

Metatechnology: Correspondence of the Arts, Sciences, Technology and Humans

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ABSTRACT

Current Western-dominated paradigms of technology are based on a reductionistic view, i.e., machines evolve to an intelligent but isolated object form by serially integrating precise subtechnology constituents. A new paradigm of technology, based on an interaction of technology, humans and the environment through Körperlichkeit (corporeality or philosophy of Mom), is explored. Parallelism based on holism and embodiment, and relative interactions based on correspondence and interrelationships, are the key ideas in the proposed paradigm. An interactive system, called the Emotional intelligence Interface and Performance System(EIPS), is proposed and implemented to explore the proposed interactive technology paradigm. Also, recent collaborations by ASTA (Arts, Sciences & Technology in Asia), an interdisciplinary project team of artists and engineers, are introduced to demonstrate these explorations.

Key Words: Interaction, metatechnology, correspondence, körperlichkeit(Corporeality or Philosophy of Mom), interactive technology, man-machine(Human) interface

1. Introduction

Currently, one important theme of the contemporary art is "Körperlichkeit(corporeality)." This idea has been spreading to other fields of cultural activities, and Körperlichkeit seems to represent the thoughts of the times. Participation of the closely related areas in the scientific and technological principles would be the most desirable and efficient way to share a common interest in Körperlichkeit[1-5].

The interpretation of Körperlichkeit in human sensibility ergonomics seems to closely resemble that in contemporary art. For successful practices, arts and technology should start at this point. Recent collaborations by ASTA(Arts, Sciences & Technology in Asia), an interdisciplinary project team of artists and engineers, are introduced to demonstrate these possibilities. ASTA explores the commonalities between

technology and arts, commonalities that are uniquely suitable for the corporeality and sensibility ergonomics of the Korean people.

2. Mom and Interactive Technology

Körperlichkeit in contemporary art is treated in two ways: the Körperlichkeit itself, and the way "Mom(Körpers)" is intervening an interfacing system in interactive art[4, 5].

The issue of Körperlichkeit has consistently drawn large attention in the artistic community. Fundamental changes in the status of Körpers cause fear and uneasiness, which originate from the exteriorization of Körpers by combining the human body with machines(transforming to a cyborg, for example) and from the multiplication/separation of Körpers by utilizing reproduction technology. Following such fear and uneasiness, much fundamental work on identifying

Körpers is in progress, especially in the European artistic community.

The second issue of *Körperlichkeit* deals with the intermediate process for *Körpers* to be connected to art work, i.e., the relationship between an interface system and *Körpers*. This process is closely related to the current progress in human sensibility ergonomics. Interactive technology plays a key role in the investigation of *Körpers*, which is an indispensable factor in interactive art.

Recent developments in and reflections on technology have tended to drive technology come closer to the human *Körpers*. Human sensibility ergonomics, among other technological principles, has been amplifying the interface between traditional engineering equipment and the human *Körpers*. Thus, technology tries to create machines that resemble the human body through refining interface codes, resulting in more complicated systems with more directed instructions[4].

These attempts to refine and amplify interface systems have been recently evaluated as being meaningless efforts. In the studies of human factors in human sensibility ergonomics, figures of the human body tend to be classified according to specific patterns. Also, in biomedical studies, human emotions are measured by bio signals and stereo images such as brain waves, electrocardiograms(ECG), ultrasonic images, and computer tomograms. Based on the structured database, biomedical mapping studies try to discover the relationship between the measured data and their corresponding emotions. Complicated sensors and sensor processing systems are utilized to interface the human body for measurements and analyses[4, 6].

The above-mentioned quantitative approaches contribute to the limited understanding of human emotions and their applications. When the averaging statistical approaches taken in the process of measurements and analyses are refined the human mind and individual personalities(personal differences) are often neglected. The organic relationship between the human body and its environment is neglected in the process. Instead isolated partial substitutes for humans are sought. Western technological paradigm, which mind is limited for understanding the human body separates the body and mind.

An interaction paradigm based on *Mom* (*Körpers*)

could overcome the complicated problems caused by traditional Western paradigm concerning technology. Recent haptics research about the human interface has tried to reach an absolute target position by reducing the relative distance and its associated force between current and target positions. This control tactic adopts a relative view of force control, as opposed to an absolute view of position control. This relative view could be a very important step toward developing a new technology paradigm based on the interactions in terms of *Körperlichkeit*.

3. Interactive System

The trend in research about intelligent machines and technology has been evolving toward an intelligent passive object and the implementation of isolated(absolute) substitutes. Furthermore, collective efforts in arts and technology can be commonly seen in the area of media fields. The leading research groups in the field of media include Karlsruhe's ZKM(Zentrum für Kunst und Mediatechnologie), MIT's Media Laboratory¹, and NTT's ICC(InterCommunication Center). Research interests at these institutions assume predetermined patterns of the human body. Over such a these classified human body, they apply methods based on high-level, long-distance sensations and perceptions, for example, vision in NTT's ICC and hearing in MIT's Media Laboratory[4, 7-10].

Engineers at ASTA have been exploring a new paradigm of human sensibility ergonomics, re-interpreting the Western trial-and-errors. We at ASTA have attempted to discover an interactive technological paradigm, based on Koreans' sensibility ergonomics,

¹ MIT's Media Laboratory, established in 1985, is leading the research in areas of information technology such as artificial intelligence(AI) and man-machine interface(MMI) design. following the Minskian agent theory, the "Brain Opera" team is developing electronic music interfaces like Sensor Chair and Digital Baton. It also explores interactive music experiments in gesture-based music composition and performance. Also, wearables are being implemented as media for the future by other research group.

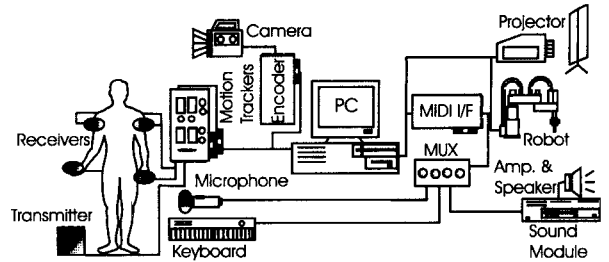
ergonomics that reflecting Koreans' unique physical, emotional, and socio-environmental conditions and mind-based systems. Koreans' unique sensibility ergonomics show the characteristics of low-level, short-distance sensations and perceptions, like touch, taste, and smell, which are instinctive, raw and holistic in nature. Recent accomplishments in contemporary art have added to these explorations[1-6, 10].

Traditional paradigms of technology seem to be based on the reductionistic view, i.e. machines evolve to intelligent but isolated objects by serially integrating precise subtechnology constituents.

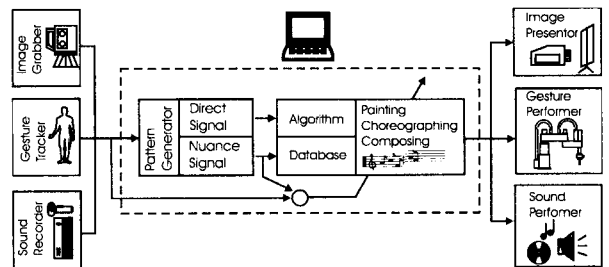
The main concept of the proposed interactive paradigm is based on a interactions of machines and humans through *Körperlichkeit*. Parallelism based on holism² and embodiment, and relative interactions based on correspondence and interrelationships, are the key ideas of the proposed interactive paradigm. Parallelism and relative interactions share similar features of complex systems[5, 11, 12].

As early eruption of interest in complexity and complex systems, after World War I, gave birth to the term "holism," and to interest in "Gestalts" and "creative evolution." The post-WWI interest in complexity, focusing on the claim that the whole transcends the sum of parts, was strongly anti-reductionist in flavor[13].

Applied to minds in particular, it is used to support both the claim that machines cannot think and the claim that thinking involves more than the arrangement and behavior of neurons. Applied to complex systems in general, it postulates new system properties and relations among subsystems that had no place in the system components; hence it calls for emergence, a "creative" principle. Mechanistic explanations of emergence are rejected. In a weaker interpretation, emergence simply means that the parts of a complex system have mutual



(a) Emotional intelligence Interface and Performance System (EIPS)



(b) Physical and mental interfaces
Fig. 1 An Interactive System: EIPS

relations that do not exist for the parts in isolation.

An interactive system is being implemented to explore the proposed interactive technology paradigm. The structure of the interactive system, called Emotional intelligence Interface and Performance System (EIPS), is shown in Fig. 1[6, 11]. Recent collaborations within ASTA are briefly introduced to demonstrate the explorations of the new interactive technology paradigm.

3.1 ASTA Project "Artificial Emotions" and Sound sculpture "Black Forest": The audience interaction

Interactivity is a key issue in both technological art and human sensibility ergonomics.

In a recent exhibition, "ASTA Project 1: Artificial Emotions,"³ ASTA created a stuffed (taxidermic) ox to interact with the audience by overall mutual sensations:

² In the words of its author, the South African statesman and philosopher, J. C. Smuts: [Holism] regards natural objects as wholes... It looks upon nature as consisting of discrete, concrete bodies and things...[which] are not entirely resolvable into parts; and...which are more than sums of their parts, and the mechanical putting together of their parts will not produce them or account for their character and behavior.

³ "ASTA Project 1: Artificial Emotions" took place at the Gallery Fusion in Seoul, Korea, on March 9-18, 2000. This exhibition was supported in part by the Korean Culture and Arts Foundation in the program year of 1999.



(a) Breathings

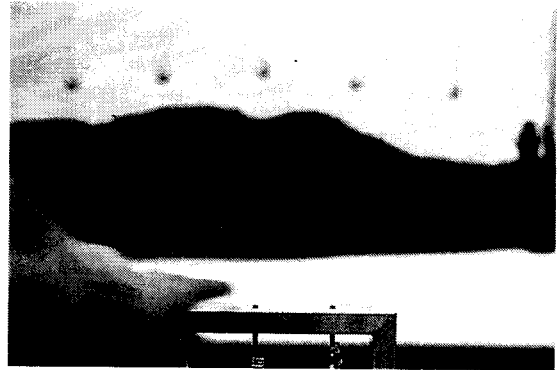


(b) Ribs

Fig. 2 ASTA Project "Artificial Emotions"

breathing, touching, and eye tracking, as shown in Figs. 2 and 3[14-16].

Also, the implemented sound sculpture, "Black Forest,"⁴ shown in Fig. 4, interacts with a spectator at up to sixteen pyroelectric sensor locations with sixteen corresponding sound samples of 2^{16} possible cases. Sound samples utilized include raindrops, noise in a fish market, quarreling, coughing, birdsongs, musical sounds, crying, barking, and glass-breaking, etc. Pyroelectric sensors were selected to isolate the spectator's movements to sense the distance between the roof and the spectator's various locations. The spectator walks



(a) Touchings



(b) Head



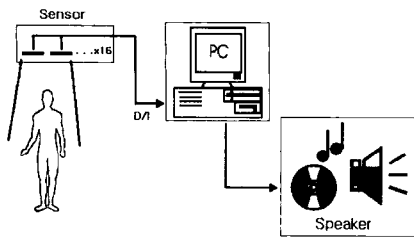
(c) Eye tracking

Fig. 3 Interactions with a Stuffed Ox

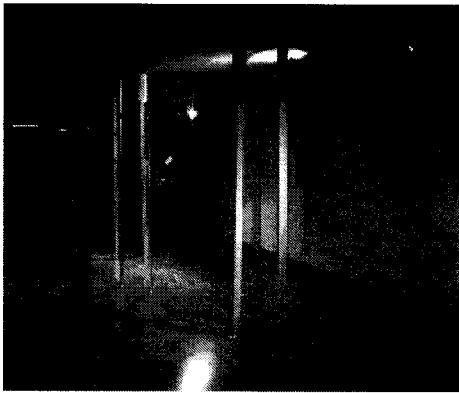
freely around the "Black Forest" and interacts with it by watching it and listening to the corresponding activated sounds. This sculpture becomes an art work as the spectator interacts with it. It is ever-changing and continues to interact with the spectator[17, 18].

The interactive systems, "Artificial Emotions" and "Black Forest," are recent collaborations of ASTA to explore the inter activity between the spectator and an art work..

⁴ The sound sculpture "Black Forest" is a technological art work that has been implemented by collaborations which ASTA and has been presented at Yong-Baek Lee's "Tactile Documentary" exhibition, which took place at the Sungkok Art Museum in Seoul, Korea, on March 5-30, 1999.

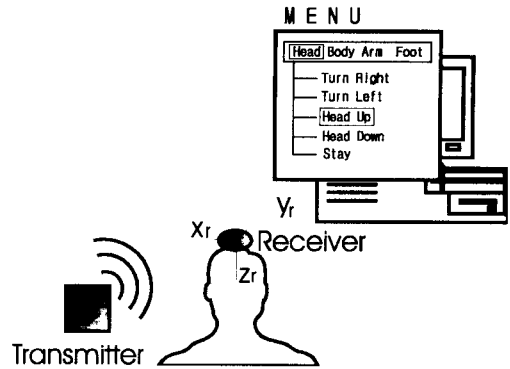


(a) Structure of sound sculpture



(b) Sound sculpture "Black Forest"

Fig. 4 A Sound Sculpture "Black Forest"



(a) Selectly-based physical interaction



(b) Motion Capture and Mimic System

Fig. 5 An Intelligent User Interface "MCMS"

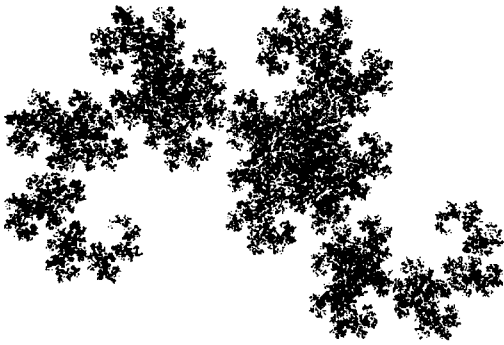
3.2 Man-machine interface "Motion Capture and Mimic System": physical interaction

Human body movements are the result of a long period of evolution and are thus very optimized motions. Complicated and flexible motions could be easily achieved by mimicking the locations and/or the patterns of human body movements. This study implements interactive systems based on head movements by tracking them with gyroscopes and hand movements by tracking them with a digital camera. Motion mapping patterns, derived from basic dance motion patterns, are classified and recognized to activate selectly-based physical interactions.

The proposed interaction technology paradigm is exploring the different individual habits of human body movements and the embodiment principle, meaning that the whole process of sensation, perception, and action is activated simultaneously. Interactive systems with the personality and embodiment factors of human body movements are being implemented with simple interfacing devices. An intelligent user interface based on select interactions is shown in Fig. 5[6, 19].

3.3 Composing machine "Interactive Fractal/GA music composure": mental interaction

An interactive system is investigated in terms of a composing machine as a contemporary art form. Various deterministic and aleatoric algorithms are currently being investigated and implemented in terms of algorithmic composition. IFGAM, Music based on fractals and genetic algorithms(GA), is proposed and composed. The self-similar nature of fractal algorithms may generate somewhat meaningful musical units. Among other fractal algorithms, dragon fractal and 1/f fractal algorithms are utilized to compose the proper musical seed data. Humans are interacting with a genetic algorithms-based evaluator, a human fitness function based on heuristic tune variations, to improve the musical seed data generated by fractal algorithms. IFGAM, evolved fractal music created by interacting with human evlauators, is shown in Fig. 6[20].



(a) Dragon fractal



(b) Musical dragon fractals



(c) A genetically evolved musical fractal
Fig. 6 An Algorithmic Music "IFGAM"

3.4 Visual Performance Depending on Convexity of CRT Panel "Flatron": human factor based design evaluation

Among information display devices, the CRT(cathode ray tube) is the most popular device because of its price, colors and gray reproducibility. However, as the time of work with CRT has increased, numerous job-related complaints of visual fatigue and poor task performance have also increased. Therefore, most of CRT manufacturers try to make less visually tiring and better performing products by including antistatic and antireflection coating on the surface of CRT panels. As a result, the curvature of the CRT panel has changed from a spherical type to a flat type[21].

Although many researchers have attempted to quantify the causes of visual fatigue and poor task performance in CRT working, they have not attempted to find the effects of convexity of the CRT panel on visual performance. Also most studies have focused on the evaluation of visual fatigue as related to the conditions of the CRT setting. The main object of study is to find the effects of visual task performance as related to the convexity of the CRT panel.

In addition to a subjective preference questionnaire, the visual search and decision-making performance of two different shapes of CRT panels, conventional convex and perfect flat, were investigated for 2 hours per CRT. The searching task during the experiment was designed to find the indicated five words and count the number of each word in each screen, which has 200 words, as shown in Fig. 7.

4. Summary

Although art and technology may seem to be very distance from each other in nature, they share the same starting point historically. The collaboration between this two areas is an important idea that this century demands. However, during the implementation of paradigm, interactions between the two often do not occur.

By exploring a new paradigm in technology and the arts through Körperlichkeit(corporeality or the philosophy of Mom), an oriental view on technology and art, interactive technology and interactive art, may evolve to expand the limitations of the Western view of machines as an absolute form.

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