Cinematrix system, which sends information to the SGI Graphics Processor. This in turn sends data via MIDI to the Interactive Audio System (detailed in Figure 3). In addition, the planetarium operates an independent multimedia system with a vector graphics system (Digistar) and numerous computer-controlled audio, video, and slide projection devices.

The vehicle for these concepts, the Group Immersive Visualization Environment (GIVE,) was a major innovation of the project and the technological point of departure for our current project. GIVE is a synthesis of new visualization and sound tools with existing planetarium media technology. The central component of the GIVE is the "Cinematrix" audience interactive processor and the system of linked technologies which provided graphics and sound which respond to audience involvement (see Figure 1.) The system uses this collective audience response (almost like that of a joystick or mouse), to control graphics projected before the audience. Information is also directed to computers which control full-surround sound, so that sound comes from the same place as the graphics within the domed space.

This technology uses retro-reflective "paddles," an infrared light source and camera linked to a proprietary computer and software system displayed through a Silicon Graphics computer via a high-definition Barco projector. In this technology, the audience simply raises and/or lowers a small paddle. Their "vote" is registered twenty times per second; the aggregate then influences a graphic display. The behavior of the system is such that the audience of 150 begins to feel that they are in control of the graphic which can be as simple as a game of "pong" or as complex as the cell maze used in "Journey...."

Part One. Where Audience Meets Artwork: On the Matter of Interface

By Paul Vanouse

Introduction

The selection or creation of a user interface is one of the most fascinating challenges facing artists working in interactive media today. Unfortunately, it is often understood in utilitarian terms: simply as a method of accessing content and not as a strong carrier of meaning and associations in its own right. Successful artworks must explore this issue and not allow for the standardization and ossification of this defining component of interactive media.

The interface is the juncture of power relations between creator and viewer. Differences between manual effectors and vision-based sensors are examples of two contradictory viewer roles, the former active and controlling and the latter passively surveilled. One speaks of empowerment, the other of manipulation. Obviously, many ambiguous technologies can be cited which fall in-between these two poles. In addition, many input devices, such as buttons, keypads and joysticks carry strong associations with electronic devices which we encounter everyday. Many artists take advantage of the obvious arcade references of coin-ops and joysticks, but many others allow for dangling conceptual loose ends. Whether through harmonious relationships between a user's actions and the artwork's response, or as a point of tension or conflict between facets of the artwork, an interface should be selected that not only works with, but also adds to the artwork. If the form of the interaction does not add to the meaning of the work, perhaps the work shouldn't be interactive.

In "Journey Into the Living Cell," we used a real-time, mass-audience polling device known as Cinematrix as our point of interface with our audiences. We incorporated the Cinematrix hardware into a total gestalt known as the Group Immersive Visualization Environment. In conceptualizing and directing interactive scenario development for the project, my objectives were to balance pedagogical content with aesthetics, while also trying to explore the unique meanings and novel characteristics of GIVE.

These objectives are similar to those of my independent artwork. In this work, much importance is placed on the interface which I feel can never be transparent. The interface carries important meanings which are absolutely integral to the understanding of the artwork. This exploration of user interface begins with two examples from my independent work, then discusses two interactive scenarios from Journey Into the Living Cell, and lastly addresses the future of the collaborative team and the GIVE.

Independent Work

"Items 1-2,000: A Corpus of Knowledge on the Rationalized Subject," 1996, is an interactive installation combining sculptural, pictorial and performative elements with custom software and electronic circuitry. It collapses Western medicine's fracturization of the body with industrial itemization techniques into a strange rationalization apparatus. A human body is half submerged in a block of wax, in a manner reminiscent of how biological specimens are fixed in a "microtome" (a machine that cuts specimens into thin slices.) A sheet of glass rests inches above the figure in a manner analogous to a cover slide used atop cross-sectional slices in microscopy. This glass is affixed with barcodes which correspond to internal organ locations of the figure underneath.

Participants interact with the work as anatomy students would a cadaver. They use a stainless steel barcode scanner much like a scalpel—slicing horizontally across the glass to reveal the hidden target organ on monitors resting on laboratory shelving. The more familiar use of barcodes and scanning procedures however are not lost, and this surgical role blurs with that of cashier—commodifying and extracting value through the denial of the body as whole (rather a rational composite of itemized parts.) Every third scan the participant makes accesses a video recollection from my own experiences in the anatomy morgue. These recollections are somewhat poetic and address the phenomena of de-humanization of the corpse as it is de-constructed and re-configured through dissection. The artwork seeks to contextualize work in anatomical imaging, using the Visible Human project as an example, with the social issues of American medicine, and my own observations as a pre-med student in the 1980's.

The barcode and optical scanner interface used in the project had both associative meaning and technical utility within the work. Such a device was intended to superimpose economic connotations upon the body of the subject (a death-row inmate was used in the Visible Human Project) and the broader field of medical imaging. Users felt an uncomfortable tension between the model's prostate body and this instrument of consumer culture. In the Visible Human project, the body was transformed into pure data by the slicing/photographing/digitizing processes and the barcode interface of the artwork provided a method to both itemize and quantify that information.

Additionally, as the work neared completion and the barcode interface moved into its final considerations, more subtle choices were made about which specific scanner to use. High-quality commercial scanning-guns utilize several lasers so that users may simply aim at the target barcode to read its data, while cheaper, one laser pen-models require the user to actually drag the unit over the barcodes at an even speed. The more sophisticated guns however carried different meanings than I necessarily sought in the work, for instance any time we aim at a target we reference warfare, handguns, etc. The pen on the other hand required users to actually glide across the body in a manner much like using a scalpel. When users occasionally had difficulty getting the pen to register their scan, they were un-flustered, perhaps because the surgical role was understood to require both patience and skill.

"The Consensual Fantasy Engine," 1995, is a computer program capable of creating a cinematic drama based on audience preferences. The engine asks the audience questions to which they answer by applauding for their preferred choice. The engine responds to the applause level by creating a customized scenario for them in seconds and projects it onto the cinema screen. Every 5 minutes the audience is invited to respond to questions of a sociological nature and influence the plot. The point of departure for the narrative is the O. J. Simpson chase which the audience can transform into a Bonnie and Clyde style road adventure, an intriguing, Film Noir search for the real villain, a suspenseful trial, or any of millions of intricate variations.

The televised O. J. Simpson chase is important because of a distinct relationship that it shows between the broadcast and society. Society's presence as viewers had an impact on both the actions of the police following, and also possibly on OJ's own actions during the pursuit. Our presence as viewers has changed the court's jury selections and even the selection procedure. Most importantly however, our responses to (or public opinion of) the constant barrage of information—truthful, real, circumstantial or fabricated—will set up lasting metaphors and prejudices which will affect our understanding of future world events. "The Consensual Fantasy Engine" explores how both the media and the public have a substantial stake in the creation of such metaphors and meanings.

"The Consensual Fantasy Engine," as a mass-audience interactive artwork, has many formal similarities to "Journey Into the Living Cell," as well as many differences in content and intent. The software applause meter user interface was created very early in the work's conception in strong preference to any type of distributed push-button system. The primary reason for such an interface was the mass spectacle that the work addressed. The response to such spectacle has always been applause and shouts of support, not unlike that delivered along the roadside during OJ's flight from the police. Secondly, it related to O. J. Simpson's history as an athletic superstar and referenced memories of sports fans shouting support for their heroes.

A somewhat unforeseen attribute of the system was that it allowed for analog input from the audience. They could clap a little or a lot, and they could further augment their vote by banging on a table or whistling. Thus opinion was scaled by enthusiasm—like a democracy in which the loudest voices had the most input. The real-time metering of response further incensed audiences to vocalize their opinions since they could note how their own participation caused the meter to register higher and thus increase the average noise-level used by the system to decide the winning response.

Journey Into The Living Cell

"Journey Into the Living Cell" certainly posed many challenges related to merging form with content. I feel that several realizations which occurred to us early in the development stage led to our ultimate success. Firstly, we decided that these interactions should work like laboratory classes in science curricula—reinforcing fundamental principles through direct involvement. Secondly, we realized that the interactive scenarios must co-evolve with the storyline—not written before and inserted as an afterthought, or envisioned afterwards, like illustrations, to support the text. Thus the entire show was conceived around balancing content with its proper form of interaction and balancing pedagogy with the excitement of interactivity. We wanted to make sure that the interactions were never gratuitous, nor were they purely illustrative or predictable.

During the Cell Membrane interaction, audience members hold up their reflective wands so that "ions" mapped to their seats enter through the membrane into a simulated cell, and hold their paddles down to bring them back out. The cell expands, somewhat balloon-like, when too many ions enter the cell and it buckles and folds inwards, deflated, when too many ions leave. A slider bar at the bottom of the screen further assists the audience in understanding the cell's state. The audience attempts to achieve a state of equilibrium to create a healthy cell, into which they will soon be traveling.

The scenario highlights an interesting phenomenon we have observed (in all 6 of the interactions) of spontaneous cooperation. Most audiences seem to easily consolidate their efforts to achieve correct concentrations. Whereas most of the scenarios in the show require a quorum of responses (similar to voting) to effect the desired change, this interaction requires them to achieve nearly perfect balance of up or down paddle response. This is a fundamental attribute of the real-time Cinematrix system that found a perfect match in the concept of cellular equilibrium. Such a result could not be achieved within a vote-and-wait system.

Additionally, the exercise took advantage of the system's capability to individuate audience members. Each audience member can actually see the simulation respond to his or her individual action since each audience member controls the state of a "personal" ion. Thus, unlike many examples of mass polling, the user gets instantaneous feedback from personal actions, while also realizing a role in the larger task.

The ATP Production in Mitochondria interaction had dual objectives: To reinforce understanding of ATP synthesis within the mitochondria and to excite the audience for the grand finale of the show. The audience is required to expend their own ATP (by rapidly moving paddles up and down) to run sugar and oxygen pumps in the mitochondria. The actions of such pumps lead to the production of ATP—the energy currency of the cell. Audiences see the sugar and oxygen molecules enter an immense mitochondrion shown at center screen (see Figure 2) and the ATP molecules shoot out like fireworks. The faster they move their paddles the more ATP is produced and the faster an animated figure runs around the mitochondrion track.

While most of the show's interactions attempted to maximize strengths of the Cinematrix system that were largely in keeping with the system's design, the ATP interaction exploited a simple, yet unexplored possibility. Rather than be concerned with an audience member's response of up or down, we wrote software that kept track of the rate at which members changed their paddle positions from up to down. This established a gradated method of judging enthusiasm and excitement, not just a binary choice.

This curious method of interaction was metaphorically linked to the mitochondria's role of pumping sugar and oxygen in the production of ATP. The audience was required to expend energy, or ATP, by rapidly pumping their paddles to create the body's energy currency. (If this seems abstract, wave your arm up and down vigorously for about one minute and you too will become keenly aware that sugar, oxygen, and ATP are not just biological abstractions.) Whereas success in other interactives within the show was based on achieving balance or successfully navigating the cell, success in this exercise was based on enthusiasm. In addition to the linkage between the biological concept and the technological means for this lesson in energy production, there was a very pragmatic reason for such an exercise—to shake some life into youngsters who were perhaps drifting off near the show's ending.

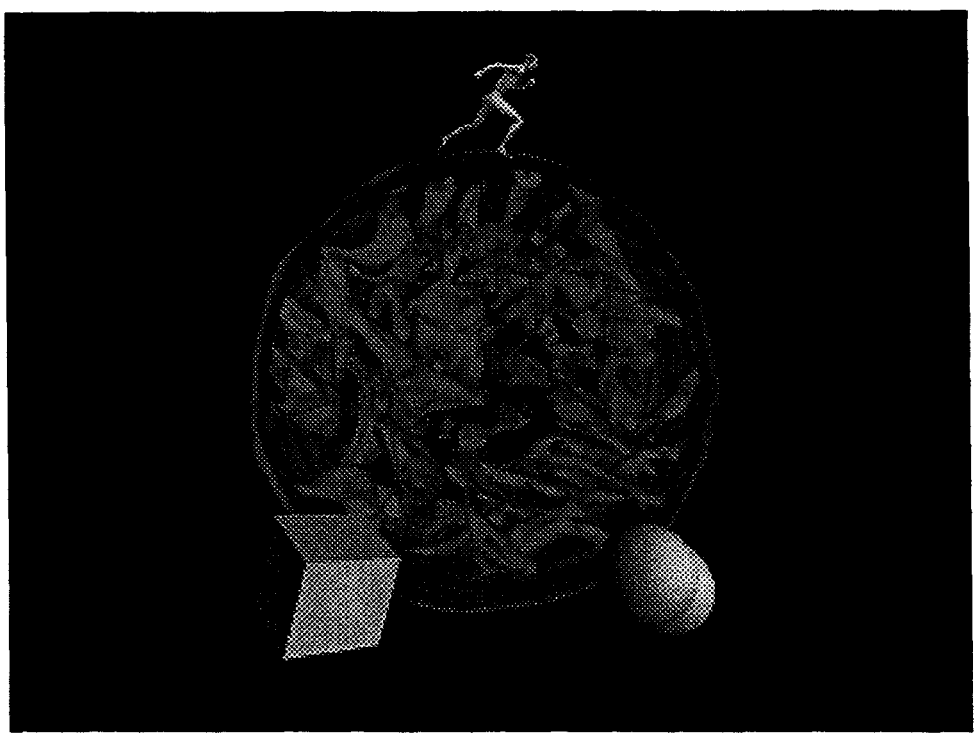

Figure 2. Scene from the ATP Production interactive segment. Audience members wave their paddles to pump oxygen and sugar into this mitochondrion, causing the man to run around.

(Mitochondrion created by Anoop Bhattacharjya from data set courtesy of Wadsworth Center of the New York State Department of Health.)

Conclusion/Coming Attractions

I have found that the most interesting interactive works address the notion of decision-making, choice, behavior and the analysis of these actions. Nearly all members of the Journey team began to recognize the strong psycho/sociological connection inherent to the GIVE and the interactive genre. Team members were always noting what audiences found exciting, what they were learning from, how their roles needed to be explained, how to motivate them to participate and how they communicated among themselves.

Our new project, tentatively titled "Tracking the Human Brain," realizes the strong psychological implications of interactivity and will attempt to make the form the content, and the content the form. For example, in explaining the phenomena of neural networks, the individual audience members will be allowed to act as neurons in a network which is in fact the audience. To do so, the system detects audience member's actions and uses their actions to pass information along to other audience members. Thus the system acts like a chemical (neuro) transmitter passing signals between neurons. This is just one of many possible scenarios planned, in which we hope that tool and content, message and medium are reciprocal in adding the most interesting associations and meanings to make a groundbreaking, communicative, and educational artwork.

Part Two. Audience Interactive 3D Audio and Sound Design

By Roger Dannenberg and Jeff Christensen

Sound is an essential component of any theatrical or multimedia experience. As part of the team that created "Journey Into the Living Cell," we had the opportunity to coordinate sound effects and music with real-time animation in a planetarium with multiple speaker systems. We developed a custom sound spatialization system and integrated it with other elements of the production.

This part describes design considerations and the technical aspects of the spatialization system. In addition to the technical aspects, we will discuss aspects of the sound design that led to the actual sounds used. In the process of integrating this work with that of many others, a number of modifications and extensions were made to the original plans. We want to describe our experience in the context of developing a large interactive multimedia presentation.

A Review of Spatial Audio Technology

As computer graphics technology evolved to provide interactive, real-time, 3D, animated, and even stereographic images, many researchers turned their attention to the medium of sound to study how the audio channel might enhance experiences with interactive graphics. Although interactive sound has been a topic of study in the field of computer music for many years, a new stream of work has been motivated by interactive graphics and virtual reality applications. This stream has largely focused on individuals listening through headphones, and some interesting technology has developed. The basic approach relies on the fact that sound waves are altered by our heads and ears according to the direction of the sound source. Digital audio processing can synthetically reproduce these directional cues and provide very convincing "3D sound." Normally, headphones must be used to provide a separate audio channel to each ear and to eliminate room effects. [Begault 1994]

Unfortunately, because of headphones, the effect is spoiled when the listener turns his or her head: normally when we turn to face a natural sound source, our head has a new angular relationship to the source, and the sounds that we hear are altered accordingly. With headphones, there is no change in the sound when we turn our heads. We can simulate the desired effect, but ordinarily this requires tracking the listener's head position and constantly compensating for changes in angle.

Thus, what has become common practice in 3D sound systems relies upon head tracking to sense the head position and headphones to deliver sounds to individual listeners. Since audiences do not expect to wear headphones and audience members do not move their heads in synchrony, this approach does not scale well to groups.

There are also "3D" systems intended for use with loudspeakers, but these generally rely upon some kind of wave cancellation effects, which in turn rely upon careful speaker and listener placement. (Kendall 1992) In general, only a few audience members would experience the full effect of these systems for 3D localization, although the effect is sometimes quite interesting in other ways.

Finally, there are various "surround sound" systems. (Dressler 1996) These use multiple speakers to give a sense of direction, and the technology is mainly used to combine the information for many speakers into only a few channels for recording purposes. These systems do not address the general question of producing or controlling the original multi-channel program, but the idea of using multiple speakers for sound spatialization is the basis

for our approach. For further information on the general topic, an excellent guide to on-line material and examples is: `http://www.dform.com/inquiry/spataudio.html`.

Our Sound Spatialization System

The GIVE sound system implements old ideas described by Chowning (1971) using new technology. Others have created similar systems (Bossi 1990, Perez, *et al.* 1996), and we do not make any claims of innovation except possibly that we have created a low-cost system that is controlled by audience members.

In Chowning's system, several cues are used for the spatial location of a sound. First, sounds are panned across multiple speakers according to the angle of the (imaginary) sound source. Second, the overall loudness of the sound falls off with distance. Third, the ratio of reverberation to direct sound increases with distance. Finally, simulated Doppler shift is applied to moving sounds.

We created a system that implements all of these cues in real-time using audio from a sampling synthesizer. Up to 4 sources can be independently spatialized and controlled via MIDI. We looked at various implementation strategies and settled on using MIDI-controlled analog mixers. Our system has a total of 4 "dry" audio inputs. Each of these is run through a separate reverberator. The eight resulting signals (4 dry and 4 wet) are routed through a full 8-by-6 analog crossbar mixer to yield 6 output channels. Four outputs are used for front-left and -right, and rear-left and -right speakers, a fifth channel is directed to an overhead speaker, and the sixth channel is directed to a speaker array located on the floor under the seats. The 8-by-6 crossbar means that each of the 8 input signals can be routed in variable amounts to each of the 6 outputs, allowing completely arbitrary panning and level control.

An all-digital implementation would require a total of 10 input and output channels combined with the computation to reverberate, control, and mix 48 patch points. This approach seemed prohibitive or at least risky. Instead, we chose a hybrid approach, shown in Figure 3. Low-cost MIDI-controlled line mixers intended for use in mixer automation (the CM-AUTOmation model MX-16) offer a mode in which a single rack space unit provides two 8-to-1 mixers. Thus, 3 MX-16 units and 2 dual reverb units provide the required capacity, and it was only necessary to make special audio patch cables to configure an 8-by-6 mixer.

Even though there are several papers in the literature about similar systems, interesting problems still had to be solved. One was how to extend Chowning's 2D configuration to 3D using an overhead speaker. After considering various formulations, we settled on a simple one: first, ignore the vertical component and compute panning coefficients for the four speakers in the horizontal plane. Then, consider only the vertical component to pan between the horizontal plane and the vertical speaker. Combining these two calculations gives weights for five speakers. (The sixth channel for under-the-seat speakers was only used for special effects.)

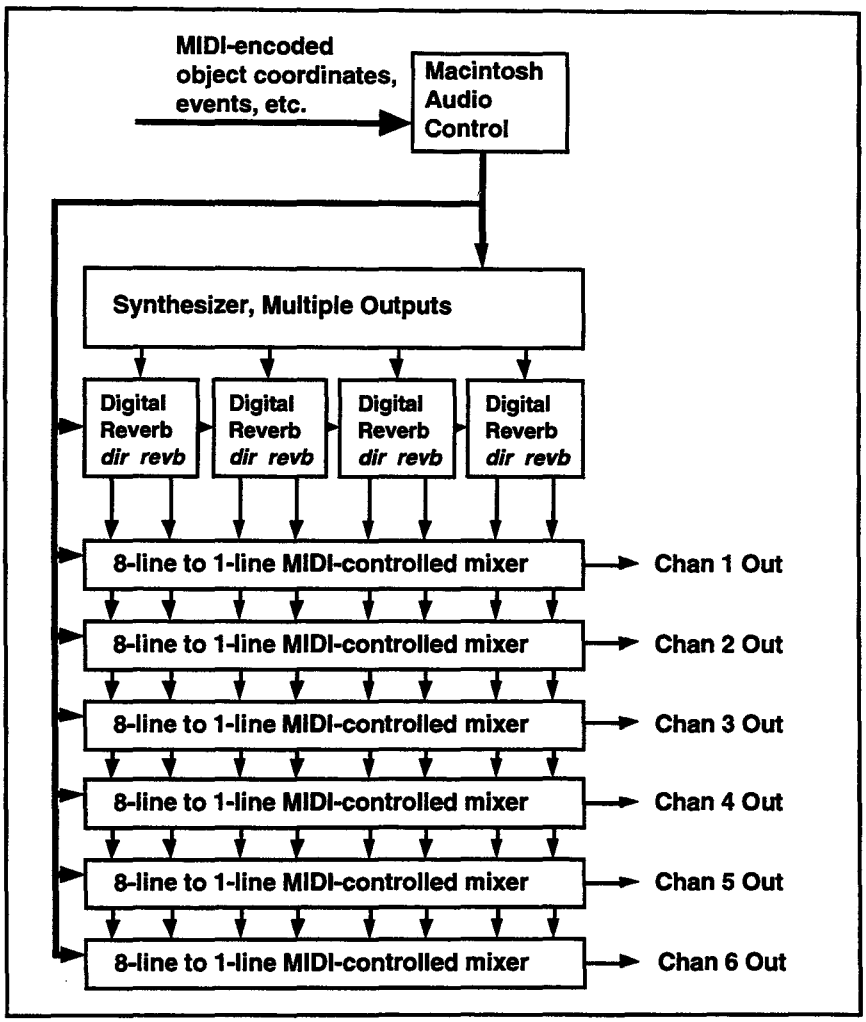

Figure 3. Implementation of the Interactive Audio System. An 8-by-6 analog mixing matrix is used to route and reverberate sound from 4 sources to 6 loudspeaker systems.

Another issue is how to pan smoothly between speakers. Chowning describes the "hole in the middle" effect where the sound seems to "drop out" between two speakers if panning is done in a linear fashion. He suggests a particular formula to boost the overall power as the sound is panned between two speakers to compensate for this loss. (As an aside, there is a physical explanation for this effect: if you direct half of the amplitude to each of two speakers, the total average power will be cut in half relative to full amplitude in one speaker.) Rather than adopt Chowning's exact formula, we made the "center boost" a variable that we could adjust in the theater. It turned out that this was a fairly sensitive parameter.

We did not find any discussion of locating sounds within the auditorium, and the standard "$1/radius^n$" formulas "blow up" at a radius of zero. In our system, when a sound is inside the speaker radius, signal is added to all speakers and the level increases linearly as the location approaches the center of the space. We found that this gives a nice, even visceral, effect when objects zoom from a distance through the center of the audience space, especially when combined with Doppler shift.

Another interesting phenomenon is the tendency of sound to perceptually "jump" from one speaker to the next during a smooth pan. To compensate for this, it is a good idea to pan

rapidly to the neighborhood of 50/50 where the jump occurs, and then pan very slowly across the 50/50 point to minimize the jump effect, and finally pan quickly to target speaker. A "center dwell" parameter allows us to vary from a smooth pan to a one that spends most of the time near the 50/50 point. Again, this parameter can be adjusted by listening in the theater.

Figure 4 illustrates the output of the system to four different speaker locations in the horizontal plane given an input that is traveling in a circle around the center of the space. Notice that the "center dwell" effect has flattened the curves between peaks and sharpened the peaks (where the source is aligned with a single speaker). Also the "center boost" raises the levels slightly between peaks.

In addition to the non-linearities that we intentionally add to the panning control, the MX-16 mixers have a non-linear (and non-logarithmic) response to the MIDI control values. This is probably appropriate for a fader automation system, but we needed the mixer to actually deliver a good approximation to our mathematically calculated attenuation factors. Since the manufacturer was unable to provide detailed information, we resorted to measuring attenuation with a digital voltmeter. The measurements were translated into a table of (software) values that converts desired attenuation into the appropriate MIDI control value.

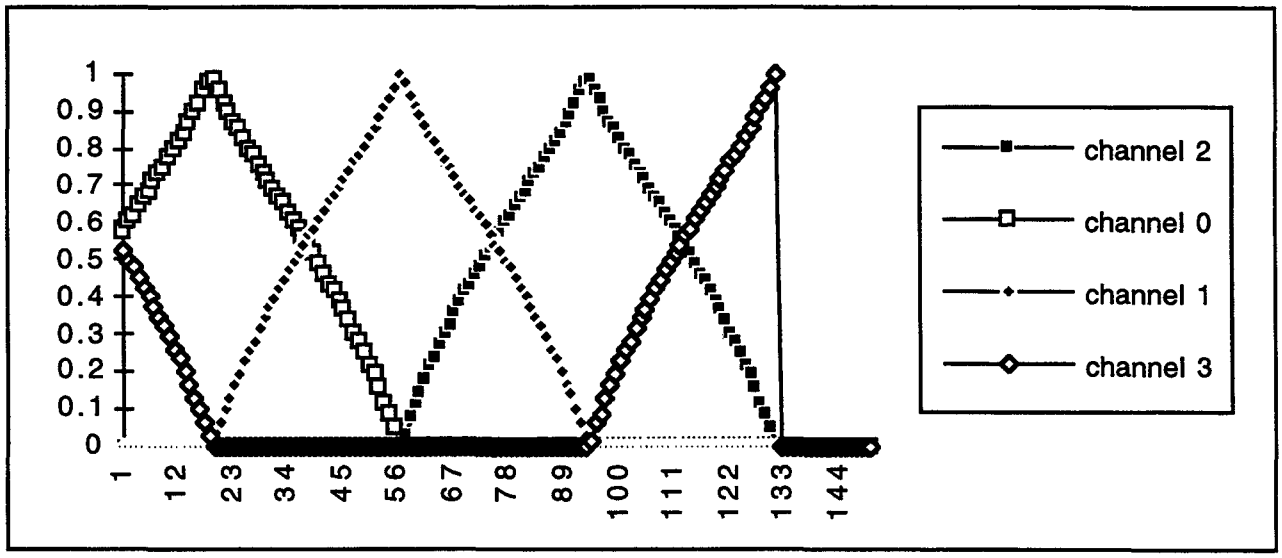

Figure 4. Output levels to 4 channels in the horizontal plane from a source moving in a circle around the space. (Time is represented on the horizontal axis.) Note the intentional non-linearities.

To adjust parameters, a program moves a sound in a virtual circle, causing smooth continuous panning around the four horizontal speakers. Parameters are adjusted to give a smooth perceptual motion without any pulsing (the "center boost" adjustment) or jumping (the "center dwell" adjustment).

Doppler shift is implemented using MIDI pitch bend control on the source (a sampling synthesizer). In our application, we were not trying to mimic a particular size of space or speed of motion, so we made the "speed of sound" a parameter. Lowering the "speed of sound" increases the Doppler effect. In general, we avoided any attempt to calibrate sound effects using physics. It seems that in an environment like this, perception is the only guide, so we adjusted parameters freely to achieve interesting and convincing effects.

Using the System

Our spatialization system consists of a Macintosh running a program written using the CMU MIDI Toolkit (Dannenberg 1993), but this is only part of the complete system shown in Figure 1. Originally, we planned to provide a general interface that would allow the animation software to specify the location and velocity in 3D for each of 4 sound sources. These could all be transmitted using various MIDI control change commands. What we soon discovered was that it made much more sense to develop specific protocols for each interactive segment of the show.

For example, there is one interaction where the audience waves paddles, causing a man to run around in circles (described more fully in Part 1 above and depicted in Figure 2). We developed a very simple protocol in which the animators only need to send out a start command, the angular position of the runner and the speed of the runner. Using this, our local software sends commands to generate heavy breathing and footsteps and moves them in a circle around the audience. With this approach, the details of the audio could be developed and tested independently from the animations, and the additions to the already complex animation code were minimized.

In general, the more self-contained we made the audio and its control, the more we, as sound designers and implementors, could test and enhance the sound without coordinating with the animation team. When schedules slipped (as they always do) and the deadline was looming, there was little time for further tuning, adjusting, and reworking. Although things worked out well, we should have anticipated this outcome from the beginning.

Sound Design for Audience Interaction

One of the challenges of the show was to come up with not just a few effects but a total sound environment for a complicated and fast-moving program. In terms of the implementation of the sound design, the show can be broken into two main parts: linear and non-linear sections. The linear section has a narrated script and soundtrack (by John Gore) that runs throughout. The bulk of the narration is handled by an adult "tour guide" figure, with two youngsters interjecting questions and comments. The tone of voice is conversational, and the characters have definite personalities. To create the impression of listening in on this conversation as it takes place, the voices are located in distinct places: the main narrator is centered in the overhead speaker channel and the two children flank her on either side. The comments from the young people often correlate directly with images on their particular side of the screen, which amplifies their physical spacing.

The non-linear interactive sections are interspersed throughout the show, so there are breaks built into the script and soundtrack. This void must be filled with a sound design environment that enhances the content and engages the audience. These environments vary in complexity and usage depending on the context of the visual content.

Some segments primarily call for feedback sounds that relate to direct manipulation of objects on the screen. This feedback reinforces the interaction techniques of the paddles, which is an important part of the early show segments. For example, as the audience moves an on-screen slider up and down, it is important to create a sound that mimics the movement. This creates an interaction that feels natural and intuitive, and gives the members of the audience a sense of empowerment and individual control. Also, as the visual imagery grows in complexity later in the show, aural feedback of direct actions gives

immediate reinforcement on group activity without forcing collective visual focus on one area.

Designing sound for a show on molecular biology is not an opportunity for literal mimicking of sound attributes, as it is doubtful anyone could rightly contest the actual sounds of a ribosome versus that of the golgi bodies. During the development of the script, it was decided that metaphor was the appropriate vehicle for both the written script and the sound design. A city was chosen as the illustrative object, with each cellular entity playing a different role, such as manufacturing, energy creation, communications hub and distribution center. This metaphor presents lots of rich sound possibilities and the relative functional connections can easily be made. As the imagery in the show is primarily scientific in nature, the sound has to be a constant reminder of our metaphor to be sure the audience retains relative organelle functionality.

These metaphorical sounds were used to illustrate the functional relationships between cellular parts in both the linear and non-linear sections of the show. Layered sound environments were created for each of the six highlighted cellular elements, which are included on the 8-channel tape in the appropriate spatial locations when featured in the linear segments. We also created long non-repeating beds on two compact discs for the transitions to and from the interactive sections. For the non-linear sections, these layers are played on the fly using a generated MIDI stream through a Kurzweil K2000 sampler. In order to eliminate audible loop points, each organelle has 1 to 3 continuously looping sound layers, each offset and of different lengths, on top of which anywhere from 3 to 20 more individual non-looping sounds are played. Some organelles play back a specific MIDI stream to recreate a precomposed pattern, and others use algorithmic music generation techniques to create pseudo-random sequences that never repeat during the show.

Fortunately, the K2000 sampler can be used to pre-mix a complex texture representing an organelle or any other sound source. In this way, even though our spatialization system has only 4 inputs, each input already represents a rich composition of sound.

With the limited RAM capacity of the sampler and a palette of just under 100 sounds, 16-bit 32 kHz sampled sound files were used as a compromise between file size and sound quality. All sounds are monophonic, as they are placed in space with our spatialization system. To preserve sound integrity, all sounds went through analog to digital conversion only once—either recorded digitally locally or digitally extracted from a sound effects library disc. All pre-layering, editing, looping and effects processing were accomplished with Passport's Alchemy and Digidesign ProTools on a Mac, and when completed were dumped directly to the sampler via SCSI.

As an example of how these sounds are used, in some of the interactive segments the audience pilots a large LDL molecule through a cell to certain destination organelles. Sound localization is used as a navigational aid, as each organelle has a distinct aural flavor. Sound spatialization is based on the distance and direction from the LDL molecule to all surrounding organelles. Since localization is stronger from front-to-back than up-and-down due to speaker placement, the plane of reference of the visual image is rotated so that "up" in the visuals corresponds to "back" in the audio. (This is not so strange to the audience: continuing "up" on the planetarium dome leads to the "back.") Left and right visuals correspond to left and right audio as would be expected. As the audience sees the cell nucleus to the right, they will hear the metaphorical "communications hub" sound environment approaching from the right. If they collide into the nucleus on the screen, they will hear a collision sound on their right, accompanied by a louder (closer) nucleus environment. This real-time mapping creates an intuitive orientation and navigation tool to aid the audience interaction.

Evaluation

Overall, we feel that our results are effective, and the sound certainly makes an essential contribution to the audience experience. The implementation approach met our needs, but it would have been much more interesting to spatialize *all* sounds rather than the limited set we could generate via the K2000 synthesizer. In the future, faster computers will make this possible by taking over all storage, processing, and playback functions.

The sound design resulted in a rich palette of sounds that seems to help the audience relate to the educational content. The continuous but subtle changes of location and reverberation of up to four independent sound streams further enriches the experience. In "Journey ...," we conservatively limited spatialized sound to the interactive segments. We look forward to future projects where spatialized sound can be used continuously and seemlessly for all audio facets of the production and where all these facets will be interactive in some way.

Part Three. Observations About Audience Interactivity in the Cell Project and Beyond

By Rob Fisher

Introduction

Audience and critical acclaim has followed the past year of daily presentations of "Journey...." But like most artists, one gets dissatisfied and perhaps hyper-critical of one's first efforts and wants to push on and evolve the art form. Such is the case with audience interactivity. As a project team, we felt we just uncovered the beginnings of very powerful possibilities. Urged on by positive response and encouragement from the National Science Foundation, the team developed a proposal for a new production tentatively titled "Tracking the Human Brain". In this new production, several very exciting partnerships were formed between the STUDIO for Creative Inquiry, the Center for the Neural Basis of Cognition and the Pittsburgh Supercomputer Center. But the most exciting aspect of the new production about the Brain is the opportunity to further explore and nurture what we discovered about audience interactivity in the Cell project. A valuable part of this case study is the evolutionary process leading to the next generation production, an evolution based in part on objective as well as personal critiques of the cell project from those who worked closely on it.

Positive Response to the Cell Show

The cell project was very well received in the scientific, education and art communities and certainly within the general public. It is estimated that as of October 1996 over 20,000 persons have seen the show in its original venue, the Carnegie Science Center. The program will continue to be presented both to schools and to the public during 1997 as well. Additionally, over 35 copies of the show have already been distributed to other planetariums worldwide. Ten thousand resource guides were printed for school groups attending the show. "Journey Into the Living Cell" has been covered by numerous newspapers, journals and other media including The Wall Street Journal, Wired magazine, and CNN. Additionally, the work has been presented and discussed in various national and international conferences such as Association of Science and Technology Centers, 96; the International Symposium for Electronic Art, 95 & 96; the annual meeting of the Society for Literature and the Sciences, 96; and the Fifth Biennial Symposium for Arts and Technology at Connecticut College, 1995.

NSF Evaluator's Comments and Remediation

An NSF evaluator was hired to formally evaluate the Cell show. He was very positive about the show overall, stating in his "critical appraisal report" that "One would have to 'declare' the cell show a success on the basis of its initial positive impact on the audience at the affective level and its coverage in a visually rich environment of a large amount of factual information relating to the workings of the living cell." However, there are several criticisms from his evaluation that are very pertinent to the future Brain project. They are also concerns which have motivated further refinement of our production model. They are certainly common criticisms regarding the development of active learning tools.

Our evaluator felt that audiences needed to be introduced to the interactive system more fully prior to the show. Otherwise *what* was being done takes time from *why* it is being done

in the show. In other words, unless the audience has an understanding of the interactive system beforehand, the learning of the system appears to detract from the conceptual learning to be achieved through the interactions. This problem was subsequently addressed by increasing the training of planetarium presenters to include two preliminary interactive sequences, the main focus of which is getting acclimated to the new paddle interface.

The first sequence simply lets the audience see the camera image of themselves and lets them find their seat by holding up their paddles row by row. There is no show-specific content to this interaction. In this way, audience members better understand how their paddle raising is tabulated by the computer.

The second sequence is a very simple exercise in which the entire audience controls a slider on a long slider bar. The presenters begin this sequence by having the audience position the slider at various points on the bar to get comfortable with the notion that to do so requirs a cooperative effort: half the audience holding up paddles and half keeping them down. This exercise has slight pedagogical content (it teaches about the dimensions of a cell), but the main focus is getting acclimated to the new paddle interface.

The evaluator noted that segues between interactives and the main show needed to be carried out in a smoother manner. Initially, the planetarium dome went dark and the soundtrack ended before the interactive exercises began. Greater smoothness helps the audience understand the relationship between the interaction and the preceding linear story. It was also felt that elements from the soundtrack should be carried into the interactions. An audio CD was produced, which was programmed into the show at the moment of transition, including student explanations and soundtrack elements, which solves this dilemma. In addition to fixing the gap, this also allows the young voices to actually explain what the audience should do. This relieves the presenters—who are generally less informed of biology than the astronomic content of most planetarium shows—from the burden of responsibility for content.

Audience Reaction to Interactivity in the Cell Show

Reactions of the audience to the interactivity system in the Cell show ranged from enthusiasm to nonchalance, to disbelief. It is the latter reaction that was for us the most intriguing. In this group the observer simply did not believe that there was any connection between the actions on the screen and his individual paddle. Some went so far as to imply that the interactivity was non-existent and that it just appeared to have a correspondence. An audience, in these people's minds, could never arrive at a clear and precise consensus in such a short time. (For example, the audience can readily position a slider along a comparative scale of sizes or find its way through a complex maze).

This is a good lesson for our design team as well as any other developer of interactive devices. Namely, users have to believe that they are recognized by the system and must be able to observe their personal impact. Given this challenge, in the context of our new project the design of the interactive interface will be subject to extensive research and refinement. The nature and effectiveness of the feedback that the audience receives will be thoroughly examined to maximize interactivity, motivation, and capability. We want the audience to succeed. The basis for the Brain project is that the audience can itself be used as an educational medium revealing to themselves, through their own behavior, many if not most of the major features of the brain's modus operandi.

Audience Interactivity in the Brain Project

The most innovative aspect of the new production will be the use of the interactive audience technique, "Cinematrix," introduced successfully in the "Journey into the Living Cell." It is our intention to expand the innovative, interactive system that has proven itself to be both workable and highly entertaining. Both the developers of Cinematrix and members of our team have intuited a potential relationship between the way in which the brain neurologically processes information and the way in which the individual audience members, using the system, unite to make a series of decisions. The possibility of using interactivity to provide an "x-ray" of the audience to itself and concurrently present complex information in an entertaining fashion should advance the field of entertainment and interactive technology significantly.

Evolution Of Delivery System From G.I.V.E. To G.I.B.E.

In the evolutionary design of delivery systems for science education, a guiding principle we have followed is the appropriate and subject-specific application of technology. In this new project about the Brain, which builds on the results and success of the prior NSF supported "Journey into the Living Cell" planetarium show, the change of subject matter from cell biology to the Brain and its behavior has led us to re-evaluate the previous delivery approach entitled GIVE (Group Immersive Visualization Environment). In the evaluation process we have isolated the key elements of GIVE that apply to this next generation project and proposed a highly refined multimedia metaphoric environment we call GIBE (Group Interactive Brain Emulator). The challenge is to align the presentation system with the subject matter and information so that the application of new A-V technologies is not gratuitous. Thus, while it made sense to immerse the audience inside a cell in order to suggest the liquid environment and the cell's architecture, the approach we are considering for the Brain focuses much more on task-oriented interactivity coupled with an enhanced stereo projection system that places the emphasis on the decision-making process and seeing and hearing. Special emphasis is given to this innovative scenario for presenting the subject matter. In an age of simulators and other virtual reality type entertainments, it is our belief that such an approach will capture the attention of a younger audience while the subject itself should find appeal in every age group.

Group Interactive Brain Emulator

The Group Interactive Brain Emulator transforms the planetarium into a virtual decision-making robot (a term coined by Herb Simon) whose task is to manipulate information in the form of images and sound and whose controls are in the hands of audience members who represent individual neurons and as a group become a metaphor of the brain.. The audience is both pilot and passenger, enabled by the technology to guide itself as a group through a lesson on the Brain. The environment is like a cockpit in which the audience is seated in a clearly segmented arrangement based on the brain's architecture with right and left hemispheres and a frontal lobe. The projection surface/audio space acts as an interface between the group and information about the subject matter. It offers navigational cues as well as a virtual stereo three-dimensional window in which images appear and events happen. There is no narrator. Voices, interactively responding to the audience actions, provide an "inner voice" that leads them or corrects them. It cajoles, admonishes, encourages, becomes irritated. The environment takes on a persona, a sense of presence, as if it is alive.

Rationale

The rationale for this shift in media emphasis is several-fold. Our interest in the Brain project is to demonstrate the manner in which the brain processes information. The emphasis on process finds its precedent in the interactive tasks developed for the cell project. In these tasks the audience was invited to use the interactive system as a tool to measure scale, as a navigation device to guide a molecule through a cell maze, as an ion exchange mechanism to expand or contract a cell membrane and as a pump to provide a cell with ATP and cause a running figure to accelerate or decelerate. These portions of the cell show were engaging, popular and novel as we believe this to be among the first times that group interactivity was coupled with science learning.

Audience As Medium

Observation of audience behavior during Cell show performances has suggested an approach for the Brain project that would utilize group behavior patterns, emergent behavior (leadership), and decision-making by a large group in which there is no traditional face-to-face communication.

Enhancement Of Audio/Visual Feedback

Enhancement of audio/visual feedback is another area of research that derives from observation of the audience during the Cell project. Navigational "directional signals" introduced during the cell maze assist the audience in recognizing the overall behavior of their input. The audience is divided in half with the left side of the audience controlling the up/down movement of the molecule and the right side controlling the left/right movement. In the upper corners of the screen, arrows point left and right or up and down as an aid to the audience. In the Brain project, the metaphoric architecture represented by the seating layout will when appropriate be projected on the screen, revealing to the audience patterns of their own behavior as it occurs. Points of light that are a picture of the reflective paddles being held up at any time will be displayed in a shape that corresponds to the seating layout so that there is a clear understanding, a one-to-one correspondence between audience member and visual image.

Use Of Audience Interactivity To Allow Experienced Based Exposure To Key Concepts

Audience members can be divided into groups corresponding to brain regions, and persons in each region can be asked to respond to particular sorts of information (visual, auditory, etc.). This will convey the idea of specialization of function. Within regions, individuals can be assigned more specific functions, e.g. to detect stimuli in particular locations, thus illustrating the topographic mapping of space within various brain regions. Combining input from multiple parts of the audience will allow illustration of cooperative action of the brain. Reassignment of roles of neighboring parts of the audience when one part is temporarily shut out will be used to illustrate plasticity and reorganization after brain damage.

Enhancement Of Pedagogical Techniques

The system described above fundamentally enhances traditional pedagogical strategies. Firstly, it allows for an active participation by the audience; they can actually manipulate objects of study. We liken this to the value of laboratory experiments in scientific education. Secondly, this interaction is special in that rather than encouraging solitary enjoyment, as do computer games, it promotes a social interaction. Audience members talk back and forth and will often coach one another. And lastly, and especially relevant to our focus on the brain, it will allow audience members to experience metaphors of neural response and perceptual thresholds as they see the responses of their neighbors projected on the screen as navigational cues. For example, we envision making each seat analogous to nerve cells, so by holding up their paddles at correct moments (as nerve cells would transmit charge in the presence of the proper chemical,) they could possibly assist in bringing an image into focus or a sound to the audience's threshold of perception.

Intelligent A-V System

Building upon the interactive system used in the "Journey into the Living Cell" project, an innovative aspect of the present project will be its adaptive nature. We propose to develop an "intelligent" system in which the difficulty or constraints on any given audience task is adjusted continually throughout the event. In the Cell show the live operator can adjust the difficulty of the maze sequence on observing the skill level of the audience. In the Brain, we plan to create an intelligent A-V system since the technology can provide a continuing portrait of audience behavior. Each vote cast can be monitored and recorded, both digitally and visually, presenting a data picture over time. The next generation system will evaluate the skill of the audience in realtime and alter contents, rate of presentation, and other factors accordingly. This will be done through the use of neural network software that will provide a realtime updating of system parameters to create "tasks" that are a function of the information provided by the audience. These "tasks" will be geared to the audience's skill and knowledge levels as revealed by their ongoing responses. This type of "biofeedback" system will serve to both illustrate how the brain functions and to "build" the presentation. Such adaptive learning systems are becoming more popular and feasible as exemplified by their use by the Educational Testing Service to administer the Graduate Record Exams at computerized centers across the country.

Planetarium Dome As Metaphor

Use of the planetarium surface with its domed shape, is an apt metaphor for the brain with different brain areas assigned to different parts of the planetarium dome. "Journey Into the Living Cell" laid out the parts of the cell on the dome surface; the brain lends itself even more to this because its surface maps nicely onto the shape of the dome. Patterns of brain activation can then be displayed illustrating the involvement of each part in different functions, such as perception, memory and language. An aspect of our research will be to see if this can be accomplished in realtime. The highly refined planetarium computer operating system, network of cable and connections, software and multiplicity of audio and visual hardware each have their analog in the human system.

Development Of A Studio, Lab And Classroom

During the evolution of the cell project, a one semester advanced class in Audience Interactivity was implemented at CMU to train, write software, debug the interactive system, learn to install and operate the system so that its operation could be learned and shared with others, and establish the robustness and predictability of the technology. A number of unrelated but highly effective prototype interactive games were developed by the class. These examples provided evidence of the potential of the system and led to specific interactions used in "Journey ...." The results of the class at CMU led to the highly successful presentation incorporated with the Cell project.

Interactivity is a topic of great interest in education as well as entertainment, yet the challenges for educators are immense, and seldom is it examined with rigor. Knowledge of these issues has led to several new strategies in the Brain production, most notably, building a dedicated classroom for in-house research and formative critique and evaluation. In this way, we will place a much greater emphasis on evaluation methods in our pre-production and production work than in the Cell show, a tactic that we feel is essential to maximize the pedagogical impact of our production.

An important part of the next project about the Brain is the design of an interactive studio/laboratory in which development of this and subsequent similar projects can be carried out in an academic research environment without the constraints and limited access of the planetarium. This flexible lab will enable the project team to experiment with all aspects of the program, from audience size and segmentation to content presentation, length of program, navigational and narrational devices, scope of subject matter, visualization techniques and interactivity. In this setting can be tested audience receptivity as well as the technical coherence of the system, especially at points between linear and non-linear narrative. Perhaps most importantly, it will provide an opportunity to monitor and evaluate the audience's receptivity to and understanding of the information presented; how well they are accomplishing the tasks assigned to them; how advanced is their progress. Evaluation experts working side by side with the show's creators will devise realtime in-line evaluation schemes

Conclusion

"Journey into the Living Cell" is regarded as a seminal project, representing a very high level of collaboration and invention in the emerging field of "edu-tainment". It broke new ground in the use of a planetarium for the presentation of material unrelated to space science, introduced to the general public an innovative audience interactive system, and presented to the public never before seen images from an esoteric but fundamental science. While it has been criticized for the overwhelming amount of information thrown at the audience, the show can be appreciated for its experiential beauty and lushness independent of its terminology and hard science. Immersion, sound, animation and entertaining interactive sequences transport the viewer into a new and different relationship with science than that ordinarily encountered in the classroom or even on Nova programs.

The task of creating this unprecedented production lay in the hands of many talented congenial artists and scientists. And it is a good thing that good humor prevailed since the task proved to be far more daunting than imagined. An artistic hand and philosophy guided the production, one that encouraged prototyping and experimentation, and maximized the application of the individual talents of the participants. After all, there were no models for us to base this experience upon and it was with great anticipation that we attended the first run through of the show to see what it was that we had created. Pressures of opening dates and

last minute technical issues mandated our accepting what we saw and heard as "the show." But we also knew that since this was in part a digital medium, we could "tweak" the results and did so with some regularity in the months that followed.

There is little doubt that we will do the next production differently. The addition of an interactive studio/lab will mean that we can prototype until we are happy with the results and can test and evaluate with a real audience under realistic conditions on a continuing basis. This will mean that the show production will be much more akin to working in an artist's studio with the added benefit of being able to move at any time to the actual planetarium space a few miles away. Since the interactive medium is so young and undeveloped we expect that an extended period of experimentation will yield a much deeper understanding of its limits and potential and will stimulate unanticipated scenarios for its use. Developing the entire show as an interactive audio-video event will also dramatically affect the continuity and integrity of the production. "Journey.." was a hybrid between a traditional planetarium show structure and something as yet undefined, one of those strange mutations on the evolutionary chain. It worked but....

As the perspectives of the authors of this paper and of the show suggest, embarking on research in the area of interactivity is serious technical and conceptual business. Adding to the mix the desire to communicate scientific information and making the final production entertaining as well would seemingly impose so many restrictions and parameters that one would have to think twice about trying to create art out of this stew. In fact, as our clear enthusiasm and motivation indicates, all of us who worked on "Journey..." can hardly wait to begin the R & D for the Brain Project, so fertile does this groundbreaking work appear. For what we are doing is producing a new artistic medium, with full knowledge that we have stepped into virtually unexplored territory, and that we are defining a new state of art/science in the process.

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VRML used in a Spinal Lumbar Puncture simulation

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Abstract

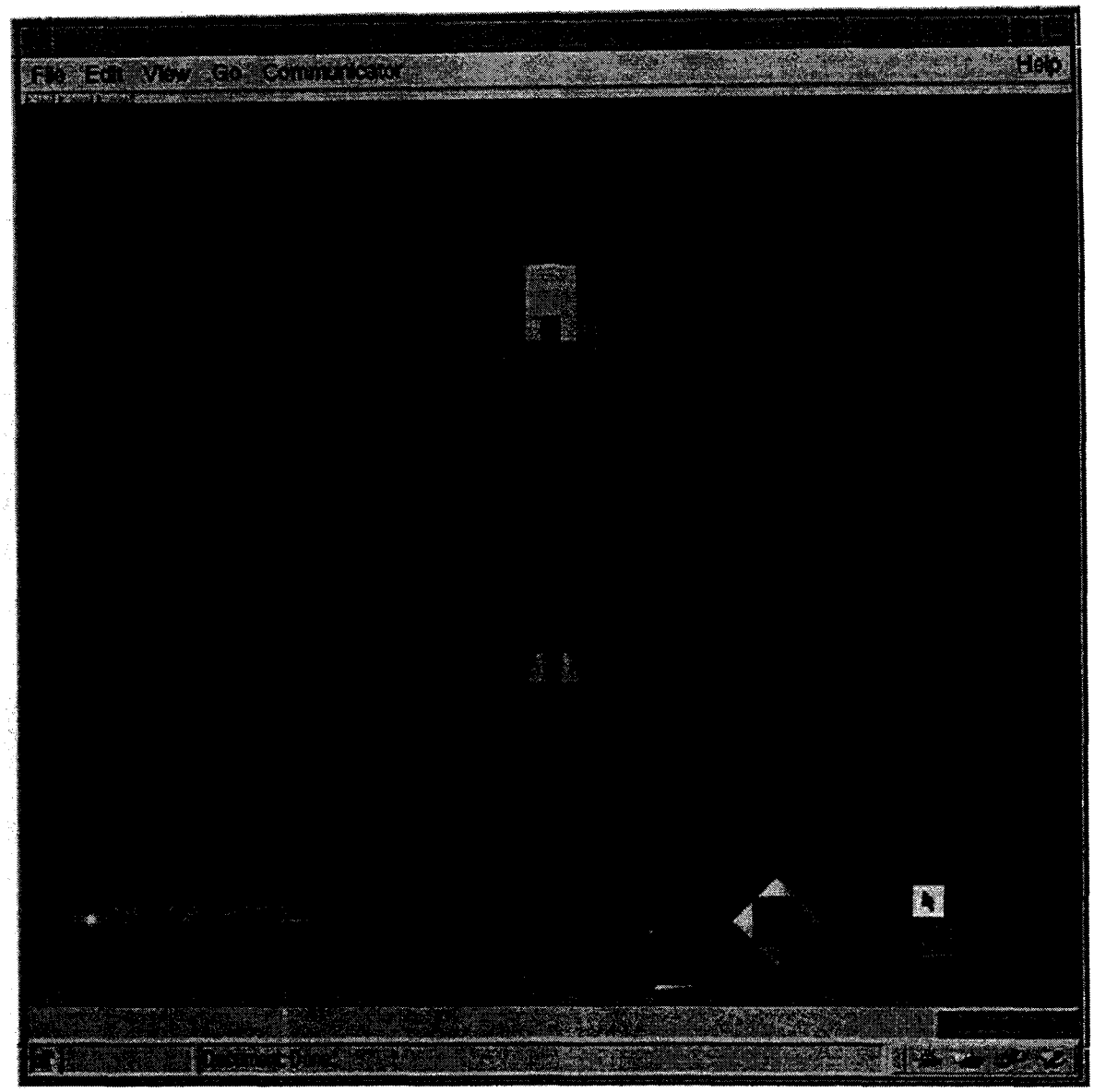
The simulation of spinal anesthesia introduces students to the task of needle insertion into the lower back of a patient. The purpose is to help the students build an appropriate mental model of this part of the body, and of the process itself, before their first application of the procedure to a real patient. Taken into consideration is the overall situation the practitioner will be confronted with when performing the task, the avoidance of inconvenience to the patient, and cost effectiveness. Special emphasize is put on the sub task of needle insertion.

The simulation will consist of two mode: 1) The exploration mode allows for the examination of the body parts involved, and to isolate parts from the model for separate examination (to introduce the student to the task and the parts involved). 2) The simulation mode is a three level representation of the task, with the first level allowing the student to trace the needle through a transparent model, the second level featuring a partly occluded view of the model, and the third level featuring the patient's back only.

Each level of simulation, as well as the exploration mode, allow for the interaction through force feedback devices. The force feedback is a very important part of the simulation as it is for the performance of the real task, because the practitioner must rely only on feel and some indirect visual cues.

Each level of the simulation has to be completed successfully several times by each student before he or she is allowed to move on to the next level.

Criteria for success or failure are the time needed to complete a pass, the number of unwanted collisions, and the deviation from the optimal path.



Executive Summary

The technologies (force feedback and interactive 3D graphics) suggested for this simulation, making use of low level, internet compatible formats, have only recently become accessible to a larger audience.

Still under development, they are about to become comatible, and will probably introduce a new era in the information age.

This thesis is looking at this development, the future application of this emerging environment - rich through the use of different media formats (text, illustration, animation, 3D graphics) and their interconnection - using the Spinal Anesthesia and Lumbar Puncture needle insertion task as an example.

Even though these technologies do not yet provide the necessary ease of use and compatibility to develop a working prototype of the simulation, this thesis is exploring these technologies for their application in training environments. At this

time, the thesis should thertefore be regarded as an investigation of future possibilities, and as an inspiration for thought and discussion of the whereabouts of technology and its use.

The introduction of simulator training into the curriculum for performing invasive medical procedures become possibile as soon as available technologies support realistic experiences. Universities are now discussing simulator certifications for laprascopic surgery (UNC). So it is likely that a growing demand for pre qualification training will force the development of all kinds of educational simulations like the one proposed in this thesis. Simulations based on standardized hardware and platform independent software will have an advantage in this future market.

The benefits of simulations include their cost effectiveness, economy of use, and transportability. The usefulness of simulator training has been proven many times, in military, civil, medical or technical applications. Simulations are beneficial to the training of medical staff and students as time, money and lives can be saved through well prepared personnel. Simulations can be shared by staff and students of different hospitals and universities around the world, ensuring high levels of proficiency worldwide.

Even though not all tasks necessarily demand a technical simulation, if society becomes more aware of simulation technology and more competent in its use, simulator training is likely to develop into a criterion for qualification. The learning of complex motor skills, like the needle insertion task to perform Spinal Anesthesia and Lumbar Puncture, is likely to become one of the skills supported by simulator technology. This is due to the unique combination of high level motor skills, high accuracy of the mental maps, and the short time desired for performance, all requiring practice to reach the desired level of expertise.

For this project, the needle insertion task for Lumbar Puncture and Spinal Anesthesia was chosen because

- it is an invasive procedure of moderate complexity
- takes a lot of experience to develop appropriate skills
- done incorrectly, it can cause considerable inconvenience for the patient

This thesis proposes a training application using virtual reality (VR) technology (3D graphics and force feedback), to help beginners form the necessary procedural skills which allow more effective first performance on an actual patient, when compared to contemporary approaches.

The assumption is that an interactive three dimensional computer model, representing accurate spatial relations and force reflections, will help students to build a good understanding of the task and the environment before the first real experience.

The objective is to provide the student with easily understood information about what she or he has to expect in the real situation, and to enable them to better interpret the tactile feedback and other cues they will encounter.

Success acquired through a simulation can also strengthen self esteem and motivation. The simulation's purpose is the formation of mental maps and basic skills, rather than to produce mastery of the procedures.

To learn about the process of Spinal Anesthesia for this thesis, a detailed task analysis was used to gain a first insight in the procedure.

A target group investigation involved short interviews with residents at the University of Pennsylvania hospital. A questionnaire was distributed to assess the degree of preparation by the students to perform the task, as well as their mental attitudes towards the first few procedures.

The students now learn the task by reading the literature, attending seminars, observing the performance of spinals, and eventually doing one.

The difficulty in learning to perform Spinal Anesthesia and Lumbar Puncture lies in the occlusion of the target surface the student has to aim at, using a thin needle that does not allow a redirection once inside the human body. To date, there are no possibilities for a student to train for the procedure other than in a hands-on experience with a real patient.

Skills not trained by the proposed simulation is the handling of different tools and medications necessary for the task, including different needles, drapes, septic solutions and anesthetics. These are mentioned only to complete the picture of what the whole procedure involves.

To develop the simulation of Spinal Anesthesia and Lumbar Puncture, it was necessary to get an overview of VR interfaces and force feedback devices currently available. Only one promising interface device available that could do the job without too much complication was found, the PHANToM by SensAble Technologies Inc. The only problem with the device is its price. But the PHANToM has three distinct advantages over gloves and joysticks: it allows for the degrees of freedom necessary, it does not need to be calibrated for each user, and it comes with different end pieces, allowing for individual tool use.

The simulations using the PHANToM also suggest that the high-resolution feedback works well enough for the anticipated medical simulation. The feedback that is created through this device is truly amazing in its sensitivity regarding surfaces and other object properties represented.

Functionally, the force feedback must accurately represent the parameters of the human anatomy. An expert practitioner set these parameters according to his own sense of touch when doing the task.

The force feedback is generated on a static model (it can't be moved while the force feedback device is active), reducing the risk of injuries to the user (through avoidance of unanticipated accelerations of the force feedback device), and requiring less calculation power from the computer. The user interacts with the model on the screen through both the PHANToM and traditional interfaces.

The proposed simulation allows the trainee to explore the environment (of the human lower back) both visually and in a tactile way, and to interactively learn about the human body, its parts, functions and feel.

The body geometry shown in the 3D simulation involves a section of three vertebrae, the vertebral discs, the ligaments (superspinal, interspinal and ligamentum flavum), the dura, nerve strings, muscles alongside the spine, and skin tissue, displayed on a neutral background.

This should help the students build an appropriate mental model of this part of the body, and of the process itself, before their first application of the procedure to a real patient. Taken into consideration is the overall situation the practitioner will be confronted with when performing the task, the avoidance of inconvenience to the patient, and cost effectiveness. Special emphasize is put on the sub task of needle insertion.

The simulation is geared towards an implementation using VRML/HTML, run locally under any webbrowser, ensuring platform independency, and allowing easy access through hyperlinks to task related information on the internet. Any interested user with appropriate hardware would be able to use the simulation at any given time and in any place. A related requirement is for the simulation to be useful without further investment beyond the possession of a force feedback device, and even without accessibility to a force feedback device.

The 3D simulation (using VRML) is embedded into an HTML document. The HTML document contains basic information about the process of delivering Spinal Anesthesia and Lumbar Puncture, the anatomy of the human lower back, and the necessary equipment to perform the task.

The VRML documents are separated into two modules, for examination and for the actualsimulation.

The examination module allows the student to explore the whole model or each single part of it. Taking advantage of the interactive possibilities inherent to these formats, the 3D graphics model of the body geometry is cross referenced with the anatomy section of the HTML document. This affords the user access to related information while using the simulation files.

Manipulation of the the human lower back can be manifold:

- free choice of perspective
- magnification
- parts can be isolated on demand.

Several feedback methods - color coding, aural feedback - are introduced to support the tactile cues, and to make the simulation work without the force feedback device.

The simulation module has three levels of visibility and restricted interactive possibilities. Each of the three simulation levels has to be completed successfully several times by each student before he or she is allowed to move on to the next level.

Criteria for success or failure are the time needed to complete a

pass, the number of unwanted collisions, and the deviation from the optimal path.

The VRML format does not currently support haptic object properties and required the force feedback demonstration to be established separately, using the inventor format and SensAble Technologies' haptic libraries.

The resulting force properties vary between the resistance of 0 (with the needle outside the body geometry), cooked chicken skin when going through the interspinous ligament, and the pop of going through a slice of eraser when hitting

the ligamentum flavum. Bone features chalky properties. Resistance is geared towards a needle as used for Lumbar Punctures.

The force properties in the demonstration reflect the properties of an average, healthy young man.

The design proposals feature sketches, models, animations and simulations, and the layout of the program structure.

Set up procedures include the construction of the 3D model, the export of data across platforms and applications, converting geometry data into the format of choice, and the programming of the force feedback using the libraries included in the PHANToM package, and the installation and calibration of the device itself.

The final design is presented through a description of the procedures applied and the process followed in the simulation. The design of the simulations described in functionality, form and procedure.

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