Science and the Art of Visualization

Sara Diamond

Director of Research, The Banff Centre

Director, Banff New Media Institute

April 13, 2005

The Banff Centre

- Arts, Leadership and Mountain Culture
- Music and Sound, Theatre Arts, Writing and Publishing, Media and Visual Arts, Aboriginal Arts
- Research Centre for Creativity and Transformation
- Banff International Research Station

Donald Cameron Hall

The Banff New Media Institute

The Banff New Media Institute (BNMI) was founded in 1995. It has a strong focus combining human needs with technology research and production. It explores multi-disciplinary arts, science and social science through think tanks, workshops, research and production.

Work with other research centers such as BIRS

BNMI summit

http://www.banffcentre.ca/bnmi

Research Professional Development: Summits

Fatoumata Kande Senghor. Visual Artist, Waru Studio, Senegal

The Banff Method:

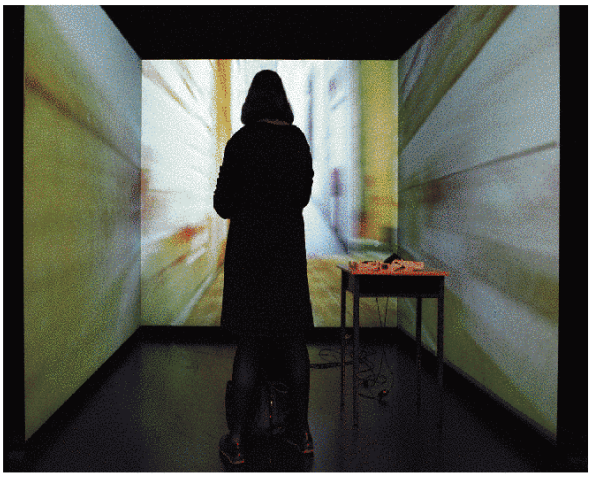
International think tanks on and off-site that bring together researchers, artists, companies--share ideas, develop and evaluate projects

Quintessence: The Clumpy Matter of Art and Science Visualization

Simulations and Other Re-enactments

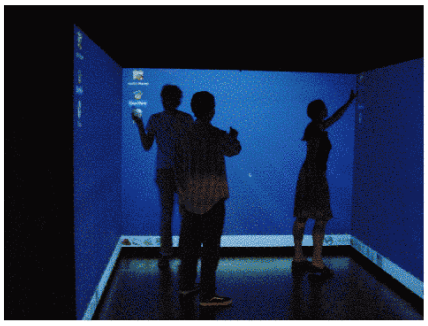
Carbon Versus Silicon: Thinking Small Thinking Fast

A.R.T. Laboratories



The Banff Centre's Visualization Lab

Visualization, Simulation, VR
Collaboration Lab
Mobile Lab

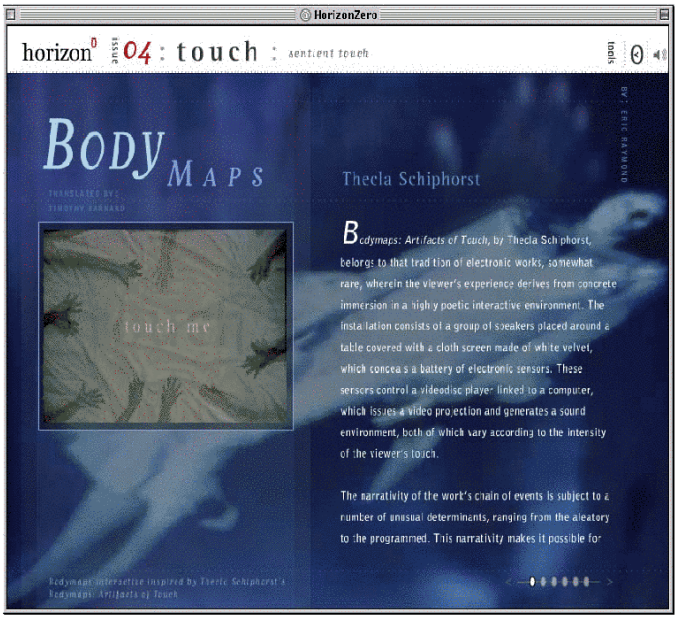


Visualization: Discovery, Expression and Cross-Disciplinary Knowledge

- The scientific method depends on observation, in defining the subject under investigation and in performing experiments
- Thomas Kuhn denied that it is ever possible to isolate the theory being tested from the influence of the theory in which the observations are grounded—visualization makes context available
- Visualization provides a bridge to that which is observed and to observing the invisible and dynamic
- It also can underscore the role of the observer, their effects and position—skill of art and design
- Heisenberg, "Natural science does not simply explain and describe nature, …it describes nature as exposed to our mode of questioning."

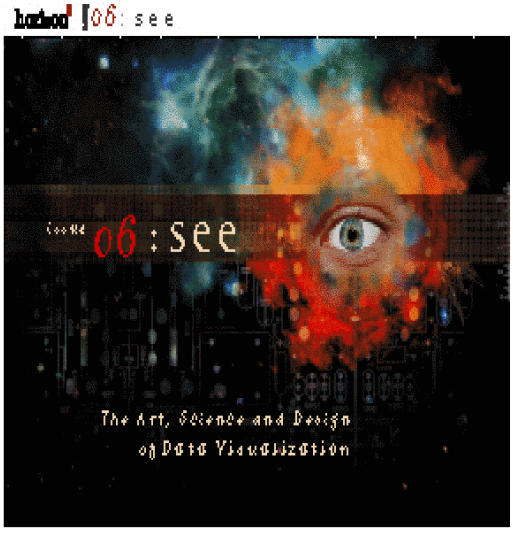
Visualization: Discovery, Expression and Cross-Disciplinary Knowledge

- Potentials of reshaping perception itself
- Embodiment
- Mark B. Hansen: "Machinic Vision"
- Expansion of the scope of the embodied human
- The selection of information is no longer performed exclusively or even primarily by the human component (the body-brain as a center of indeterminacy)



Visualization: Discovery, Expression and Cross-Disciplinary Knowledge

"…foregrounds the urgency… differentiation of properly human perceptual capacities form the functional processing of information in hybrid human-machine assemblages. Only such a differentiation can do justice to the affective dimension constitutive of human perception and to the active role that affectivity plays in carrying out the shift from a mode of perception dominated by vision to one rooted in those embodied capacities—proprioception and tactility—from which vision might be said to emerge."



www.horizonzero.ca See. Issue 6

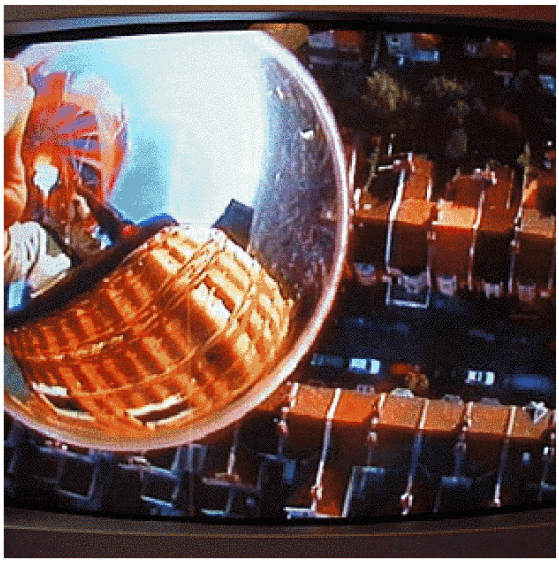
Visualization is multi-sensory

- "Visualization" includes sonification, audio is powerful realm in which to express and EXPERIENCE data
- Tactility—feeling, orientation, immersion
- Locative Design—moving through actual regions of study

n-Cha(n)t

Visualization: A tool for Beauty

- Artists define beauty through histories of modern art while scientists and mathematicians define beauty as simplicity
- Scientists look for theories that are "elegant" or "beautiful", meaning the ability of a theory to explain as many of the known facts as possible, as simply as possible, or at least in a manner consistent with Occam's Razor while at the same time being aesthetically pleasing



Luke Jerram

Visualization: A Tool for Beauty

- Most science remains closer to modernism—where artists sought the "essential"
- Antithesis of how many artists now work—context specific practice and deep understanding of language of expression as shaping all perception
- Data is never pure
- Banff ideal site to work out these tensions—FAST PROTOTYPING
- Pierre Boulanger—iCORE Chair--telematics and visualization—3D objects that can be manipulated in real time—interested in what is meaningful, even theatrical

Pierre Boulanger shows off the Banff New Media Institute's *Advanced Research Technologies* Lab

Realism, Abstraction, Representation

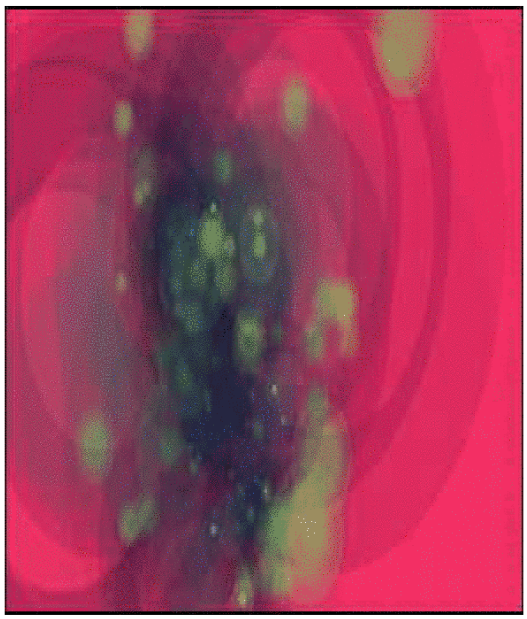
- Designers seek metaphors that are appropriate
- Challenge of communicating to audiences
- SEE is an issue of Horizonzero.ca
- It explores that ways that visualization always requires metaphor
- Subjectivity of images
- Color theory—color is both a scientific and a cultural object

http://www.horizonzero.ca

Catherine Richards, Banff, National Research Council of Canada

Spectators walk up to a microscope and peer in, holding a hand-sized sphere—they see images in stereo that flash with rapidity and create ghostly afterimages in the viewer's eye—they build up images only possible in the human mind.

Response to the Sudbury Nutrino Observatory—2 km. underground—observatory of the sun, scientists detect neutrinos through the spherical device—"filled with heavy water, it hangs in the earth like the yolk of a giant egg buried in the dark to observe the sun"—working with spheres—interested in the twin themes of shielding and immersion



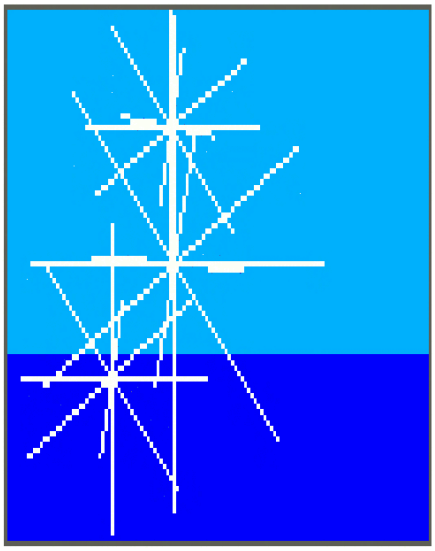
Catherine Richards, Banff, National Research Council of Canada

- Reversal of scales, peering into the dark to see
- Three worlds with fast flickering between these
- Used a wireless controller, mapped between Maya and Virtools to create spheres
- Built a paper clay ball to control the installation
- 2 Week fast prototype to test concept and technical challenges

Information Visualization

Web Stalker by
http://www.backspace.org/iod

"…The user opens a Web address, then watches as the Stalker spits back the HTML source for that address. In a parallel window the Web Stalker exhaustively maps each page linked from the URL, exponentially enlarging the group of scanned pages and finally pushing an entire set of interlinked pages to the user. The pages are mapped in a deep, complex hypertextual relation."



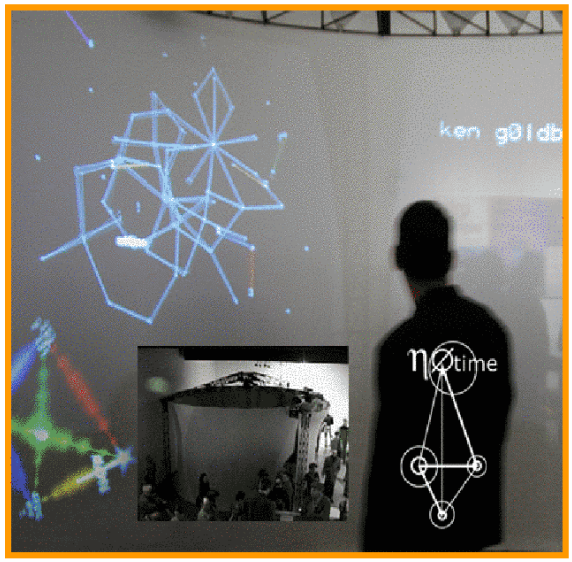
Visualizing the Time of The Internet

NoTime Project

Victoria Vesna

Visualization of information tracks of busy individuals

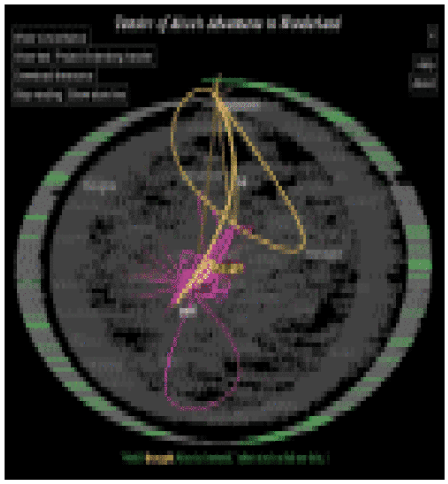
Your agent is active while you are offline



NoTime Project V.Vesna et al

Language Simulation and Visualization

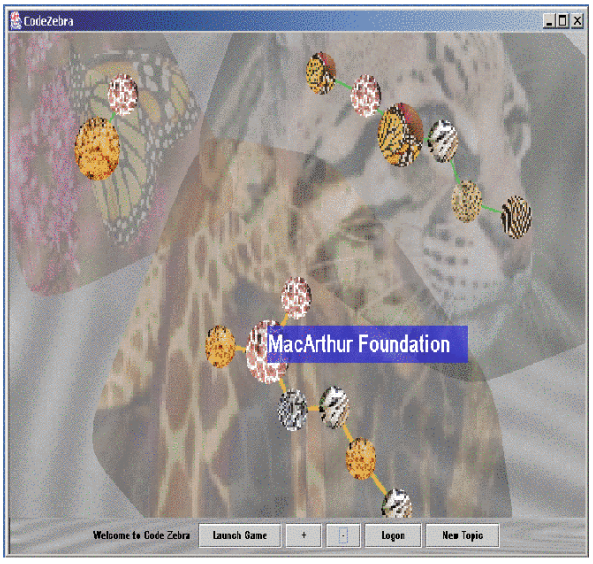
- "The linguistic turn"— language shapes understanding
- Enhance cross-disciplinary collaboration in face-to-face and on-line environments
- Build specific tools with participants
- E.G. Simulation of Simulation summit



TextArc by Brad Paley

Language Simulation and Visualization

- Made Use of conversation process in CodeZebra where dialogues are organized by topics, postings connected and emotional qualities of each posting read and group averaged

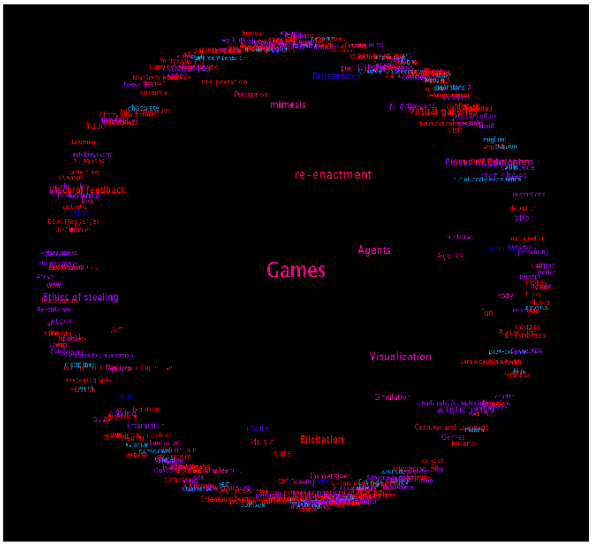


CodeZebra

Language Simulation and Visualization

Participants wanted to:

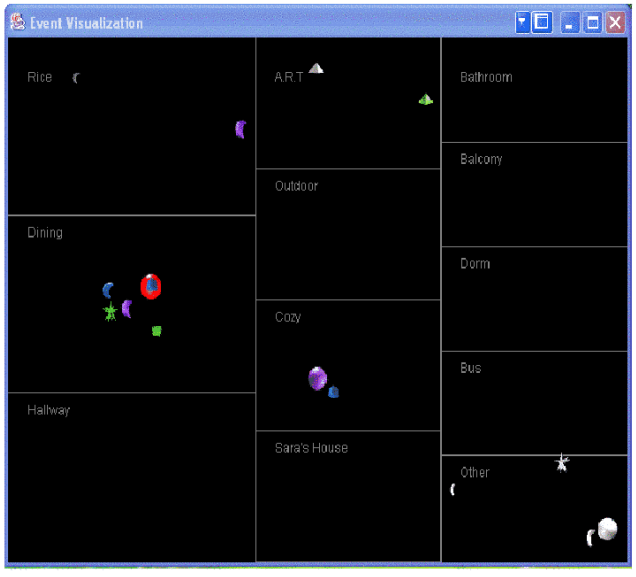
- See what the weight of concepts in the event were
- Track new ideas as emerged
- Find feeling towards the concepts



Word simulation

Language Simulation and Visualization

- See who was associating with whom
- Literally trace the social architecture of where ideas came from (dining room, pub, my party)
- Relate emergence of popular concepts to social network
- Required extensive data collection
- Next generation, automatic collection—develop physical prints or embroidery of patterns using disappearing threads (CodeZebra and Simulation Tool)



Language Simulation and Visualization: CodeZebra

CodeZebra

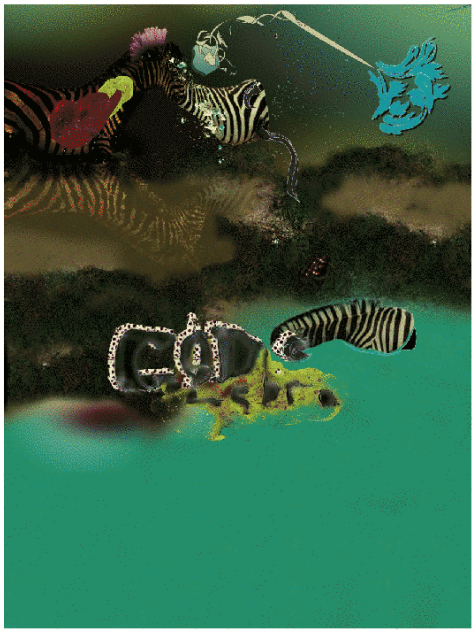
Language Visualization tool for real time dialogue on the Internet

Responding to text intensive nature of chat

Create a tool with all of the strengths of chat but with the capacity to show "affect", be used in performances, conferences and on-line, or side by side with television environments

Has been used for dance events, fashion expression as well as chat

www.codezebra.net



Language Simulation and Visualization: CodeZebra

Inspired by natural patterns of relationship

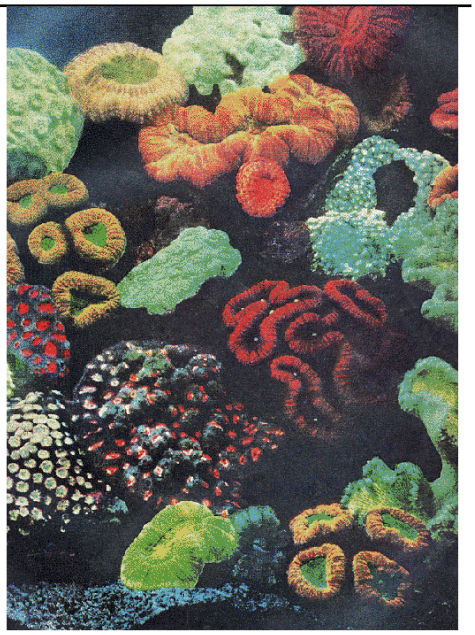
Reaction diffusion and voroniod sets

As environment grows it reshapes itself, adaptive

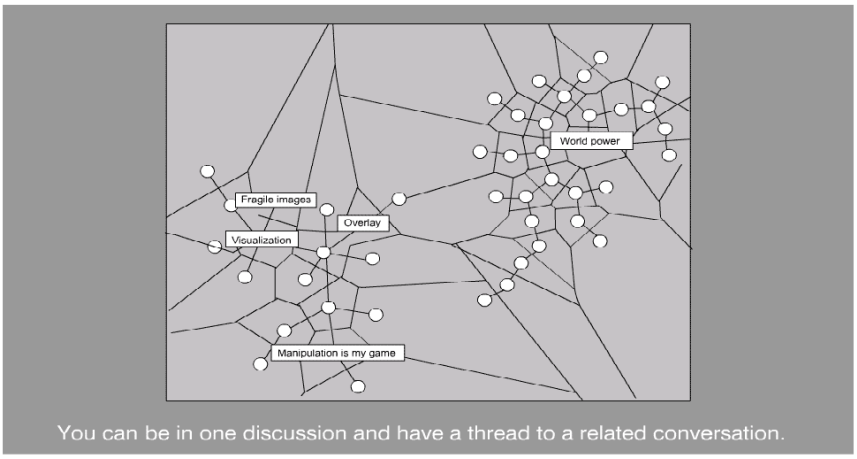
Indicate social relationships

Conceptual relationships

Emotional state

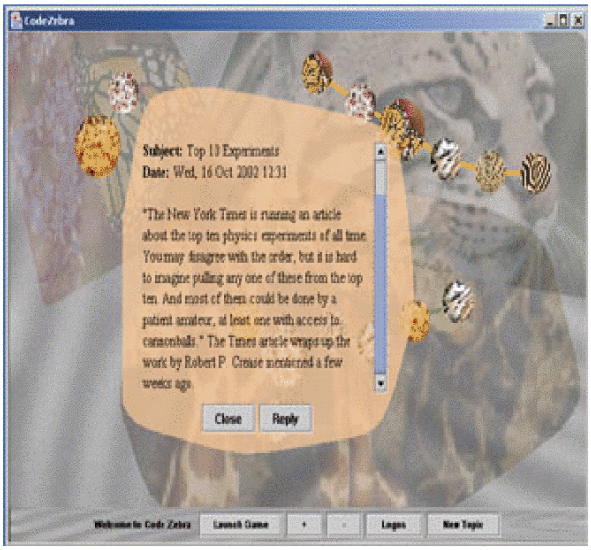


Language Simulation and Visualization: CodeZebra



code zebra project

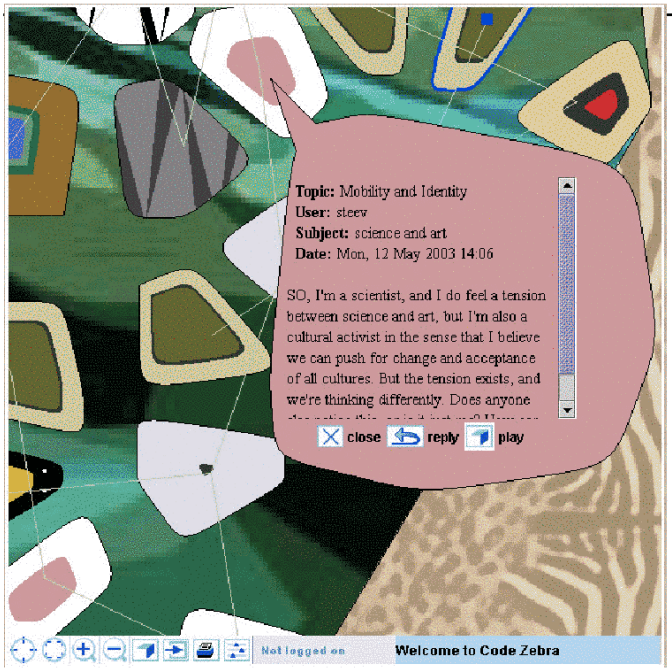
Language Simulation and Visualization: CodeZebra



CodeZebra

- Real time analysis of links between postings
- Color used to designate timeliness versus history
- Each client was adapted to the history of the user
- Big worlds allowed view of Topics, subjects, user and time stamp

Language Simulation and Visualization: CodeZebra



Prototype Three:

- **AI worked in developing the characters**
- **Each conversation was averaged**
- **Could choose to play a game to resolve disputes**
- **Tests: Habituation Cages; Conversations between Computer Scientists and Nanotechnology researchers, Sociologists, U. of Surrey**

Language Simulation and Visualization: CodeZebra

CodeZebra

Process and Media—video, chat, face-to-face

- Time and collaboration: face-to-face, on-line chat and posting time, living in the asynchronous http.www.codezebra.net
- Flexible creative tools versus closed systems

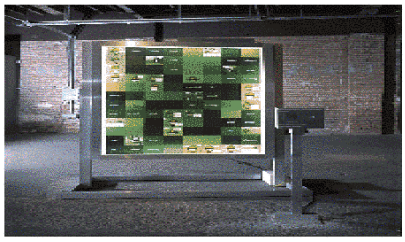
CodeZebra

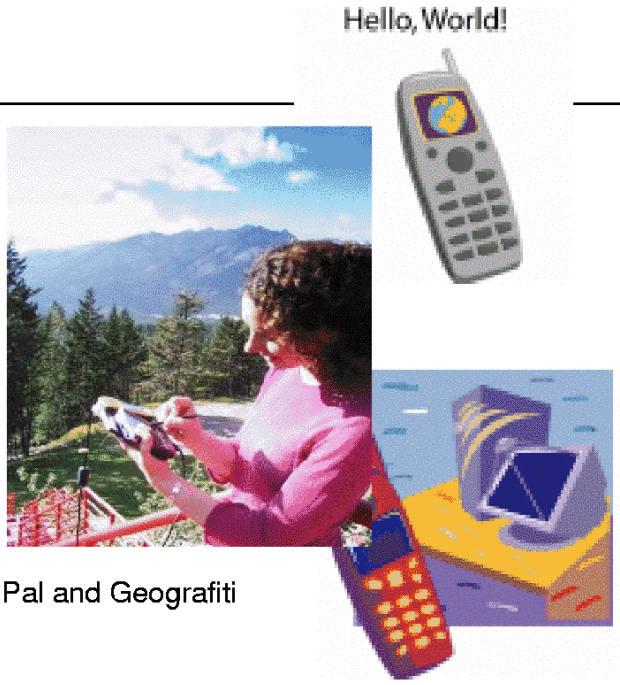
Language Simulation and Visualization

- Next generation, automatic collection—relate location and concepts
- Develop abstract patterns
- Develop physical prints or embroidery of patterns using disappearing threads (CodeZebra and Simulation Tool)

Mobile Media and Visualization

Large-scale social networks, mobile technologies and location based experiences



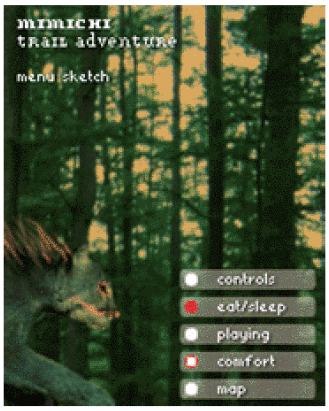


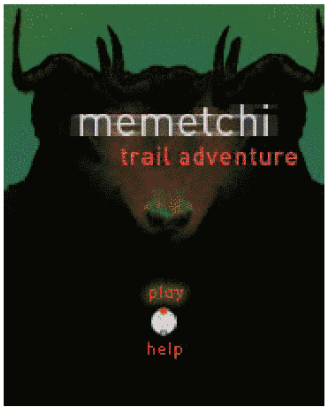
PDPal and Geografiti

Global Heart Rate

- Embodied understanding of environments
- Consider relationships between space and time of the geological and biological worlds and those of the human body
- Use actual data from environment, accelerometers and biometric readers
- Applications: national parks in Canada; monitor ecological crisis points
- Goals: lifestyle, sports, wellness and education
- Learning about the environment and create responsibility systems for fragile environments
- Link human embodiment with animal—link human histories with animal and environmental
- Amplifying emotional experience in park
- Use blogging and personal diaries
- Content for different markets that is "personalized"

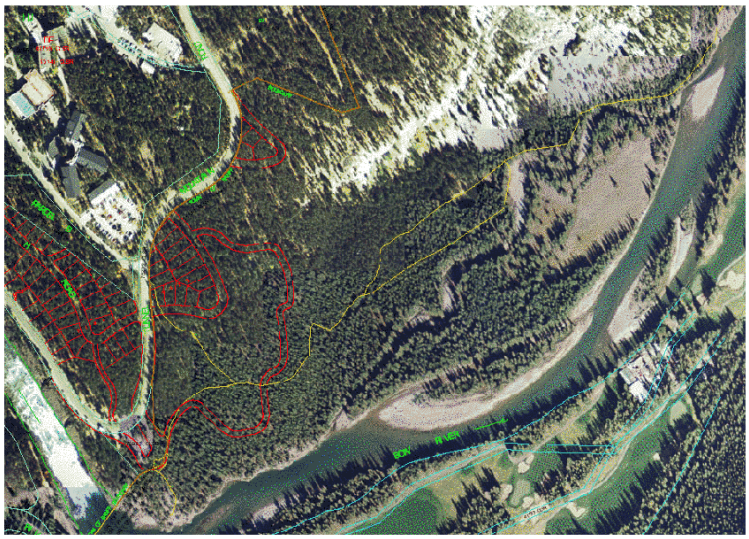
Global Heart Rate: Game Design Prototypes



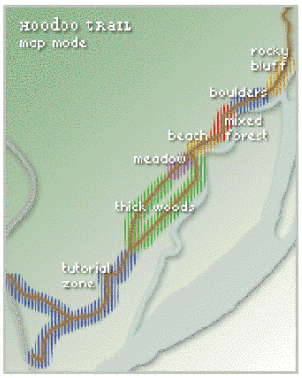


Screen interface sketches

Global Heart Rate: Game Design Prototypes



Hoodoo Trail aerial view with GPS data

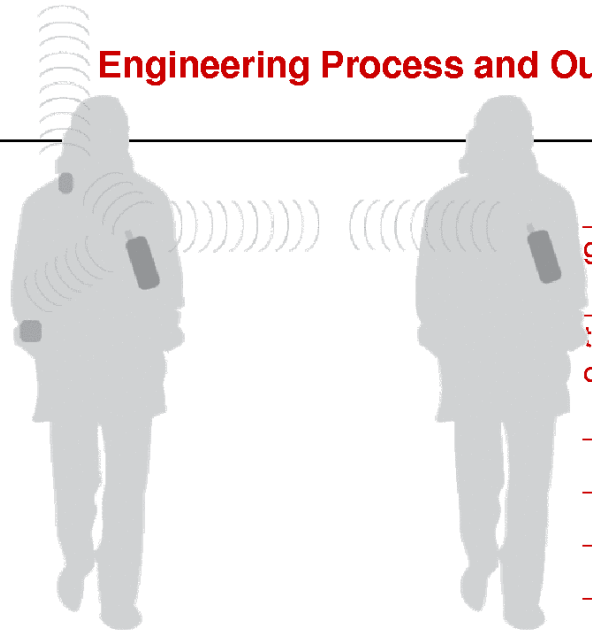


On-screen map view

Global Heart Rate: Game Design Prototypes

Locative cinema experiments

Engineering Process and Outcomes



_iterative design process with versions of the games

_authoring system for mobile locative content that is ineractive—viable for engineers and content creators

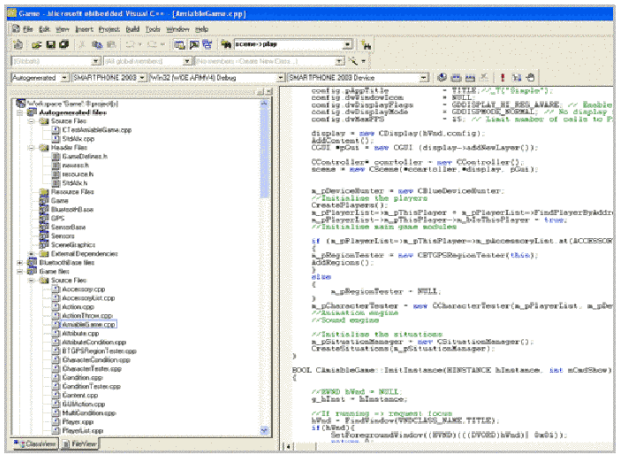
_results of fast prototyping

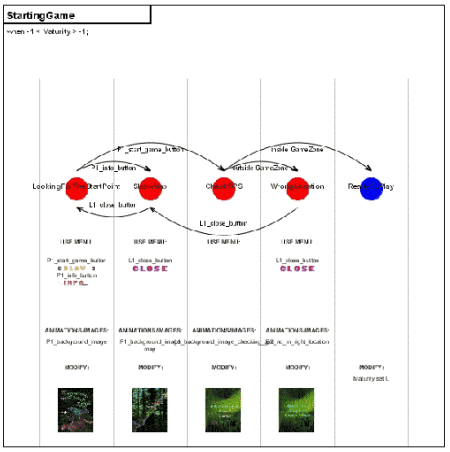
_bluetooth accelerometer to phone for gesture

_bluetooth phone to phone for p2p applications

_GPS to mobile phone for locative applications

Engineering Documents



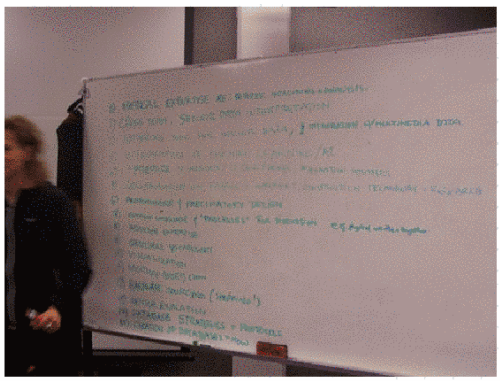


Automated XML and game-flow-diagram generators

MOBILE DIGITAL COMMONS NETWORK

Collaboration Network Staff

Design workshops/Iterative Design



Game design workshop, Banff, October 2004

MOBILE DIGITAL COMMONS NETWORK

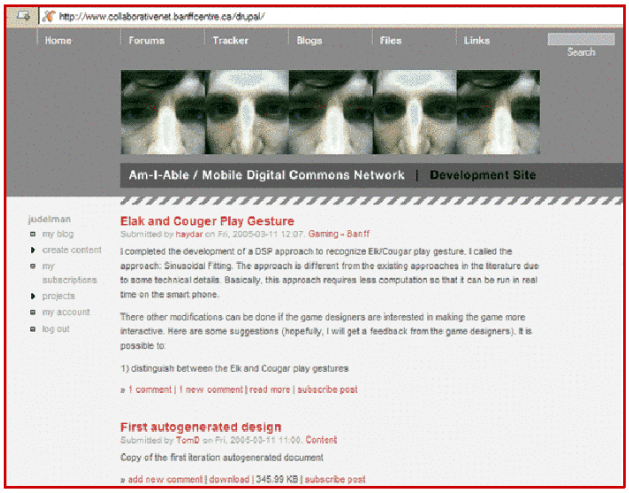
Collaboration Network Staff

Use of Technologies

Evaluation:

Understanding Social Collaboration in the Mobile Environment

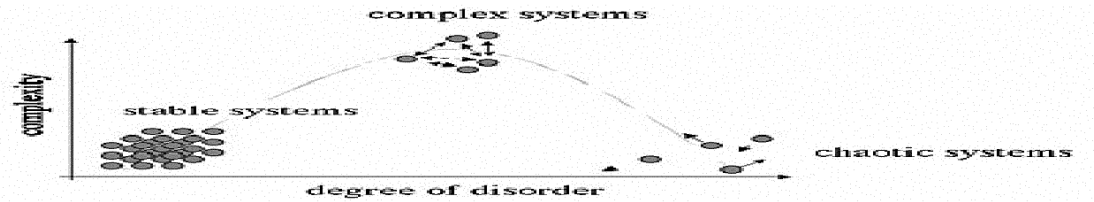
On-line development of content and engineering combined with Development of project in the field



Screenshot of project development website

Cross-disciplinary teams and collaborative technologies

- **Networks, ageographic relationships distribute skills**
- **Technologies change relationships in co-located as well as distanced contexts**
- **Visualization is key to providing "materials" for scientific collaboration**
- **"Boundary objects" between disciplines that can bridge knowledge**



Visualization of Science Innovation
Barry Sanders and Maria Lantin

This initiative is focused on using visualization to convey the abstract possibilities and implementations of quantum information to multiple audiences:

Science centre (family/children)

(artistic; colorful; heavy on physical interface)

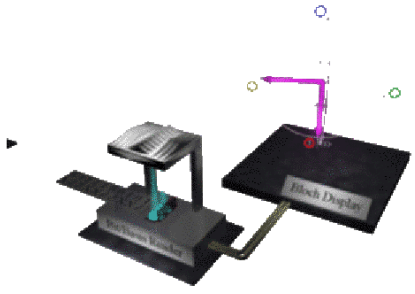
Educational (technicality and explanation; but still easy to understand

Decision makers

(similar to educational)

Quantum

Visualization of Science Innovation
Barry Sanders and Maria Lantin



Quantum

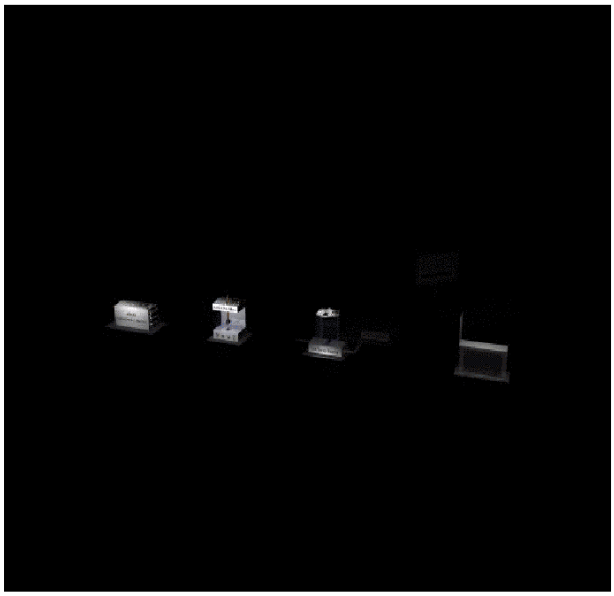
Mr. Photon Game—created in the CAVE, on mobile phones and with an accompanying Television/DVD program

The problem of detection and the capacity of quantum information to arrive unscathed

Player "picks" a photon of a light source with laser pointer as a pulse inside the CAVE—chooses a door

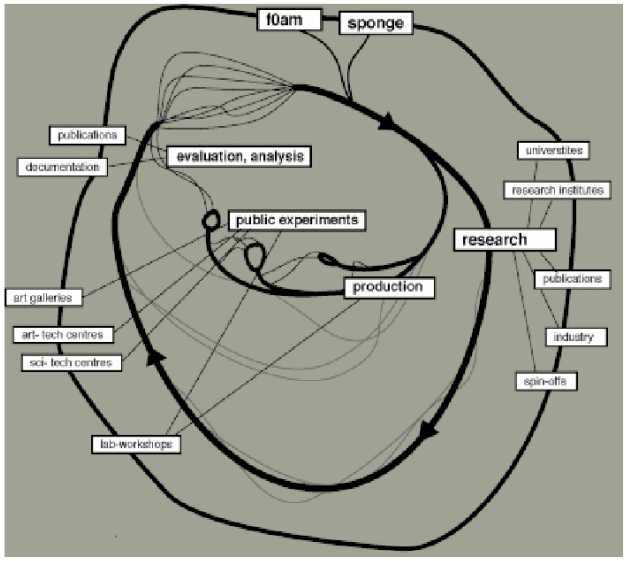
The photon leaves crystal in known state; already dressed by Alice

Visualization of Science Innovation
Barry Sanders and Maria Lantin



- Some photons won't get to bob:
  - due to noise in the atmosphere, temperature fluctuations change the refractive index of air (this scatters the light)
- Eve can control this (eve is all powerful)
- Once mister photon gets to bob, mister photon is safe from Eve
- Eve – progressively more complex attacks
- Public Score
- Learn through physicality of doing

Creation and research combined



T-Garden/F0.am and Sponge

- Flow of research and creation (model from think tank at Banff)
- (SPONGE/FOAM/T-Garden)

http://f0.am