

Monika Fleischmann/ Wolfgang Strauss

MEDIAL ARTS AS KNOWLEDGE ARTS

“Artistic processes are always part of the sciences, especially where new and surprising discoveries are made.”

Paul Feyerabend¹

Research in Art and Technology

Research forms the basis of any creative practice. It is meant to help us increase our knowledge about human beings, their cultures and their societies, and to use this knowledge for the benefit of these societies. This applies equally to the natural sciences, the humanities, and to engineering and the technical sciences. Researchers are searchers. Etymologically, the English term clearly derives from the Old French “recherche”; interestingly, however, the modern German “forschen” has its roots in the Old High German term “forsca,” meaning “question.” Researchers search by asking questions, by questioning, by calling things into question. They seek or find answers—sometimes by searching quite unconsciously, in a daydream, as it were. In these instances, academic research resembles artistic research. In art, one tends to find rather than to seek. Artists experiment with ideas, and they do not necessarily do so with a particular purpose in mind. The results are works of art and manifestoes—rarely, however, academic treatises. PABLO PICASSO is quoted as having said: “I do not seek. I find.” In terms of artistic research, finding means going in new directions and leaving behind the familiar world of the known.

Science starts with collecting, ordering and describing the material under scrutiny. It formulates hypotheses and theories that are then either confirmed or refuted. Art, by contrast, is a system of expressions of culture in general. Like a mosaic, art and culture are made up of a diverse range of individual artistic expressions. What constitutes art is the process of studying, producing and looking at works of art; artistic research sees, hears, smells, feels, is curious and finds. Taking more subjective, less easily standardized approaches, artists make poetic, radical, subversive, political, ironic and erotic statements. BAZON BROCK equates the role of the artist with that of the inventor who offers individual propositions and thus creates something new.²

The intention of “medial art” (*Medienkunst*) as “knowledge art” (*Wissenskunst*) consists in reflecting on the system of art, technology, and society and drafting new models of perception and action. The art historian SÖKE DINKLA describes “knowledge art” as “a connection between science and art, or more

precisely: between science and the arts.”³ By linking art and information technology at the level of content, medial art integrates scientific methods into its processes as a matter of course.

Medial Art as a Field of Research

The artistic research of medial art deals theoretically and practically with digital media and its reception. The technology, which we all use daily, often creates dependencies, which seldom reveal the truth behind things. Since 1987, we have worked as medial artists, seeing things not only as they are but also as they could be. We work on the conceptualization of medial notions of the body, space and energy, with technology that has evolved from KONRAD ZUSES’S Z1 codeable calculator of the 1930s to today’s interactive information and communication media. In information technology, interactivity describes the ability of a program to react to a user, that is, to interconnect with and feed back into human action. In the time of ubiquitous networked media, the traditional understanding of the interaction between man and machine changes significantly. Man no longer only communicates with a machine, but communicates in a sort of medial reflection with himself, or sets himself by means of the new medium in connection with others.

Located between the physical world of the machine and the ideal world of mathematics, the study of information technology is a structural science, concerned with information and its automated processing. What characterizes this discipline is then automation of intellectual labor. Units of information that are meaningful to people are digitized, thus brought into a form that a machine, which knows no meaning, can process. Machines increasingly decide on relevance and meaning of information. Search engines work on a principle of reciprocity: it isn’t just that people find something, but also that something finds them. The question is, what reads us, as we are reading? Critical medial art sets the disclosure of structures in place of full intellectual and technological automation and “retroperspectively”⁴ looks at the origins of the Internet’s “Interconnected Networks.”

New Thinking About Dealing with Information

The scientist VANNVAR BUSH stated in the 1940s that with the growing mountain of research, specialization increases and researchers hardly have the time to fully comprehend their peers’ results.⁵ In his visionary article, “As We May Think” (1945), BUSH, today considered the father of the Internet, describes his idea of “Memex” (abbreviated from “memory extension”). As a knowledge-management system, the “Memory Extender” should support human memory and order the flow of information: “A

memex is a device in which an individual stores all his books, records, and communications.”⁶ It was meant to network scientific findings in an associatively, and in doing so, pave the way to new ideas. In his analysis, BUSH states that the real difficulty in selecting information lies in the “the artificiality of systems of indexing. When data of any sort are placed in storage, they are filed alphabetically or numerically, and information is found (when it is) by tracing it down from subclass to subclass.”⁷ This process is reminiscent of the ways in which today’s search engines operate. The human mind, however, “operates by association. With one item in its grasp, it snaps instantly to the next that is suggested by the association of thoughts, in accordance with some intricate web of trails carried by the cells of the brain.” What ought to be mechanized is thus the process of “[s]election by association, rather than indexing.” Selection through association is a principle that TIM BERNERS-LEE realized to some extent through the hypertext-system of the “World Wide Web” (1989). The concept of hypertext underlying the WWW goes back to TED NELSONS “Xanadu Project” (begun 1960). Nelson took a new approach in concentrating on the data structure within a network rather than on the technology. His ideas differ still from those in which the WWW is transcribed today: “It is vital to point out that Tim’s view of hypertext (only one-way links, invisible and not allowed to overlap) is entirely different from mine (visible, unbreaking n-way links by any parties, all content legally reweavable by anyone into new documents with paths back to the originals, and transclusions as well as links—as in Vannevar Bush’s original vision).”⁸ Nelson’s ideas concerning copyright and authorship also come into consideration today.⁹

Artistic Research into Interfaces

Digital media can, however, only fully unfold their technical potential in a realm that lies essentially beyond considerations of a purely technical nature. Societal discourses, as pursued in art and culture, offer competences, modes of reflection and alternatives for action that are traditionally unavailable to the technical sciences. Given the Internet’s evolution into a global information and knowledge medium, organizational, structural, linguistic and semantic questions are gaining increasing significance. Medial Art here becomes interface for the design of and reflections on societal interactions and digital media as part of a structure of communication and knowledge.

The artistic research into interfaces projects new paradigms of interaction and differentiates itself from pure technological research in that it does not rely on models and simulations alone, but develops experimental tools and methods setting the scene for the emerging work proper. Ergonomically speaking, artists invent intuitive interfaces. From the point of view of media theory, these interfaces are essentially performative in nature and support perception and awareness of action processes. As communication media, the interfaces allow, according to user preferences, contemplative, explorative, narrative, or

structuring access to information. They invite the user to pause and reflect, and to enter into a ritual, experimental and educational state of play. The interfaces of medial art have a disruptive effect, as in WOLFGANG ISER'S notion of the "blank space" (*Leerstelle*)¹⁰, which demands attention and thus supports a reflective reception.



1. Liquid Views

In the series of works that make up "Liquid Views" (1992/93),¹¹ an interactive situation emerges that draws the viewer into the picture. A complex narrative is created through minimal interactivity, perceived through a process of self-reflexivity or autistic opposition. By means of a "viewing-machine," created by connecting a computer to a video camera, the participant bodily realizes the OVID'S myth *Narcissus*. Attention develops from the staging of seduction with an inbuilt experience of disruption. The disruptive factor in "Liquid Views" is produced by the viewer'S interference with the picture: the picture dissolves and reemerges, slowly coming to rest in its original form. Visitors to the Sevilla Bienalle 2008—"YOU_niverse"—loaded their own photos from their cell phones onto the Internet. Through mobile communication technology, the original site-specific and intimate staging of the work experiences a changed mode of participation and mass reproduction on the Internet. In accord with the title of the exhibition, the viewer acts as a part of the system and a part of the YOU_niverse.

Knowledge Arts as Information Networks

SIGRID WIEGEL describes the "Knowledge Arts" (*WissensKünste*) as encounters between the art of knowledge and the knowledge of art. We define our artistic research into knowledge media and the visualization of information as "knowledge art." In the history of ideas and knowledge-oriented practices, visualization serves as a method of portraying and conveying information. In science, measured data is processed; in art, invisible processes are visualized. In medial art, both forms of representation are united. Medial art as knowledge art is interactive, generative, and semantic. It is an art form that transforms

digital information and translates it into an aesthetic of participative processes. Information is made available to the recipient as material to playfully manipulate. Semantic Interfaces and cartographic tools analyze the hidden references and relationships in archives of data, making the data visible through a metaphorical “mapping”¹² of information patterns. This mapping links aesthetics, media archaeology and informatics, and creates realms of knowledge to be experienced through the senses and cognition.¹³ The digital knowledge artwork is simultaneously an archive, exhibition space (*Schaulager*), and a stage for forms of data representation.

By “knowledge,” we do not mean the sort of knowledge bound to human beings, but knowledge that originates in machine processes controlled by humans and in artificial neuron networks (“self-organizing maps”¹⁴). Human beings train this mapping-system, which itself is as capable of learning or ‘intelligence’ as the training permits. The data mapping reveals the invisible connections within the data pool. An archive is then no longer a card box, but rather a net of information. At the exhibit “Wissenskünste,”¹⁵ SÖKE DINKLA made the following analysis of the performance installations:

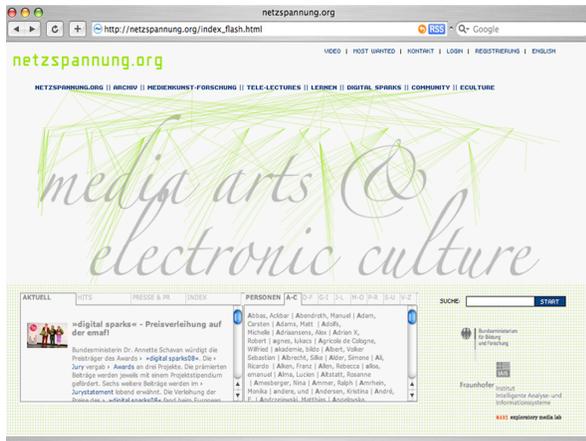
“Fleischmann and Strauss use digital media in order to restructure the current mode of knowledge, to make it available to the senses, and thus to feed it back into the discourse about medial culture. Knowledge is not acquired here through reading or hearing, but rather through physical, bodily means. That distinguishes their work. In many works of Knowledge Art the content is at least as important as the technology. Sometimes this relationship between form and content is turned around—there is an initial desire for a certain form which is then gradually filled by content.”¹⁶

Creating Relationships between Information

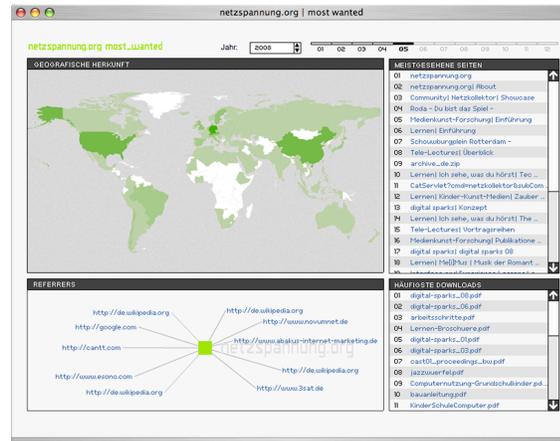
Through the development of the medial art platform “netzspannung.org”¹⁷ we took our bearings of an idea by MARTIN MINSKY, a researcher doing work on artificial intelligence: “Can you imagine that they used to have libraries where the books didn’t talk to each other?”¹⁸ The platform was one of the first online archives with its own tools for the structuring and visualization of data. A subject editor arranges the works and learning models thematically. Artists and curators can upload their own works in the “netzkollektor.” Users can compile and arrange content according to their personal interests: thematically, chronologically, historically, at random in the form of images or by direct search in lists. Synchronized visual representations refer to the forms of the “Memory Theatres” and ABY WARBURG’S “Mnemosyne-Atlas,”¹⁹ which through its ordering system shows what cannot be seen and, in doing so, brings together philosophical and historical modes of (image) perception. The “Knowledge Discovery Tools”²⁰ from

Fleischmann, Monika; Strauss, Wolfgang: Medienkunst als Wissenskunst. / Medial Arts as Knowledge Arts. In: Wissenkünste! Das Wissen der Kunst und die Kunst zu wissen. / The knowledge of the arts and the art of knowledge. Sabine Flach, Sigrid Weigel (eds.) VDG Verlag und Datenbank für Geisteswissenschaften, Weimar 2011

netzspannung.org present the artwork on the platform as a result of this process of creating relationships. Current trends in the field of medial arts are linked semantically and through multiple media, and documented in the form of texts, videos, and lectures, as well as teaching and learning material. As of February 2010, ten years after its online-debut, the platform contains about 2,500 contributions and is accessed monthly by up to 150,000 visitors throughout the world. “Most Wanted,”²¹ the application visualizing user statistics, depicts the worldwide accesses—netzspannung.org is a digital archive, virtual artist museum, and a place of learning on the Internet.



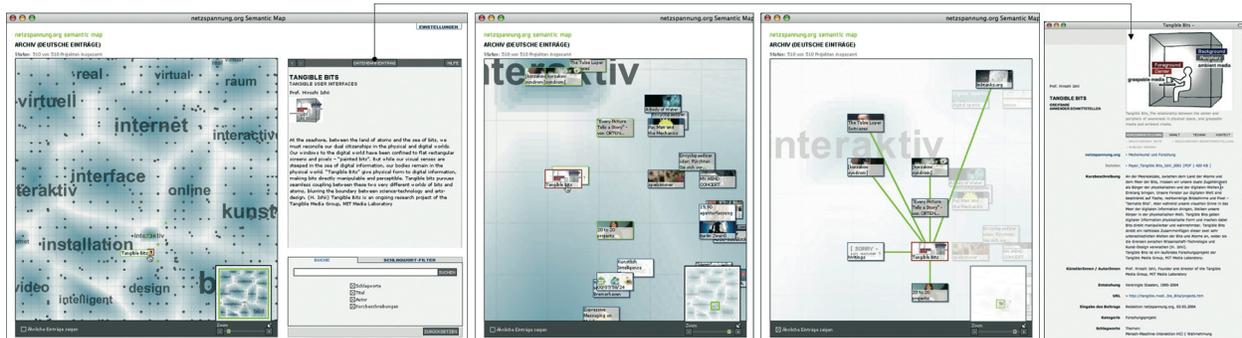
2. Homepage netzspannung.org



3. Most wanted from netzspannung.org

Digital Maps for Navigating the Data-Cosmos

“Knowledge Discovery Tools” aim at the analysis and visual representation of semantic connections within digital information collections. These tools filter relevant data from a deluge of information and weave a web of meaning. “I know, what you are looking for,” these tools seem to say, taking their cue from the visions of BUSH, NELSON, and BERNERS-LEE. On the internet platform “eTeaching”²², netzspannung.org-tools such as “Timeline” (2001), “Semantic Map” (2001) and the mediaflow browser (2006/08) are available for teaching and learning.²³

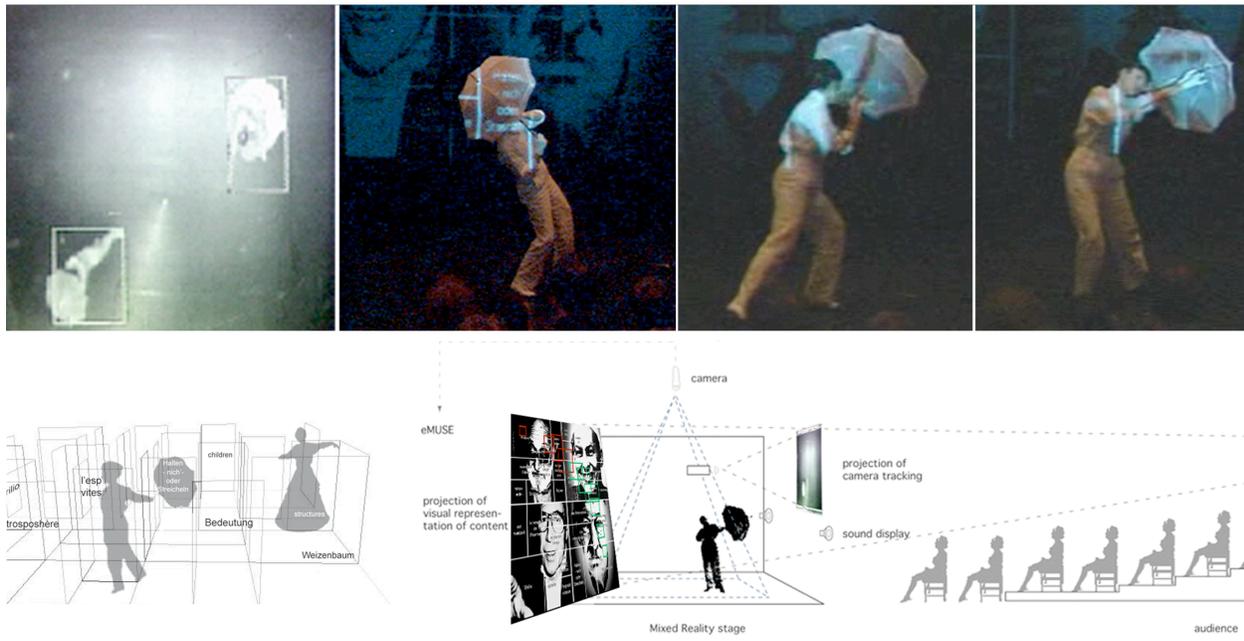


4. Semantic Knowledge Maps from the Internet Platform netzspannung.org

The Semantic Map is a dynamically generated map for navigating data spaces. It arranges related content within graphic clusters, where spatial distances and proximities represent semantic ones.²⁴ RUDOLF FRIELING compares WARBURG'S Mnemosyne-Atlas method to the visual clustering method: "Only these are not ordered according to visual similarity [...]; but rather through relationships caused by an 'affinity for one another' and the principle of 'good company,' which let themselves be reconstructed through the study of texts [...]."²⁵

The map interface is generated on the basis of automated text analysis and its appraisal by a neuronal network. Instead of employing linear and hierarchical notation systems, information is here calculated and depicted as a network of semantic relationships. The "Semantic Map" is a roadmap of the data collections of the media art archives at netzspannung.org, the most distinguishing feature of which is its ability to visualize the variance and variety of utterly diverse approaches to works of Medial Art. Knowledge is thus transmitted to the user through a process of differentiation. Just as large telescopes allow astronomers to look into space, digital cultures need powerful tools that allow them to sift, review, and evaluate large volumes of data. The astronomer ROGER MALINA compares these Knowledge Discovery Tools to a "telescope for viewing and evaluating the data cosmos."²⁶

Exploring Knowledge Spaces, Knowledge Map in Hand



5. Murmuring Fields: Data Actors on an Interactive Stage

The question as to how digital information spaces can be transformed into tangible and accessible knowledge spaces, not only in a metaphorical and virtual sense, but also in the sense of their physical reality, marks the passage from medial information planes to a medial architecture. Human beings, space and data are bio-sensorially linked in the art installation “Murmuring Fields.”²⁷

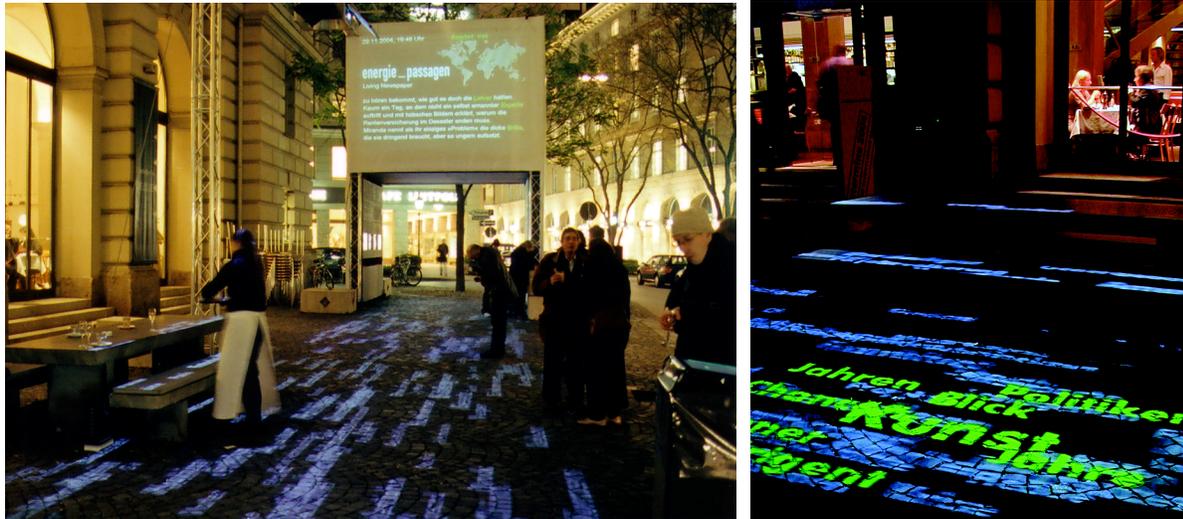
The installation is a walk-in sound archive and, simultaneously, a rehearsal stage for the creation of walk-in knowledge spaces. Visitors trigger sounds with their physical movements. Digital information units located across the virtual space are activated by actual body movement via optical tracking devices, as if the space was ‘furnished’ with data.²⁸ These virtual furnishings of an interactive space are recorded on a semantic map that here serves as a dynamic floor plan. The audio-visual space “Murmuring Fields” can be entered and explored—in the real world or via the Internet—by several people at once. The movement of the participants in the networked space is visually recorded; the marks fade after time, but remain saved in the memory of the computer.

The art historian DANIELLE PERRIER draws comparisons with JOHN CAGE’S sound installation “33 1/3,” which encourages visitors to take an active part in the creation of a sound collage. Unlike “33 1/3,” however, the optical tracking system in “Murmuring Fields” captures the physical movements of the performers and thus creates a link between people and the audio-visual scenario. In their performance, dancers play with words and statements, which they stage interactively. These words and statements are provided by the digitized voices of the computer scientists and media philosophers JOSEPH WEIZENBAUM, MARVIN MINSKY, VILÉM FLUSSER and PAUL VIRILIO. Linking the stage with the superimposed data space and creating this kind of gestural and bodily interactivity allows the events in the room to be observed. The exploration of the spatial and physical is correlated to the collection of information and the development of new knowledge, furthering the participant’s awareness of his body and the observer’s awareness of his gaze.

Public Realms of Data and Dialogue

The project “Energy_Passages”²⁹ explores the connection between walk-in data spaces and reading archives in public. “Energy_Passages,” a site-specific installation, projects the daily stream of news reports as an audio-visual flow of information in the space of the city. The public space of the city is depicted as a textual stream of data consisting of hundreds of headlines from current newspaper articles. The resulting ‘mixed reality space’ surrounds the visitor with light, sound, words, and movement. A continuous murmur of artificial voices reads the 500 most frequent headlines from the continuous flow of daily news. According to their frequency, the headlines move in different sizes and saturation. Text and language are removed from their context and are performatively staged as a medial montage in the space

of the city. As the transmitter of language, the written word directs the dialogue between the installation and the participant. Visitors can use microphones or touch-screens to select individual words, turning the previously invisible connections within the text flow into visible networks of ideas. Through their selections, visitors create a “Living Newspaper”³⁰ that reflects their individual interests.



6 / 7. Energy_Passages: Narrative street and interactive narrative on the ground

While the individual concepts and resulting concept networks in the “information flow” stimulate a plethora of associations, the text fragments strung together in the “Living Newspaper” reference the loss of contextual meaning that results from the accelerated speed and sheer volume of information. In its telegraphic style, the “information flow” shows how reality is constructed and perceived by the mass media.

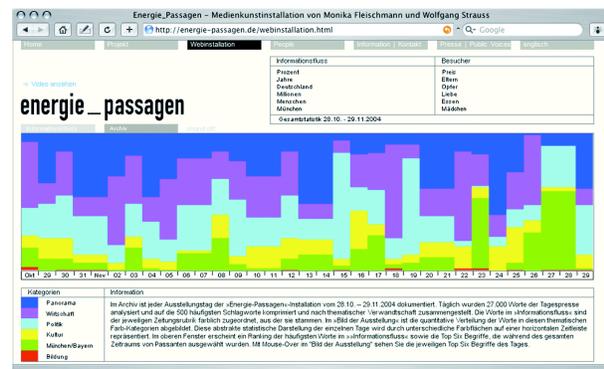
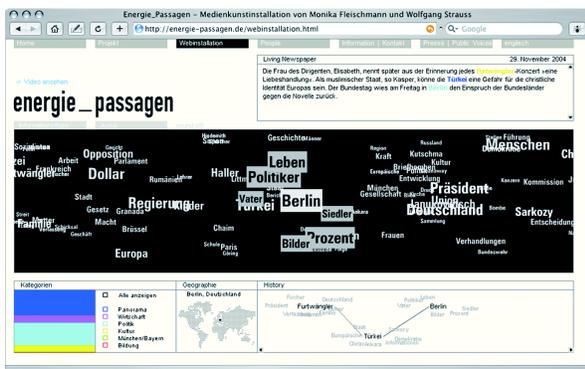


8. Energy_Passages: Visitors interfaces and Living Newspaper

The linguist and literary educationalist KASPAR SPINNER describes operative processes such as omission or manipulation experiments—the principle means of interaction in “Energy_Passages”—as illuminating for the interpretation of texts.³¹ The manipulation experiments of the visitor are saved over the course of four weeks and archived as a medial record on the homepage. The medial flow stands available as an interactive model on the Internet.³² Likewise, the statistical user access records are read as a graphic data pattern in the archive of the web-installation.

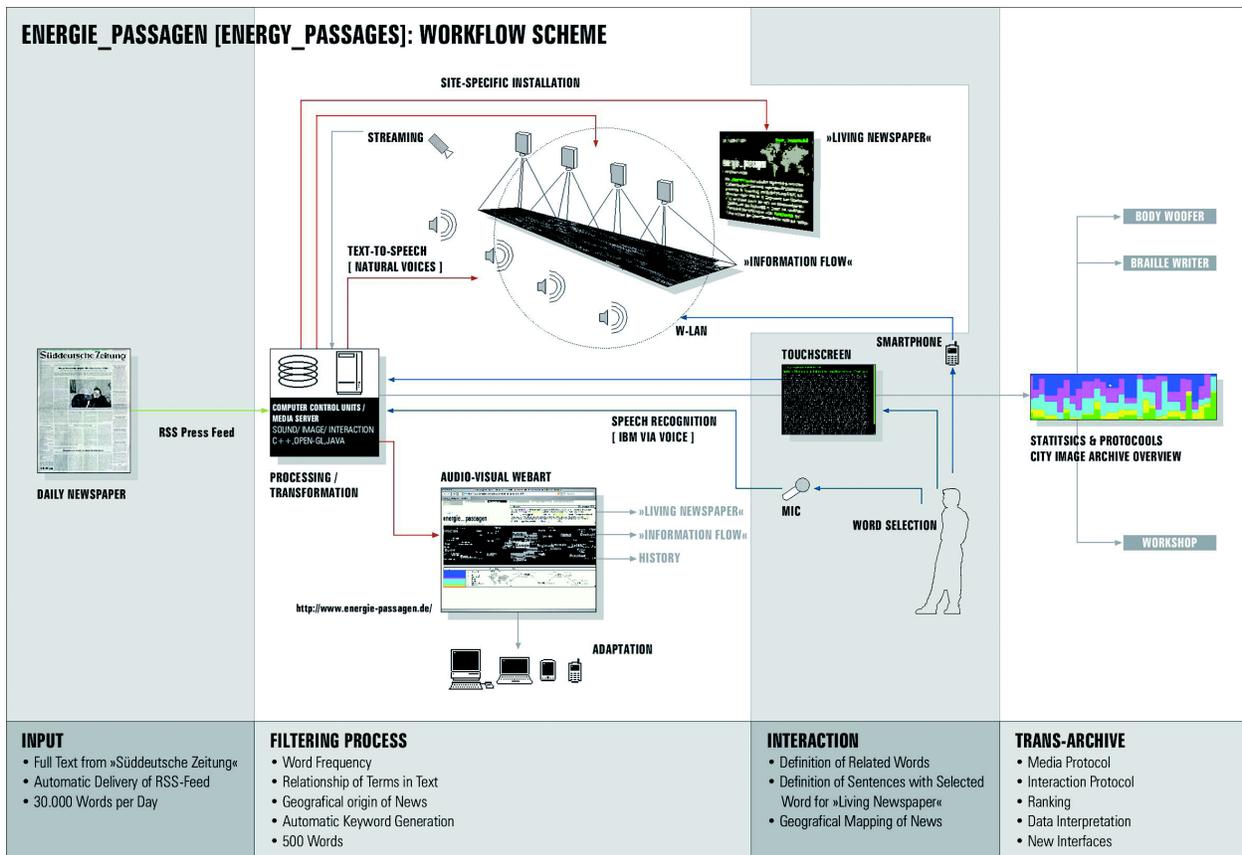
The artistic concept of “Energy_Passages” is based on an understanding of language and information as a form of mental energy. “Energy_Passages” refers to VILÉM FLUSSER term “passage” as a journey on which one “passes through” individual elements, i.e. fragments of a larger context, in order to condense individual impressions, parts of a whole, into a concrete and tangible image. According to WALTER BENJAMIN’s model *Arcades Project*³³, “Energy_Passages” shows a model for generating a textual montage of collective forms of experiences. The cultural theorist’s attempt to “eliminate all overt commentary and to have the meanings emerge solely through a shocking montage of the material” is what THEODOR ADORNO calls the montage of reality.³⁴ “Energy_Passages” fragments the newspaper clips and re-presents them as a ‘montage’ in a way that is startlingly new even to the participant. The project aims to ‘measure’ the power of language effective in a specific location, and in doing so, visualize the spirit of a place.

“Energy_Passages” works as a device measuring user access, referring back to DÜRER’S *Books of Measurement*.³⁵ The measurement records take the form of color-coded statistics, developed through a mapping of user-intervention and functioning as an abstract image of the city. After four weeks, the „Energy_Passages“ installation statistically showed that most frequently used words in the mass media were “percent,” “years,” “Germany,” “millions,” “humans,” and “Munich.” In contrast the terms most frequently chosen by the visitor were “price,” “parents,” “victim,” “love,” “food,” and “girl.”³⁶ In this manner, the media art installation becomes a system of measuring the sensitivities of a city.



9. Energy_Passages: Web Interface and measurement protocol of visitors interventions

Through the staging of medial art, “Energy Passages” reflects on WOLFGANG ISER’s “blank space theory” from the 1970’s as reception aesthetics. The concept of blank space, or void, refers to the point at which various narrative perspectives and threads collide. The reader is required to bring these different elements into relation with one another. The interactive process of “Energy Passages” works similarly. The visitor uses the weave of terms in the information flow as open yarns in a fabric. A meandering narrative develops from the emerging dialogue. “Energy Passages” is not interactive in the sense of clicking on a mouse button, but in the sense of initiating intellectual movement.³⁷



10. Energy Passages: Workflow scheme

Knowledge Art as Cultural Technology

The technicalization of knowledge and the mass dissemination of every kind of information via the Internet have also been accompanied by an increasing de-humanization of our knowledge-processing operations. Human beings have handed over to technology what was originally part of their subjective life initiative. It follows that with the mechanization of human knowledge, technology today increasingly impacts the generation, storage, processing, dissemination, and exploitation of knowledge. Business informatics specialist HOLGER NOHR describes the changing relationship between knowledge and

technology thus, that knowledge is no longer confined to be the condition of technology, but has rather become its goal.³⁸ Such a goal demands experimentation.

Spanning a variety of disciplines, medial art-research must develop new ways of thinking, stimulate alternative approaches to knowledge and not-knowledge, and strengthen the process of thinking in terms of relationships and associations. Medial artists and artistic research exemplify the development of new type of researcher. Visualization of information, mapping, comparative literature, statistics and other fields are perceived today as research-based art. Media Art's laboratory of knowledge complements the artist's studio. Achieving critical and innovative strategies, Media Art must be supported with research funds rather than charity stipends; the medial artist's need to access appropriate facilities is a precondition. To the art- and science facilities: Start dealing with Media Arts! Let the artist in!

Monika Fleischmann and Wolfgang Strauss are media artists working with mixed reality; up to 2007 they directed the research group MARS—Media Arts & Research Studies at the Fraunhofer IAIS near Bonn.

¹ “Künstlerische Verfahren kommen überall in den Wissenschaften vor und besonders dort, wo neue und überraschende Entdeckungen gemacht werden,” Paul Feyerabend: *Wissenschaft als Kunst*, Frankfurt a.M. 1984.

² See also Bazon Brock: “Gauernerprüfung für Medienkompetenz, die nur als Fälschungskompetenz in erkenntnistheoretischer statt krimineller Absicht verstanden werden kann,” in: Monika Fleischmann/ Ulrike Reinhard (Ed.): *Digitale Transformationen. Medienkunst als Schnittstelle von Kunst, Wissenschaft, Wirtschaft und Gesellschaft*, Heidelberg 2004, cf. also <http://netzspannung.org/media-art/publications/digital-transformations/index.xsp?lang=en> (last accessed: 1 June 2010).

³ Söke Dinkla: “Von der Medienkunst zur Wissenskunst. Zur Ausstellung Wissenskünste aus der eCulture Factory,” introductory lecture in German, Neues Museum Weserburg Bremen 2006; see pdf document on <http://netzspannung.org/database/377391/de> (last accessed: 1 June 2010), p. 2.

⁴ “Retrospective” is a new word created by Catherine David, who, as the artistic director of the *documenta X*, thought it her mission to elaborate “a historical and critical gaze on [...] the recent past of the post-war period, and on everything from this now-vanished age that remains in ferment within contemporary art and culture.” See Preface of the *Short Guide to dX, 1997*, http://www.universes-in-universe.de/doc/e_press.htm (last accessed: 1 June 2010).

⁵ Cf. Hartmut Winkler: “Vannevar Bush. As We May Think,” in: *Form Diskurs*, No. 2, I/1997, section “Wiedergelesen/ Re-read,” p. 136–147. http://homepages.uni-paderborn.de/winkler/bush_e.html (last accessed: 1 June 2010).

⁶ Vannevar Bush: “As we may think,” in: *The Atlantic Monthly*, July 1945, paragraph 6. <http://www.theatlantic.com/doc/194507/bush> (last accessed: 1 June 2010).

⁷ This and the following quotes: *ibid.*

⁸ Quoted as in footnote no. 3 on Ted Nelson's homepage <http://ted.hyperland.com/> (last accessed: 1 June 2010).

⁹ Konrad Lischka: "Ted Nelson. Der Hypertext-Erfinder druckt ein Buch," *Spiegel Online*, 21 Jan 2009.

<http://www.klischka.de/joomla/artikel/netzwelt/750-ted-nelson-der-hypertext-erfinder-druckt-ein-buch-spiegel-online-2112009> (last accessed: 1 June 2010).

¹⁰ See Wolfgang Iser: *Der implizite Leser. Kommunikationsformen des Romans von Bunyan bis Beckett*, München 1972.

¹¹ Monika Fleischmann et.al.: "Rigid Waves – Liquid Views," in: *Visual Proceedings: Machine Culture*, SIGGRAPH 1993, Anaheim/ LA 1993.

¹² Cf. Martin Dodge/ Rob Kitchin: *Mapping Cyberspace*, New York 2000; Cf. the theme "Mapping und Text" with contributions from Rudolf Frieling, Martin Dodge, Christine Buci-Glucksmann, Stephane Marchand-Maillet, Graham Harwood http://www.medienkunstnetz.de/themes/mapping_and_text/ (last accessed: 1 June 2010).

¹³ See Monika Fleischmann/ Wolfgang Strauss: "Berechnete Gedanken – Interaktivität als mediale Spiegelung," in: Reiner Matzker/ Ursula Dreyer (Ed.): *Medienwissenschaft*, Part 8: *Verständigung über die Verständigung. Aspekte der Medienkompetenz*, Bern 2009, p. 111–128.

¹⁴ Teuvo Kohonen: *Self-organizing maps*, Berlin/ Heidelberg 1995.

¹⁵ "Wissenskünste aus der eCulture Factory," exhibit at Neues Museum Weserburg, Bremen, 6.10.–2.11.2006. <http://www.weserburg.de/index.php?id=231&L=1&id=231&0=> (last accessed: 1 June 2010).

¹⁶ Söke Dinkla: "Von der Medienkunst zur Wissenskunst. Zur Ausstellung Wissenskünste aus der eCulture Factory," Lecture at the opening event, Neues Museum Weserburg Bremen 2006, pdf document: p. 4. [http://netzspannung.org/cat/servlet/CatServlet/\\$files/383986/dinkla.pdf](http://netzspannung.org/cat/servlet/CatServlet/$files/383986/dinkla.pdf) (last accessed: 1 June 2010).

¹⁷ Monika Fleischmann/ Wolfgang Strauss: "On the Development of netzspannung.org – An Online Archive and Transfer Instrument for Communicating Digital Art and Culture," in: Ursula Frohne et.al. (Ed.): *Present Continuous Past(s). Media Art. Strategies of Presentation, Mediation and Dissemination*, Wien/ New York 2005, p. 162–173. Monika Fleischmann und Wolfgang Strauss initiated and led the research group MARS—Media Arts & Research Studies at the Fraunhofer Institute for Media Communication from 1997-2007.

¹⁸ Raymond Kurzweil: *The Age of Intelligent Machines*, Cambridge/ MA 1990, p. 326.

¹⁹ See Martin Warnke (Ed.): *Aby Warburg. Der Bilderatlas Mnemosyne*, Berlin 2003.

²⁰ See Monika Fleischmann/ Wolfgang Strauss et.al.: "netzspannung.org: an internet media lab for knowledge discovery in mixed realities," Fleischmann/ Strauss (Eds.): *CAST01 // living in mixed realities*, Sankt Augustin 2001, p. 121–129. Cf. <http://netzspannung.org/version1/cast01/> or <http://netzspannung.org/about/tools/index.xsp?lang=en> (both last accessed: 1 June 2010).

²¹ Monika Fleischmann/ Wolfgang Strauss: "Most Wanted," statistical tool from netzspannung.org, Fraunhofer IMK, Sankt Augustin 2005. Cf. <http://netzspannung.org/tools/most-wanted> (last accessed: 1 June 2010).

²² <http://www.e-teaching.org/praxis/referenzbeispiele/netzspannung/> (last accessed: 1 June 2010).

- ²³ <http://netzspannung.org/about/tools/timeline>; <http://netzspannung.org/about/tools/semantic-map>; Medienfluss cf. <http://netzspannung.org/database/372947/en>; cf. mediaflow browser <http://medienfluss.netzspannung.org/index.html>; in general: http://eculture.salzburgresearch.at/2003/presentation_fleischmann.pdf (all last accessed: 1 June 2010).
- ²⁴ See Monika Fleischmann/ Wolfgang Strauss/ Jasminko Novak: "Semantic Map, tool for the semantic contextualization of heterogeneous content from netzspannung.org," Fraunhofer IMK, Sankt Augustin 2001/2004. Cf. <http://netzspannung.org/database/semantic-map/> (1 June 2010).
- ²⁵ <http://www.mediaartnet.org/works/mnemosyne> (last accessed: 1 June 2010).
- ²⁶ Roger Malina: "ARTMEDIA 8," October 2002, Paris; quoted on <http://netzspannung.org/about/tools/intro>, pdf document: p. 5, (last accessed: 1 June 2010).
- ²⁷ Monika Fleischmann et.al.: "Linking real and virtual spaces," in: *eRENA – Electronic Arenas for Culture, Art, Performance and Entertainment. Second Year Report*, Brussels 1999, Esprit i3 Project 25379 (1997–2000). Cf. <http://www.nada.kth.se/arena/partners.html> (last accessed: 1 June 2010).
- ²⁸ Wolfgang Strauss et.al.: "Staging the space of mixed reality. Reconsidering the concept of a multi-user environment," in: *Proceedings of the fourth symposium on the virtual reality modeling language, VRML*. February 1999 Paderborn; New York 1999, p. 93-98; see also: Strauss et.al. 2003, p. 23.
- ²⁹ Monika Fleischmann/ Wolfgang Strauss: "Energie-Passagen: die Stadt lesen und (be)schreiben," Medienkunstinstallation im öffentlichen Raum, Munich 28.10.–29.11.2004. Cf. http://www.ortstermine-muenchen.de/archiv/seiten_2004/projekte_2004/energie_passagen.html (last accessed: 1 June 2010).
- ³⁰ The "Living Newspaper" is a theatrical method, here used as an interactive narration, the stages daily news reports in public spaces.
- ³¹ Cf. Kaspar H. Spinner: „Interpretieren im Deutschunterricht“, in: *Praxis Deutsch* 81, 1987, p. 17–23.
- ³² See archive on <http://energie-passagen.de/webinstallation.html> (last accessed: 1 June 2010).
- ³³ Walter Benjamin: *The Arcades Project*, [1927-40], trans. Howard Eiland and Kevin McLaughlin. Cambridge/ MA 1999.
- ³⁴ Theodor W. Adorno: „A Portrait of Walter Benjamin“, in: *Prisms: Studies in contemporary German social thought*, Cambridge/ MA 1981, p. 227–242, here p. 239.
- ³⁵ Cf. Albrecht Dürer: *Unterweisung der Messung*, reprint of the first edition Nürnberg 1525, Nördlingen 2000; transl. by Walter L. Strauss as: *The Painter's Manual*, New York 1977.
- ³⁶ See archive on <http://energie-passagen.de/webinstallation.html> (last accessed: 1 June 2010).
- ³⁷ See Monika Fleischmann/ Wolfgang Strauss: „Energie-Passagen: die Stadt lesen und (be)schreiben. 2004“, in: Gerhard Kilger (Ed.): *Szenografie in Ausstellungen und Museen IV*, Essen 2010, p. 118–125. Cf. also <http://energie-passagen.de/projekt.html> (last accessed: 1 June 2010).
- ³⁸ See Holger Nohr: „Wissen wird zum Fokus betrieblichen Managements“, in: *Arbeitspapier Wissensmanagement* 4 (2001), FH Stuttgart, Studiengang Informationswirtschaft.