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AWARENESS OF THE EARTH AND POSSIBILITIES FOR NEW SCIENCE EDUCATION IN THE INTERNET AGE

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Abstract: The internet as "the nervous system of global size" and multimedia technology have changed our global experience radically and suggests possibilities of entirely new approaches to the conventional education of sciences and the environment.

They are not merely the changes where printed text books are converted into dynamic things with vivid appeal to our senses and information about the world's museums and art galleries, digitalized and shared by all.

If the seismic activities occurring every day in various parts of the world can be seen in real form directly through the internet by all the people of the world, how will children's views of the earth change and how will their scientific understanding improved?

If there was a system whereby one could monitor, in real time, how one member or others of the world net surf the global home pages, and if one could follow the "moving" process on the internet, children would certainly appreciate the presence of the internet as a global network of information.

The web site "Sensorium" (http://www.sensorium.org) was created by us in an effort to put these live experiences of the internet into design.

Sensorium is not a site merely to digitalize and list the existing knowledge and data. It is an experiment for the Digital Museum as a new "forum" where we may experience and share a moment. It is also an attempt to create tools for science and environment education which are only available on the network.

I would like to introduce works using the internet and to share my attempts to encourage children to understand the internet through experiencing in with their bodily senses at a children's workshop jointly given NTT (including an experiment to create a structure simulating the internet by use of paper-box-and-thread telephones). In addition, I would like to present my proposals for use of the Internet/Multimedia for education.

The following three points are of particular importance:

1. The substance of world experience in the age of the internet; possibility of integrating "Intelligence" and "Sensibility".
2. Taking out media from the Black Box (understanding not only "the result" but also "the process").
3. Bridging/combining "Real space" with "Cyberspace".

Awareness of the earth in the age of the internet

In a deep blue space spreading on a computer screen, a vibrating silver globe is drifting. On a closer look, one sees that bubbles are being generated

incessantly at various places as if the entire earth was breathing in and out. It is a part of our Web site, "Sensorium", which was named "Breathing Earth" (http://www.sensorium.org/breathing earth).

Recent images of inner movements of the globe (to be more precise, movements in the two weeks preceding the moment when one watches the home page) obtained by monitoring the seismic movements occurring daily all over the world, were compressed into a CG animation of less than 20 seconds.

The important thing is that this is not a mere fictional image, but is the self-portrait of the "real" earth based on the observation data recorded by seismometers of the world and collected daily through the internet.

Seismometers scattered all over the world are none other than sensors which sense what may be called the fetal movements of the earth at every moment. Data of minute crustal reformations at these sites are successively collected through the information network based on the internet (WWW) and make up a realistic seismic database of global size which is updated daily. Similar real-time data sensing and its accumulation in a database are being performed from various sides such as the temperature of the air, the sea level, wind directions and sea currents, and they enable understanding of world-wide climatic changes such as "El Nino" and the earth's crustal deformations which had before been impossible to comprehend.

In this context, we human beings are now acquiring "a nervous system of global size" which monitors total changes of the "physical" and "emotional" condition of this alive and breathing planet.

Unfortunately, such information resources remain as mere lists of dull numerical data used only by a handful of specialists such as seismologists, and most people do not even know that they exist. Most of the humans on this earth neither feel the presence of this "nervous system of global size" in their daily life nor sense the throbbing pulse of the living body called the earth.

We were thus prompted to create a program based on the seismic database, which is public information property, to convert numerical data, which are meaningful only to specialists, into visible and dynamic expressions which the general public and children can intuitively understand.

This may be described as "building a platform for global sensibility" and an attempt to open a window in each of the individual terminals (PCs) in order to actually feel that each and every one of us potentially has "a nervous system of global size".

We thus understand that the earth is constantly breathing as a "whole", that earthquakes are by no means abnormal phenomena that occur only occasionally

but are "normal" for a healthy earth as they occur every day all over the world, and that earthquakes which we experience in Japan are not isolated or abnormal but are parts of "the incidents on the network of the earth" and linked to other earthquake in Indonesia or the Philippines.

Designing New Experience — The "Hows" and "Whats" of Media

Although what I have described is only a part of the primary experimental stage of the Sensorium project, it is already possible to glimpse the signs of new global awareness and the possibilities for science education brought about by the internet and multimedia.

Our aim was, above all, to search for new world experience brought about by the internet which is something that can only be done by a new media structure called WWW (World Wide Web).

It does not mean merely converting the conventional media contents such as textbooks and TV images into electronic media, and transplanting the collections of museums and art galleries into cyberspace by simple digititalization. It is possible to use the inherent structure of such Web environments to realize platform where one's experiences are holistic.

Further good examples of unique experience in the Web environment are two contents of Sensorium, "Cell Meter" and "Star Place". The former graphically shows how many percent of the body cells of a person accessing the page have been replaced since the last access. (Our body cells are said to be replaced at a rate of several hundred billions a day). The latter is a live system which imparts the sensation of speed with which the earth (on which one exists) constantly moves at an astonishing speed in the space of the solar system by showing how rapidly the number on the counter increases from the moment the page is opened. (Several thousand km in a minute, since the speed is 30 km/second.)

Both designs offer experiences unique to the Web environment which achieves "live" and "updated" recognition that our presence, mistaken as constant and immobile, actually continues dynamic movements and changes, visualized by the unique characteristics of this interaction (mass customizing), which is validated only by individuals actively accessing the pages at different times.

Education through the Internet/Multimedia is not a mere issue of introducing computers and networks as tools. It should be perceived in the sense of how new experiences (WHAT) can be created in children by extending the concept of skillful use of digital technology as a means (HOW) for more effectively conveying existing knowledge.

Only then, does integration of "intelligence" and "sensibility" in its true sense become possible.

"Jigsaw Puzzle" Type Media Structure

In this context, "Breathing Earth" aims at visualizing "earthquakes" and "living earth", but also aims to bring out the substance of the internet simultaneously (indirectly), and to focus on the holistic "sensibility" of living in the new information environment as a latent theme.

It has become possible only through the Net to realize this "daring" attempt to accumulate the data of seismometers from all over the world or nearly every moment in real time and visualize them on a screen which is accessible to all. This is indeed astonishing, and we wished to share with many people our sense of astonishment and gratification or the possibility of such experience. (The site name "Sensorium" expresses our wish to share such a new experimental environment and also to share the "common sense" for the time and situation we are placed in).

The structure of this global experience may be captured by an image which is just the opposite to the one described by Russell Schweicart, an astronaut. He says that his experience of seeing the earth as a whole from outside played a decisive role in creating a new relationship between humans and the earth. This is symbolically expressed by the metaphor of a jumping flea. A flea sitting on top of an elephant does not think that the elephant is a living thing because it is too big, but sees it as a part of the earth which extends almost endlessly. However, if it jumps high in the air and looks down, the flea realizes for the first time that the elephant is not a part of boundless earth but is a limited and fragile living creature like himself. This certainly expresses the situation currently surrounding us where a new phase began for the humans of the 20th century who have gained a privileged viewpoint of looking down at the earth from space — capturing the earth as Gaia, and considering the limits of resources and preservation of the environment in earnest.

Our attempt to monitor the vital movement of the earth through the internet, however, points to another approach to recognizing the elephant called the earth as a whole.

If the view seen by a jumping flea was a whole image seen from the top down, this global sensing of earthquakes may be described as a whole seen from the bottom up by accumulation and editing of the perception of innumerable fleas feeling minute shakes of the earth which clinging to the various parts of a giant's surface.

Recognition of the earth by each local clinging flea is like a fragment (as each piece of a jigsaw puzzle); the fleas are like a group of blind men touching an elephant, as the Japanese proverb goes. But when they are connected by the

network and begin to share their data of "feel", the whole elephant appears as in a completed jigsaw puzzle. It is an image of the world as sensed by a networking group of blind people.

This is a form of recognition inherent to the age of the internet and heralds the birth of a new mode of experiencing the world. It is neither a one-dimensional bird's eye view nor a discrete and localized insects' eye view. It is not a personal structure like telephones or letters nor is it a mass structure like TV and publishing, even though it started from recognition by individual sensors. It enables creating and sharing of the whole image, which is distinct from conventional images, and re-arranges the relation between the individual and the whole in an entirely new way.

Opening Up the Black Box of the Media

This is naturally the reflection of the structural characteristics of the internet.

Often described as "the network of networks", the internet has grown into a complex network of global size from multi-dimensional small local networks as they reached out and joined hands. The hardware structure of the internet has the history of a kind of voluntary "jigsaw puzzle".

The structure of information carried thereon inevitably creates a whole in various areas as small diverse pieces are chained and come together voluntarily as in a jigsaw puzzle.

An easy-to-understand example is the contents of art galleries and museums. Many art galleries and museums of the world currently maintain home pages to show their collections in digital form. As one browses through the world's art spaces by going through the list of page addresses, one fantasizes that one is walking through "a museum of global size". As museum collections are connected on the internet, users are presented with a cyber-museum housing a collection of global size without anybody having designed it.

Even a museum with an enormous collection is merely a small piece among the collections of the world. Instead of the collections being monopolized and concealed in the enclosed spaces of individual museums and art galleries, they are publicly shown in an electronic "Commons" called the internet and shared as a resource, making up a magnificent art collection as in a jigsaw puzzle. The image of the whole "elephant", artistic resources owned by humans, thus surfaces unexpectedly.

This does not stop at a quantitative explosion of vistas of cultural properties and works of art of the world, but is a qualitative leap in information experience. While these contents are the material information of real space (such as paper

and fabric) transferred into cyberspace, they are beginning to be endowed with characteristics unique to the age of the internet in its synergistic mode of experience.

Children, however, will find it difficult to intuitively understand this bottom-up formation of the net sphere.

When looking at home pages, for example, one feels like turning the pages of a book and hardly feels the reality of going through various servers of the world or realizes that the contents of the world are being connected as in a jigsaw puzzle. For them, it is not much different in substance from looking at picture reference books or CD-ROMs.

In addition, as current media education tends to evaluate its effectiveness only in terms of the volume of knowledge acquired and emphasizes skill in the use of the computer as a tool too much, it appears too preoccupied by the result of media technology such as transmission of e-mails and use of home pages and data bases to notice the mechanism or process which enables such results (as in other media). The internet tends to remain a Black Box for many. We have therefore designed an experimental scheme to attract children's attention to the structural substance of the internet and its fun by using two contrasting methods.

Integrating "Cyberspace" and "Real space"

One is an application of "Web Hopper", a content of "Sensorium", which was constructed in the Electronic Arts Museum (Ars Electronika Zentrum) in Linz, Austria (Where most of the visitors are children).

"Web Hopper" was originally designed to show in real time on a world atlas on the web (Sensorium) the loci of trips made by people as they go net-surfing through the home pages of the world. Supposing a person watches home pages from a gateway on the net, we can obtain the IP address data of the servers at his starting point and the destination from the information packet flowing there, through using a tool called TCPdump. When this is converted to geographical information and shown in real time on the atlas, the net-surfing process or the movement of each person is dynamically shown, e.g. from Tokyo to London, and then to New York.

Based on this system, we installed many internet terminals with different color screens and a monitor showing a huge world atlas in a room at Linz Museum. When children browse through Tokyo or London pages from a red terminal, their "red" trace is instantly drawn on the atlas (for instance, from Linz to Tokyo to London). Children can intuitively understand how they are traveling the world by using the network.

With their global travel, the "green" and "blue" traces of their friends who are also net-surfing on the green or blue terminals next to them are visualized on the same monitor. As they share one cyberspace with many others, they can appreciate in real time the sense that accumulation of their information exchange is making up the substance of the internet.

Another experimental attempt which we carried out in a multimedia workshop for children and their parents, given jointly with NTT, used a contrasting analog method to make them understand the internet through their bodily senses.

A simulation experiment was participated in by children who created an internet in the classroom will paper-box-and-thread-telephones in order to understand the bottom-up network structure in a visible, tangible form, and achieved unexpected success.

They experienced the process of creating a local network by dividing themselves into groups of 10, connected to each other by the thread phone, and designating the groups as America, Japan, etc., and then connecting the local networks into a global networks as in a jigsaw puzzle. The analogy will the characteristics of the thread telephone which does not carry voices well unless the thread is given adequate and uniform tension helped them to understand the bottom-up type network which is supported mutually by small pieces.

As they experienced in real form the successful transmission of a message by another circuit when one circuit was cut, they understood the strength and interesting character of the bottom-up, loose-structure network at a far more intuitive level than that the logic of adults, which was born out of the necessity for distributing risks in the age of nuclear wars.

By going through such realistic creative experiences, visualizing such a net-surfing as "Web Hopper" is understood in more concrete terms.

What is Transparency of Media?

To sum up, such attempts are supported by the awareness of two important issues which have a complementary relation with live designs of world experiences such as "Breathing Earth", which I discussed in the beginning.

The first is to emphasize intuitive insight and understanding of the substance of the global information environment called the internet by focusing on the "Black Box" of the media. Additionally, information exchanges or movements should be focused upon nurturing a holistic sensibility of living in that new environment.

Contemporary media such as television, e-mail and home pages are generally like Black Boxes and it is hard to actually visualize their mechanisms and processes. Given only the technical result, one cannot say that the users' sensibility toward the media is being totally nurtured.

"Transparent" media which are merely easy to use become, in a sense, increasingly "clouded" for users.

Secondly, the experience in real space and the challenge of bridging with cyberspace the thread telephone, the internet and "Web Hopper" were all attempts to introduce tangible bodily senses and feeling of distance into abstract media (the process of practice and information exchange).

This viewpoints is the basic concept for the entire "Sensorium" built by us. As the first example of "Breathing Earth" showed that the earthquake experienced earlier in the morning can be seen by re-positioning it on the net, the bi-directional dynamism of the most physical experience is expanded by mediating it in electronic space. There are many people who have become sensitive to the actual shaking of the earth and climatic phenomena since they started looking at these contents.

"Net Sound", the audio content of Sensorium, which is heard by applying a kind of "stethoscope" to the internet and listening to the sounds obtained by converting the packet movements on the network, was created as a mechanism to feel the presence and practice of others who are active in cyberspace or in the real space beyond. When one applies the stethoscope system to the Linz Electronic Art Museum, it is noisy at the time when many children are there using terminals and quiet during the night. It is a system of sensing that one is connected to others who are strangers and that there are certainly real people on the other side of the cyber-network. Could this be another public standard for thinking about the transparency of network media?

At any rate, the concept of not completing our (especially our children's) media experience in cyberspace seems to gain the most importance not merely from the view immersion into electronic space as dangerous but also in fermenting the feeling for more total media and truly expanding the possibilities of the internet and Multimedia.