Springer Series on Cultural Computing

Naoko Tosa

Cross-Cultural Computing: An Artist's Journey

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ISSN 2195-9056 ISSN 2195-9064 (electronic)
Springer Series on Cultural Computing
ISBN 978-1-4471-6511-8 ISBN 978-1-4471-6512-5 (eBook)
DOI 10.1007/978-1-4471-6512-5

Library of Congress Control Number: 2015957194

Springer London Heidelberg New York Dordrecht

Printed on acid-free paper

Springer-Verlag London Ltd. is part of Springer Science+Business Media (www.springer.com)

Foreword

The Cultural Computing Series is showing how the centre of computing has moved away from the concerns of the technology itself, and the early technically oriented applications, into the much more significant domain of the very culture of our lives. For a long time now we have seen the importance of computing in every aspect of work, from the manufacturing plant to the office and the corner shop. The tight coupling of computer developments with communications technologies has enabled the construction of the Internet and the Web, without which many people today feel completely lost. This all-pervasive presence of computing very naturally changes the cultural context of our lives. It changes our relationships, our understanding of others, our international perspectives and, more and more, the way that we make and relate to art and entertainment of almost every form.

To take one example, innovation in the products and systems that surround us comes from design. Innovation in design is frequently inspired by art. Art is where we can find significant pointers to the future of computing and its likely impact on the world around us.

Another example is that today, through the new technologies, we cross cultural boundaries with ease. On the day that I am writing this I am having physical meetings with people in England and virtual ones with people in both Australia and China. This does not mean that cultural differences disappear, but it at least means that they become more obvious and important. Will there be one global culture in the future? Will new cultural patterns emerge?

This book tackles these issues from the perspective of a cross-cultural artist to whom technology is central. Her experience and knowledge place her in an ideal position to illuminate several key aspects of cultural computing. Although this is not the first book in the series, conversations with Naoko Tosa were important in forming the idea of creating Springer's Cultural Computing books. Her story is a special one today but one that may be a model of many stories of the future.

Peak District, UK
November 2015

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Acknowledgments

Art and technology research that began in the 1960s has, to this point, not been present in the relatively disconnected culture of now. Indeed, as for culture and computing, this is perhaps the biggest challenge. However, for me, there is a working relationship between art and technology research, and it seems that now is the time when IT can be connected by the cloud network, for technology and culture link continents, creating a new digital cultural world. Through this book, it was my aim to express this idea to the world. However, the situation was complicated because this is a new concept, and therefore, it would not have been possible to publish a book in such a new genre. Under these circumstances, however, Springer has made the new genre possible via a new cultural computing genre. To achieve this endeavor, there were two people who made great efforts over the long run. Helen Desmond, editor of Springer, invited me to publish this kind of novel work. And, Professor Ernest Edmond, the editor of the *Cultural Computing* series, was the first to recognize the value of this book. First and foremost, I would like to express my sincere thanks to these two people – I am so grateful. Professor David J Dalsky, a colleague of mine at Kyoto University, did his best to brush up my English, and finally, by my side, always, I wish to deeply thank Professor Ryohei Nakatsu, my partner in life.

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Introduction – The Discovery of Cultural Computing

1.1 Media to Supplement Thinking and Memorization

"The ethnic crisis, the urban crisis, and the education crisis are interrelated. If viewed comprehensively, all three can be seen as different facets of a larger crisis, a natural outgrowth of man having developed a new dimension – the cultural dimension – most of which is hidden from view. The question is, how long can man afford to consciously ignore his own dimension?" This phrase is from the book, "The Hidden Dimension (Hall 1990)," by an American anthropologist and cross-cultural researcher, Edward T. Hall.

Nowadays, computers play many important roles in our lives. Smartphones, e-mail, Websites, games, and personal computers (PCs) are an integral part of our lives, and every facet is used as media (McLuhan 1994). While computers were initially simply high-grade calculators, media have developed their use into supplementing thinking and memorization.

Consider the relationship between traditional customs and computers. Computers are often used for calculations, to store data, or for historical simulation. Fading cultures can be archived using computer technology to supplement memorization, if only to a limited extent, but this is not an optimal application of computer capacity because these machines are fully-fledged multimedia devices with the benefit of being able to be networked together. Nowadays, as people often communicate with other people of different cultural backgrounds, they are expected to understand the histories of other cultures as well as their own. Because the typical methods for understanding a culture involve reading books about the culture or visiting relevant museums, it is not easy to understand another culture by merely finding the appropriate information. Could the development of information technology help us understand a culture by using computers as media to supplement thinking and memorization, which has become more suitable for networking, mobile connections, and two-way communication?

N. Tosa, *Cross-Cultural Computing: An Artist's Journey*, Springer Series on Cultural Computing, DOI 10.1007/978-1-4471-6512-5_1

This book explores the topics of art and technology, culture and technology, and, based on the integration of these two different concepts, finally discusses a new world where both creators and consumers can reach a deep mutual understanding. These topics are the field of cultural computing (Rauterberg et al. 2010); that is, using computing to explore the essence and inner lives of cultures, including sensitivity, national traits, and folklore. The essence of cultural computing integrates verbal and nonverbal information, which proposes a prosperous field in which computers can improve the exchange of cultural information by using cultural models. Cultural computing, which is essential for the communication abilities of future computers that are now being introduced, is a new field that utilizes the actions and mannerisms of humans in each culture and history to share common or peculiar aspects by demonstrating some concrete methodology and examples.

1.1.1 The Transcendental (Cross-Cultural) Artist

What is the aim of art? This is a multi-faceted question, but if I dare to give a short answer, it is "the visualization of the status of someone's heart (Tosa 2010)." I have been interested in this idea since I was very young.

I became interested in surrealism after being influenced by my art teacher in both my junior and high school. I was influenced by the techniques and perspectives of various surrealism artists, from Salvador Dali, Max Ernst, and Rene Magritte, to Pierre Molinier. I was particularly interested in the 'automatic' method that many surrealists used in their mind's creative visualization process. Some examples of such methods are the following: frottage (taking a pencil or other drawing tool and making a rubbing over a textured surface), decalcomania (placing a paper on top of another painted paper, pressing the paper against the painted paper, and copying the drawing on the separate paper) and marbling (creating beautiful patterns similar to marble by dropping paper ink into water, taking out the paper, and copying the design and intricate pattern drawn on the surface of the water).

I was inspired by surrealism because of the following reasons. When creating an artwork using an automatic method such as decalcomania, the intention of the author is not explicitly expressed in the created artwork. However, we can say that these methods make it possible for his/her unconscious intention to be expressed to some extent. Additionally, as the appearance of the created pattern is not directly controlled by the author, but is indirectly or unconsciously controlled, the artwork would appeal to the unconsciousness of its audience effectively. I have also taken an interest in images that may produce dualistic abstract thoughts such as 'good and evil,' 'negative and positive,' and so on. I have looked for a way to express these indefinable thoughts as art.

After graduating from high school, I became involved in modern art and the idea that I could better visualize my feelings through physical expression such as paintings, films, etc. I also took part in theatre. After that, my interests shifted to film; I have created experimental movies and video art pieces. Little by little, I began to use

technology for the purpose of expression. I began creating graphics using computer software, and began creating complete artworks using technology. To supplement this work, I started to create interactive artworks; expressed using computer graphics, these artworks transform themselves based on user interactions.

What have I created through these works? Looking back at these works, which came from the heart, I think that I have expressed human emotions, memories, and the underlying signs and signifiers of communication. Of course, to realize my artistic expressions, my working environment slowly changed.

I had studied at a university for the arts, but at the same time I aspired to study at some high-technology laboratory or university. I devoted myself to research and creating new art; I was always looking for the best way to express my art as time passed. During this process, I became determined to be a 'cross-cultural' artist and transcend the field of art itself, rather than to be simply an artist.

Artworks made with technology are called 'media arts' or 'interactive arts' t but if an artist relies exclusively on technology to create works of art, the resulting work is not interesting in itself. However, the expression of art in the context of technology or pursuit of technology in the context of art is quite interesting.

The value of art contrasts with the value of technology. Great pieces of art have universal values that may possibly never fade. In contrast, old technology is often discarded and surpassed by new technology. Media art can transcend its parts and create a new relationship between art and technology, which influences other fields. In other words, art transcends technology as technology transcends art.

I was conscious of my journey to become a 'cross-cultural' artist, and I determined that my next step would be to obtain a global perspective, instead of merely communicating an ordinary Japanese perspective. I moved my base of research activity to the Massachusetts Institute of Technology (MIT) in Boston, MA. While there, I saw a true difference between cultures. I noticed differences not only in our daily life, but also in the feelings, memories, signs, and unconscious communications that were strongly related to American culture. I noticed that, although I had tried to express art generally, alongside my globalized artistic expressions there were some that were characterized as being extremely Japanese.

At first, I tried to assimilate myself into American culture, but I quickly realized that my strong Japanese heritage meant that becoming accustomed to American culture would be difficult. Regardless, I paid attention to the actions and mannerisms that were considered as 'Japanese culture' in America, and then I tried to express the difference between American and Japanese actions and mannerisms in the arts.

At that time, I became acquainted with the Shan shui,[1] 'mountain-water' paintings by Sesshū Tōyō,[2] a Japanese master of Shan shui. Shan shui paintings are

[1] Shan shui (山水 in Japanese) painting came from a style of Chinese painting. Shan shui, the translation of which is ink and wash painting, involves or depicts scenery or natural landscapes that are created using a brush and ink rather than more conventional paints.

[2] Sesshū Toyo (1420–8 August 1506) was the well-known Japanese master of Shan shui painting from the middle Muromachi period. After studying at Sokokuji Temple in Kyoto to become a Zen

landscape paintings depicting imagined scenery. This is related to the psychology of the unconscious in Carl Gustav Jung's analytical psychology (Jung 1968). I researched the way of unconscious communication to understand other cultures by exploring and using the components of unconsciousness in Shan shui paintings.

I succeeded in creating an interactive artwork, the "ZENetic Computer (Tosa and Matsuoka 2006)," by modeling the structures of Zen and Shan shui, which are thought to be strong representations of Japanese culture. After that, I created the kanji (Chinese characters)-inspired "i.plot (Tosa et al. 2005)," which displays relationships between psychological associations and graphical images as ideograms. Still later, I produced the "Hitch Haiku (Tosa et al. 2009)" system, which allows the user to create a haiku poem from kanji input, using the standard haiku template of 5–7–5 characters.

Surprisingly, when I published these works overseas, for example, at MIT, many Americans showed an understanding of them. For these artworks to have become media that people in other cultures can understand, they have transcended time in the form of history and culture, and transcended space in the form of geographic distance, by picking up the structure of traditional Japanese culture through computers.

1.1.2 Cultural Poiesis

In continuing these studies, I discovered that I could surpass these methods of art and technology. Interactive works using computer models of Japanese culture can act as a new form of media that enables all people to understand other cultures by experiencing them. Thus, various specific features within traditional Japanese culture that are thought to be peculiar by other cultures will cease to be a hindrance in cultural exchange.

Many people worldwide can now create their own haiku or experience Zen. Using computers and a traditional cultural model, we can show people the world of traditional Japan. Of course, computers can model not only Japanese cultural metaphors, but also, for example, the works of Shakespeare, or even Kabuki, composed as if in the Globe Theatre. I think that in this way, cultural computing may even be paving the way for new cultures to emerge.

I noticed that computers have an appropriate feature for creating these new cultures. Computer processes are divided into thousands of complex algorithms to work with data, but the interface we are often presented with is so simple. Handling cultural exchanges using a computer is what will lead to the creation of new cultures. The culture we will see in that context is a poiesis (meaning 'creation' in Greek) of communication between different cultures.

Buddhist, he went to China at the time of Song Dynasty and studied landscape paintings. Although influenced by the Chinese painting style, after coming back to Japan he established his own landscape painting style.

Pride for my mother country made my perspective increasingly patriotic, and I became more cautious to avoid just going along with things abroad. I obtained two different perspectives; namely, what Japan should be as seen by the world, and what the world should be as seen by Japan. With those perspectives, I could look at everything calmly and clearly. When I noticed this for the first time in my life, I had the impulse to write a book and teach this perspective to others.

1.2 From Occidental Unconsciousness to the Eastern Shan Shui Paintings

1.2.1 "Neuro-Baby" Connecting Here and There

I am from the postwar generation, when American culture was widely available in TV shows after I was born. This exposure was the reason behind my unconscious interest in surrealism during adolescence and eventually I learned about Jung's psychoanalysis of unconsciousness. After that, I began to express something intangible in my art, such as consciousness or feelings. That is why I started to create computer characters—characters in virtual reality (VR) through which we, as humans, could communicate with each other.

At that time, computers were still in an evolutionary phase between workstations and PCs. When I saw a PC for the first time, my intuition told me that it had functionality comparable to a human. I wanted to create a grown-up human and make him or her talk, by visualizing an internal consciousness, about his or her feelings.

In the field of artificial intelligence (AI), many researchers worked on computers that could talk with humans. However, their conversations were almost conventional verbal exchanges that were programmed in advance. We cannot help feeling that we are forced to talk along certain language or thought patterns. Conversations should be fresh, enjoyable, and flow freely.

I created "Neuro-Baby (Tosa and Nakatsu 1996)" based on these ideas. This baby computer character cries, laughs, and performs various other actions based on the user's vocal expressions. When I announced it in an international conference, it became the center of attention of researchers in the fields of AI and robotics. I did not know why at the time, but now I think it is because this was their blind spot; "Neuro-Baby" aimed to have the feeling of a conversation in any exchange, instead of their aim, which was to exchange or communicate information.

A festival called "Artificial Life" took place at Ars Electronica in 1993. Studies and artworks used computers and robots aimed at simulating lifelike evolution or humanization by using theories behind biological and neural networks. There, I met an eccentric person who watched "Neuro-Baby" many times, and spoke to it in a funny tone. After a casual greeting, I realized that he was Rodney Brooks, a worldwide authority from MIT in the field of AI and robotics.

AI and robotic technologies meet in interactive art. I felt that technology was approaching art in a new way. I also met Thomas Ray, who was studying artificial life in the biology department at Advanced Telecommunications Research Institute International (ATR).[3] At that time, few people were creating interactive art, and there was no concrete authority in this field.

I met Dr. Tokura Yoichi, who was the president of the Human Information Communication Research Laboratories at ATR [12]. I studied sound using babies at ATR, where I was employed as guest researcher at a new laboratory: Media Integration and Communications Research Laboratories. While there, among many technological researchers, I studied the mechanism of communication using feelings from 1995 to 2001.

Is technology using art? Or is art using technology? Looking back at this period, I realize that I focused on the essential component of human communications, their art, rather than their technology. I think I spent more time visualizing art than using technology. Communication is a deeply instinctive action, and includes many interesting phenomena. First, I focused on handling nonverbal information, such as feelings, by starting with "Neuro-Baby," and then I began to work on verbal information.

Typical examples of nonverbal information are feelings, but these contain much more information than they initially suggest, from simple feelings like happiness, anger, sadness, and comfort, to sensitivity and the unconscious. Therefore, tackling these problems can enable us to have interactive visualization of feelings, sensitivity, and the unconscious.

1.2.2 MIT Center for Advanced Visual Studies

After I left the Media Integration and Communications Research Laboratories at ATR, I stayed in Boston as a fellow of the MIT Center for Advanced Visual Studies (CAVS) from 2002 to 2004.

The history of art and technology starts from the avant-garde art group, Experiments in Art and Technology (EAT), which acted in the latter half of the 1960s. The main members of this group were engineers employed in the Bell Telephone Laboratory at AT&T. Famous contemporary artists, such as American pop artist Robert Rauschenberg, and American composer John Milton Cage Jr., set a foothold in New York and participated in and carried out activities that crossed the borders of art, dance, music, and video production, and pursued the borderline between art and technology. EAT is the original organization of CAVS established at MIT in 1967. A Hungarian painter György Kepes, who had defected to America

[3] ATR is a unique private company established in the Kansai region in Japan in March 1986, based on the broad support of industrial companies such as NTT, NEC, Hitachi, Fujitsu, etc. and the Japanese government. Its aim is to promote fundamental and innovative R&D activities as well as to contribute to society in a wide range of telecommunication fields in Japan.

and become a professor of architecture, also joined EAT. He prompted large movements in various fields such as urban life, environment and life, the fusion of art and science, as well as architecture. Kepes founded CAVS and became its director. CAVS has the longest history as a laboratory of art and technology (and it is now on the third floor of the MIT Museum, above the main gallery). It was a pioneer of performance and collaboration, and its influence on the newer generations is quite profound.

One of the famous artists who once stayed at CAVS is Nam June Paik, a Korean-American artist. He used a variety of media in his artworks and is considered the first video artist. Another artist, Charlotte Moorman, was a cellist who collaborated with Paik. She performed in Paik's "TV Bra for Living Sculpture (1969)" with two small television sets attached to her breasts. Scott Fisher was another member; he was an inventor of the head-mounted display, which is one of the key VR technologies. CAVS has been a source for unlocking human knowledge and explorative research about the art of the future.

Invited by Prof. Steve Benton, the fourth director of CAVS, I worked as a fellow at CAVS from 2002 to 2004. Prof. Benton is a recognized authority on the study of holography, and he invented the rainbow holograph. He is also one of the founders of the MIT Media Laboratory. He appointed me so that CAVS could change its direction from 'art and science' to 'art and computers,' which indicated a shift from analog to digital. My expected role was to bring in an Asian influence of digital arts to CAVS, based on an idea that had been deeply rooted in European culture. Benton had a great appreciation of Japanese culture. In MIT, many people were interested in my work, but it was difficult for them to identify the fundamental value and/or meanings in my artworks. It seemed to me that only Prof. Benton understood my works.

1.2.3 We Cannot Remove Our Culture

Have you ever been impatient in a conversation and thought, "why can't the person I'm talking with understand what I'm trying to say?" The main issue is that we usually communicate with someone under the assumption that they should be able to understand us. However, communication is required to reach mutual understanding. If both sides understand this principle, then desirable communication can be achieved.

If everyone already understood each other, no one would need to communicate. Japanese people take strong pride in their homogeneous race, and are apt to have relatively similar feelings, impressions, and opinions about someone's actions, phenomena, and the direction of their society. It would be a direct communication from mind to mind, which is a common saying in Japan. They are prone to thinking something and expecting that someone should understand if it comes up in conversation.

This Japanese characteristic becomes obvious when we go abroad. That is because we face a situation where we cannot make ourselves understood, even if we try to make ourselves easy to understand. Many other Japanese qualities do not appear normal while abroad, and it is like herbivores living with carnivorous animals.

In America, however, it seems that Anglo-Americans especially will often communicate while considering that a person cannot understand them. In fact, I found this behavior in colleagues with German, Greek, Lebanese, Japanese, Chinese, French, and Anglo-American backgrounds. Southern Europeans usually use nonverbal communication similarly to the Japanese, which made me feel a sense of closeness. However, it is my experience that Americans keep their distance when they communicate. Somehow, they do not open their hearts, or they tend to hesitate to show their feelings. This fact shows that they communicate with a consideration that a person cannot understand them. The same situation sometimes occurs when we communicate with a computer.

In Boston, audio response systems often answer when we call to enter into contracts with a telephone or a gas service. Computers speak, "My name is Alice (e.g.), please answer me to register." "May I ask your name, please?" "May I ask your address?" These questions continue. However, speech recognition sometimes fails. Then the computer says, "I couldn't recognize that. Please repeat it again." Answering the computer about three times would be the limit of patience, but one of the better things about the American frontier spirit is a big-hearted disposition.

"Are people here really patient with computer operators?" I asked my friend. She told me, "Not really. They are rather annoying, and it is typically better to wait until a human operator gets on." She said that such systems are meddlesome, and extend the time in which we decide something. This analysis also shows the difference between Japanese, who are accustomed to communicating tacitly, and Americans, who are accustomed to being verbose.

While I stayed in Boston, I realized from my experience that we should think of communication as occurring only when people cannot understand each other, while considering the differences of their cultures. Many times, I experienced the satisfaction of empathy when I could communicate with someone with whom I thought communication was almost impossible. We cannot communicate vigorously without this kind of experience. If we communicate not only through discovering our errors, differences, and empathies, but also by exchanging and amplifying our knowledge and feelings, communication will transcend cultures.

We have obtained global communication by adopting media technologies in face-to-face communication, which had previously been limited to small communities. E-mails, social networks, and blogs have enabled us to communicate more easily with people from around the world, overcoming the barriers of distance and culture. Conversely, many people feel communication has become increasingly shallow. Rather, these shallow communications have recently produced a typical face-to-face conversation, "Did you read my message?" Communications may be becoming extremely superficial because of the waning of individualized cultures.

Ignoring this current trend will cause a decline in our ability to communicate, which has been a basic instinct since ancient times. We immediately need a new form of media for communication that can convey one's depth of feeling across the borders between cultures. I could tell that this goal was possible during my 2 years in Boston. I wanted to create media with which we can communicate deep feelings that transcend cultures. I left Boston with this idea.

1.2.4 Technologies Combined with the Spirit

In the latter part of July 2002, I visited western China for 10 days. The aim of this trip was to exchange information with Tibetan doctors and philosophers and to complete the fieldwork for my research theme by looking for communication problems among art, technology, and hearts.

First, I visited Xining, the capital of the Qinghai Province. The Gelug lineage and its founder, Je Tsongkhapa, along with the fourteenth Dalai Lama, originate from here. The religious precepts of the Gelug lineage are considered highly important in this region.

Many tulkus, including the fourteenth Dalai Lama, practiced asceticism in the Kumbum Monastery (Ta'er), one of the six largest temples of the Gelug lineage. I inspected the temple in which 4000 monks practiced asceticism, and felt a great energy, or a sense of many people's minds, flowing inside the temple, where many pagodas (stupas) were standing.

Tibetans believe that medicine and philosophy are the same. Doctors are philosophers and Buddhist priests at the same time. I was impressed with the manner doctors first used to see what was wrong with each patient's inner heart.

Tibetan philosophy has a faith that gives freedom to all afflicted lives. Their thoughts are deeply related to consciousness, feelings, space, and lives, centered on the bowels of mercy and wisdom. Their cosmic view has to do with our essential problems, the wheel of life, and existence. Many cultures in Tibet include Buddhist Tantra as the appreciation of the idea that life moves in cycles.

South of Xining is Kitoku, which is famous for its hot springs. A 3800 m highland is nearby. I visited a Tibetan tent (Yurt), and they offered us butter named Tsampa, yak milk, and dishes with barley in them. I remembered that I used to eat similar foods in my childhood and was impressed that Tibet and Japan share a lot of traditions. I returned to Xining and visited the Arura Tibetan Medical Center, where I discussed my work with five people, including the famous Dr. Denchi, the hierarch and Buddhist philosopher, and Dr. Tanjinja who is a Nyingma (spiritual exercise specialist in Tibetan Buddhism). When I referred to my spirituality of arts and the possibility of fusion between art and technology, they identified with my ideas and said, "It is a possible idea as a future figure of religion." This encouraged me greatly.

Tibetan Buddhists see the spirit of the bodhisattva as being very important. This means they must drop their tenacious desires and self-love and have altruistic love. I noticed that this spirit is deeply related to interactive art.

Interactivity in art is shallow and the value is low if the purpose is self-assertiveness or communication of the artist's feeling. What is important is the interaction between the spirit of the bodhisattva and altruistic love. That is, if computer systems succeed in interacting with the spirit of the bodhisattva, the interactivity of the system can deeply resonate with the spirit of other peoples' cultures.

I knew from my visit to Tibet that their Buddhism, which was born in India, has been adjusting to the culture there and that the global consciousness remains. I was impressed with the fact that we Japanese and Tibetan Buddhists were able to understand each other deeply within our spirits. I hoped to create something for Westerners so they could also understand Buddhism, using a technology-based expression in media. Then I came upon Sesshū, which critically affected my artwork after that.

1.2.5 Meeting the Shan Shui Master

I encountered Sesshū, the most prominent Japanese master of the Shan shui painting who lived in the middle Muromachi period, at the exhibition "Sesshū – Special Exhibition at the 500th Anniversary of His Death" at Kyoto National Museum (Kyoto National Museum 1990) in 2002. I was fascinated by the world Sesshū had created. I had not had any particular special interest in Japanese culture before that. For some reason, the Shan shui world of Sesshū in that exhibition seemed to become a VR that fully expressed his heart in my eyes.

In ancient China, a Shan shui painting featured a landscape that we wanted to view forever, a place we wanted to go to play, a place we wanted to live, or a hometown in our heart in which we wanted to pass away. Shan shui pictures are that type of imagined scenery. Its bleeding, cracked, feathering lines of ink draw the movement of the heart. It makes us feel color even if it is in monochrome.

I had an inspiration to compute Shan shui pictures and the world of Zen Buddhism expressed in Shan shui pictures when I first saw the Shan shui pictures created by Sesshū. Zen makes us feel immersed in Japanese culture because of its absence of absolutes and beautiful sense of "Wabi-sabi.[4]" Wabi-sabi is the aesthetic characteristics specific to Japanese culture that include asymmetry, simplicity, austerity, modesty, intimacy, and appreciation of the ingenuous integrity of objects and processes. One good example of Wabi-sabi is a Japanese garden style that was first introduced from China, but became a new style by removing the water features from the original Chinese garden style. Many elements in Japanese culture are gathered in Shan shui, like the ume Shan shui (Shan shui with Japanese plums). I wanted to express these pictures and Zen culture, centered on Japanese Zen, in my art.

[4] Wabi-sabi is a Japanese aesthetic feeling that became apparent in the late Muromachi period and became shared by many Japanese throughout the Edo period. The thought such as "everything has to change" or "nothing is eternal" is the basis of Wabi-sabi. Based on such thoughts, Wabi-sabi emphasizes the beauty existing in something simple, old, small, and sometimes poor contrary to beauty in huge, gorgeous, new, and luxury objects.

Culture is the integration of human behavior that includes attitudes, norms, values, beliefs, actions, communications and groups (ethnic, religious, social, etc.) (Kroeber and Kluckhohn 1952). Cultures have been created, changed, opposed, and fused with each other over time, and can be rational and irrational. Cultures that have both rationality and irrationality seem difficult to comprehend fully.

Almost all existing Japanese media artworks feature traditional contents like Noh[5] and Kabuki Theatre[6] with added interactive functions. These media artworks are seen as being superficial digital expressions, even though they are extensions of texts, images, videos, and combinational multimedia that explain traditional culture. The thing is that they are only an explanation and are not new art. What these media are doing is only to view the surface, instead of to approach the culture directly.

No research has been undertaken to make use of the hierarchy of Japanese culture within the computer for existing computer technology. This is the reason why there is no art expressing deep, historical 'culture' on a large scale yet. Another reason is that most artworks have paid attention to the uniqueness of Japanese culture and seen it as a sum of superficial expressions.

In contrast, engineering identifies the mechanisms behind phenomena, and analyzes their elements alongside the structural form. Engineering studies find new relationships between different things and their constructions, by reconstructing, trying some combinations, and comparing them.

In creating new media art, we can make use of the extraction of the basic structure or thoughts of Japanese culture, and modeling them or using them as tools to create new technology. Fresh media works or artworks are likely to be created that way. This method will bring about greater possibilities for advancing media art and interactive arts hereafter.

I had a little advantage in this difficult challenge, in which I reconstructed the world of Zen, which was expressed in Shan shui pictures on the computer. Although we needed 3 years, we finally produced a unique system that we called the "ZENetic Computer" (see Chap. 3 for more details).

I succeeded in constructing this futuristic interactive system by projecting a part of allegory or symbols in Shan shui pictures, Yamato-e (Japanese traditional paintings), haiku, and kimonos that reminded me of Japanese culture—the structure of the Oriental thought, the structure of Buddhist philosophy and the mechanism of Japanese traditional culture—which were rarely featured in computers previously.

This system uses various symbols and allegories that are included in Buddhism, Oriental thought, and the Japanese cultures. This is because they all include plenty

[5] Noh derived from the Japanese word for "skill" or "talent," is a major form of classical Japanese musical drama. Noh was first introduced from China more than 1000 years ago during the Nara period. Although originally it was entertainment including dance, music, performance, etc., gradually the form was purified and minimalized and around the fourteenth century was established in its present form. Many characters are masked, with men playing male and female roles.

[6] Kabuki is a classical Japanese dance-drama. Kabuki theatre is known for the stylization of its drama and for the elaborate make-up (called "Kumadori") worn by some of its performers. The expression Kabukimono referred originally to those who were bizarrely dressed and swaggered on a street.

of cultural implications, and they have extraordinary terms, figures, or colors. There are many rules in Shan shui pictures and the world of Zen. I discovered that computers could handle these, if they are first selected and then extracted t. For example, there is "三遠 (San-En)," which is a special perspective found in Shan shui pictures; a combination of looking-up, parallel, and looking-down views. Another is "Go-Un," which means five elements; "色 (Shiki)" is the superficial appearance of reality, "受 (Jyu)" is intuitive impressions, "想 (So)" is perceived images, "行 (Gyo)" is activation of behavior, and "識 (Shiki)" is the deep mind behind all of the above, which functions in recognition of the human in Buddhism, and so on.

The first exhibition of this system was in the MIT Museum. I was concerned whether Westerners would understand it. Despite my initial worry, however, the system was accepted by many Westerners and won great popularity. Westerners felt that Shan shui pictures and Zen were extremely Oriental and hard to approach, but they gave me the impression that they could understand the concepts through interaction with this system. I, myself, felt that we could realize the initial goal of expressing culture through media when I saw an American child interacting joyfully with the system.

After that, the system was exhibited at ACM SIGGRAPH, a well-known international conference on computer graphics, and Kodaiji, a Zen temple in Kyoto. Each exhibition won great popularity. The success of the experiment using this system made me feel certain that 'cultural computing,' which computes culture itself, was a reasonable research goal.

1.3 Cultural Structure Becomes a Communication Technology

I was encouraged by the success of "ZENetic Computer," and felt that the interaction that reached deep racial memories was the very research I wanted to realize in the next stage of the development of cultural computing. From the dry, natural interaction of computers to a friendly and impressive interaction… How could I realize this challenge?

I tried to classify the types, structures, and relationships of what supports racial memories in Japanese culture. Below are the details of my findings:

1. Japanese natural climate

   Japanese transient weather and nature, thoughts of transience such as "Mono no Aware,[7]" a sense of beauty such as "Wabi-sabi," and existential thoughts of love for the present situation.

[7] Mono no Aware is a Japanese aesthetic feeling that frequently appears in Japanese literature in the Heian period (794–1185). Direct translation of Mono no Aware is deep and sentimental feeling when looking at or listening to something. In the Heian period based on Buddhism's teaching about the end of the world, such thoughts as "everything has to change" or "nothing is eternal" became common. The feeling of Mono no Aware is tightly connected to such a thought.

2. Relationships between Japanese culture and general Asian cultures (Japanese methods overriding the Asian culture within Japan)
3. Transformation from Chinese Shan shui pictures to Japanese ones. And transformation from Chinese gardens and grove gardens to Japanese rock gardens called "Kare-Shan shui[8]" in Japanese.

1.4 Characteristics of Japanese Language

A Waka poem[9] is a classical Japanese verse form and has played a major role in Japanese literature. The oldest literature in the world, "Tale of Genji"[10] and "Pillow Book",[11] provides such examples in the life of noble people. There are several applications of Waka poetry. One is 'Honka-dori,[12]' which is an allusion within a poem, particularly a reference to older poems that are generally recognized by its potential readers. Another format of poem, Haiku,[13] is the shortest poem in the world. Haiku

[8] Kare-Shan shui or often called a Zen garden is the Japanese dry rock garden. Its characteristic is a miniature stylized landscape consisting of carefully composed arrangements of rocks, moss, pruned trees and bushes. Its most distinctive feature is to use gravel or sand to represent ripples in water.

[9] Waka (literally, "Japanese poem") is a type of poetry in classical Japanese literature. In contrast to the Chinese style of poetry that is composed using only Chinese characters and are called Kanshi, Waka consists of 5 phrases each of which involves 5, 7, 5, 7, 7 Japanese syllables respectively.

[10] The Tale of Genji (called "Genji Monogatari" in Japanese) is a classic work of Japanese literature written by the Japanese noblewoman Murasaki Shikibu in the early years of the eleventh century, which were culturally the peak of the Heian period. It is sometimes called the world's first novel. The novel also illustrates a unique depiction of the livelihoods of high courtiers during the Heian period.

[11] The Pillow Book (called "Makura no Sōshi" in Japanese) is a Japanese book the contents of which are observations and musings recorded by Sei Shonagon during her time as a court lady to the Empress Consort Teishi during the 1990s and early eleventh century in the Heian period in Japan.

[12] Honka-dori is one form of Waka composition in which an old famous Waka is treated as a reference and a part of the referred Waka is used in a newly composed Waka. By doing it, it is believed that the composed Waka would deepen its meaning and become more valuable by expanding the imagination of listeners.

[13] Haiku is a very short form of Japanese poetry. It consists of three phrases each of which contains 5, 7, 5 Japanese syllables respectively. The origin of Haiku is Waka. which consists of five phrases containing 5, 7, 7, 7, 7 Japanese syllables respectively. Based on Waka in the late Heian period the new type of Waka composition (called Renga in Japanese) become popular where multiple continuous Waka are composed by multiple people. Then the first part of Renga consisting of 5, 7, 5 syllables became treated as an independent form of poetry. The famous poet Basho Matso through his Haiku composition raised the position of Haiku to sophisticated minimalist poetry.

poems use the rule of "Uta-makura",[14] which is a rhetorical concept in Japanese poetry.

1.5 Japanese Design

Japanese design is one of the most popular forms of Japanese culture. Two-dimensional designs include Mon (Japanese family heraldic symbols), Ori (pattern of textiles), colors, paper patterns, or lines. One of the typical three-dimensional dynamic designs is the design of Noh Theatre, which is a major form of classical Japanese musical drama that has been performed since the fourteenth century. Many performers are masked, with male players playing both male and female roles. Another is the design of Kabuki Theatre, which is well known for its stylized drama and for the elaborate make-up worn by some of its performers.

On this basis, we can refer to various racial types and structures of Japanese culture and communication.

1.6 Computers Do Not Have a Cultural Information Hierarchy that Is Indispensable for Symbiosis with Humans

Scientific technologies have developed Web 2.0, such as Google, YouTube, Wikipedia, and SMS, through which we can send information with greater ease. Robotic technologies are also developing new basic techniques to realize the superior functions to which living things currently have exclusive access. More specifically, these are abstract global communication technologies such as movement functionality, manipulation systems, and distributed autonomous systems for upgrading intelligence.

However, there is no cultural information hierarchy needed to live with humans. Adding the local cultural information here by cultural computing may contribute to creating higher-level communication systems.

These 'cultural computing' methods enable us to model and structure the inner essentials of culture, like sensitivity, intuition, racial characteristics, and narratives that we have not yet been able to quantify. I am setting my goal as the realization of expanding present computers' communication abilities to be able to reflect differences in feelings, consciousness, and memories, based on each individual culture. If these systems are realized, social, practical, and cultural information expression

[14] Utamakura is a category of poetic words, often involving place names, which allow for greater allusions and intertextuality across Japanese poems. Utamakura includes locations familiar to the court of ancient Japan, such as particularly sacred Shinto and Buddhism sites.

systems through various languages, voices, and movies could be enabled in various fields.

Now, I would like to introduce you to the methods of cultural computing.

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Chapter 2
Computing Feelings

2.1 Media Art, Culture, and Feelings

In this chapter, I will describe the concepts and specifications of artworks I have created (we call them 'systems,' from a technical perspective). As discussed in the Introduction, I have created media artworks (Tribe et al. 2006; Schwarz 1997; Shanken 2009; Rush 2005) while approaching how to deal with feelings. Through this process, I gradually noticed the importance of stories, and I expanded my work to connect with people's unconsciousness, as well as consciousness. Finally, I conceptualized 'cultural computing' (Tosa et al. 2005; Hu et al. 2008; Rauterberg et al. 2010). In describing my works chronologically, I trace the path that I followed from the fields of media arts to cultural computing.

2.1.1 Mediation

"We should be more sensible and serious about the transcending information that exists beyond mere understandings, because we are in an information society. The meaning of 'art' that has strange powers to provide non-sensory information is especially emphasized there." This is a statement by the famous Japanese artist, Taro Okamoto (1993).

From ancient times, humans have associated images with certain fixed things. Historically, we left evidence of our consciousness in images on cave walls (Curtis 2007; Whitley 2008). These days, we leave images on media like papers and computers.

At a basic level, media are externalized parts of human senses. Speech is the first externalization of our thoughts. We have sung, told, and drawn on walls to pass down memories. From such speech and pictures, written characters (Fenollosa et al.

N. Tosa, *Cross-Cultural Computing: An Artist's Journey*, Springer Series on Cultural Computing, DOI 10.1007/978-1-4471-6512-5_2

2010; Houston 2008) and grammar have been developed, and we now have coherent sentences.

McLuhan, a media scholar, said that a medium is an extension of ourselves (McLuhan 2011; McLuhan and Lapham 1994). For example, a hand became a spoon as an extension of the human body. Writing extended into printing, cameras were developed as an extension for our eyes, and microphones and recorders became the extension of our voices (McLuhan 2011).

Media artworks form 'senses' or 'images' within people through media. That is, media art contains transcending information that reaches a human's subjective view, sensibilities, and the information of his or her culture by using images and sounds to move the viewer's heart.

This transcending information is mediated by computers as the externalization of human memories and thoughts. In ancient times, the mediations between humans and other things were considered spiritual channels (Arewa and Hale 1975; Roman and Packer 1993). Today, the mediation of expanded media is carried out by media technology. People who are working on media technology are like the shamans of today.

2.1.2 The Definition and Classification of Media Art

After the mid-twentieth century, there was an artistic movement to actively take up recent media technology in their artworks and create new artistic expressions using the innovative characteristics of new technology.

A style of experimental movie existed in the 1910s or 1920s (Lee and Rennert 2011), which never played commercially in general movie theatres, but they are one of the roots of media art. After that, video arts came into being with the spread of video-editing technology (Meigh-Andrews 2006). For example, experimental video arts by Nam June Paik (Hanhardt and Hakuta 2013; Lees 2011), multimedia works, and performance works by Fluxus were created.

In the latter half of the twentieth century, computer technology was developed, and people focused on computers that enabled them to use various software applications to create media. Many media artworks already began to use computers. Recently, PCs became very popular and many media artworks use computers for their expressions (Cousens 2013; Paul 2008).

Next, I will refer to the classifications of media art. Media art has a rather shallow history, and the field is not fully established. Therefore, there is no well-established system for any of these classifications. Here, I try to classify media art based on my experience as a media artist.

2.1.2.1 Media Art that Corresponds to Communications: Telecommunication, Wireless, Net Art, Global Positioning System (GPS)/Locative Media

Art is originally a kind of communication in which an artist sends messages to artistic appreciators. Also, media artworks have a stronger tendency to be interactive because they use computers (Kwastek 2013; Costello et al. 2005). In this case, they are even closer to communication media in that sense. For example, there are Web arts that fully utilize the World Wide Web (Bayraktar et al. 1998), or interactive virtual pets that play roles of middlemen in communications between people. Recently, a smartphone-based augmented reality (AR) artist group called Manifest. AR was formed.

2.1.2.2 Media Art Using Machines or Robots and Tangible Interfaces

As media artworks often use computer graphics, like the aforementioned Web arts or virtual pets (Eisenmenger 1997), they tend to realize communication through computer displays. By contrast, mechanized media artworks focus on human-like physical communication. Typically, they use robots (Moura 2013), or they set up their works to have physical movement capability.

2.1.2.3 Media Art Using Narrativity

Communications with virtual pets or robots tend to be in the form of a chat. We can expand these chats to have narrativity in their communication (Audet et al. 2007). Present movies have linearly progressing stories, but narrative media art let users interactively create the story or play the roles of the characters. Video games (McGonigal 2011) are a primary example of this.

2.1.2.4 Media Art Related to the Environment, Urban Design, and Architecture

Most of us live in an urban environment and, because of this setting, there is great potential for interactive arts in our urban environment and architecture. New technological possibilities can produce environments that can communicate and interact with us (Kastner 2010). Some media art has already been seen on signs that use LED billboards and which relate to the area they are placed in, and this may develop further in the future; for example, houses may become robots.

2.1.2.5 Media Art Using Nanotechnology and Biotechnology

Nanotechnology and biotechnology are now being developed at a very fast pace. Using these technologies, new art expressions may be born. For example, there is a nanomandala, which is an experimental work for visualizing the nanoscopic world. There is also a work in the field of biotechnology that sets an electric potential sensor on a plant to generate a computer graphics-based virtual plant on the computer[1] (Sommerer and Mignonneau 2006).

2.1.2.6 Media Art that Fuses Information Technology and Traditional Culture

Common present-day approaches to culture from a technological perspective are, for example, high-quality archives of cultural heritage or interactive exhibitions of traditional cultures. Cultural computing (Rauterberg et al. 2010; Curtis 2007), as suggested in this book, is meant to advance this field.

The development of media art varies depending on the development of IT. A new possibility is being created by merging media art and IT. For example, it is now possible to create an artwork that interactively conveys the abstract thoughts of Eastern cultures to Western viewers (Hu et al. 2008). I would like to show these new possibilities in this book.

2.1.3 Applications of Media Art to Culture

Let us think about the applications of media art. I discuss the following features, which correspond to media art. It is not enough to digitize superficial thoughts or cultural information into a static digital archive as we have done previously. It is important to let any users understand these cultures by showing them through interactive artworks using the feelings and interactivity in media art. A large market will emerge there. Additionally, these works could become a very important part of society in the future.

2.1.3.1 Nonverbal Interface

Communication with words is called verbal communication. In contrast, communication using feelings or sensibilities is called nonverbal communication (Mehrabian 2007; Knapp et al. 2013). Let us think about the relationship between culture and

[1] The Interactive Plant Growing is the interactive installation created by two media artists; Christa Sommerer and Laurent Mignonneau. By using this installation users can create their own artificial creatures and can then interact with the creatures they have developed.

nonverbal communication using feelings and sensibilities as the central focus. I will explain my works as specific examples on this basis.

When we talk about communication, we often use the word 'interface.' An interface is what stands between two things with intermediate information. We need an interface when we communicate with computers (Dix et al. 2003; Lazar et al. 2010).

We use a nonverbal interface to communicate feelings. This is an interface in which we can interact with computers using nonverbal messages like figures, colors, motions, circumstances, music, or sensibilities. Nonverbal interfaces have been thought to be important since the 1960s (Esposito et al. 2007; Wachsmuth and Sowa 2002). They will increase their usefulness in multimedia and mobile media that send images and music throughout the world.

According to researchers investigating nonverbal communication, 65 % of all messages used in communication are nonverbal. Albert Mehrabian (1972), a social psychologist in the United States, found that only 7 % of knowledge about feelings, behavior, and personality are acquired from actual words, 55 % are acquired from motions, and 38 % from paralanguage (Key 1975; Nagamachi 2010).

We can pick up feelings without needing to filter through the logistic content of words, and we can express our status, feelings, or sensibilities to others without words, as well. That enables us to experience a deeper collective communication, in other words, human communication.

I have focused a great deal on a subset of nonverbal information, feelings, and studied interfaces that recognize and generate feelings. Assuming that a nonverbal interface is based on technology to capture a human's feelings or sensibilities, there has been various research related to both hardware and software that is said to be able to process various feelings and sensibilities, and available because of the advancement of computer technology such as VR (Rheingold 1992; Eisner 2002). They often aim to realize the functions of the five human senses used in daily life.

Our five senses are more real than the ones provided by present technologies, and in some cases, we are not satisfied by these technologies and feel uncomfortable. Moreover, we are now more accustomed to technology than we were in the past, so I think we tend to be less impressed by simple and shallow technologies.

To resolve these problems and obtain tastes and impressions, I call for using cultural approaches. Cultural activities are emerging as ways to boost our quality of life by letting spiritual works of art, morals, and religion make us ethnically conscious using our sensibilities I set my goal as using computer software based on cultures to produce a model to recognize the sensibilities of a culture that engages in nonverbal communication with users.

2.1.3.2 Importance of a Feeling-Based Interface

Information on sensibilities is too complex to process at this time because they have many different interpretations depending on individual personalities. Therefore, it is reasonable to specifically use feelings only when these are thought of as easier to treat because of their relative clarity in classifications used by the interface.

Present research on human interfaces are using engineering approaches (Lazar et al. 2010). In contrast, the approach described here is more of a cultural approach. In other words, my research is about investigating human senses and technology to expand the range with which computers can interact with humans through emergence in art and culture. Artists rarely have a final image in mind when they start to create an artwork. The process of creating an artwork is not in reaching a goal, but looking for a goal (Eisner 2002; Zeder and Hancock 2005). The method of searching is different from the technological objective quantification. It is based on the personal, subjective view of the artist. The artist's depth of view and sense of values are represented in the resulting artwork. An artist creates artworks that reflect their inner world or consciousness; therefore, considering these features will let us think about new feeling-based interfaces. Nowadays, analog information is being replaced by digital, so feelings may not be exceptions in being digitized. These methods may be adopted as tools to develop deeper interfaces with human consciousness. I have worked on recognition and generation of feelings with this perspective in mind.

The description above may seem abstract, but this is an extremely down-to-earth approach. For example, Brenda Laurel used a drama metaphor as an interface between computers and users in her book "Computers as Theatre" (Laurel 1993). She divided a theatre into three elements: viewers, a stage, and effects. She claimed that the main role of a computer interface is to let the minds of viewers focus on the events on a stage and to give them the expected effect, like spotlights or sound effects.

This perspective can be applied to other fields. For example, the Japanese Noh stage is a metaphor that has a dual nested structure of a corridor; one is a corridor connected to another world and the other is connected to the main Noh stage (Fenollosa and Pound 2011; Takahashi et al. 2010). Based on such structure, a nested Noh narrative called "Fukushiki Mugen Noh" is performed. Here Noh drama construction has two parts: a dream and the present. Shite (the main actor) wears a mask and has left something incomplete before he died. Waki (the supporting actor) is a man who completes what Shite has left. Connecting expressions of images that construct this theatre to information within computers will increase our thoughts or imagination. This is an example of merging engineering and cultural approaches.

As we can see, the emerging possibilities of research to process the information of feelings have initiated various studies about humans' mental activities, such as empathy and sensibilities, in fields like recognition technology (Gibson 2005), AI (Russel and Norvig 2009), neural network computers (Haykin 2008), and brain science (Schwartz and Begley 2003). The results of these studies are capable of being applied to cultural interfaces in the future. I think a concrete cultural interface can be realized only by connecting the ethnic unconsciousness and technology to the processing of emotions.

2.1.4 Communication of Feelings Between Humans and Machines

Nowadays, the work being done on interfaces between humans and computers is increasing, corresponding to the increase in people's opportunities to interact with computers. The present recognition technology for speech and images for interaction between humans and computers is precise enough in a logical sense (Jurafsky and Martin 2008), but these technologies make us feel that they can be used only in very limited situations. That is because there is no "information of sensibilities (Nagamachi 2010)" that represents the level of culture that is always transferred in communication between humans.

While research about feeling recognition using facial expressions are being studied (Bhatia 2012), I think that it would take less work to produce cultural depth in technology. Several studies (Brabe and Nass 2009; Breese and Ball 1999) have made computers generate sensibilities as if they have feelings, but these computers lack the ability to communicate using cultural information.

More feelings than logic are used in human communication. However, engineering research has focused on communication of global logistic information. Local information, such as culturally dependent feelings, has been ignored. In these systems, humans should try to fit themselves to the computer, which makes it difficult for humans to communicate on a deep level.

One ability we want computers to have is the ability to process feelings. This does not mean programing the computer to do something empathetic with its users. By adding feeling recognition to a computer, it will work more effectively than before (Rao and Loolaqudi 2012). The easiest way is to recognize the status of the user's feelings and run programs based on that. To accommodate unexpected interactions from the user, we may need to apply the famous Three Laws of Robotics (harmlessness, obedience, and self-defense) proposed by Isaac Asimov (Asimov 1950) so that future computers act responsibly.

This engineering methodology of emotion generation is typically taken from fields of psychology. For example, according to Prof. Paul Ekman, the leading psychologist in the fields of feeling and nonverbal communication, six basic feelings—namely fear, surprise, anger, hate, sadness, and happiness—occur corresponding to specific triggers (Ekman 2007). Each emotion has a facial expression and a patterned bionomical symptom. In the process of evocation of the facial expression generated by the pattern, a specific sense behind an impulse generates a specific reflection in facial expression or physical pose, which triggers activities of specific automatic nervous system reactions and feeling experiences.

The Affective Computing Group at the MIT Media Laboratory (Picard 2000) is famous for research in this area. They study the effect of feelings in our daily actions like determination, recognition, or sense. Based on these effects, they also research the whole concept of feeling recognition in systems design while constructing theories of basic emotional information.

Concretely speaking, their research includes the following: wearable emotion sensors and the design of its learning algorithm, and multimodal channeled analysis of results from feeling recognition; methods to evaluate frustration, pressure, and mood in natural conversation; an intelligent system that alleviates humans' negative feelings by detecting frustration; resolving autistic patients' feelings using communication; evaluation of effects of feelings on human health; and searching for ethical issues of emotional computing.

2.1.5 Realizing Empathy

We can analyze classifications and definitions of empathy from novels, poems, dramas, colors, figures, or tones. We can also analyze feeling expression and its dynamics over a time axis from movies and theatres. André Bazin, a French film analyst, used the term "presence" in the historical work "Qu'est-ce que le cinéma? (Bazin et al. 2004)."

Presence is a term that represents the viewer's feeling as if she or he is in the screen, and the word describes the phenomenon well. Movies instigate the viewers' dreams, and viewers feel as if they are encountering them in a reality that is supported by technology and human imagination. Considering the methodology of films is expected to create deeper cultural interfacing by realizing empathy.

However great the virtual world is, it is only superficial if we cannot feel empathy within it. People never spend a long time in the virtual world. Empathy means to understand and share the feeling of others. In other words, it is a pseudo-experience within another person's mind (Lancoboni 2009). An idea I had was to use interactive computer characters to realize human empathy.

One of the basic design concepts of avatars is that they work with us, and they make us feel an affinity, as if they are our alter ego. It is like a baby who came from There (another world) to Here (this world). I started this research while wondering how we could express a communication using technology containing a state of mind, feeling expressions, characteristics, intelligence, and actions.

In this research, I set the virtual world as dreams we experience while we sleep. It shows a real expression of the world of a dream (Fagan 2011). When we dream, we are proactive in whatever we do. However, our empathy cannot reach within this dream because of the barrier between the real and unreal. In this research, I introduced interactions to break that barrier. The user can enter the virtual world, have fun within the programmed circumstances, talk with the characters, and interact with the scene to dynamically change the context and the story. My methodology uses this communication to utilize the differences between our cultural sensibilities in systems design through feeling recognition and an interactive story.

An interaction cannot cause the desired result if the human is not positive (Nissenboim and Vroman 1998). People are positive when they are experiencing good feelings, so we should create a situation in which everyone can feel good. A common example of this situation is the relationship parents have with their babies.

Babies have only two notable feelings: excitement (positive or negative) and interest. However, they acquire other feelings as they grow. They do not learn directly from anyone, but the signs of their feelings are directly related to their growing maturity.

2.2 "Neuro-Baby": Voice-Based Recognition/Generation of Feelings

2.2.1 Japanese Love the 'Humanoid'

Why do Japanese people like 'humanoids,' regardless of age and sex? The Japanese have created human-like figures from clay dolls to robots, and have felt empathy for them (Pate 2008; Takahashi 1990). Recent 'humanoid' robots are being developed with the hope of creating something resembling humans (Clay 2014; Sakagami et al. 2002). These robots represent a 'relationship' between humans and machines. Robots are machine dolls, in a sense, and robots mean a similar thing as dolls are to humans. Nowadays, dolls or robots exist as virtual characters beyond the physical limitations of computers. They are like physical computer game characters. Our empathy with computer characters is expected because we can more easily interact with them (Betsz 1997). They play important roles in social events of culture as we can see in the example of the recent "yuru-kyara" (mascot characters).

We can see communication by feelings in the broad context of cultural communication. People express their feelings through various nonverbal outputs. These are sometimes complex, like "smiling with your face but crying with your heart," and sometimes we talk as if something is favorable, but in a strained tone of voice (Kalat 2011).

There is some engineering research about feeling recognition, but none of their approaches consider differences in culture. Information about feelings includes subjectivity, ambiguity, and situation cognition (Nagamachi 2010). We also need to research external factors that generate specific feelings. I think that feeling information is not universal but personal, and these systems should provide the ability to interpret differences across cultures.

Here, I aimed to design and implement an emotional dialogue system that recognizes and generates voices with feeling, and enables us to communicate with various speakers across different cultures.

Now, I introduce the communications by computer characters with an emotional voice.

2.2.2 Human Feeling Recognition and Generation

I needed to design the computer characters for this system to generate natural feeling expression, and to easily feel empathy.

I considered both verbal and nonverbal action in the design of the feeling model. People sometimes show conflicts in their nonverbal and verbal actions. Consistent actions make us feel honest and reliable, but conflicting ones make us feel dishonest and misleading.

Larger conflicts appear between verbal and nonverbal actions when someone lies than when they tell the truth, according to research from psychologist Mordechai Rotenberg. Real feelings are thought to "trickle out" through nonverbal actions (Rotenberg 2003). The subtle motion of hands or legs are easier to use to show real feelings than more consciously controlled parts, such as eyes or facial expressions.

In the concrete design of the feeling model, I have developed a feeling model that can involve any type of feeling expressions in any language. Computers can map the detected feeling expressions onto this model (Tosa 1993). I designed a feeling recognition/generation algorithm using this model.

2.2.3 A Cue to Birth

In 1989 at an international conference for computer graphics, I met Dr. Koichi Murakami, who was studying human interfaces at a laboratory at Fujitsu. I was becoming tired of video arts and computer graphics that simply expressed consciousness or feelings over time. I was more interested in computed consciousness or personification and was looking for new interactive expressions by computers. Dr. Murakami suggested that I should use a neural network (a model that applies the mechanisms of human brain). I felt that it might lead to an innovative result, so I started collaborative work with him. My main theme was to visualize intangible feelings or consciousness, but it was too hard to realize this at that time by using computers Therefore, I set my goal to visualize emotions that are visible right from the start. I wanted to prepare an adult character and realize subtle emotional dialogue like 'hate, but love.' However, this was impossible because of the technological limitations. I wonder whether anyone can perfectly match their actions and the feelings expressed in their dialogue; I was always struggling with conflicts in my actions and emotions. Regardless, I first needed to determine how to process feelings in a neural network. The first things I had to decide were what to set as input, what to set as output, and what to fill the gap with. This information is very important.

2.2.4 *Predawn*

From 1990 to 1992, we carried out various trials. Kenichi Tanigawa, a jazz pianist, joined us. The first achievement based on this collaboration was 'Neuro Drummer'.[2] In this Fujitsu-sponsored Neuro-Drummer project, we succeeded in developing a neural network software called 'self-modifying connection networks.' This has a function of learning similar to the way 'neural nets' in the human brain learn about rhythms using a neural network. The interaction of this system works in the following way: when a user strikes a drum, the computer-based Neuro Drummer answers with a drum rhythm. I created various facial expressions for the Neuro Drummer. Depending on the rhythm of the drum played by a user, the facial expression of the Neuro Drummer changes—but the concept was still fuzzy.

After the Neuro Drummer project, we tried to create various design concepts for an effective application of a neural network. Finally, we found a method that uses the position of a mouse as input, facial expressions as output, and a quantified change of feelings in the center.

We created the character's facial parts with both eyebrows, both eyes, and a mouth with 20 vertices, to display facial expression on the two-dimensional (2D) screen of a workstation. It took about 3 days to calculate a neural network that had 100 elements in its input layer and 100 elements in its output layer. It was far from real-time processing, but we found a ray of hope when we saw the wireframe image change its facial expression. Nonetheless, speed was a big issue.

We needed to drastically reduce the input and output layers so we mapped x and y in 2D coordinates onto input and output layers of a neural network. This method reduced input/output elements from 100 to 2 and lightened the calculation amount. The system acquired the ability to process data in real time.

The next problem was the computer graphics-based facial expression. Even if it was based on a wireframe model, drawing a number of cells by hand was hard work. As it was around 1990, no general computer graphics software was available, so I used the computer graphics modeling software developed by Mr. Masanori Kakimoto The first "Neuro-Baby" was developed by implementing various previous ideas. We mapped each 3D facial expression onto 2D coordinates. Interpolated 3D images from the base elements were generated depending on any data in the x–y coordinates (Tosa et al. 1994).

We had to create many things that had not existed in the world yet. We tried to realize them step by step. Because they were created by hand for this purpose, their accuracy was less than we hoped, but we felt the greatest R&D achievement was when we realized interactive functionality.

We made a baby character for the system because adults were difficult to create, as I mentioned previously. I consulted the human facial expressions of "Man

[2] Neuro Drummer is a project by Fujitsu that started in 1991. Through this project a neural network software was developed that has the structure of self-modifying networks of connections, similar to the way some neural nets in the human brain process information.

Watching" by Desmond Morris in creating the computer graphics of the facial expressions.

We changed the input from mouse position to voice input to make the system recognize the user's feelings. Then the interpolation method also changed from neural interpolation of vertices to direct linear interpolation of free transformations.

Finally, we developed a system that had its own feeling model and facial expressions to recognize the user's feelings from an input voice. A computer character, "Neuro-Baby," was born by combining these elements, and it can communicate with people through feelings (Tosa 1993, 1995; Tosa et al. 1994; Tosa and Nakatsu 1996).

2.2.5 Interactive Design of "Neuro-Baby"

Here, I introduce the character design for "Neuro-Baby." If the user talks to the character with empathy, the system judges which of eight feelings should be shown using the user's voice inflection and replies accordingly. For example, if the user says nothing, he sleeps, or if the user says something, he replies "Hello" or "Bye," depending on his mood. If the user shouts at him or tells him off in a low tone, he gets angry. If the user teases him in a high tone, he does a handstand. If the user whistles in a high tone, he cheers up. If the user speaks weakly, he gets sad and hides his face in his hands. Sometimes, he even loses interest in the user and complains.

2.2.5.1 Emotion Model

The emotion model is expressed in 2D coordinates, as shown in Fig. 2.1. The *x*-axis shows comfort level, and the *y*-axis shows the strength of emotion. The following are the eight concrete feelings and corresponding input voice tones:

Joy (happy, satisfied, funny, comfortable, smiling)

*High strong voice, whistling

Anger (angry, mad)

* Low strong voice, scolding, etc.

Surprise (shocked, surprised)

* Sudden strong voice

Sadness (sad, weeping, lonely)

* Low weak voice, etc.

Disgust

* Tired voice as though you lost interest in him

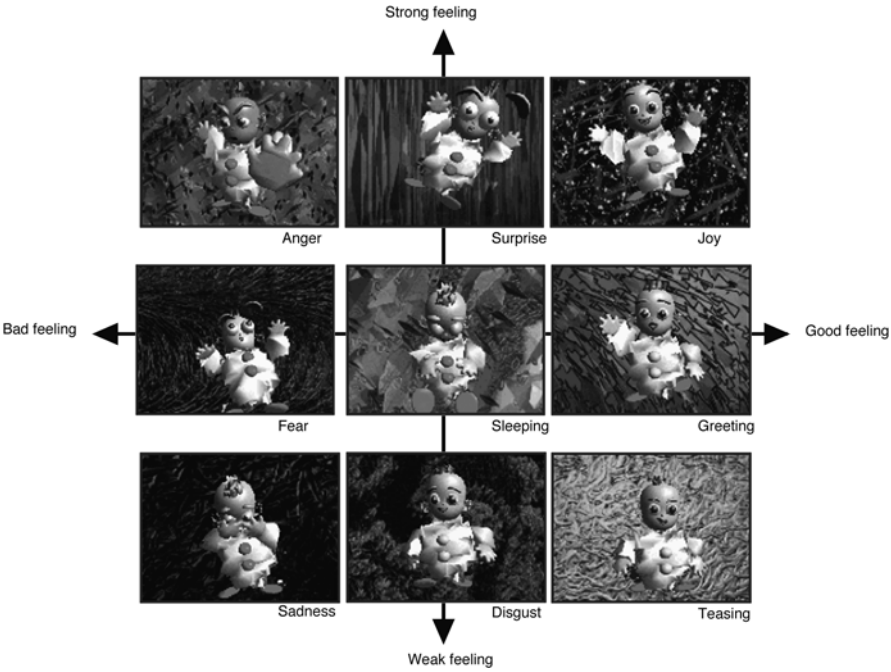

Fig. 2.1 Emotion model of “Neuro Baby”

Teasing

* High and light voice tone

Fear

* Low and threatening voice

Neutral

* Normal voice

Emotional voices are different in each language. Learning special emotional voices for the language in a given locale will help the system recognize emotions more precisely. In the future, the system will be able to transfer this emotional voice among different cultures.

2.2.6 Technology of “Neuro-Baby”

We aimed to develop the basic technologies to realize smarter interactions between humans and characters. We realized the following:

2.2.6.1 Real-Time Processing

To realize interactions between humans and virtual agents, the system needed to process feature extraction, emotion recognition, and responses in real time (Kuo et al. 2006). This system realized real-time processing through sound processing and system composition.

2.2.6.2 Handling Various Feelings

How many and what kind of emotions to handle was a difficult and important problem. For example, some of the research on emotion recognition handled the following emotions:

(a) Anger, sadness, happiness, joy (Tosa and Nakatsu 1996)
(b) Neutral, joy, boredom, sorrow, anger, fear, teasing (Mozziconacci 1995)
(c) Anger, fear, sadness, happiness, hatred (Schemer 1995)
(d) Neutral, happiness, sadness, anger, fear, boredom, hatred (Klasmeyer and Sendlmeier 1995)
(e) Fear, anger, sadness, happiness (McGilloway et al. 1995)

At first, I worked on the four emotions indicated in (a). However, as I absorbed the lessons from the experience of exhibiting the first "Neuro-Baby," I added several types of emotions that the character could recognize and express. To enrich the interaction with the expression of subtle feelings, finally we decided to use the eight emotions described in Sect. 2.2.6 (Fig. 2.1).

2.2.6.3 Precise Voice Processing

It is important to consider what kind of features to use with the voice recognition. One idea is that the voice feature for emotion recognition should be different from the one for speech recognition. In the field of speech recognition, "phonological features" (King and Taylor 2000) are used, such as a frequency spectrum. In the field of emotion recognition, a general idea is that we should use "prosodic features" (Shriberg et al. 2005) instead, such as tone, pitch, or rhythm.

However, there is another perspective. When we speak, the phonological and prosodic features are strongly combined, and it is hard to express emotion while only processing the prosodic features. Therefore, we decided to use both features at the same time. In this research, we used the latter idea to use two features (that is, phonological and prosodic), as parameters.

2.2.6.4 Speaker-Independent, Context-Independent Feeling Recognition

Speaker-independent recognition is important in the field of speech recognition and emotion recognition (Lee 1998). We do not want the system to learn only the feature of one speaker because the speaker may change. From another point of view, humans can recognize content and emotions at the same time regardless of the speaker.

Context-independence is important, especially for emotion recognition. In daily conversation, we use the same word or sentence with various emotions attached to it. In this research, we used a neural network as a type of recognition architecture and learning process with a large amount of samples to support independent speakers and independent contexts at the same time.

2.2.7 Flow of the Entire System

Figure 2.2 shows the block diagram of this system. The entire process consists of three parts: voice feature extraction, emotion recognition, and response generation.

In the voice feature extraction, voice feature parameters are extracted from the input voice. Considering the amplitude, the data is divided into sections. Voice feature quantities are determined corresponding to the input voice of each section. These quantities are sent to the emotion recognition section.

Next, in the emotion recognition, there are two levels of feeling recognition. The first level has eight neural networks that are taught to recognize each of the eight feelings. Output from the feature extraction is input to these eight neural networks at the same time. The next level has logical parts that process output from eight neural networks to map them on the 2D emotional plane. The eight feelings are mapped to this plane. The position and movement of recognized emotions in the 2D plane affects the response of "Neuro-Baby"; that is, the facial expressions and motions that are generated. Facial expressions and motions to output for each emotion were considered by artists as fitting. The response generates computer graphics and appropriate voice and music are played.

Now, I will explain the real-time phonetic feature extraction and the structure of emotion recognition by a neural network.

2.2.8 Phonetic Feature Extraction

There are two types of feature parameters for emotion recognition: phonological and prosodic feature parameters.

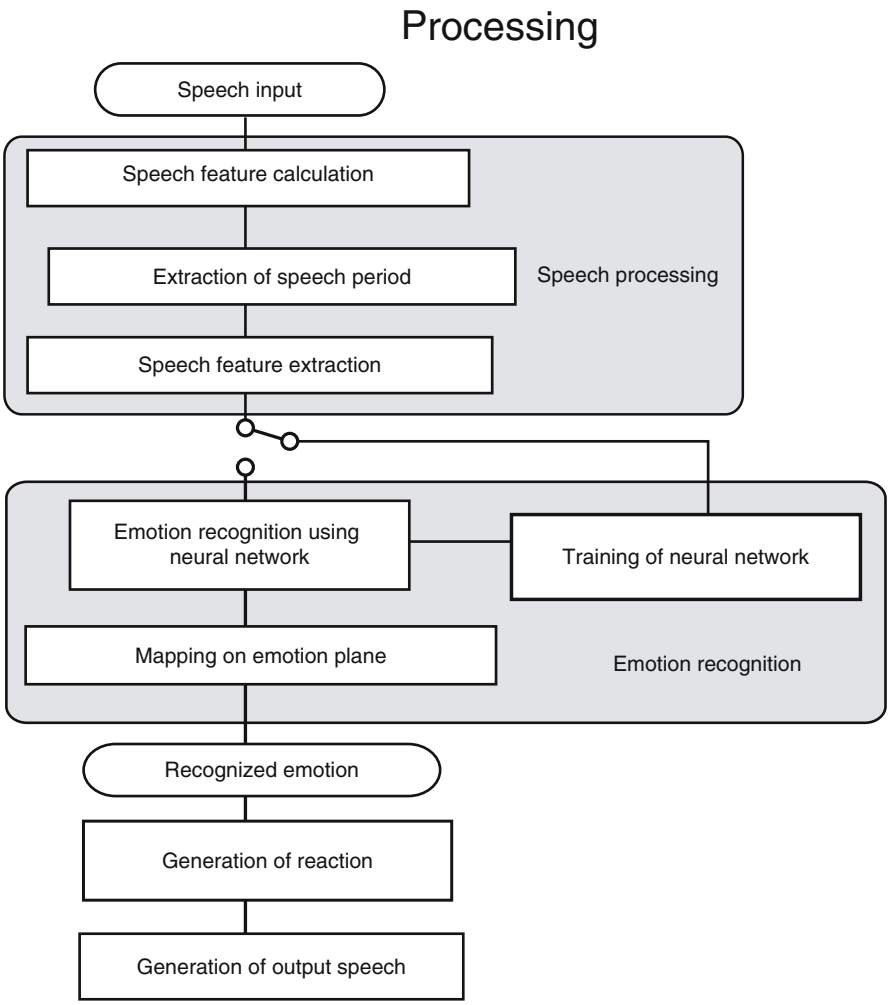

Fig. 2.2 Block diagram of "Neuro Baby"

We used linear predictive coding (LPC)[3] (Gray and Markel 1976) for the phonological feature. This is one of the methods for coding voice signals; it is based on a human speech model. LPC is a typical parameter to express voice features and is popular for speech recognition.

Three parameters were used for the prosodic feature: energy, time changes in the phonological feature, and voice pitch. Energy is determined from the sound level

[3] Linear predictive coding (LPC) is a tool used mostly in speech signal processing. It is used to represent the spectral envelope of a digital speech signal in compressed form. LPC is one of the most useful methods for encoding good quality speech at a low bit rate and has been used in speech coding, speech recognition, speech synthesis, etc.

and voice pitch information from LPC parameters. We used the time changes in LPC parameters for the last parameter.

2.2.9 *Emotion Recognition*

Emotion recognition (Nicholson et al. 2000) is hard to target in research. The major reason for this difficulty is that babies act by recognizing other people's emotions (they are said to start recognizing emotion before they understand any contexts), but adults mainly use contexts that are included in speech to communicate with each other. Therefore, researchers of speech recognition have regarded the emotional information in speech as a mere variation or noise.

What's more, semantic content and feelings are combined mutually in our voice (in both cases they can be conscious or unconscious). Context especially plays an important role in that they often control the level of emotion that we emit or sense unconsciously. In other words, the amount of emotional expression in one's voice is strongly dependent on circumstances. Of course, the best solution is to recognize the emotion even if the input data includes both unconscious emotions and semantic content. However, it is difficult to recognize unconscious emotions because of the reasons I referred to above. Therefore, this system fully processes only conscious emotions within voices.

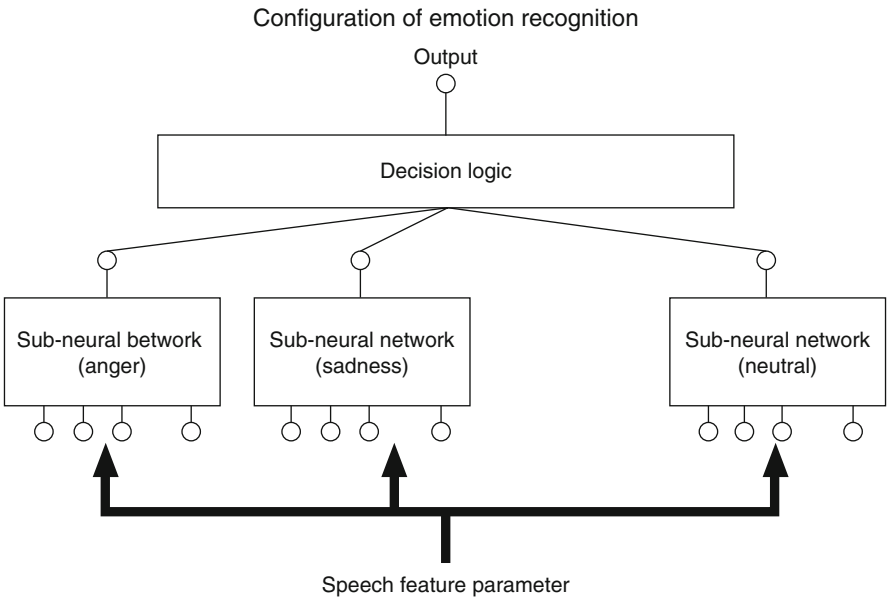

Fig. 2.3 Structure of the neural network for feeling recognition

2.2.9.1 The Structure of the Neural Network

Figure 2.3 shows the structure of the neural network for feeling recognition. This network consists of eight subnetworks and a logic part that integrates the eight outputs. Each subnetwork is tuned for each feeling (anger, sadness, happiness, fear, surprise, hatred, teasing, and neutrality). The logic section decides output by extracting the nearest supervisor data from the eight neural networks.

2.2.9.2 Supervised Learning of the Neural Network

To perform emotional recognition, we needed to make the neural networks learn patterns beforehand. We prepared the following voice samples that were considered to realize speaker independence and context independence.Words 100 phonologically balanced words
Speakers 100 people (50 males, 50 females)
Emotions Neutral, angry, sad, happy, scared, surprised, hateful, or teasing
Sample voice 1 100 words in each emotion from each speaker
Sample voice 2 Vowel sounds with each emotion from each speaker

We conducted a preliminary experiment using this learning data. The results showed that it is better to prepare two independent networks for males and females rather than putting them together, for both learning and recognition.

2.2.10 Emotion Recognition Engine Between Different Cultures

We should produce 'supervisor data' localized for each country for this type of dialogue system. Tuning is required to make the neural network learn emotional expressions for each country. If we talk to the Japanese emotional system in English, the feeling outputs from "Neuro-Baby" increase in randomness because of the quicker changes in intonation in English in contrast to Japanese. The transitions among emotions then become random, such as him getting angry soon after he cries, then suddenly becoming surprised, and so on.

To collect the relevant data, we used typical emotional words from each language for the supervisor data. They enabled us to extract the 'structure' of intonations in each country's emotional expressions. It is very important to fit the phonetic emotional expressions to the country's culture. Software agents for emotion recognition software with voices like this will be developed and applied to the speech of robots in the future.

2.3 Cross-Cultural E-mail Software with Emotion Translation

2.3.1 Emotional Translation in E-mail

In the following section, I will introduce research that used "Neuro-Baby" as an agent of cross-cultural communication.

In cross-cultural communication, we often face collisions rooted in differences between cultures (Neogy 2012). Most people think that these depend on the conversational ability in other languages, but in reality, there are many problems beyond language alone. Nonverbal messages from each culture highlight differences, especially in lifestyle (Neogy 2012). I focused on these points and tried to improve "Neuro-Baby" so that it could translate emotions that exist behind e-mails in other languages.

The common understanding of culture among cultural anthropologists, sociologists, and psychologists is that senses of value, beliefs, attitudes, and ideologies form the subjective side of a culture. We can see that different cultures have different subjective sides, and these sides hold important roles in communication.

Mutual understanding through communication is never realized unless the two sides understand the behavioral differences of the other side based on cultural difference. In this sense, appropriate emotional expressions also play important roles in communicating with each other.

I will introduce a story of a communication misunderstanding that became the basis of this research. I exchanged some e-mails with Prof. Steve Benton before I joined MIT. Prof. Benton used elegant and learned English, so I used a dictionary to write back to him. However, he suddenly stopped replying to me. I felt that something was wrong because Prof. Benton was a kind person but he had not replied to me for almost 3 months, even though I was soon to go to MIT. I asked Ryohei Nakatsu,[4] then my boss at ATR, to inquire as to the reason why he did not reply. I finally discovered that the reason was the mistranslation of my thoughts into English. My messages had made Prof. Benton angry, which was why he stopped replying to me.

This problem occurred because the expectation of the sender did not match with the interpretation of the receiver. As you know, once a relationship goes sour, it is difficult to repair by merely exchanging messages. Communication through e-mail is convenient, but in many ways, especially across cultures, it is difficult.

[4] Ryohei Nakatsu (born 19 October 1946) is a researcher who has been pursuing communication technologies, focusing on emotion extraction from speech and facial images, emotion recognition, nonverbal communications, and integration of multimodalities in communications. At the same time, he has been trying to cross the boundary between pure technology and other areas such as art/design, cognitive science, social science, etc. Based on such trials, he has succeeded in developing new interdisciplinary research areas such as art and technology, entertainment computing, entertainment robotics, cultural computing, etc.

As you can see in this example, Japanese people sometimes fail to read subtle nuances in English e-mails because of the limits of their vocabulary. However, they can use "Neuro-Baby" to emotionally transform the expressions and, from the other end, understand the feelings behind them without words. This is the concept of e-mail software with emotion translation.

2.3.2 Emotion Translation of E-mail Using "Neuro-Baby"

2.3.2.1 The Process

The system picks out the words that represent emotional expressions from the contents of an e-mail and outputs the feelings of each word with motion and sounds. This emotion translation of e-mail is a kind of mail client with read-out functionality.

The character used in this software is "Neuro-Baby." Babies are good for expressing raw emotions because they are loved by everyone. "Neuro-Baby" can express eight emotions and also some greeting expressions. The emotions expressed in this system are happiness, fear, surprise, neutrality, sadness, anger, boredom, and teasing. "Neuro-Baby" reads the e-mail aloud, showing motions corresponding to the emotion (Fig. 2.4).

2.3.2.2 To Send an E-mail

Emotion Translation Mail is developed based on Java software that works on Web browsers. The user must sign in to the special database server before starting.

An 'emotional words database' is stored on the Web database server, which is needed for emotional transformations. It has a list of emotional words corresponding to eight emotions like happiness or anger, and it is used for picking out the emotional words from an e-mail.

The database is on the Web because it grows daily. The user can register new words to the database as emotional words. As the number of users grows, the translation becomes richer and richer. There is also a 'behavior database' that defines the behavior of the computer graphics character corresponding to each emotional word.

2.3.2.3 User Customization

After writing the e-mail, the user can access the database by clicking the 'convert' button. Emotional words in the text are listed and each behavior is played. Then the computer graphics character reads the text aloud by synthesizing its baby-like voice.

The user can customize the motion of the computer graphics character if it is inadequate. Customized data is stored in the user's own database, so it can be used

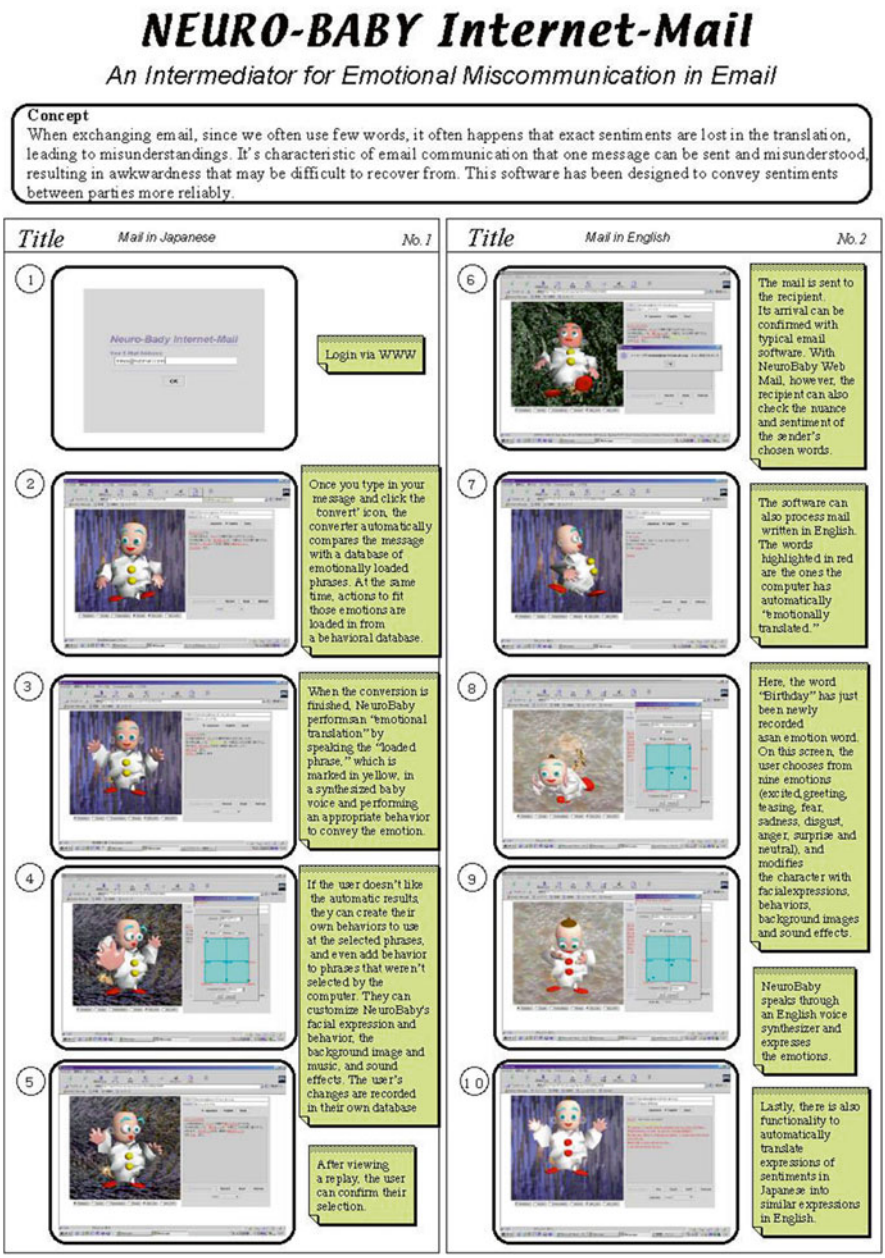

Fig. 2.4 Procedure of creating and sending e-mail

repeatedly. E-mails sent from Emotion Translation Mail can be opened in widely used mail clients, so the receiver does not need to run this software to see this e-mail. However, if the e-mail is opened in another mail client, only text is displayed. If Emotion Translation Mail received the message, the text is read aloud with motions that the sender decided on. This system enables us to realize more reliable e-mail-based communication that can convey the writer's feelings.

2.3.2.4 Each E-mail Is Stored on the Server

You can receive e-mails from Emotion Translation Mail using general e-mail software. In fact, Emotion Translation Mail sends only text to other e-mail addresses. Then, when this software sends data such as emotional words, voices, and motions of the character, how are they viewed?

This system gives an "E-mail ID" to each e-mail. Then the system automatically adds the E-mail ID, password, and URL of the Web server to the body of the e-mail. The receiver software accesses the server and automatically inputs the ID and password to get the "emotional mail" stored on the server.

Figure 2.4 shows the whole procedure of creating or sending e-mail. The Web server and the sound-processing server are kept separate in order to avoid concurrent access to these servers.

The user downloads the Java applet every time he or she writes or reads e-mails. This method enabled the system to exist across any Web browser and be free in constructing its environment.

The Web server requires "send-mail" to send and receive e-mail and access its database. These are open source and widely used. By using this software, we kept the development costs down, and the maintenance is easier.

2.3.3 Emotional Translation Character in a Computer Network

This software can connect the world's e-mail systems using Emotional Translation Software. Each country's own emotional characters can convey a message using responses that correspond with the relevant nationality. By exchanging emotionally-translated content, we can achieve cross-cultural dialogue through emotions.

By factoring in the emotion types of each country, emotional expressions of a country can translate into other countries' emotions. Then, communication through emotions while considering other cultures' feelings is achieved. This system has the potential to be an emotional programming software that strengthens the mutual understanding between people from different cultures.

In the future, we will be able to understand more emotions by merging these emotional models into one and analyzing the emotions on a computer. We will be

able to make collections of the emotional information of each culture through computers. If it is possible, this technology will contribute to humanity as a rich media that conveys deeply felt images across the world. This could have a huge impact and change the structure of our social system. This may even change normal relationships within the information structures of modern society.

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Chapter 3
Computing Stories

3.1 Transforming the Real World into the World of a Story

Stories stay alive by being handed down for hundreds or thousands of years by those who remember them. Largely as a result of my experimental impressions, I noticed the importance of stories in communicating with others reflected the information produced by cultures.

In 2001, I was invited to a workshop held in the The Banff Center, Canada. There, I witnessed the great talent known as 'storytelling' for the first time in my life. In Canada and America, some people were employed as storytellers. The first storyteller I met was Louise Profeit-LeBlanc, a cultured Inuit woman from Yukon Territory, Canada. Profeit-LeBlanc was popular because she had appeared on TV or radio programs and worked as an adviser on the traditional culture of the Yukon Territory. When she started to tell a story, the world changed slowly into a world of her creation. I felt that our VR experience using computers looked cheap in comparison.

I was so impressed when I felt that the scenery of the real world transforms into the world of the story. Other adults around me were absorbed in the world of her story, like children. Profeit-LeBlanc, like the Pied Piper of Hamelin, seemed to enchant the audience with her story; everyone in the room felt a sense of togetherness as they listened. Great empathy was cultivated in her audience and energy was fed back into our hearts. Noticing the infinite power of stories, I was very eager to create a superior virtual interaction that would immerse our minds into a story, while analyzing the narrative on a computer.

Based on this experience, I started to develop systems that could fascinate people based on stories: an interactive poem system (Tosa and Nakatsu 1997, 1998), a comedy system (Tosa 2002), and an interactive movie system (Tosa and Nakatsu 1996a, Nakatsu and Tosa 1997).

N. Tosa, *Cross-Cultural Computing: An Artist's Journey*, Springer Series on Cultural Computing, DOI 10.1007/978-1-4471-6512-5_3

First, I created an "Interactive Poem," which composes a Renga poem[1] with the user using "You," a poem written by the Japanese poet Shuntarō Tanikawa,[2] as the basis for generating the poem. As a comedy system, I created an "Interactive Comedy" in which a user plays a Japanese two-person comedy on a PC, with the computer taking the role of the Tsukkomi[3] (offensive person) and a user the role of Boke[4] (defensive person). For the movie, I created a work named "Interactive Theatre", which uses Shakespeare's "Romeo and Juliet" (Shakespeare 2012) as the basis and enables users to adopt the roles of the main characters and interact with other computer-generated personas.

Although these works might not be able to reproduce the magnetism of Profeit-LeBlanc's stories, I found that users of the "Interactive Comedy" sometimes retorted back at the computer with anger and users of "Interactive Theatre" hugged each other after they played their roles as Romeo or Juliet; frequently, users felt deeply moved.

Many technical systems are expected to convey information. By contrast, I think these systems that I created could convey feelings like laughter, assent, and impressions. These systems could realize this by centering on important roles in our daily communication like feelings and stories and on communicative interaction between humans and computers.

I think stories and memories are very important pieces of information in a culture. If there were no stories, people could not pass down their memories (Gottschall 2013; Simmons and Lipman 2006). The feeling of being approached by something intimidating remains in one's memory and constitutes a story. It is important for the audience to have their own internal sense of personal narrative that recall their own memories. One example can be observed in the patterns of Jōmon[5] earthenware. The relationship between patterns A and B constitutes a story as a code described in

[1] Renga is a genre of Japanese collaborative poetry. The origin of Renga is Waka, Japanese poetry that consists of five phrases each of which includes 5, 7, 5, 7, 7 syllables respectively. The first form of Renga started as a collaborative Waka creation between two people; one person created a former part with 5, 7, 5 syllables and another a latter part with 7, 7 syllables. Then the longer Renga, which is based on the repetition of this collaborative Waka creation, appeared as a collaborative Waka created by multiple people became popular.

[2] Shuntaro Tanikawa (born 15 December, 1931 in Tokyo, Japan) is a Japanese poet, translator and scriptwriter. He is one of the most widely read and highly regarded Japanese poets, both in Japan and abroad. Several of his collections, including his selected works, have been translated into English. In addition to his poetry creation he has actively been doing various activities such as scenario writing, essay writing, lyric writing, etc.

[3] Manzai is a traditional style of stand-up comedy in Japanese culture. Manzai usually involves two performers – a straight and offensive man (Tsukkomi) and funny and defensive man (Boke) – trading jokes at great speed. Most of the jokes revolve around misunderstandings, double-talk, puns and other verbal gags.

[4] See footnote 3.

[5] The prehistoric period in Japan is named Jomon (around 16,500 years ago – around 3000 years ago). The name Jomon (straw-rope shaped pattern) came from the fact that a straw-rope shaped pattern is typically seen on many pots excavated from the strata of this period. The Jomon period finished when rice farming was introduced into Japan from the Eurasian continent.

letters and pictures, which are compiled into works ranging from short haiku (Hirshfield 2011) to grand operas.

Joseph Campbell (Campbell 1991), a mythologist, discovered a basic structure in the story of a hero's birth. There are three central plots that are common among the birth of heroes in myths: Separation, in which the hero begins a journey; Initiation; and the Return. Campbell also indicated that five factors are important in story construction: World Model – The World: this world or another world; Story—Plot, Script; Scene; Character; and Narrator—Omniscience, Omnipresence. We should note that the perspective of the Narrator can change from macro to micro perspectives.

A story is the combination of its center and circumjacent parts and this is the basis of variations in a story. I think that a culture has a similar structure. In each country there are basically two types of cultures; culture in an urban area and culture in a rural area. As people move between urban and rural areas, these two types of cultures are combined and thus a culture tends to change.

3.2 Stories and Culture

When we think about stories, we think first of myths and fairy tales. Children grow up listening to myths or fairy tales told by their parents or grandparents. Myths are records of information as old as our racial origins. Learning a myth means implicitly learning details of a culture. We can learn about original Japanese feelings or sensibilities, as well as ideas behind Japanese culture, by learning myths written in the Kojiki (Record of Ancient Matters)[6] (Ono et al. 2012) or the Nihon-Shoki (Chronicles of Japan)[7] (Ono 2013). Some tales are based on historical events, and others are fables meant to teach lessons to children. Stories that have been handed down for many years teach us basic morals or ways to identify good from evil. Listening to such tales is entertainment and moral education at the same time.

These days, fewer children listen to myths or fairy tales in the conventional sense, but fairy tales and fantasies still play important roles in animation and children's films. Role-playing games (RPGs) (Peterson 2012) are a subset of video games such as "Dragon Quest" (Hartwig 2008) and "Final Fantasy" (Amano 2009) that use these fantasies. Even though fewer people listen to myths or fairy tales from their family members, they can access them through other media and are almost as likely to hear the old tales.

[6] Kojiki (Record of Ancient Matters) is the oldest extant chronicle in Japan, dating from the early eighth century. The Kojiki was composed in 712 by Ono Yasumaro at the request of the Empress at that time. The Kojiki is a collection of myths concerning the origin of the islands of Japan, various Japanese Gods, and the unified process of the nation.

[7] The Nihon Shoki (Chronicles of Japan) is the second oldest book of classical Japanese history completed in 720. It is more elaborate and detailed than the Kojiki, and has proven to be an important tool for historians and archaeologists. At the same time it is sometimes criticized that the content of the book is to justify the ruling system of the Emperor in Japan.

Stories provide interesting themes in the sense of differences between cultures. Interestingly, even though the situations or scenes of the world's fairy tales vary depending on culture, the rough contents are the same. For example, the basic outline of "Cinderella" (James 2013) is as follows: A bullied heroine, who often appears as a fallen figure, calls for help from her late mother. As proxies of her mother, animals, trees, and a 'wizard' as a godfather or godmother help the heroine with their marvelous powers, leading her to a happy ending The oldest model of Cinderella is the Chinese story "Ye Xian" (Mah 2010) by Duan Chengshi published in "Miscellaneous Morsels from Youyang" (Reed 1995) in the ninth century. "Rhodopis" (Climo 1992) from ancient Egypt is another version of the Cinderella story. Depending on the culture, Cinderella's glass shoes may be written poems or the wizard may actually be a fish.

Taboos sometimes appear in myths or folk tales. In the story of "Urashima Tarō",[8] in Japan, there is a treasure box that the hero should not open, similar to the Greek myth of Pandora's Box (Marzollo 2006). The world's stories have thus spread while transmuting through cultural translation.

Myths and fairy tales from all around the world convey ancient racial memories and at the same time teach us morals for our daily life. There are two aspects of myths: their commonality among different cultures or races, and the items, modes, and codes of the local ethnicity. These two aspects are deeply embedded within our ethnic memories. I hoped to recall these memories, which were originally previously realized using storytelling, books, films, or animations, using new media. In this chapter, I will introduce three story systems. These systems differ from the present methods—like those of books, films, or animations—in that they can interact with the user; scenes can change depending on the user's action, instead of complying with a purely linear story. Additionally, I tried to import cultural expressions that I learned from puppeteers, engineers, scientists, poets, and comedians into the stories. Moreover, I will show you how people perceived the computed emotions I created.

3.3 A Computer Composes Renga (Japanese Interactive Poetry) with a Human

In Chap. 1, I introduced a computer-generated character called "Neuro-Baby (Tosa and Nakatsu 1996b)," which can communicate with humans based on feelings and emotions. However, it could not recognize language. Because humans assign

[8] Urashima Tarō is one of the most well-known Japanese legends. It is about a fisherman who rescues a turtle and is rewarded for this with a visit to "Ryūgū-jō," the palace of the Dragon God, under the sea. He stays there for only 3 days and, upon his return to his village, finds that 300 years have passed. Rip Van Winkle is a similar story in America authored by Washington Irving.

emotional meaning to dialogue, they always tried to speak in their own language with "Neuro-Baby," even though the software could not interpret their language. Even a child has the ability to create meaning when they are talking with puppets or other inanimate objects. Therefore, as a next step, I designed a communication tool that could identify the emotions behind words for the computer character.

In Japan, we have several ways of verbally expressing our emotions such as haiku or Waka. In this work, because the interactive exchange of emotion between a computer and a user is the center of interest, I adopted the Renga style,[9] a traditional Japanese style of interactive poetry, as the basic 'structure' of the interaction. Based on this basic concept, I developed the "Interactive Poem (Tosa and Nakatsu 1996a, b)," with which the user could interactively compose poems.

Using "Interactive Poem," the user can not only receive, but also actively collaborate with the computer in creating a poem and producing an interactive story. The story varies depending on who creates it. In other words, we realized a collaborative story artwork controlled by an individual's style using an interactive dialogue method.

3.3.1 Interactive Poem

MUSE, a character based on the Greek musical goddesses with the same name, appears on a large screen. MUSE recites a poem while talking to the user, in a manner akin to singing, and says a short poetic phrase full of emotions. The user listens to the phrase and replies with a short phrase, and so unknowingly becomes absorbed in the world of poetry. Through this exchange of poetic phrases, "Interactive Poem" can create a world of improvised poems that are full of inspirations, feelings, and sensibilities (Fig. 3.1).

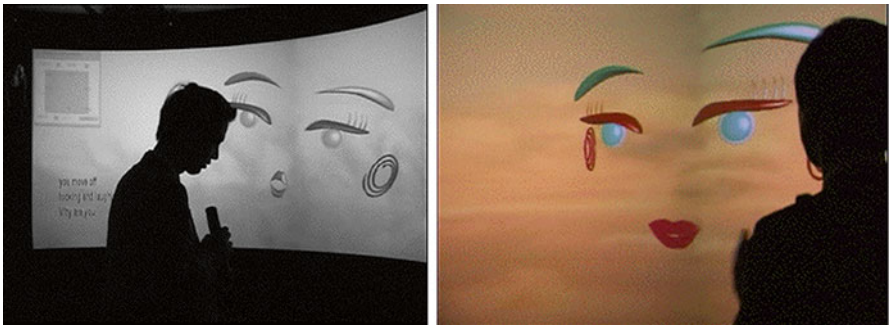

Fig. 3.1 Interaction between "Interactive Poem" and a user

[9] See footnote 1.

3.3.2 Technology Used in This System

The "Interactive Poem" system is comprised of four parts: System Controller, Speech Recognizer, Image Generator, and Speech Output (Fig. 3.2).

3.3.2.1 Interactive Poem Mechanism

The most important function of this system is to create an interactive poem. I will begin by describing the database of the "Interactive Poem" system. Conventional poems are considered as a set of conjoined static phrases. That is, the basic composition of a conventional poem is expressed as a simple transitional network. In this network, each phrase corresponds to a state, and each status connects to other states (Fig. 3.3).

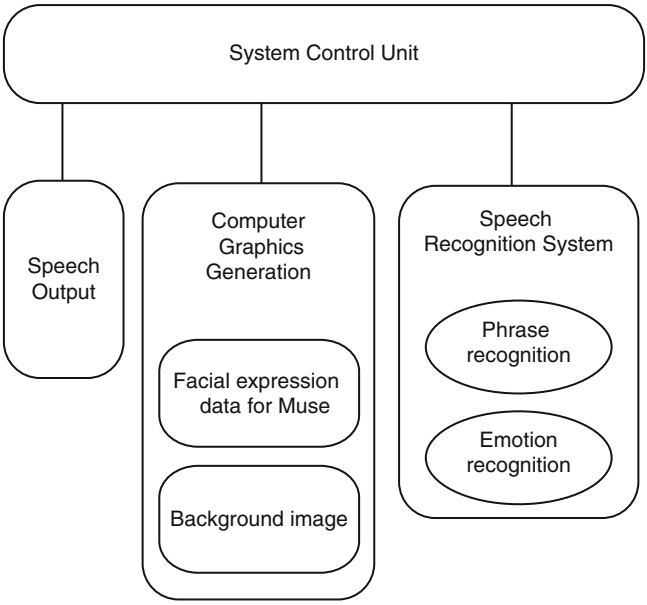

Fig. 3.2 System structure of "Interactive Poem"

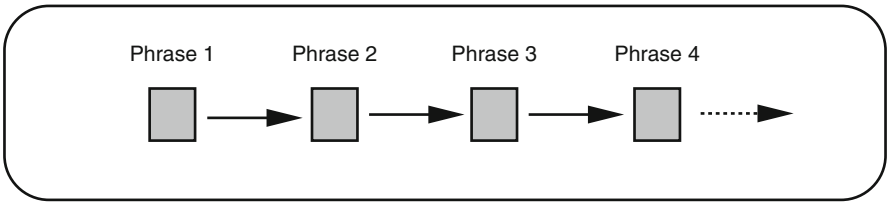

Fig. 3.3 Simple transition of poem production

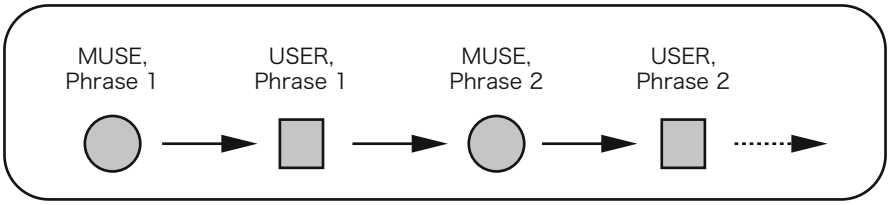

Fig. 3.4 Simple user and computer interaction network for poem production

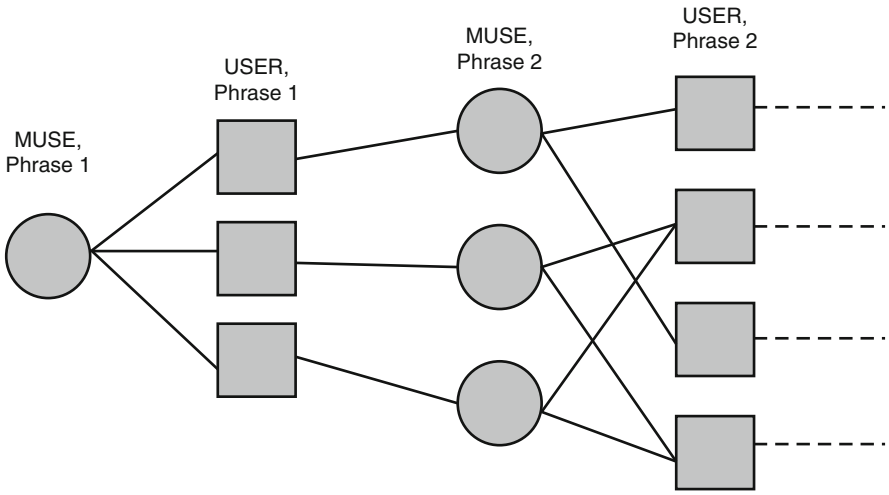

Fig. 3.5 Transition network for multiple poem production

The basic form of the "Interactive Poem" has a small difference from the simple transitional network. The simplest dialogue system with which the computer and the user alternatively speak to compose phrases of a predetermined poem is illustrated in Fig. 3.4. To realize higher-order dialogue, we prepared multiple phrases that connect to the computer's phrases. These phrases are selected carefully to match with other phrases in both phonological and semantic senses (Fig. 3.5). This transitional network is saved in the database and used to control the entire process. By these mechanisms, the user can add his own feelings or sensibilities to the world of the poem by talking to the computer and selecting phrases that fit his feelings or sensibilities.

The "Interactive Poem" uses the poem called "You," composed by Shuntarō Tanikawa. Using this process, we changed "You" so that it could be implemented by the "Interactive Poem" system.

First, the system delimits the poem into phrases, and separates these phrases into two categories: phrases that the user speaks, and phrases that MUSE speaks. A part of the poem is shown in the following:

(a: a user, b: a computer)

0. Who are you? (b)
1. You are not me (b)
2. You are not him (b)
3. Another person (b)
4. You have the same ears as mine (a)
5. And you hear different sounds from me (b)
6. You are like me (a)
7. You have ten fingers (b)
8. Something I cannot grab (a)
9. You try to grab it (b)
10. You (b)
11. You are standing (a)
12. In the sunlight of midsummer (b)
13. Toward the ocean (a)
14. Turning your back on me (b)
15. You are looking (a)
16. To the far horizon (b)
17. In your heart (a)
18. To a town I have never seen (a)
19. On it I have never walked (a)
20. A path is continuing (b)
21. On the path (a)
22. The snow is calmly falling (b)
23. Someone I have never met (a)
24. Is running toward me (b)

Figure 3.6 shows a morphing animation that adapted the emotions from the computer poet, MUSE.

In the next stage, the system selects multiple phrases that the user can speak, which correspond to each phrase that MUSE speaks. Below is an example:

You are like me (a)
Who are you? (b)
You have the same ears as mine (a)
You have ten fingers (b)
In your heart (a)
Another person (b)
On it I have never walked (a)

Then, the system expresses these as the transitional network shown in Fig. 3.5, and saves them in the System Controller database.

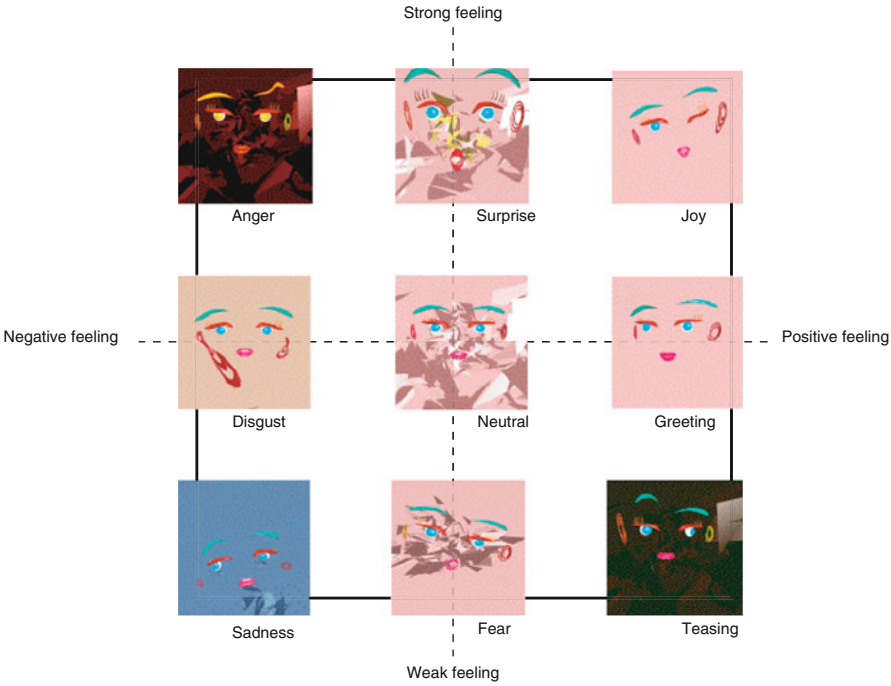

Fig. 3.6 Two dimensional plane showing various "Muse" reaction

3.3.2.2 Other Processes

Speech Recognition has two recognition modes: semantic recognition and emotion recognition. The system uses speaker-independent speech recognition to recognize the user's semantic speech (Lee 1988). Each phrase is expressed as a sequence of phonetic parameters and saved into the Speech Recognition database. At the same time, the system recognizes the user's emotions (Davis and Oda 2006, Nicholson et al. 2000). As the basic architecture for emotion recognition, I used the neural network first introduced in "Neuro-Baby" as described in Chap. 1.

MUSE's response to the user's speech is expressed by music and images. Speech Output has the voice data of each phrase that MUSE speaks and plays them if needed. Computer Graphics Generation controls image expression. The image is composed of MUSE's facial expressions and the background scene. MUSE's facial expressions express MUSE's response to user emotions. These facial expressions are expressed in a 3D morphing computer graphics animation corresponding to each of eight emotions (Fig. 3.4). To express the circumstances of the world of the poem, various background scenes are prepared and displayed in the screen, depending on the state of the transitional network.

3.3.2.3 System Processing Details

When MUSE starts to speak the first phrase, a Recognition Process starts up. When the user talks into the microphone, the phrase is recognized by the computer's semantic recognizer. The recognition system uses a subset dictionary that corresponds to the next state of the transitional network. At the same time, the emotion in the phrase is recognized by the emotion recognizer.

The system's response is based on the results from the recognition process and transitional network. MUSE's facial expression changes depending on the emotion recognition results, and the spoken phrase is determined by the semantic recognition and transitional network results. The background scene changes depending on the state of the transitional network.

In this way, the system realizes a poetic interaction between the user and MUSE.

3.3.3 Debut of the Prototype of This Story System

Using the "Interactive Poem," a user can create a new poetic world that takes in the user's feelings or emotions with assistance from the computer. This shows that the computer can draw out the user's emotions and allow him to enjoy expanding his world and help create a story. My work was greatly admired, and the "Interactive Poem" won the L'Oréal Grand Prize of a L'Oréal competition for the fusion of art and technology, headed by the chairman of the award, Dr. Ilya Prigogine (winner of the Nobel Prize for thermal dynamics). If we can create systems with a basic story and grow the story by allowing it to branch off by itself, the possibilities and interest in this system grow bigger than ever.

3.4 A Computer that Makes People Burst into Laughter

3.4.1 Humor Is a Highly Internal Intelligence

In my work "Interactive Poem," I created the story through poetic dialogue with a computer in VR. The vitality of our daily life can often be found in sharing a moment of laughter with a witty friend. Therefore, as a next step I tried to model these information structures for humor to spark more emergent communication.

Humor is frequently based on regional culture. Even within Japan, Eastern and Western humor are completely different (Davis and Oda 2006). We cannot understand these differences in humor without understanding the relevant nation and culture. A typical example would be comedies in the United Kingdom (Hill 2013), which frequently include many moments of humor where Japanese people cannot understand why anyone should laugh.

I studied the defensive person (Boke) and offensive person (Tsukkomi) in Japanese comedy[10] and found that their interactions made people laugh because the user, acting as the funny person, is mocked in a form of comedy.

Computers help us to think or remember more than before by storing information. With this artwork, we are trying to make computers instigate laughter for internal fulfillment or for the happiness of living. It is difficult to use computers for a field like this because while humor is an important interface that connects our subjective lives, it is more of an internal intelligence than, say, the problems of analysis or logic.

In other words, humor is an intelligence that represents empathy (Lachmann 2007) and has a very strong power over humans. AI used to focus too much on the analysis and understanding of observable intelligence, but I wanted to develop computers that have the flexibility to communicate with people in good humor. Now, I will introduce the system I created while considering this as a basic concept.

3.4.2 Interactive Comic Dialogue

"Interactive Comedy" is a computer system that I developed with Yoshimoto Kogyo[11] as a joint research project. A computer plays the role of a straight person (offensive character) and the user plays the role of the funny person (defensive character). When the user talks to the computer, it detects the user's feelings, meanings, speed of speech, and determines the phrases and the timing of its replies to the user. The conversation goes well through these interactions. The user can enjoy the dialogue like a game of catch. The user unconsciously plays the role of the funny person, and is responded to by the computer (Fig. 3.7).

An example of a conversation using various conversational scenarios provided by Yoshimoto Kogyo follows:

User	We're happy that people come to see us when they're doing busy research or work!
PC	That's true.
User	But I think that people who are truly busy are not here.
PC	Don't say unnecessary things!
User	But, everyone, do you know how long we've been tackling this research? It's taken nearly 300 years!
PC	You're kidding!
User	I got it. You are comfy because you are devotedly executing the operation.
PC	I can't understand what you're saying.

[10] See footnote 3.

[11] Yoshimoto Kogyo is a major Japanese entertainment conglomerate, with its headquarters based in Osaka. It was founded in 1912 as a traditional theatre, and since then has grown to be one of the most influential entertainment companies in Japan.

Fig. 3.7 A user interacting with "Interactive Comedy"

User You are replying to us by thinking for yourself, aren't you?
PC I'm sorry, but I couldn't hear you.
User You're great! One and all, please give him your applause!
PC I don't need your clapping, but I need some money!

3.4.3 Technology Used in This System

The system consists of five parts. The Speech Recognition system processes the meaning recognition of a phrase uttered by a user. Then, the Feeling Analyzer analyzes the tone of the user's voice, the input timing, and the speed. Using these results, the system obtains the level of the user's absorption. In Character Composition, the facial expression of the computer graphics comedy player is determined by using the results from meaning recognition and detection of absorption level, and generates the reply voice (Fig. 3.8).

3.4.3.1 The Feelings Model

The model consists of nine feelings: happiness, joy, teasing, fear, sadness, disgust, anger, surprise, and the static state; these are similar to those of "Neuro-Baby." Various kinds of utterances corresponding to each of these feelings were collected and used as the supervisor data for the development of the neural network (Fig. 3.9).

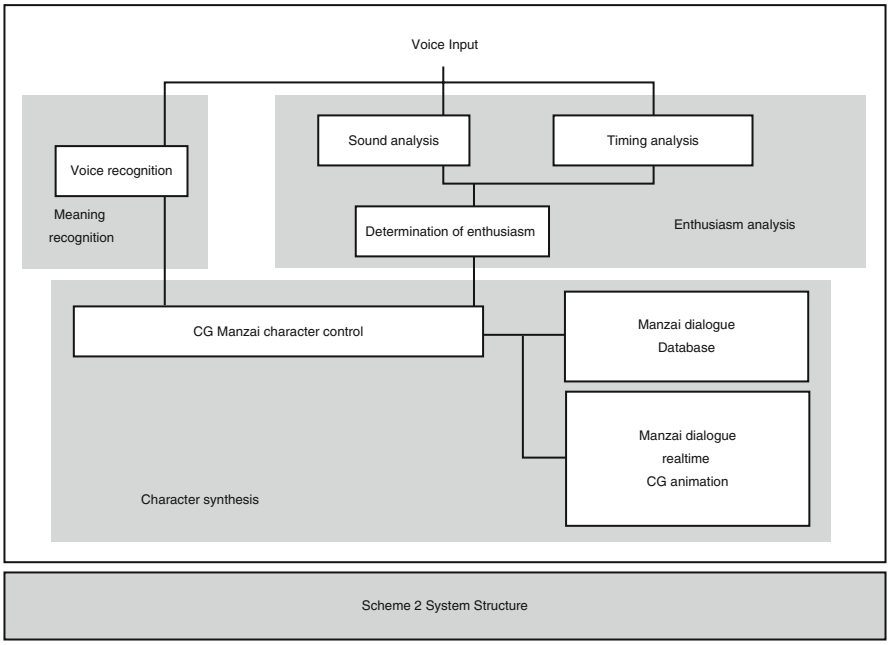

Fig. 3.8 Block diagram of "Interactive Comedy"

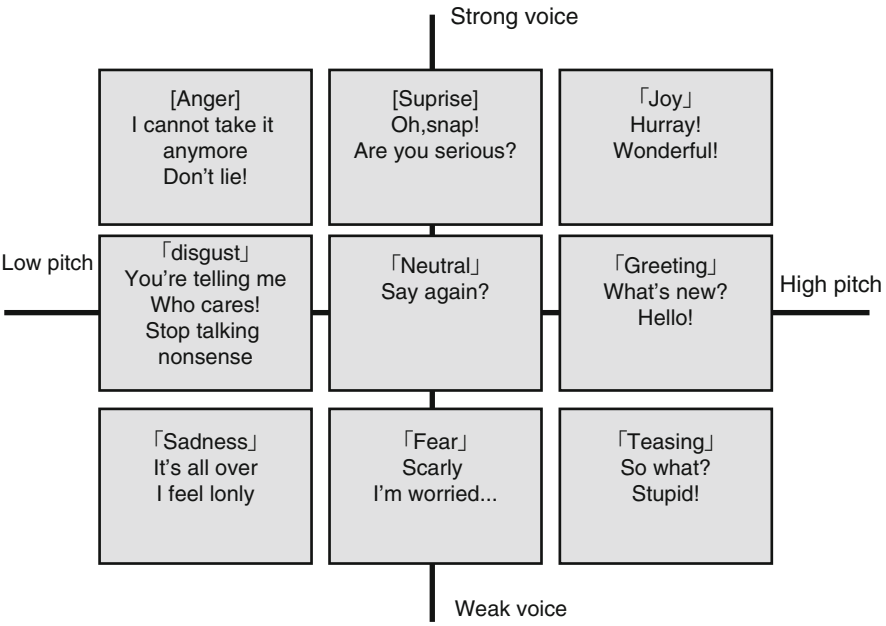

Fig. 3.9 Emotion model of "Interactive Comedy"

3.4.3.2 Mapping Feelings

The feeling recognition result is converted into a two-dimensional feeling map and is sent to the script manager. When the user's identity changes, the system tunes the expected value to the voice of the new user.

3.4.3.3 Speech Recognition

The speech recognition result is compared with the dictionary. If the result corresponds with one of the words/phrases in the dictionary, the script manager decides the phrase to be sent by the system. If no words are recognized, it uses output from the feeling recognition result (Fig. 3.10).

3.4.3.4 Script Manager

The script manager determines the level of the user's absorption from the feeling and speech recognition results, and determines the facial expression of the computer graphics-based agent as well as the speech output (Fig. 3.11).

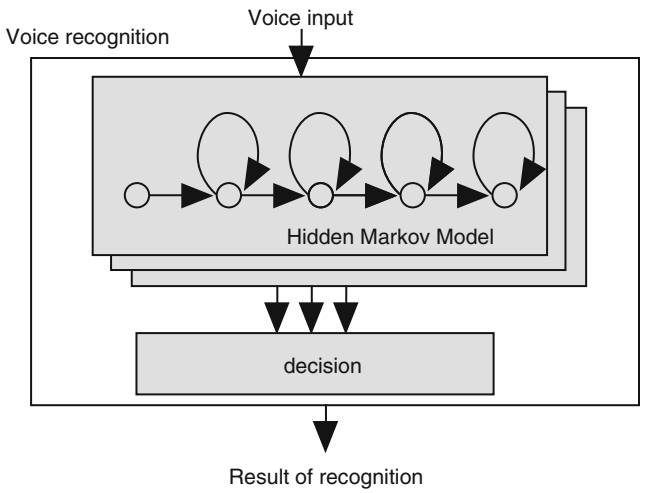

Fig. 3.10 Structure of voice recognition part

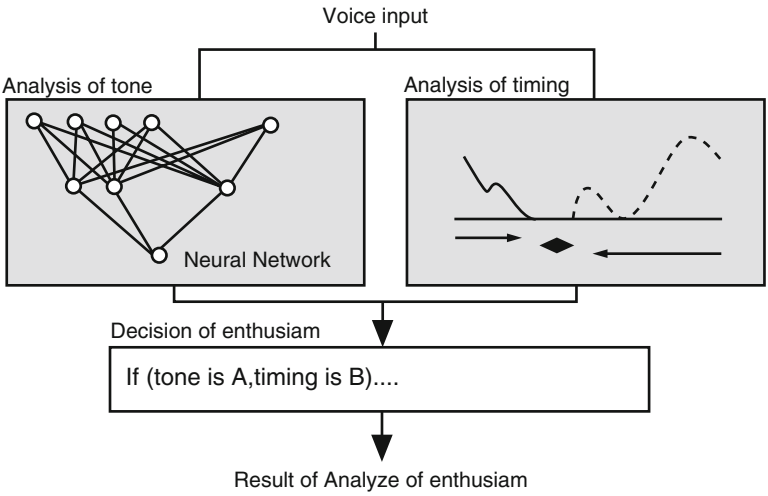

Fig. 3.11 Structure of absorption recognition part

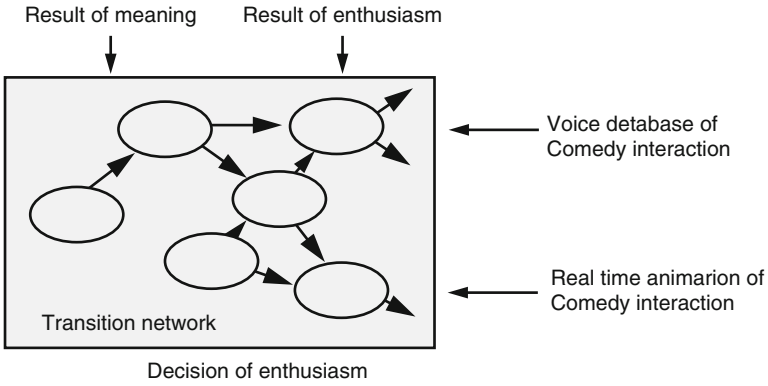

Fig. 3.12 Structure of character response generation part

3.4.3.5 Real-Time Computer Graphics Generation and Speech Output

The script manager sends the results to the Computer Graphics Generation, which has 30 patterns of facial expressions that are complemented in real-time by the data to create a facial expression for output. At the same time, the script manager determines the speech output and the type of voice (a feeling-based voice or the result of speech recognition) (Fig. 3.12).

3.4.4 "Interactive Comedy" Incident

I was invited to deliver a speech titled "Japanesque Interactive Arts" at a large Japanese cultural event named "Spring Fiesta" held by the Consulate-General of Japan in Boston to demonstrate "Interactive Comedy." This system was originally developed to entertain Japanese people by enabling them to play Japanese comedy using a computer, as mentioned previously. I collaborated with Mr. Isao Takenaka, a producer colleague of Yoshimoto Kogyo. I developed the interactive function of the system, and Yoshimoto prepared the Japanese comedy script to be stored in the system. The developed system won greater popularity among the general population in Kansai, Japan than I ever expected.

However, humor depends on the local culture and we were in Boston. To test the system before the cultural event, I showed the system to my supervisor, Prof. Benton, but he did not laugh at all. I thought that it was necessary to change the script for Bostonians, and I looked for comedians within Boston who could play similar comedy to Japanese comedy. But the two-person style Japanese comedy seems much more popular in Asia than in the United States. Later, I found that improvisational comedy has some similarity. In improvisational comedy, a leader proposes a theme, and the other members improvise jokes based on that theme.

I watched a live performance of a locally very popular improvisational comedy group called "Improv Asylum"[12] in Boston and decided that their comedy could be applied to our system. The group came to see the demonstration of "Interactive Comedy" and showed interest in the system. I then met with their director. Once our collaboration began, Improv Asylum members changed Yoshimoto's Japanese text to one that was full of Bostonian slang and jokes. At that point, the scenario was no longer understandable to the Japanese, but Bostonians laughed! Humor is such a delicate aspect of local culture.

As a challenge, we should investigate the relationships between 'stories' and 'reactions' that generate the internal side of humor. People say that a story 'jumps' when its center and fringes collide. A story's humor is generated when people feel some abnormalities, forces, collisions, or backlashes among the story's elements. For example, if we encounter a wild animal while walking in the woods or we suddenly receive an unexpected gift from our friends, this randomness sparks humor within our stories, and this jump or spark is a basis for comedy. Additionally, we would be surprised if, after using a certain doorknob every day, we discover that it is actually made of sweets. These elements of surprise arise when a daily event is transformed, and the user's consciousness jumps from the elements of surprise.

[12] See footnote 8.

3.4.5 Automatic Generation of Feelings and Stories: "Interactive Theatre"

Here, I introduce a system that enables the user to be an actor or actress of a story and to have fun with the changes in the story. Nowadays, story contexts in which the users can play the roles of characters in films or video games are popular. However, it is very challenging to produce an automatic story generation based on interaction results. Most of the research in this 'interactive story-telling' (Cavazza et al. 2002; Glassner 2004) field focuses on automatic generation of interactive stories after presetting their theme.

In contrast with interactive stories, the stories of present novels or films are called 'linear stories.' Interactive stories, relative to linear stories, have the following benefits (Riedl and Young 2006; Murray 1998). The user does not watch passively, but actively participates in the progress of the story (so the user is not only the viewer, but also the participant). In this case, the user can create his or her own ideal stories. The application of these interactive stories can vary from being mere entertainment to having educational or training uses.

Current linear stories are based on the well-thought-out plans of authors and methods to fascinate readers in VR have been established, but interactive stories are relatively new, so there are many unknowns, especially for methods to construct these stories. Below, I will show the concept and features of the system I created, and show how to make the story progress within this system (Tosa and Nakatsu 1996a, b; Nakatsu and Tosa 1997).

3.5 Interactive Theatre Generates Feelings and Stories

3.5.1 Story Generation

Here, I refer to methods of designing or creating a story on a system that processes interactive stories. The following methods can be considered when we think about the interactive generation of stories:

3.5.1.1 Fixed Story Method

This method has been used in one-way transitional media like present novels or films. Non-interactive media naturally uses this method. The merit of this method is that successful methodologies for literature and films have been established based on their long history. Experienced authors or film directors know how to construct good stories (Mackendrick and Cronin 2005; Lumet 1996).

3.5.1.2 Half-Fixed Story Method

This is a method in which the rough scheme of the story is already prepared. In this sense, it is the same as the fixed story method, like novels or films. However, the story has a little latitude to be changed (or it has multiple possibilities that can be chosen to progress the story). The user interacts to some extent and has fun within the freedom of the story. Many recent RPGs apply this method (Tychsen et al. 2006).

3.5.1.3 Free Story Method

This is a method where the story is not prepared at all and depends on interaction with the user. The software's creators construct only the world in which the story progresses, and lets the users create the story. Superficially, this method is the freest and it may give the user fulfillment, but this is not always true for the following reasons: (a) We needed to create a system that considers all possibilities because we cannot predict user actions. This is equal to creating a whole world, so it is very difficult, if not impossible. The closest thing to this would probably be massively multiplayer online RPGs (MMORPGs) (Feng et al. 2007); (b) The same thing occurs with the user, that is, if the user is given true freedom, she or he may be bewildered as to how to do anything in the VR world. This reproduces a similar situation as the first trip to culturally dissimilar countries, where the user cannot tell left from right.

Therefore, the free story method is currently difficult to realize, but it may be possible to fully realize it in the future. In designing the "Interactive Comedy" and "Interactive Poem" systems, I felt that the half-fixed method was the most realistic current approach (Tosa and Nakatsu 1997; Tosa 2002).

3.5.2 Story Interactivity

When we think about the interaction between the user and characters, the following points are important.

3.5.2.1 Multimodal Interaction

Humans communicate using multimodal interactions. Concretely speaking, we use our voice, facial expressions, and gestures in face-to-face communication. Therefore, multiple inputs are better than a single input (Norris 2004). This concept is important in realizing more natural interactions, deeper absorption, or empathy.

Because "Interactive Theatre" is new media, we can use inputs other than the normal inputs in our interactions or communications. It is necessary to use more stable input methods when we consider that the voice and image recognition

technologies are not fully matured and that they produce results with more errors than human processes. We can use push buttons or use foot sensors and motion captures for these methods.

3.5.2.2 Verbal/Nonverbal Interaction

Human communication contains both verbal and nonverbal information. Nonverbal information contains personality, feelings, and sensibilities (Mehrabian 2007). As I referred to in the previous chapter, information about feelings or sensibilities plays an important role in our communications. Therefore, our characters should have functions to recognize and express feelings to realize nonverbal communication with humans. But nonverbal communication is insufficient to convey all information, which means that verbal communications are still required. We still need to use speech recognition to recognize the meaning of the user's words.

These are the concepts that "Interactive Theatre" are based on. This is new media with a style that integrates previous films, novels, video games, and communications. In comparing this media with present media, the closest description could be 'a movie or theatre that the viewer can participate in.' The name of "Interactive Theatre" is based on these basic concepts.

3.5.3 System Features

In the following, I refer to example artworks that I constructed based on the concepts of "Interactive Theatre."

RPGs are the typical example of interactive stories (Fine 2002), a subset of video games. Users can have fun in the story by playing the role of the main characters. Most RPGs have complete stories that are a mixture of the growth of the hero and the standard adventure game story, such as where the hero fights against evil and wins, but develops strong motivations along the way.

While RPGs have succeeded commercially, they have some limitations because their R&D in interactive storytelling is limited. I designed this system to differentiate from conventional RPGs, by providing new functions and considering future possibilities to be developed. The features of this system are below:

3.5.3.1 Controlling the Story with Multiple Inputs

The basic input method of video games are buttons. Some currently designed controllers have acceleration sensors that also allows them to detect movement. Interactions that progress the story should be closer to communication between humans. In this system, we aimed to realize natural voices and interactions with gestures using speech recognition and motion capture, which will enable the participant to feel as if she or he is an actor or actress in the movie or drama.

3.5.3.2 Realizing a Natural Interaction at Any Time

In interactive stories, the story may be distributed to the user through media's interactions with the user. Therefore, RPGs limit the possibility of unfolding stories through interaction. For example, when the user talks to a character, she or he will find no important reaction from the character if the character is not key to progressing the story. Therefore, interactions that have no relation to the story are usually disabled.

To include more frequent user interactions, we can create a mechanism for the user to interact with the characters in the story any time, which will be dramatic when sentimental interaction largely affects a story (Nakatsu et al. 1998).

3.5.4 Software Composition

We needed to control the story appropriately and improvise interactions by considering the unfolding story and 'any-time interaction.' Therefore, we created a displaced-control-like system. The system composition is shown in Fig. 3.13. I shall explain each part of the system simply.

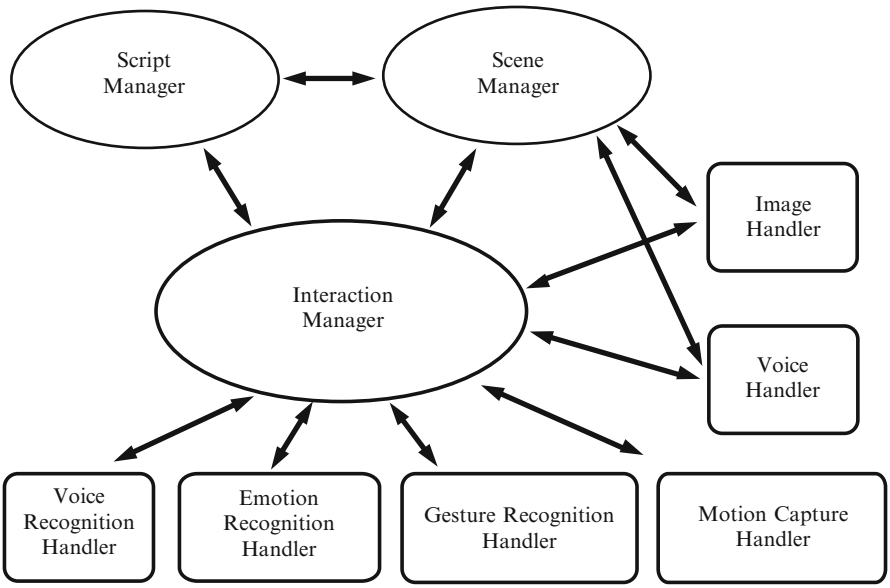

Fig. 3.13 Block diagram of "Interactive Theatre"

3.5.4.1 Script Manager

The Script Manager controls the entire interactive story by generating the interactive scenario using a prepared scenario that was written by an author. Concretely speaking, the Script Manager defines the elements of each scene and controls the transition between scenes. The transitions between scenes are expressed in the transition diagram (Fig. 3.14).

3.5.4.2 Interaction Manager

The Interaction Manager is placed under Script Manager and Scene Manager, and controls the interactions of each scene. We used vocal information and observed actions for these interactions. We applied a combination of speech and action recognition to realize this multimodal interaction (Fig. 3.15).

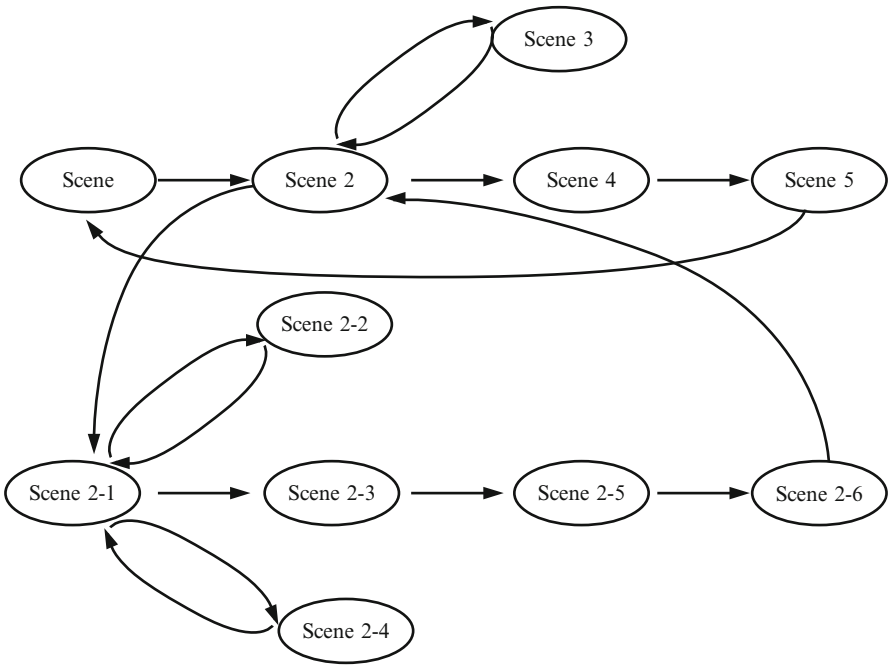

Fig. 3.14 Transition network of the script manager

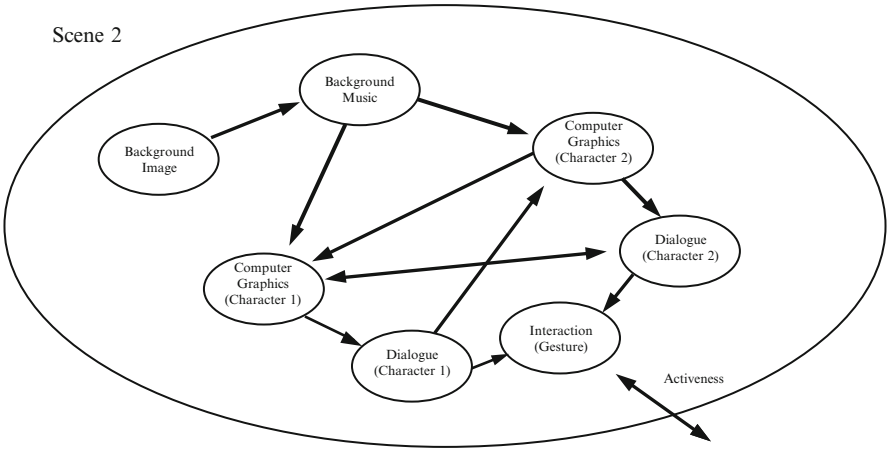

Fig. 3.15 Transition network of the interaction manager

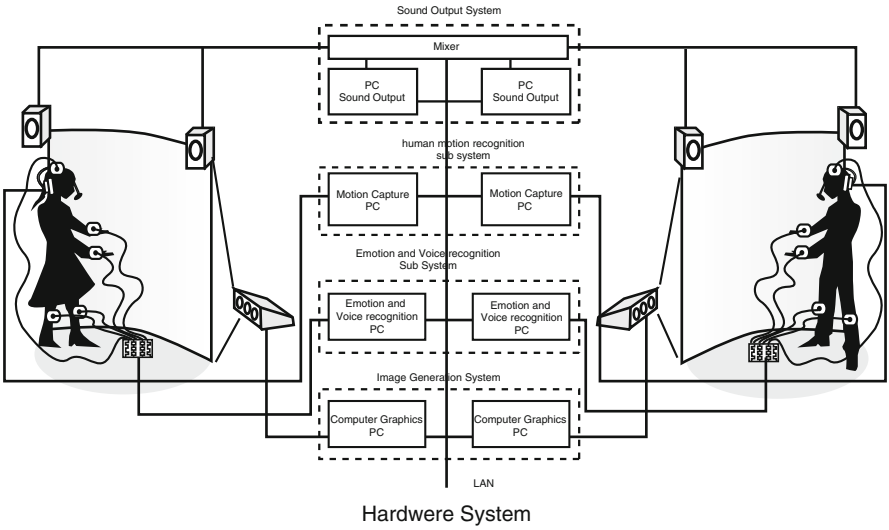

Fig. 3.16 Various handlers used in "Interactive Theatre"

3.5.4.3 Handlers

Handlers (Fig. 3.16) are placed under the Scene Manager's Interaction Manager. They control the input and output devices. We prepared the following handlers: (a) Speech Recognition Handler, recognizes the words or sentences the user has voiced, and sends them to the Interaction Manager. (b) Feeling Recognition Handler, recognizes feelings and sends them to the Interaction Manager. The methods of feeling recognition are the same as that of "Neuro-Baby." (c) Motion Recognition

Handler, sends the input data from motion captures to the Interaction Manager. At the same time, this part recognizes simple gestures for input data. (d) Sound Handler, processes the characters' speech and any BGM (background music). (e) Image Handler, outputs the Computer Graphics character and the background images.

3.5.5 The Future of Digital Storytelling

As I referred to above, a story has basic structures in it. The combination of these structures creates the backbone of a story. Myths and fairy tales have their own structures and have passed down through generations, spread out, and changed to fit the culture of each region.

Stanisław Lem, who wrote "Solaris," visualized the intelligence of future generations as one that transcends the biological limits of current humans' brains through works that set their concept as a "collection of introductions to virtual books," a book of "bit literature," which are impressive books written entirely by AI and not by humans. These could include "harlequin romance novels" written and updated by a future-predicting computer or the lectures of Lem's "Golem XIV", which is a future computer with an intelligence far transcending that of humans. In the future, like these works, we will be able to construct databases of worldwide stories by systematization and accumulation, to make computers generate scenarios, and to read stories by computers that humans have never imagined before.

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Chapter 4
Computing Culture

4.1 Picking Up Cultural Information

The previous chapters illustrated how to compute feelings and stories, which are important elements of culture. Now it is time to show an example of cultural computing that applies to culture itself.

Currently, many computing projects that contain cultural content have only digitalized cultural information as data and archived them. Some have visualized cultural heritage like urban heritage using VR technology (Song 2009; Falser and Juneia 2013; Silberman 2005). Unfortunately, most of them do not show the depth of the culture, but only the surface.

As I mentioned in the first chapter, we have obtained a global communication sphere by introducing various media technologies into our daily life; however, we are also concerned that our communication is becoming shallower. We urgently need new communication media that can convey the depth of a person's feelings. Originally, communications were fostered in the cultural environment created by a region, race, climate, and language. Cultures are rooted in their unique histories.

Communications by letters, music, and movies have been developed to mutually communicate the unique qualities of various cultures. Today, when computers are widespread, those computers should take up the challenge to promote communications among local and global cultures properly. Computer engineers are also needed to put the local characteristics of each culture to practical use on the computer.

Informatics has been developed separately from technology, but in order to utilize the quantity of information, it has focused on the creation of an infrastructure to manage the quantity. However, there is another classification of this information called 'information of meanings,' which represents the quality of the information, such as feelings or culture. It is important to deal with the 'information of meanings.' Present technologies have used only the globally shared aspects of the world and ignored the local. However, locally produced technology has cultural information that is unique to each country.

N. Tosa, *Cross-Cultural Computing: An Artist's Journey*, Springer Series on Cultural Computing, DOI 10.1007/978-1-4471-6512-5_4

To investigate cross-cultural communications (Neogy 2012; Cohen 1997), there have been several experiments that allowed a machine to engage in cultural interactions with users. One experiment showed that machine translations seem to be effective in cooperative research and development between different cultures (Yamashita and Ishida 2006). Another study explored the role of computer agents in cross-cultural communications on the Internet and found that if the agent broke a cultural taboo, people tended to gather on the Internet, and communications among people tended to go smoothly (Ishida 2006). These results are interesting, because it shows that people do indeed want 'depth' in their communications.

This research is practical for studies of universal cross-cultural communication, but in identifying the universal aspect of communication, it must be related to its local aspect. The depth of individual communication is seen as being included in local cultures, but few studies have focused on this kind of experience and these unique ways of communication.

It is time to research systems that help us to experience the cultural stories buried inside our indigenous identity. Here, I present research on interactive expressions that synthesize the inner essentials of culture such as subjectivity, feelings, ethnicity, and narrativity, which have never been quantifiable before. I define 'Cultural Computing' (Rauterberg and Hu 2010; Tosa 2006) as the integration of these research topics with a method of storytelling that reflects differences in feelings, consciousness, and memories, which are essential for future communication using computers.

Let us consider the benefits of cultural computing by comparing it with current computing culture. First, cultural computing expresses not only visualized cultural contents, but also the structure of each culture. Therefore, it enables us to understand different cultures more easily. Cultures have complex structures, so museums often exhibit only some aspects of cultural contents. However, knowledge and interest levels vary between visitors, and no system has been created that can reply to all potential questions.

This type of system would enable us to simulate a person with a given cultural model. We could interactively experience the spirit of a culture we are interested in by controlling the process (for example, the entry of Buddhism into Japan). Furthermore, it would become possible to create a brand-new popular culture that would integrate multiple existing cultures.

Needless to say, these are currently only a possibility. Cultures have layered structures, and quantifying them is not simple. What I discuss in this chapter are examples of the processes with which I approach the larger idea of 'Cultural Computing.' I hope that researchers and artists with the same interests would participate and widen the foothold that cultural computing is gaining.

Now, I will show methodologies for cultural computing. What I want to show you at first is an interactive system named "Unconscious Flow" (Tosa 2006; Tosa and Nakatsu 2000) that was designed to visualize an affinity for communication.

Cultural information also exists behind communicative information in our daily communications. Everyone remembers cultural courtesies in face-to-face commu-

nication. In Japan, even if we are angry, we will smile and thank someone as a matter of courtesy (Nishiyama 1999). Every culture has its own social rules that people are expected to follow.

Edward T. Hall, a cultural anthropologist, spoke about the differences in 'space' between cultures; that is, that people in different cultures not only speak different languages but, in a sense, they also live in a different world. He called this "proxemics" (cultural proxemics) (Hall 1973, 1990).

Hall divided the potential distances between humans into four: "intimate distance," "personal distance," "social distance," and "public distance" (Hall 1973, 1990). An "intimate distance" is a close distance characterized by not only love and protection, but also arguing and fighting. A "personal distance" is the distance during communication with another person. A "social distance" is the distance during business talk, and a "public distance" is the distance of a speech in a lecture meeting. The differences of each culture's characteristics are explained, to some extent, by using proxemics. This is because the human desire for close distances, and the actions related to those desires, are what form human relations. In other words, the distance between people is determined by the feelings they have about each other.

In thinking about signifiers of communication from a physical perspective, it is obvious that verbal lies are easy to speak, but physical lies are difficult to hide. In "Unconscious Flow," I tried to visualize cultural codes as empathy within communication by using proxemics and physiological information.

The next thing I learnt was the experiential system of Sansui Zen called "Art of ZEN" (Tosa et al. 2005). The concept of cultural computing uses culture itself, so we needed to focus on a certain culture initially and I created a system based on Japanese culture. I tried to compute the spirit that represents this culture. In making the "Art of ZEN," I researched the possibility of interactions based on inspiration included in Zen dialogue and interactions associated with Japanese symbols and allegories. The system was exhibited in a museum in Japan, in other countries, and in a Zen temple.

Next, I will discuss "i.plot" (Tosa et al. 2008), an association system for words and images that inspire the user. We can use various search engines to access large amounts of data on the Internet. However, the access method is limited to a simple search that uses only given key words. "i.plot" seeks to create an inspiration space that can be intuitively imagined using 'forms of thought' from the given search words. I describe new access methods (for example, the context of an inspiration, visualization of the atmosphere in a dialogue, and the association space of kanji and English). As an access method, they give inspiration to users to seek new hidden relationships between things. "i.plot" is a trial to connect words and the contexts of images, which are related to creating abstract contexts and association images using computers.

Finally, I will explain "Hitch Haiku" (Tosa et al. 2009), which focuses on haiku generation with structures that evoke many images using minimal syllables.

One example of research on haiku and computers is the creation of a system that would suggest a relevant Kigo[1] (season word) to users for their haiku and provides a space for users to submit and appreciate haiku among their user group. However, this system focuses on the analysis of haiku rather than the creation of new Haiku. In "Hitch Haiku," I focused on the creation of haiku. Basically, "Hitch Haiku" supports the creation of haiku by using the Saijiki (the dictionary of Kigo, a glossary of seasonal terms for Haiku composers). In the process of creating haiku phrases, "Hitch Haiku" generates many associations from the singular input, with the use of a dynamic search method called "Kanji (Chinese character) Inspiration," to create interesting haiku that directly reflect the power of the given idea. I will introduce the design and composition of the haiku-supporting system with which users can enjoy creating haiku, inspired by the combinations of witty haiku phrases.

4.2 Visualizing Communication

This work was a collaborative project with a group of AI and image-processing specialists headed by Masamichi Asukai, who was a researcher at Sony Kihara Research Center at that time. This work is designed for the visualization of human empathy.

Computers analyze and express the empathetic levels behind face-to-face communication. The computer graphics-based mermaids work as user agents. They express both stress and interest using the users' heart rate and a sympathy model calculated from their physical distance. For example, the agents may fight together even if the users are posing quietly.

4.2.1 System Configuration

The two computer graphics-based mermaids function as agents of two viewers. Each mermaid moves in sync with a viewer's heart rate, as detected by the electrode attached to their fingers. The computer characters express nonverbal communications (that is, the distance and interest between the viewers), their mutual interest is calculated using the viewers' heart rates and the interactive model, designed with proxemics in mind and their mental distance is calculated based on the distance of their hands. For example, consider that the viewers are interested in each other, but are posing as if they are disinterested. In this case, if their hearts are beating quickly, the hidden relationship is revealed by the behaviors of the two mermaids.

[1] Kigo (season word) is a word or phrase associated with a particular season, used in Japanese poetry. Kigo was first used in the collaborative linked-verse forms such as Renga and Renku. As Haiku was a sophisticated form of Renga and Renku, Kigo also became commonly used in Haiku to indicate the season referred to.

The computer analyzes the images from a camera sitting on the top of the system to capture the movements of red and yellow sticks attached to the viewers' hands and use them for the interactive model. With a high degree of synchronization, the agents mimic the hand gestures of their subjects, but with a low degree of synchronization, the agents tend to run away from each other. By touching the agents, the agents will directly follow the pallets, or, if their empathetic level is low, the agents will give advice to the viewers. The users' heartbeats are picked up by electrodes and output as biofeedback.

4.2.2 Synchronization Interaction Model

The data from the relaxation–strain calculated from the heart rate (the X-axis) and the interest calculated from the distance between the viewers' hands (the Y-axis) are mapped on a 2D model. The movement of two mapped points on this plane produces the interaction model. If the two points entered the same area, the viewers are considered empathetic. We created this interaction model with Prof. Gaku Tokita, who is a physiological psychologist at Nihon University, Tokyo and aimed to express the following communications in this hidden dimension that do not appear in our superficial communications (Figs. 4.1, 4.2, and 4.3):

1. When both participants are highly relaxed and interested during the experiment, they are considered empathetic. Animation is generated in which, for example, their mermaid agents hold hands or display other friendly actions (Fig. 4.4).
2. When both participants are in a situation where they feel highly stressed and disinterested, they are considered unfriendly. Animation is generated in which, for example, their mermaid agents quarrel with each other.

Fig. 4.1 An example of the movement of two mapped points

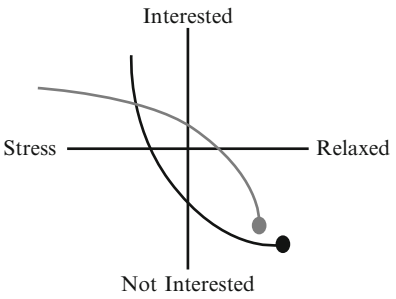

Fig. 4.2 Another example of the movement of two mapped points

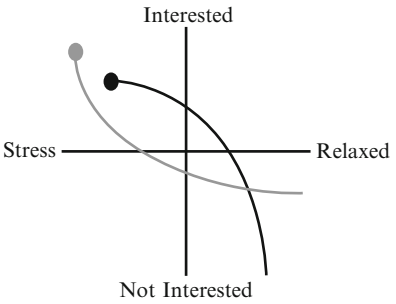

Fig. 4.3 Hardware structure of "Unconscious Flow"

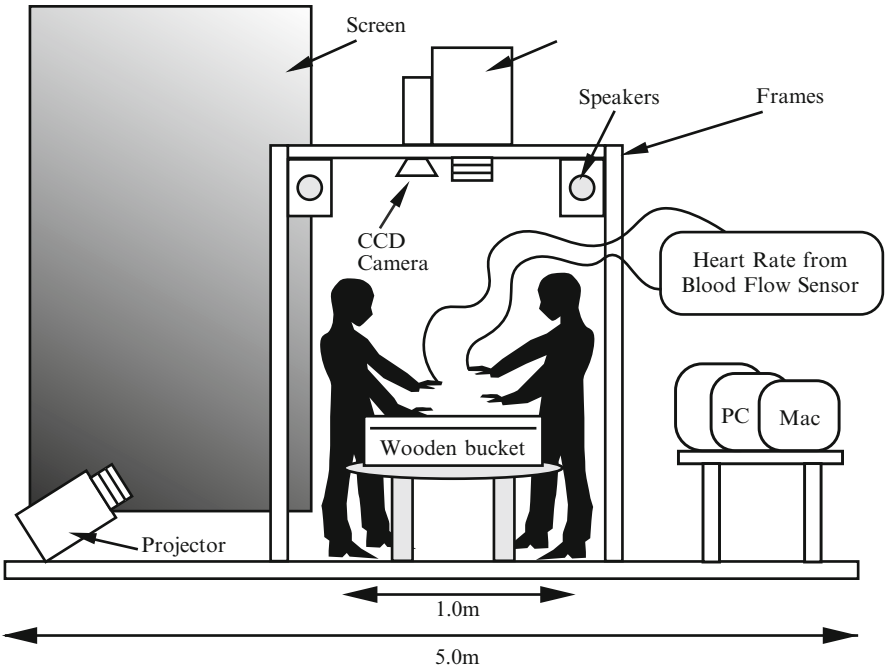

Fig. 4.4 Animation of two mermaids showing friendly actions

3. When both participants are in a situation where they are highly relaxed, but disinterested, the agents stay away from each other. Animation is generated in which, for example, their mermaid agents play separately (Fig. 4.5).
4. When both participants are in a situation where they are highly stressed and interested, they are considered to have conflicting feelings (that is, there are some differences between their characteristics). Animation is generated in which, for example, their mermaid agents look interested, but also embarrassed.

Through the animation of the mermaids, we can discover new codes of communication that we cannot find in superficial face-to-face communications (Fig. 4.6).

Fig. 4.5 Animation of two mermaids relaxed but not interested in each other

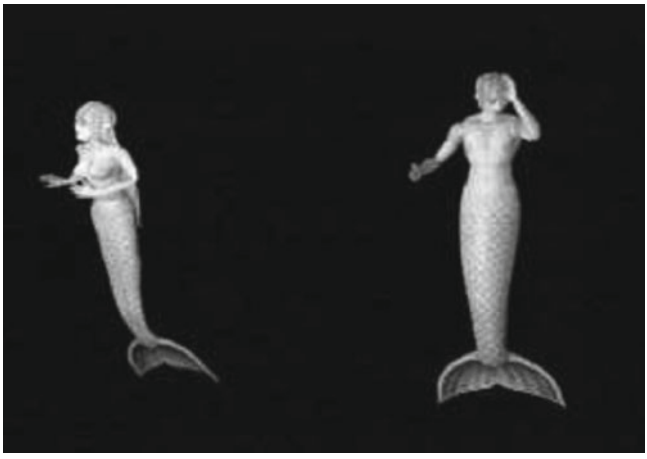

Fig. 4.6 Animation of two mermaids highly stressed but interested in each other

4.2.3 Software Configuration

4.2.3.1 Hand-Position Detection by Color Information

The camera recognizes the color of yellow and red sticks that the viewers have, and based on this the recognition program detects the position of their hands. The distance between red and yellow sticks is detected by the stereo image input from two cameras. This distance is mapped into the interaction model and reflected in the reaction of the computer graphic-based mermaid agents (Fig. 4.7).

4.2.3.2 Heart Rate Sensor

The viewer's heart rate is measured by placing a heart rate sensor (Fig. 4.8) on his/her finger. The measured heart rate is sent to a PC connected to the sensor and is mapped on the synchronicity model.

4.2.4 Biofeedback from Heart Sounds

The viewer's heart rate was used for biofeedback and played as background music to relax the users. The heart rate analyzer analyzes the input data and sends it to Event Control as event data. The heart rate information is also sent to the sound processor as a MIDI command. The sound processor processes the data into sound as output.

Event Control sends commands to the Computer Graphics Generator if computer graphics need to be changed based on the current heart rate. The Computer Graphics Generator creates graphics based on these commands and produces the new images.

Fig. 4.7 Recognition of red and yellow sticks

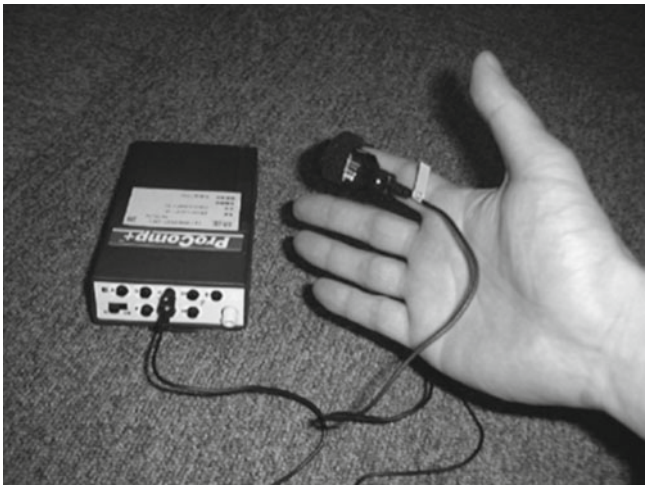

Fig. 4.8 Heart rate sensor

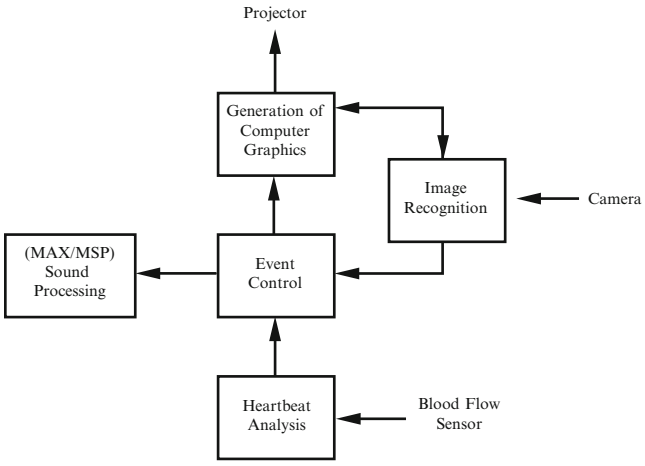

Fig. 4.9 Software configuration of "Unconscious Flow"

Image Recognition analyzes the image data fed from the cameras and relational information of the two hands and displayed computer graphics, and sends them to Event Control. Event Control again sends commands to the Computer Graphics Generator if the graphics need to be changed depending on the new data. The sound data is also continually sent to the sound processor as MIDI commands depending on the observed changes in heart rate (Fig. 4.9).

4.2.5 The Staging of the Installation

I secured the installation of the system for exhibition in the United States, Europe, and Asia (Korea). I often think about installation in parallel with designing the system. This time, I decided to project the computer graphics of mermaids onto a Japanese wooden bucket filled with water, viewed from above. The users stand with red and yellow sticks on their hands, and interact with each other. The camera detects the colors of their sticks from above and measures the distance between them. By projecting various star images onto the water, I created a mixed reality effect that includes both VR and the real world. The detected heart rates of the interacting users are output as biofeedback. Sound designers from Sony did a great job on the sound, which calms us in a way similar to prenatal training.

I set the system in a covered area with a space of two Tatami[2] mats, like a teahouse in Japan. The viewers did not actually drink tea, but I wanted the stage of the interaction to be an important and satisfying place. A bamboo frame and a thin, golden cloth walled the space.

4.2.6 From the Unconsciousness to Zen and Sansui

This system was exhibited in several international media arts centers such as Ars Electronica in Linz, Austria, and in the Art Center Nabi in Korea. Did the new communication code that visualizes empathetic information of communications leave any impact on the world through this exhibition?

I had devoted myself to Jung in my teenage years and have always been greatly interested in the existence of the unconscious mind, and set that as the target of my artistic expression. This work is my first step in visualizing an 'unconscious mind.' How do we reach a deeper side of the unconsciousness? As you know, Jung described the 'anima' or 'animus' as Jungian archetypes. What validates these archetypes are their various sources of images and allegories, which change depending on the analogies generated by human desire. These changes in images become symbols of the unconsciousness, and can create new cultures, with the assumption that the unconsciousness is strongly related to culture. Day by day, I became more certain of this idea, but I could not challenge it directly. The problem was huge and I could not determine what to tackle first.

A culture is vast, and encompasses both the consciousness and unconsciousness of humanity. A sense of similarity arises when people live together, which develops into a culture of sorts. I wanted to express the unconsciousness aspects of culture hidden within ethnicities. How should I realize this goal? I brooded over how to

[2] A Tatami is a type of mat used as a flooring material in traditional Japanese-style rooms made of rice straw to form the core, with a covering of woven soft rush straw. After the Second World War, along with the rapid introduction of Western culture, the usage of Tatami became less and less. And nowadays a Tatami room is not common in Japanese houses.

express unconsciousness in cultures. At that time, I was interested in Japanese culture, especially the cultural structures of tearooms and Noh theatre, but I had no idea how to grapple with these structures.

4.3 Sansui Zen Using Computers “Art of ZEN”

In April 2002, I visited a great exhibition in Kyoto. It was a retrospective exhibition of Sesshū’s work (Chiba 1989; Tanaka 1972). I visited this exhibition with technology in mind. Sesshū’s work looked like a huge VR world and I had a strong desire to use technology to create this kind of perspective.

Then, something unexpected occurred suddenly in my life. After viewing the retrospective exhibition of Sesshū’s work, my brain became filled with Sansui paintings while awake or asleep. I was completely fascinated by the VR expressed in Sansui space, and I wanted to achieve that by myself as quickly as I could. I loved the strong feeling of Sesshū’s Sansui paintings. Even more so, I was fascinated by the Sansui paintings’ worldview.

I am drawn in by Sansui paintings as I view them. In the past, the Chinese put Sansui paintings on walls, and contemplated what it would be like to go there. The paintings represented the places in which they wanted to pass away.

Two or three months later, I received a letter that notified me of my acceptance as an artist fellow at the MIT CAVS, which I had applied to in the previous year. However, there was a rule that I could not go abroad and conduct research funded by national Japanese research grants; because of this, I almost had to give up my research. However, owing to the great generosity of Prof. Fumio Harashima, a research manager at the Japan Science Technology Agency (JST) and President of Tokyo Metropolitan University, and the advice from Prof. Toshio Fukuda of Nagoya University, I was permitted to research stories based on Sansui paintings at MIT in the United States. I went to the United States in April 2002. Even though this was a great opportunity to spread my research internationally, as I expected, things did not go smoothly at first.

4.3.1 Cultural Differences and Taboos

A culture is rooted in the ‘climate’ generated by the combination of the unique physical national conditions and the sprits and thoughts of the people there (Wong 2011; Tetsuro 1971). I could not become accustomed to the Japanese dishes served in Boston, as they were affected by the climate differences. Food is the basic source of human energy and we Japanese cannot work well without eating rice daily and having the flavor of soy sauce in our food.

At MIT, there are many Asians and Jewish people. It seemed to me that as many as 60 % of MIT students were Asians, and many famous professors were Jewish

such as Mavin Minsky or Noam Chomsky. I often felt that Japanese are like herbivorous animals and Westerners are like carnivores. I felt that there was a huge difference in energy between Japanese people and Westerners. I worked as diligently as an ant because, as a foreigner, I did not need to follow Westerners' style of work. At the same time I wanted to explain to my Western colleagues Japanese culture through the works of great Japanese artists whose works are not well known in US,

I visited Andrew Gordon, the chief of the Reischauer Institute of Japanese Studies, to ask him to write pamphlets about my exhibition. That was the day that the Dalai Lama was to visit Boston, and he had a speech planned at Harvard. The popularity of the Dalai Lama there was amazing; he was like a super star. Even my taxi driver knew about his speeches at MIT and Harvard, and how the $100 tickets had sold out in one night. People who missed the chance to attend his speech watched it on a video projector. Harvard even dared to offer a church as the venue for the speech of the Dalai Lama. Mr. Gordon mischievously asked, "What would it be like if he was a Japanese Buddhist monk?"

Because Tenshin Okakura[3] was an attendant of the Boston Art Museum, and he was in good relations with the Gardner Museum, there are many Japanese art collections and gardens in Boston. I was moved by many types of Netsuke carving[4] that I had not seen in Japan. These inspired the question: Why is it that the Japanese could not evaluate these Japanese great artworks in the past very well, but started to value them when foreign arbiters gave them value? This is a bad habit carried over from the ancient eras when Japan imported various cultures from China.

I collaborated on research with Prof. Ian Condry, who is a researcher of Japanese culture. We started a translation of the story I wrote for "Art of ZEN," and discussed Japanese culture. Prof. Condry is currently studying Japanese hip-hop culture.

Japanese Otaku[5] culture and anime were well known there. The Berklee College of Music holds concerts every day. Jazz pianist Toshiko Akiyoshi often plays there. But, what if we want to see Japanese traditional culture? There is a Japanese garden at the Isabella Stewart Gardner Museum, but the rustic garden seemed to appeal more to me than to the Americans to whom it had been designed to appeal.

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[3] Tenshin Okakura (26 December 1863–2 September 1913) was a Japanese scholar who contributed to the development of arts in Japan. Outside of Japan, he is chiefly remembered as the author of "The Book of Tea." Although his original name was Kakuzo Okakura, in Japan he is well known by his poet name: Tenshin Okakura. He was invited to the Museum of Fine Arts, Boston in 1904 and became the first head of the Asian art division in 1910. He is also known as one of the founders of the Tokyo University of the Arts.

[4] Netsuke are miniature sculptures that were used as accessory pouches in Japan. Netsuke were invented in seventeenth-century (Edo era in Japan) and were used commonly among men at that time. Traditional Japanese clothes called Kimonos had no pockets. Therefore it was necessary for men to store their personal belongings, such as tobacco, money, or medicines in a Netsuke.

[5] Otaku is a Japanese term used to refer to people, usually the younger generation, with strong interests, particularly, in Japanese animation, Manga (comic) or video games. Otaku has had some negative meaning such as obsessive, monomaniac, etc. At the same time it should be recognized that new Japanese and pop cultures are being created by them.

4.3.2 Japanese Culture Used in Cultural Computing

Because cultural computing has a broad meaning, we needed to create a system with a focus on local ethnicity. Here, I will describe how I computed the structure of Japanese culture and Eastern thoughts, the structure of Buddhist psychology, and the mechanisms of Japanese traditional culture. I focused on the structures of Sansui paintings and Yamato-e,[6] and allegories or symbols of kimono. I also applied communication methods that have been nurtured in Japanese culture for a long time. I researched and developed the interactive system called "Art of ZEN," which makes us feel newly enveloped in Mother Earth.

I organized symbols and allegories in my cultural computing system, such as important key words from Buddhism, Eastern thought, and Japanese culture. I used these key words because they have plenty of good implications, and the impacts of their terms, figures, and colors in our lives are extraordinary.

Sansui was originally developed by Zen[7] Buddhism, so we looked especially carefully at Zen culture. Zen Buddhism is a sect of Mahayana Buddhism that Bodhidharma had brought into China. The sitting meditation called Zazen[8] from the Soto Zen[9] sect and the practice of telling Kōans (Zen riddles) from the Rinzai Zen[10] sect are examples of Japanese Zen.

I focused on a fluctuation caused by the conflict between peoples' consciousness and unconsciousness. This kind of fluctuation is seen during the process of a Zen Buddhist answering Kōans while being led by his/her master. I aimed to create a computer that would give us the virtual experience of sitting in Zazen. I displayed these Oriental and Japanese sensitivities on a computer screen and tried to create an interface in which users can become absorbed in the Japanese world of Sansui ink paintings.

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[6] Yamato-e, the translation of which is 'Japanese painting,' is classical Japanese painting established in the late Heian period (ninth to twelfth century). In the Heian era Chinese style paintings were imported from China (at that time Tang Dynasty) and were a strong influence to the development of Yamato-e. Since the Muromachi period (fifteenth century), the term Yamato-e has been used to distinguish Japanese paintings from contemporary Chinese style paintings (Kara-e).

[7] Zen is a school of Buddhism that originated in China during the sixth century. From China, Zen spread to Vietnam, to Korea and to Japan. Zen emphasizes the attainment of enlightenment and the personal expression of direct insight into the Buddhist teachings. As such, it de-emphasizes mere knowledge of Buddhism principles and emphasizes the importance of reaching enlightenment through hard mental and physical exercises.

[8] In Zen Buddhism, Zazen, which means seated mediation, is a way of meditation. A Zazen practitioner sits down, calms the body and the mind trying to dispel every unnecessary thought form his/her mind.

[9] In Japan there are three Zen parties: Sōtō, Rinzai and Ōbaku. Sōtō Zen is the largest of these three parties and emphasizes the importance of sitting and meditation exercise (Zazen).

[10] The Rinzai school is one of three schools of Zen in Japanese Buddhism. Rinzai Zen emphasises the importance of Kensho ("seeing one's true nature") as the gateway to enlightenment. As for the exercise to attaining Kensho, instead of practising meditation, Rinzai Zen emphasizes the training to embody the free functioning of wisdom through the activities of daily life.

4.3.3 Meeting the "Art of ZEN"

A rough outline of a user's experience with "Art of ZEN" is described as follows. First, the user builds a 3D Sansui ink painting on the 'scroll' on display, using iconic Sansui elements that are attached to the top of the display.

The images used in this interface express the conceptions of nature and philosophy that characterize the history of Japanese Zen Buddhism, and provide the user with a dramatic experience very different from the images of modern life. Thus, in the introduction, the system brings about a kind of awakening within the users and encourages their unconscious imagination.

Next, because the system classifies the state of the user's consciousness based on the user's design of the Sansui landscape, it generates a story appropriate for the users, drawing them through the display and into their alternate worlds.

I included mechanisms in the story that were meant to stimulate the user's consciousness by various haiku and Kōans generated by the system. The story built from these elements is not a complete linear story like those found in movies or novels, but is rather a nonlinear collection of short story fragments. A user experiencing these inconclusive story fragments will feel uncertainty, and have the expectation and desire to connect these fragments to build a complete story. Because of this desire, while the users may feel that they are being asked questions without a 'correct' answer, they cannot help but attempt to answer these questions.

4.3.4 'Ma' Interaction

Using their hidden cultural triggers, users connect these stories and build their own unique narratives. Next, while the user uses a virtual brush, a rake for the rock garden, and other tools in response to questions posed by the system via images and a voice, the door to the realization of consciousness begins to open further. As the users' desire to connect the story fragments mixes with the system's user interface, the distance between their everyday and hidden selves begins to shrink.

'Ma' interaction plays an important role in the process of fusing those two selves. Ma[11] is a very Japanese concept that emphasizes ephemeral events such as the here-and-now within every experience. Having traveled through several stages and scenes, at the end of their trip, the users converse with an ox, which is an interaction used in Zen as a metaphor for expressing one's true self. Through this dialogue, the

[11] Ma is a Japanese word which can be roughly translated as "gap", "space" or "pause." Ma means both special gap and also time interval depending on the situation. Japanese culture emphasizes the importance of a special gap and time interval. For example, the time interval between utterances of two people talking face-to-face is considered an important factor for communication. Also the special gap between these two people is considered, especially in more serious situations such as a theatrical play or a match between two Samurai. The time interval and special gap have been considered essential in Japanese culture.

Fig. 4.10 “Art of Zen” installation

user can experience a process through which the everyday self and the subconscious self, fuse together and bring about a unified self-awareness of consciousness.

Because the environment surrounding the system plays a very important role in the user experience, I decided to prepare an Eastern atmosphere for the “Art of ZEN” installation (Fig. 4.10).

4.3.5 Drawing Up a Scenario of Sansui Experience in the Clouds

I did not decide on the complete scenario from the beginning and so each story was created separately. As a result, the scenario was separated into six parts: the creation of a 3D Sansui painting; travel into the world of the Sansui painting; interactions based on Zen dialogues; interaction with the chaos engine; kimono interactions; and an interaction with the Ten Oxherding Pictures story.[12]

Mr. Seigow Matsuoka designed the Zen dialogue interactions and wrote the sentences voiced by the system when the user approaches the Sansui objects. I used to travel frequently between the United States and Japan, and on one airplane journey, I wrote the whole scenario for the user’s experience while using the individual interaction design and user-prepared sentences. Because I could concentrate on reading or writing on the airplane, the 12-h flight gave me plenty of time to do what I

[12]The Ten Ox Herding Pictures (or Ten Bull Pictures) is, in the tradition of Zen Buddhism, a series of short phrases and accompanying pictures that are intended to illustrate ten stages of a Buddhism practitioner’s progression towards enlightenment, as well as his or her subsequent perfection of wisdom.

needed. I asked MIT students, colleague researchers, and Prof. Condry whether they could understand my scenario and changed my scenario when they could not make sense of it.

The entire interaction flow is as follows, which has a total time of about 30 min. The complete story progression is shown in Fig. 4.11.

1. Creation of a Sansui painting.
2. Generation of haiku related to the Sansui icons.
3. When the user approaches an object in the Sansui painting, related Zen dialogue appears.
4. Depending on the result of the Zen dialogue interaction, a specially designed kimono appears with each of the following design concepts that vary corresponding to the users' personalities: Kisoi, a comparative design; Mitate, choice and metaphor; Awase, design in pairs; and Soroe, design based on sets.
5. At the end, a Ten Oxherding Pictures story (a metaphor for the 10 steps leading to enlightenment) corresponding to the user's interaction is displayed.
6. The users create a Sansui ink painting using the "Art of ZEN" (Fig. 4.10).

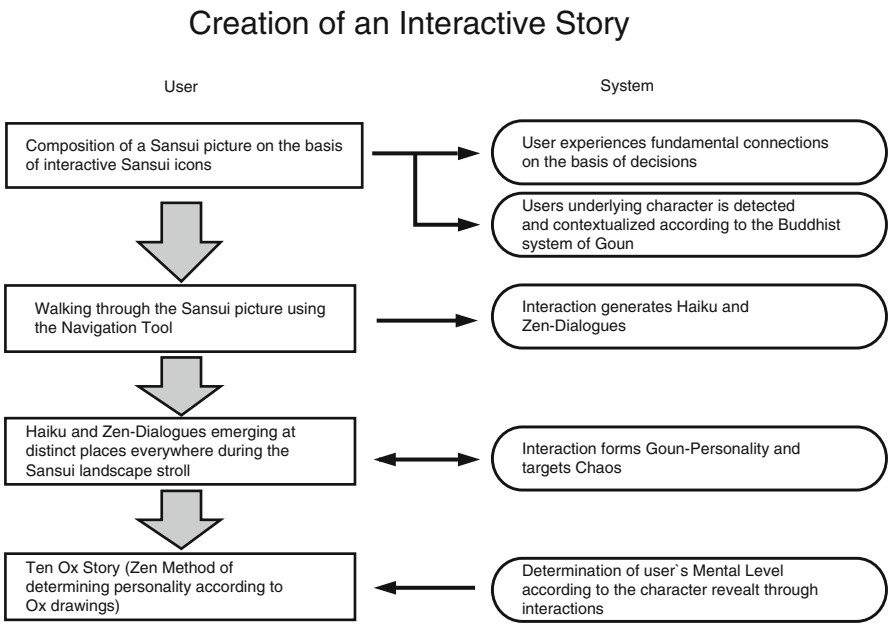

Fig. 4.11 Story progression flow

4.3.6 The Contexts Generated by the Sansui Symbols

At first, I intended to make the user paint a Sansui painting using real-time 3D calligraphic effects like blur, feathering, and cracking. However, in the original system, some users gave up drawing a picture and explored the 3D objects because the Sansui painting process was difficult. Therefore, I decided to produce icons consisting of the 12 elements of Sansui paintings: rocks, mountains, the moon, travelers, bridges, birds, trees, houses, flowers, clouds, water, and wise men. Each of the Sansui icons is expressed by a hieroglyph or a kanji script. Users can drag and drop the icons where they like, and compose their own 3D Sansui painting. Using this method, everyone can make their own Sansui pictures, regardless of their drawing skills.

Figure 4.12 shows an example of a Sansui painting composed by a user. The composed stones, mountains, the moon, wise man, and water represent associated contexts. The computer determines the value of five personality categories with the information from the selected icons and where the user placed them. By arranging the kanji scripts, users create the story they experience.

4.4 Sansui Perspective Method—Sanen

Please look at the painting by Sesshū carefully (Fig. 4.13). Unlike Western picture's perspective methods, Eastern Sansui paintings have an Oriental 'Sanen' perspective scheme, which has three different types of perspectives: Koen, Heien, and Shinen. Koen is the view from far away and from below, Heien is the straight view and Shinen is the near view from above. A Sansui picture includes these three perspectives within it.

Fig. 4.12 An example of a Sansui painting

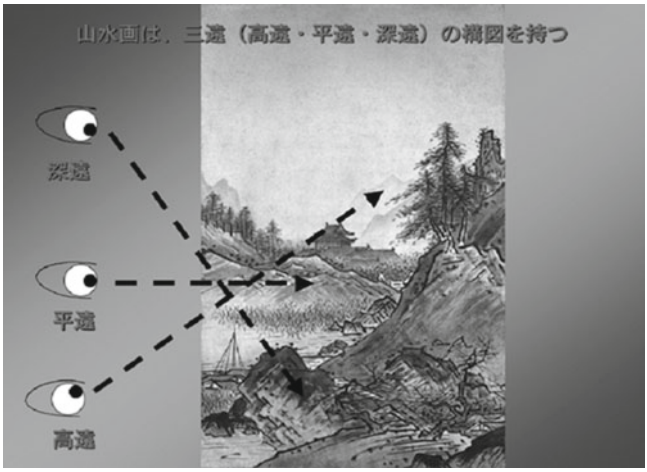

Fig. 4.13 A Sansui painting that consists of three types of views

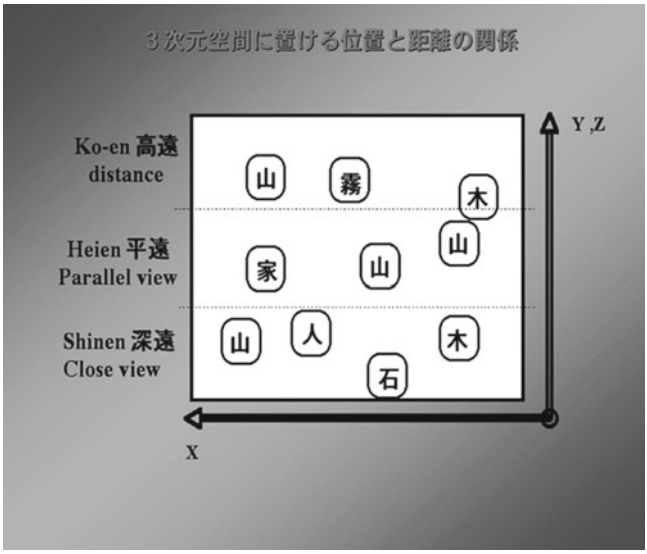

Fig. 4.14 Relation between 2D position and three types of views

These panorama-like pictures include the prospects relative to one's eyesight. I tried to include this Sanen perspective in the system. Figure 4.14 is a Sanen perspective from the computer's point of view. Depending on the position of a placed icon, the computer calls a relevant graphic to display, which corresponds with each of the Sanen perspectives.

4.4.1 *Playing with Sansui Paintings (Interactions with Allegories and Symbols)*

When the users finish their painting, they operate a 3D compass whose interface imitates the pond of a 'rock garden,' as shown in Fig. 4.18 where a young Zen Buddhist and a MIT student are interacting with the system. The user enters into the created Sansui painting world, and begins a Zen training journey. When the user approaches the river in the Sansui space, the sound of the river will play. The user can also experience Zenki (phenomenon of the results of Zen training), such as jumping fish. The associated allegories and symbols trigger the appearance of haiku or Zen dialogues related to the landscape.

Symbols and allegories advance our recognition, thought, expression, and action in large steps. For example, a mandala is a communication tool invented by ancient people which is full of symbols and allegories. Also the ancient ethnic world used symbols like tigers and condors that allegorically triggered people's memories based on their long history. The combination of the symbols enabled ancient peoples to communicate with each other.

If you approach a 'bridge,' for example, a haiku is read out, that translates to, "A grass matting makes me feel cool, smells like tea from the bridge." The haiku selection is the work of the staff of the Editorial Engineering Laboratory in Tokyo. When you approach a river, a Zen dialogue related to water, "The Catfish and the Gourd," appears (Fig. 4.15).

Haiku Output	Icon Priority		
The day passes slowly; A pheasant comes down onto the bridge.	Bird	Bridge	House
The rift in the clouds, whence snow falls on the distant mountains.	Bridge	Mountain	Cloud
Advancing through pebbles, there flows a rivulet running from a spring.	Water	Cloud	Rock
An old quiet pond; A frog jumps into the pond; Splash! Silence again.	Moon	House	Water
The autumn moon; I wandered around the pond all night long.	Moon	Traveler	House

Fig. 4.15 Relationships between Sansui symbols expressed by hieroglyphic icons and Haiku

4.4.2 *Eastern Human Recognition Model*

In "Art of ZEN," I wanted to use an Asian unique psychological model instead of a Western one. I adopted the Goun model,[13] which is a model of interaction between Zen masters and disciples. Goun is a model to recognize human characters, which is also a style of Buddhism that has existed for over 2000 years. I designed the system to use Goun and Tao's four seasons (spring, summer, autumn, winter) and five directions (east, south, center, west, north) in the interactive models.

When I was at MIT, I asked American information science researchers if they had ever researched a recognition model based on the spirit of Buddhism. Unfortunately, they had never used a Buddhist recognition model because they only ever needed to use normal Western psychology models. However, they were greatly interested in the proposed Buddhist recognition model. These researchers said they wanted to use one, but they could not understand it because interactions based on Asian philosophies like Buddhism have not been studied in Western science. Based on this experience, I can imagine that perhaps Asian cultures will be better able to develop human recognition models to use in IT technologies.

4.4.2.1 Expression of a Sansui World Based on the Taoist World Model

The basic concept of Sansui is rooted in Tao (Wong 2011; Simpkins and Simpkins 1999), which is a Chinese idea of cosmological principles that teaches us the life of Xian (an enlightened person). When we explore the Sansui world, the climate changes based on the four seasons and the five directions. For example, if we move to the north, the climate changes to a snowy winter; if we move to the south, the climate changes to a summer evening; if we move to the east, the climate changes to a misty spring day; and if we move to the west, the climate changes to a rainy autumn day. Connecting the elements of Sansui paintings and Sanen, haiku, and Zen dialogues as well as the direction of movement will enable us to create many contexts and generate various affordances.

[13] Goun is a philosophical principle in Buddhism to explain how humans are structured, and is based on the principle that humans consist of the five elements below:

1. "form" or "matter": external and internal matter. Usually this means human physical body and physical sense organs.
2. "sensation" or "feeling": sensing an object as either pleasant or unpleasant or neutral.
3. "perception", "conception", "apperception", "cognition", or "discrimination": registers whether an object is recognized or not (for instance, the sound of a bell or the shape of a tree).
4. "mental formations", "impulses", "volition", or "compositional factors": all types of mental habits, thoughts, ideas, opinions, prejudices, compulsions, and decisions triggered by an object.
5. "consciousness" or "discernment": a series of rapidly changing interconnected discrete acts of cognizance. The base that supports all experience.

Icon	Koen	Heien	Shinen
Rock	Jyu	Sou	Siki
Mountain	Jyu	Gyou	Siki
Moon	Siki	Jyu	Shiki

Fig. 4.16 Examples of relationships between symbols, Sanen perspective and Goun

4.4.2.2 Classification of User Personalities Using the Goun Model

Buddhist thought holds that five basic physical and mental elements, called Goun, make up the world. In this interactive system, I applied these elements in the classification of one's personality. The five personality categories are as follows: Shiki (色), a personality that focuses on nature and materials that actually exist; Ju (受), a personality that focuses on intuitive impressions; Sou (想), a personality that focuses on perceived visual images; Gyou (行), a process of mind that activates behavior; and Shiki (識), a deep spiritual function that reaches beyond the above processes.

When the users create a Sansui space they like, the computer unifies the Sanen categories (Fig. 4.16) and classifies the created Sansui painting. Then user personalities are determined as one of the Goun, and the journey begins by assuming this Goun as the users' personality.

4.4.3 Zen Dialogue Interactions

When users approach a certain object within the Sansui painting, a Zen event occurs. Every event is constructed so that one can have an interactive virtual experience with a Zen Kōan. For example, the Kōan "Dharma Anjin" (Fig. 4.17) is a dialogue in which, when a pupil complained, "Even after training, my inner spirit is still troubled," Dharma Anjin replied, "Then show me your troubled spirit." In this interaction, users are asked to draw their spirit in the screen at the rock garden interface (Fig. 4.18).

When users meet a flower, a Zenki[14] occurs, and the flowers fall. A very young Buddhist monk appears and a Zen dialogue, "The Lotus Smiles," starts. This Kōan explores telepathy. In his later life, the Buddha bent a lotus in the presence of his disciples and threw it to them with a smile. A disciple, Mahākāśyapa, understood the meaning and caught the flower. This disciple started Zen Buddhism.

[14] Zenki is the moment for a Zen practitioner to be able to reach a higher level toward enlightenment. In Zen Buddhism, enlightenment has been considered the ultimate target for a person to reach. To achieve this one has to go through a difficult exercise of Zazen (Zen meditation) and also questions and answers with a Zen teacher. And at some moment it is said that a Zen practitioner can suddenly reach a higher state and finally he/she can reach the state of enlightenment.

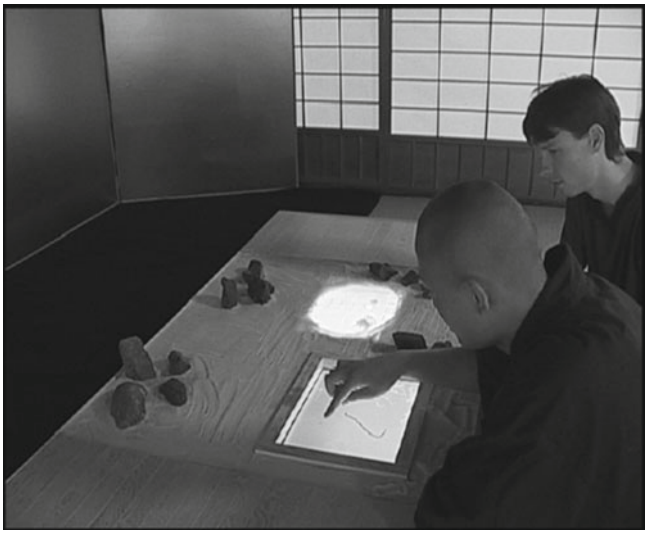

Fig. 4.17 Zen Koan interaction called "Dharma Anjin"

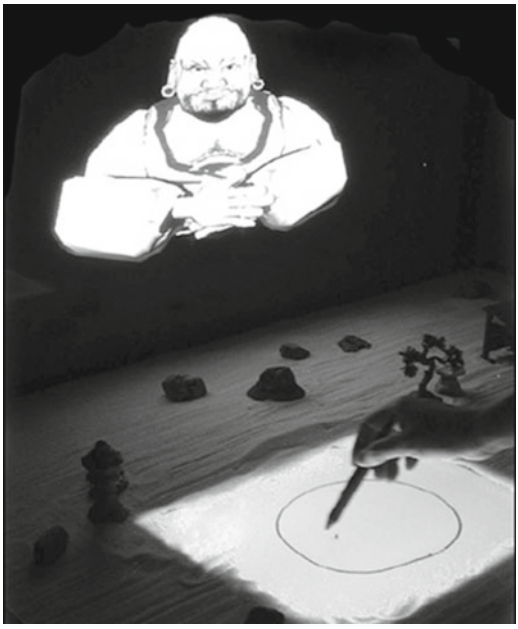

Fig. 4.18 Zen Buddhist interacting with "Art of Zen"

The Buddhist monk tells users, "There is a face and a back in anything. Feel it. Touch the leaves." When users touch one of the leaves on the screen, the monk says, "Yes, that is a face mask from Noh Theatre. Find the same mask as it." Users have to match each mask displayed on the stone garden interface (Fig. 4.19).

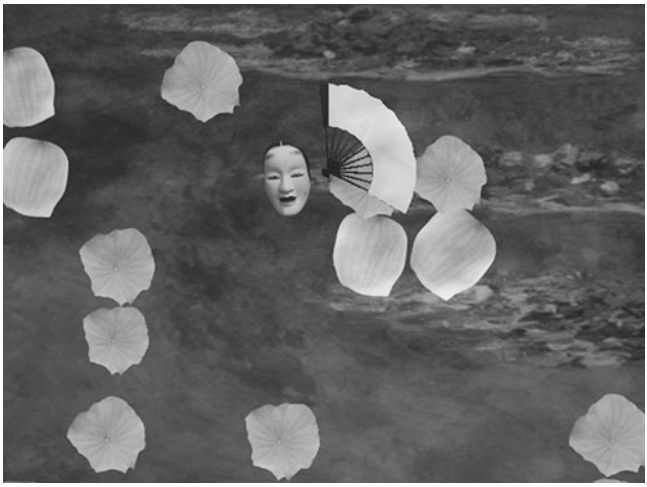

Fig. 4.19 Zen Koan interaction called "The Lotus Smiles"

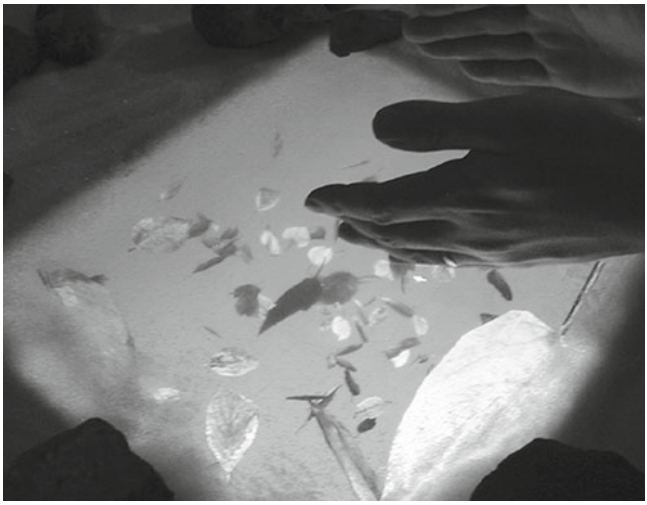

Fig. 4.20 Zen Koan interaction called "One Hand Clapping"

When users approach a standing tree in the Sansui painting, a Zen dialogue "The Sound of One Hand Clapping," related to the autumn leaves, appears. Autumn leaves fall on the screen, and the Zen master advises, "Clap your hand." If users clap their hands, the falling leaves stop, and the master says, "This is the figure of your feelings" (Fig. 4.20).

When users approach the water, the sound of a river is played, and they find a catfish in the river. This is the Zen dialogue named "The Catfish and the Gourd." The Zen master asks users to "Put the slimy catfish into the narrow-mouth gourd."

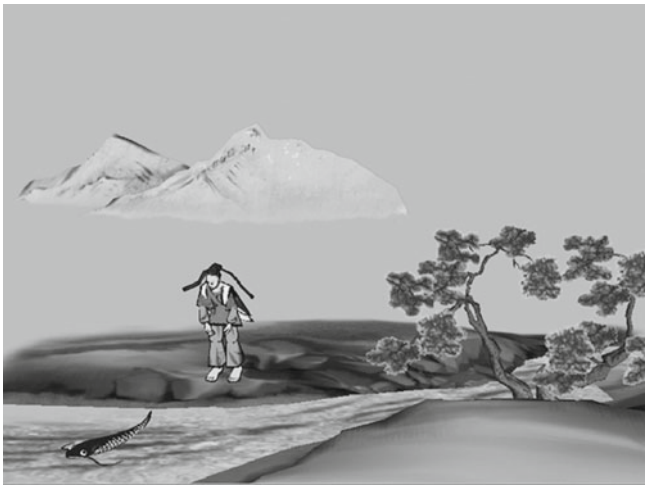

Fig. 4.21 Zen Koan interaction called "The Catfish and the Gourd"

The catfish looks at the users from the pond in the rock garden interface. Users can try as hard as they like, but as users pursue, the catfish flees faster and faster. The Zen master says enigmatically, "The chaser and the fleer; I want both of them to be free from each other" (Fig. 4.21).

In each interaction, a duplicative, synchronized chaos engine starts up. This chaos engine generates three types of chaos, each of which represents the behaviors of the User, the Zen Master, and the Target. Depending on the ways users interact with Zen, the User and the Zen Master are or are not considered to be synchronized. The contents of the interaction change as the User approaches the Target.

4.4.4 Controlling Ma with the Chaos Engine

"Scientists think that human recognition is chaotic. We try to reflect the core process of the user's recognition in an interaction, as well as to make it more varied and dynamic," said Dr. Peter Davies, who is a chaotic complex system researcher at the Adaptive Communications Research Lab at ATR and who designed the chaos engine, told me when we started our collaboration.

Scientists have no way to describe 'thoughts,' 'feelings,' or 'concepts.' However, if we apply the laws of modern physics to the activity of neuron cells, we notice that the activity of our brain has the same characteristics as everyday chaotic physics (Gleick 2008), such as the movement of planets, the behavior of a wind or water vortex, or the explosive growth of tissue cells.

Taking note of these similarities, we can imagine that such a chaotic mechanism is an essential part of the spontaneous reactions of our bodies and brains. Assuming

this, all the available processes are explained by complex combinations of each dynamic process—each reflects the interaction of our bodies with the outer world—which can be thought of as an example of imports and exports. I designed a chaos engine based on these ideas and through discussion with Dr. Davies.

The Chaos Engine is composed of many dynamic elements that imitate multiple basic elements that our 'self' has. The 'self' is the combination of two conflicting elements that sometimes synchronize and sometimes do not. These processes of synchronization and contradiction are called 'chaotic synchronization.' These can be likened to the synchronization of pure chords of music, but are more complex and subtle in their behavior. Sometimes they react passively to external pressure and suction. Other times, they lock onto each other and act as one. Sometimes they act instantly and independently based on their own mechanisms without any external controls. By feeding the results back to themselves at the same time, they sometimes enter an unregulated mode in which controlling and controlled elements are not distinguishable. When the system is stable, the Chaos Engine acts like a control unit. However, the system has the possibility of entering the other modes I referred to above, so this chaos engine mechanism can be more dynamic, spontaneous, and creative.

Is the behavior of the chaos engine 'creativity,' 'free will,' 'oppressiveness,' 'confusion,' or 'loss of control'? I tried very hard to control the chaos. The chaos engine worked well conceptually, but I did not consider it to be effective, so I fine-tuned parameters dozens of times and modified the engine.

I think of the Zen dialogue as being controlled by a combination of both cooperative and oppositional interactions between three different states: the current state of the user (User), the goal the user should reach (Target), and the Zen master guiding the user (Zen Master).

To imitate this process, I used a model that relates these three elements, User, Target, and Zen Master (they are expressed as points within Goun space), and trigger changes in the reactions of the system as the user interacts with it. Appropriate 'fluctuation' is needed to make users experience as many of the various interactions as possible when they interact with the system. The system uses a method for a dual synchronization of chaos to realize this fluctuation. The method for this dual synchronization of chaos is a model handling the synchronization of two or more chaos states. In this case, we employ a model containing three chaos states, corresponding to the User, Target, and Zen Master. Each chaos state corresponds to a point in Goun space. Using the method for dual synchronization of chaos, if one applies an initial value and appropriate input values, the three chaos states relate to one another and move through Goun space to generate output corresponding to the executed interactions.

As the chaos input, the system uses data obtained from the user's interactions. When the user interacts actively, the Zen Master chaos helps the User chaos and leads it to the next Target. If the interaction is not as active, the Zen Master chaos corresponds with the User chaos, and returns it to the previous Target.

For example, in the Kōan "Dharma Anjin," the position of the Target chaos changes depending on the curvature and density of the drawing that the user

sketches. The higher the density and curvature of the drawn lines, the better the Goun state achieved. This status is best expressed in the expression of Zen as the completion of an Ensō (circle) in a single stroke. Additionally, in the Kōan "The Lotus Smiles," the Goun state increases with increasing accuracy in matching images of Noh theatre masks and the Zen Master leads the User to the next Target step.

In the Kōan "The Sound of One Hand Clapping," the Goun state increases with the stability of the speed of the clapping sound, which reflects the stability of one's mind. However, if the clapping speed is not stable, the user is scolded, "What are you doing!" Figure 4.22 shows the rules used for the chaos model and how the system is affected (that is, the chaos states are changed) by the output data.

4.4.5 Computing the Yuzen Kimono Patterns of Kisoi, Awase, and Soroe

After the journey through the Sansui space, the user returns home. The Zen Master says to the user, "Here is a kimono. This kimono represents your mind." The user looks for a kimono pattern using the rock garden interface, and a kimono pattern from Miyazaki Yuzen[15] is selected from different designs such as Kisoi, Soroe, or Awase, depending on the user's interactions.

Because the rules that exist behind these design principles of Kisoi, Soroe, and Awase are complicated, I could not compute this part effectively. I would like to try to compute it more effectively in the next version of "Art of ZEN" by studying the mechanisms and structure of Kisoi, Soroe, and Awase.

4.4.6 Interactive Ten Oxherding Pictures Story

I set the Ten Oxherding Pictures story[16] as the ending of "Art of ZEN" following the Yuzen kimono interaction. The Ten Oxherding Pictures story is a Zen method that leads us to enlightenment using the following ten pictures of an ox. The ox is a symbol of our mind. I designed this story as an interactive story.

Jingyu (尋牛) – In search of the ox
An ox is an animal that appears in Shan Hai Jing, which does not have a fixed figure.
The user is told that it will die if he/she does not draw eyes, nose, and a mouth. The user has to interact with this ox.

[15] Mr. Miyazaki Yuzensai (1654–13 June 1736) is known as the founder of Yuzen dyeing. At first he focused on painting on Japanese fans, then as the fans painted by him became famous, he started designing Kimonos. It is believed that he invented a dyeing method to apply his design to Kimonos and nowadays usually Yuzen means a Kimono using a design similar to his.

[16] See footnote 12.

Interaction	Goun Input to Target Chaos	Output from User Agent Chaos
Haiku Output	Apply goun assigned to the Haiku	The goun changes
Dialogue: "The Catfish and the Gourd"	Change goun depending on part of catfish touched Touch the head → rise (toward shiki+) Touch the tail → fall (toward shiki−)	Catfish's movement changes
Dialogue: "The Lotus Smiles"	Goun target changes based on clicks Sample every time user selects 2 leaves If the masks are the same, goun target rises If the masks are different, goun target falls	Buddha's movement changes Output audio changes
Dialogue: "Dharma Anjin"	Goun value changes based on drawn lines Sample data every three seconds X Axis: Curvature (0.0 ~ 1.0) Y Axis: Density (0.0 ~ 1.0)	Output audio changes
Dialogue: "The Sound of One Hand Clapping"	Change goun value based on clap timing and movement of fallen leaves A: Sample deviation based on timing of first two claps Small deviation → rise (toward shiki+) Large deviation → fall (toward shiki−) B: Goun value rises as the movement of fallen leaves increases	Speed of falling leaves animation changes Output audio changes
Yuzen kimono patterns	Refer to the goun result of previous four interactions and select a Japanese cultural form for each. Mitate: shiki; Kisoi: sou; Soroe: gyou; Awase: jyu, siki	Kimono design is displayed based on Japanese cultural forms awase, kisoi, soroe and mitate.
Ten Bulls Story Finding the Bull	Change target based on the distance between first two points drawn (eyes) Far apart → rise (toward shiki+) Close together → fall (toward shiki−)	None
Ten Bulls Story Catching the Bull	Change target based on how user pulls rope Pull moderately → goun value rises Pull strongly → goun value falls	Bull animation changes Bull sound changes

Fig. 4.22 Relationship between chaos engine input and output

Kenseki (見跡) – Discovery of the footprints

The chaos engine asks the user to draw the eyes, nose, and mouth of the ox. The user draws them on the touch screen.

Kengyu (見牛) – Perceiving the ox

When the user draws the eyes, nose, and mouth, the figure of the ox becomes clearer gradually.

Tokugyu (得牛) – Catching the ox
The user tries to catch the ox, but only the footprints are visible. The ox says, "Catch me," even though it cannot be seen. The user must consider how to pursue it. The ox comes to life when the Ensō (a complete circle) is drawn. If the user fails to draw the Ensō, the ox dies, and the story ends.
Hogyu (牧牛) – Taming the ox
If the user succeeds at catching the ox, the figure of the ox becomes fixed and then the user has to tame the ox using a rope.
Kiyukika (騎牛帰家) – Riding the ox home
This is an interaction in which the user plays with the ox. The user caresses the ox with a feather and the story moves to the next scene if the ox sleeps. However, if the ox wakes up, the story will end.
Bogyuzonjin (忘牛存人) – Returning home, forgetting the ox
When the user returns home, the ox has disappeared and he/she sees a Chagama (tea kettle) steaming.
Jingyugubou (人牛倶忘) – Both ox and self transcended
A scroll appears at home, and the sentence '色即是空' (Every form in reality is empty) appears.
Henponkangen (返本還源) – Ordinal scenery looks great
When the user gets out of the room, there is a great 3D Sansui space that has not been seen before.
Nittensuishu (入鄽垂手) – Return to society
As the ending scene, the screen projects the scenes of "Art of ZEN" and the user's Goun states are shown through flashbacks, and finally the scroll is closed and the scene ends.

Figure 4.22 shows the relationship between user interactions and Goun space.

4.5 Opening, Traveling, and Living in Sansui Zen

The sound for "Art of ZEN" is an important element that connects one scene to another. I asked Toshinori Kondo, a globally famous jazz trumpeter, to create the music for "Art of ZEN." Kondo is a trumpeter who travels to rarely visited regions around the world to play the trumpet. The two mindsets of Kondo's jazz and the Sansui paintings of "Art of ZEN" corresponded well, and the music harmonically matched with the world of "Art of ZEN."

When the user creates a Sansui space on the scroll, human icons are selected to talk to him or her. When he or she is traveling in the Sansui world and walking toward the waterfall, the sound of a waterfall is played. When he or she approaches a mountain or bird, their sounds are also played. Thus, we staged the sounds of the Sansui space.

Many users appreciated the voice of Matsuoka reading the haiku. There are Japanese, English, and French versions of the "Art of ZEN." I asked artists at MIT

CAVS for their opinions on relevant English voices, because the English version should contain English voice-overs of the haiku. Many of my friends at MIT CAVS including Hisham Bizri[17] said that as the Japanese voice is well-matched to the screen, it would be better to provide captions in English for the Japanese voice.

Now I will refer to the creation of different language versions of the "Art of ZEN." I needed to translate Japanese phrases into English because it was to be exhibited at the MIT Museum. We asked Prof. Condry to cooperate with us. He had worked as a journalist at "Yomiuri Shinbun" (a Japanese newspaper) after he graduated from university, so he speaks Japanese fluently. He translated Japanese phrases that are rich in nuance to beautiful English phrases that people from other countries could easily understand. Bradford Ellis, who was a senior student at the Faculty of Technology at Harvard University, also assisted with the translation of the Japanese text.

4.5.1 The Death of Prof. Stephen Benton and the Exhibition

In autumn 2003, my former advisor, Prof. Benton, gave me the opportunity to exhibit the result of our shared research in the main gallery of the MIT Museum, where several successful creations by MIT students were exhibited.

The exhibition was advertised on the MIT Web site and newspaper o, headed by the title "Zen and the Art of Computers," which was a parody of "Zen and the Art of Motorcycle Maintenance," a bestselling book in the 1970s by Robert Pirsig. The work was welcomed by the unique humor of Americans. I should say that the experience gave me great joy and moved me deeply, for the work was born through much difficulty, and in reality, my mind was anxious and stressed. The exhibition at the MIT Museum enjoyed great success and was supported by the Japanese Consulate in Boston, the Boston Japan Society, the MIT–Japan Program, and members of the Reischauer Institute of Japanese Studies. There was also success during the commemoration of the 150th anniversary of Japan–America relations.

To my deepest sadness, my former advisor Prof. Benton, the inventor of rainbow holography, passed away because of a brain tumor around the time of the exhibition. I had wanted to show him the exhibition. Thus, I experienced both the birth of our artwork and the death of my former advisor at the same time. As they say, c'est la vie (that's life).

It is important to experience Zen with a Zabuton, a square cushion, so we lowered the desk and made viewers experience the exhibition while kneeling on a cushion. We put the rock garden interface on the low desk, and embedded a 14-in. touch screen into it to let it resemble a pond in the garden. We tried to express the

[17] Hisham Bizri is a Lebanese-American filmmaker. He has worked in the US and Hungary with filmmakers Raúl Ruiz and Miklós Jancsó and has made short films in the US, Lebanon, Ireland, Korea, Italy, and France. As of 2014, Bizri was an Associate Professor of Film at the University of Minnesota, Minneapolis.

Zenki by the effect that the images jump from the 100-in. screen to the embedded pond on the desk.

We asked a calligrapher to draw four large calligraphic images 3 m in width, and put them on both sides of the main screen, which made the installation appear regal and tension-sensitive. One of the exhibitions was held in Kōdaiji, a Zen temple in Kyoto, as well as in America and Europe.

I read many English books about Zen for my explanation of the exhibition in English. Many of these books use difficult expressions, or easy, but misleading, expressions. One of the clearest books about Zen was written by Daisetsu Teitaro Suzuki.[18] Half of the book was written in English, and the other part was written in Japanese, so the book came in handy because I could look up each word.

4.5.2 "Art of ZEN" at Ubiquitous House

The "Art of ZEN" exhibition was sponsored by two governmental research institutes (France Telecom and the National Institute of Information and Communications Technology (NICT) that study ubiquitous houses, which are the smart houses of the future. These research institutes seemed to think that this work would fit future houses.

To set the "Art of ZEN" exhibition up in the ubiquitous house at Lennes Laboratory by France Telecom, we needed to synchronize the system with the interior controllers of the house. I staged the mechanism so that the blinds were closed, the lighting dimmed, and incense was burned at the startup of the "Art of ZEN." In every scene, the related movies were projected interactively by the projector on the wall. I staged the space like a theatre for the "Art of ZEN"—for example, wind blows in the scene of "The Sound of One Hand Clapping," and the scent of flowers drifts in the scene of "The Lotus Smiles." For a French translation of the text, I asked a French researcher who studied Japanese at Maison Franco-Japonaise.

I changed some haiku to the words of Montaigne and some Zen dialogues to the words of la Fontaine, based on French ideas. Thus, the system became an actual example of cultural computing in which the cultural contents were replaced and mixed with those that were regionally relevant.

In the ubiquitous room at NICT, we set a 30-in.-wide plasma display in the drawing room like an alcove in a traditional Japanese house, and projected "Art of ZEN" onto the display. Many RFID (Radio Frequency Identifier) tags were mounted in the room. The system was designed to draw the Sansui paintings on the display when

[18] Daisetsu Teitaro Suzuki (October 18, 1870–July 12, 1966) was a Japanese author of books and essays on Buddhism, especially, Zen Buddhism. Suzuki was also a prolific translator of Chinese, Japanese, and Sanskrit literature. Suzuki spent several lengthy stretches teaching or lecturing at Western universities, and devoted many years to a professorship at Otani University, a Japanese Buddhist school.

the family sat around the table. When the user walked, he/she could listen to the voice of the Zen Master and interact using the real room.

4.5.3 Computing the Spirituality of Japanese Culture

The calculation ability of computers, the resolution of the display, and the ability of input device advances are advancing beyond human comprehension. I expect that future technology will be able to enter the spiritual region of humans.

As I referred to in the Introduction, Tibetan high priests believed in the fusion of sprits and technology, which I think is not so far away. If a computer system can realize a kind of Bodhisattva-like interface, the interactivity may be that of a system that can resonate with the spirituality deep within someone.

To Western society, Japanese Zen is a mysterious form of psychology from the past. While there are books like "Zen for Everyone," there are still doubts about whether everyone can understand Zen as it is. We tried to make "Art of ZEN" something through which users can learn about Japanese spirituality by tackling Zen dialogues, hearing haiku, and stepping into kimono designs.

The research into Japanese spirituality sponsored by France Telecom may have been made possible by the deep understanding of the cabalas of Christian Baloquie, the general manager of France Telecom's branch office in Japan. Everyone had an interest in the computing of Japanese spirituality. At the end of the sponsored research, an evaluation committee was held in Paris. From Japan, I invited Prof. Makoto Nagao,[19] the director of NICT at that time, and Prof. Michihiko Mino[20] of Kyoto University, to come. A staff member of France Telecom concurrently had work as an officer in the Institute of Science and Technology for France's government. He asked us why we used chaos in "Art of ZEN."

Prof. Nagao explained, "The understanding of scientists about the mechanisms of a human's mind is strongly limited. However, we can make a prediction that our brains have chaotic dynamics. Running with this idea, we can think that chaotic mechanisms are the essential parts that support all the immediate movements our bodies and mind have." This answer was conveyed with conviction.

From now on, thoughts and designs for this cultural computing that boldly cross cultures were strongly desired. Through the research discussions with many common researchers, I found that from the ancient days, people used symbols and allegories to understand or convey the story of something. It was an easier way for

[19] Makoto Nagao (born October 4, 1936) is a Japanese computer scientist. He contributed to various fields: machine translation, natural language processing, pattern recognition, image processing and library science. He was the 23rd President of Kyoto University and also the Director of the Japan National Diet Library.

[20] Michihiho Mino is a Professor at the Department of Digital Content Research Academic Center for Computing and Media Studies, Kyoto University. The mission of Minoh Laboratory is to research in both computation and multimedia communication.

people to remember a story. Therefore, our next object of research is interactive storytelling, which we should research after exploring the current interaction technologies between computers and humans.

I considered these things and composed the entire system. To realize the system, I took advantage of the chaotic model that represents human minds, the rock garden interface, and the interactive 3D computer graphics technology.

I am very thankful that we could obtain worldwide empathy for "Art of ZEN," that I had success developing new technology that connects traditional cultures with modern cultures using educational computers, and that our system should deepen the understanding between cultures.

"Art of ZEN" was sponsored by the "Interaction and Intelligence" area of JST, France Telecom, ATR, and MIT CAVS. This system was exhibited not only in the MIT Museum, but also in Kōdaiji temple, Kyoto in 2004 and in the emerging technology sector of ACM SIGGRAPH. This system won the prize in the UNESCO Digital Cultural Heritage Competition in 2005.

4.6 Computers Read the Situation

I introduced a system in which the viewer can be inspired by Sansui pictures or dialogues from Zen culture. As a next step, I developed a search/generation system named "i.plot," which extracted the essence of inspiration. The 'i' stands for all of inspiration, information, and interactivity.

Each culture has contexts for its structure-like style, mode, or code. For example, there are poems, tea cultures, Noh dramas, comic dramas, Kabuki. These 'structures' of Japanese rules of behavior exist in order to convey tradition. In other words, they are the existence of Iemoto (grand master, for example of tea, calligraphy, flower arrangement, etc. in Japan) and Ma that we physically remember. And in each of the process learning mastery in Japanese culture such as tea, calligraphy, etc. as well as Ma, there are always three levels called "Shuhari": the fundamentals, breaking with tradition, parting with traditional wisdom.

The concept of "i.plot" was to construct what drives our ethnicity inspirationally, beyond general synonyms or associations, by creating a database of these 'structures' that identifies culture.

When we think about new words, we classify and describe them by discovering the general idea that contains the words, or we think about the usage or the function. We collect related words, and make associations. In this way, we nurture our understanding of words. If we see them from the perspective of phenomena, all the words of the world have been named, described, systematized, and related like a complex web. We are also included in the world of words and framing it at a certain moment. All things are processes that may relate to each other, and they exist. Alfred N. Whitehead, an English mathematician and psychologist, says in his book "Process and Reality" that there are four hypotheses about creative power: (1) Physical association, (2) Conceptual imagination, (3) Propositional imagination,

and (4) Reserved judgment. We considered inspirations of contexts that are hidden between words for the database of cultural structures.

This was my first research project after I returned to Kyoto from Boston. Two young American researchers did excellent work for this research. Jordan Gilliland came to Japan through an internship for the MIT-Japan Program, when the research was at a brainstorming level. He had studied under Noam Chomsky, the famous philologist, who expanded the generative grammar model and grammatically resolved the letters by Shakespeare.

After him, Bradford Ellis, who had just graduated from Harvard University's School of Engineering, came to my laboratory. He was interested in scientific technology, arts, and Japan. Japanese engineering students rarely take up non-engineering fields as their research, especially when they have passed through graduate school level education. However, I felt the two interns had a capacity to tackle fields outside the range of pure technology flexibly, even though they had come from schools of engineering.

The contexts of daily and general dialogues with computers, for example, to make purchases from a vending machine or to reserve something, are what we call monotony. If computers can give inspiration with humor and creativity to their users, we will be stimulated, and the future relationship between humans and computers, or using computers in education and entertainment, will change dramatically.

4.6.1 Generating Inspiration

Every time we try to do something, we try and fail dozens of times, like a patience test. Every path is filled with difficulties. One's aptitude for science is determined by whether they can tolerate these situations for a long time. This is likely the reason why researchers are always patient.

People talk about many ideas, but usually no concrete conclusion is seen. One may think nothing is advancing then, but new thoughts were certainly spreading within our thought processes.

Originally, a word has its origin and a designated system. If it is a completely standalone word, it is just a sound, not a word. A word has choices and metaphors from association of its meanings. 'Emergence' means the appearance of a new paradigm that we have not thought of before, which has discovered a new direction to move in and, in doing so, break down a large barrier. When the emergence of words occurs, elements such as 'kind' and 'individual' or 'position' and 'figure' connect to each other in the 'story.' These phenomena lead to the discovery of new relations and the creation of brand-new images. To compute these verbal items, we considered mechanisms that have various rules. When I struggled to think of an ideal mechanism to stimulate this inspiration, my cooperative researcher talked to me about the idea of editorial thought forms, which hit me like a bolt from the blue. I designed the system using the open source psychological association data from Edinburgh University, which contains about 20,000 words, synonyms, antonyms, and thesau-

rus dictionaries of word nets from Princeton University and about 5000 pieces of data on thought forms. These thought forms are not simple, so I will explain the concept in the next section.

4.6.2 The Forms of Thoughts

The 'editorial thought forms' are forms of thoughts to edit information. These consist of five types, as you can see below. I constructed a database for the relationships of these thought structures.

4.6.2.1 Concatenation

This is information where three words are arranged in order of continuity and they specify the following conditions:

1. The three pieces of information, A, B, and C, are of the same rank.
2. The order of A, B, and C specify the position.
3. The differences between (A and B) and (B and C) are the same.

For example: Hop–Step–Jump.

4.6.2.2 Balance

The information about balance specifies the following conditions:

1. The three pieces of information, A, B, and C, are of the same rank.
2. A, B, and C pull each other with the same force.
3. The relations between (A and B), (B and C), and (C and A) are the same.

For example: The Holy Trinity of Christianity (Father–Son–Holy Spirit).

4.6.2.3 Division

This is the division of an idea and the information specifies the following conditions:

1. The parent information, A, can be divided into the child information, B and C.
2. The child information, B and C, is balanced.
3. The relationship between A and B is equal to the relationship between A and C.

For example: Computers can be divided into software and hardware.

4.6.2.4 Unification

This is the combination of two ideas to produce a new word or a paradigm. For example, radio and cassette combines to produce a 'radio cassette' player.

4.6.2.5 Crisscross

There are two patterns of crisscross:

1. Parallel combinations of B, C, D, and E connect to A as the center.

* The information B, C, D, and E are of the same rank.
* The information B, C, D, and E pull each other with the same force.

For example: If we take four seasons to be A, and B–E to be spring, summer, autumn, and winter.

2. The combination of two axes B–C and D–E.

* Each relationship of B, C, D, and E to A is the same.
* Assume the orthogonal coordinates for simplification. Information B–C is set to axis Y, D–E is set to axis X.

For example: The information 'young and old of both sexes' sets two axes, 'young–old' and 'man–woman.' We can multiply the information in each space divided by the axes. That is, we can have the extremes 'old man,' 'old woman,' 'young man,' and 'young woman.' These may generate new images or ideas.

4.6.3 Dictionary of Images

4.6.3.1 Psychological Association Dictionary

I used an open source database, the Edinburgh Associative Thesaurus (EAT) of "psychological association data" of Edinburgh University (Kiss et al. 1973). The data of EAT was created in the following steps: 1. In the 1980s, Edinburgh University made their students give words that most associated to each of 100 randomly selected words as fast as they could. One hundred different answers were collected. 2. They made the data the small core of an association network. If we input a word, all the associated words will be output. 3. They used the associated words generated described in the second step to generate more associated words. Repeating these steps three times, they created a huge association network in which a great many words were linked to many others.

4.6.3.2 Conception Dictionary

I used a conception dictionary (a dictionary of meanings) named WordNet, which was created by the Cognitive Science Laboratory of Princeton University (Miller 1995). In WordNet, words are classified into sets of synonyms named synsets. A simple definition and relationships to other synonym groups are described. The goal of WordNet is to realize a dictionary that we can use intuitively to support automatic document analysis systems and artificial intelligence systems. The database and software are opened based on BSD (Berkley Software Distribution) license, one of the free software license mechanisms, so anyone can download and use them. We can even access the WordNet online database by visiting the Princeton University Web site (Princeton University 2015).

4.6.4 Willful Chaos Search

If we perform a search using two words, most systems select many words as long as they have short distances with the words and simply return the search results. However, I used another way of searching. The data I used have a 'structure' called thought forms, which is a huge association structure like the psychological association dictionary and the conceptual dictionary structure, which contains strong, weak, opposite, and similar connections to other words, such as 'neurons' and 'synapses'. The chaos system doesn't simply connect the closest words, but connects two different words using a unique way of searching, which we usually do not notice. I used the dual synchronized chaos engine to determine the length through which to search for relationships. The system let the dual synchronized chaos engine determine the distance between the input words and even searches the newly inspired words by adding elements depending on their relationships. Using the 'thought forms,' 'psychological association dictionary,' and 'chaos search,' I developed a type of inspiration computing, based on a database of 20,000 or more words.

4.6.5 "i.plot" – A Thought Space to Connect Images and Words

I will introduce the system named "i.plot," which forms associations to create inspirations using a chaos search and generate an inspiration space.

4.6.5.1 Inspiration Space

If a user selects two words, the system presents the hidden relations as an 'inspiration space' to the user. The strong point of the system is to create a 'thought space' by connecting the thought forms and psychologically associated words from the

huge number of chaos searches like a spider's web. Some chaos parameters may result in a distant relationship that enables us to discover even more unexpected relationships between words. The association abilities of computers are shown to be usually beyond the association abilities of humans.

Each word has its synonyms and antonyms and can be divided and unified, the results of the search using these word relationships generates the association space for any words. When we think about something, external and internal information is mixed a 'thought space' in the brain is generated. The system visualizes an inspiration space that is similar to the internal one.

I researched the rules to connect images and words, and first tried to connect the image of the wall paintings of South America (Satumo and Taube 2009) to each word. The reason is that each painting is classified into some concept such as gods or animals in the text. However, the paintings were hard to connect because the classification included much less variance than the data of 20,000 words and the differences between their ages and cultures, and I was unable to find adequate correspondence between these two types of classification. Next, I tried to create a database that used comic book frames and the words representing the contents. However, the comic book frames were already related to the context around the adjacent frames, so I could not find significant correspondence either. Then I attempted to use pictograms instead, but pictograms, like traffic signs and smartphone icons, could not be a common visual language, and the correspondence was often nonsensical. Finally, I considered hieroglyphs in wall paintings, and I decided to use Kanji (Chinese characters) because Chinese characters are pictographs, like hieroglyphs. Although there are various types of Kanji depending on age, I used the oracle bone scripts that were used in the eleventh to fourteenth century BC, as these old kanji are close to visual images.

If the user inputs two words, the software generates the translation in hieroglyphs associated with the input words, namely, the kanji of the words are expected to generate inspiration. We can observe the relationships between images and words by the inspiration created from the combination of kanji, as hierograms, and English words, as phonograms (Fig. 4.23).

4.6.6 "i.plot" for Reading the Situation

I designed software that shows various relationships of words through 'inspirational' computing when the user inputs a sentence. The first step in designing this software was to create software that would help Japanese people understand English contexts, as Japanese people may misuse English vocabulary when they write English e-mails. However, the results were beyond my expectations.

With more and more refined sentence input, this software can generate more words that reflect the rich vocabulary of the original sentence. I could feel the imagination and the extent of the sentence. Next, I tried to visualize the words related to both previous and next sentences. This means that the computer tried to 'pick up the subtext' of the sentences.

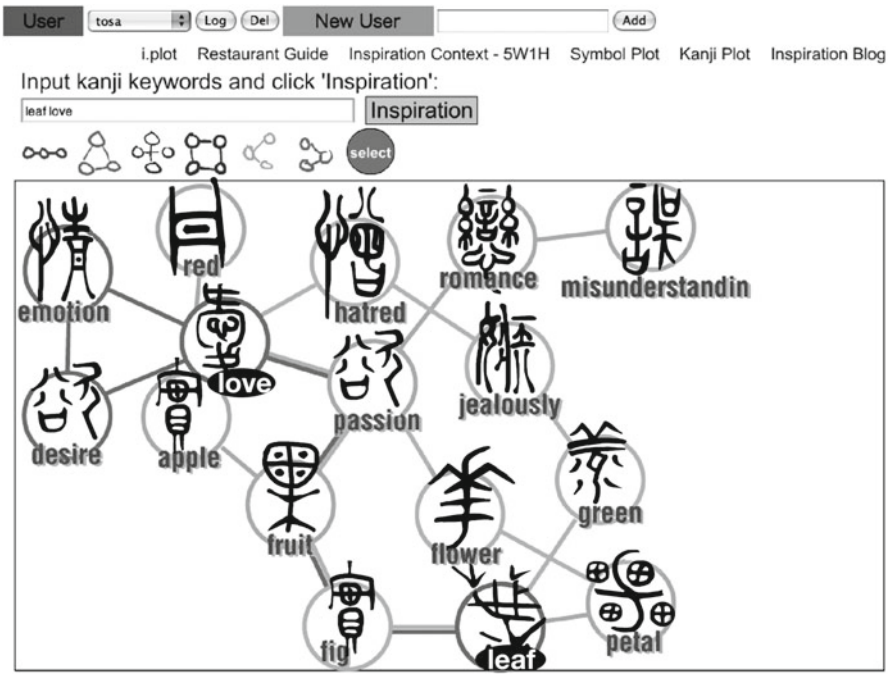

Fig. 4.23 "i.plot" showing the relationship between two words both English words and hierograms

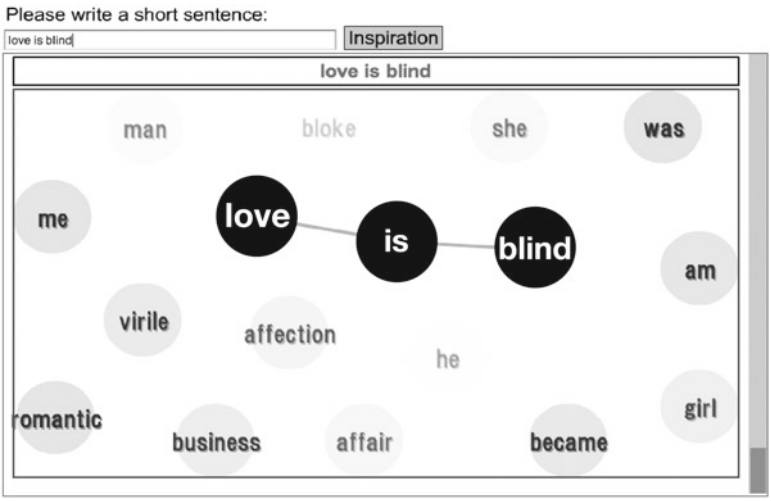

Fig. 4.24 "i.plot" showing words related to the input "Love is blind"

For example, we input three sentences: 1. “Love is blind,” 2. “To be or not to be,” and 3. “That is the question,” from the most famous part of “Hamlet” by Shakespeare. Then the hidden backward words associated with sentence 1 are displayed in blue font (Fig. 4.24).

After that, the computer carries out the search for 2. “To be or not to be,” and displays the associated words related to the context of sentence 1 as well as sentence 2. Comparing the first result and the second result, we can see the movement of the context between these sentences (Fig. 4.25).

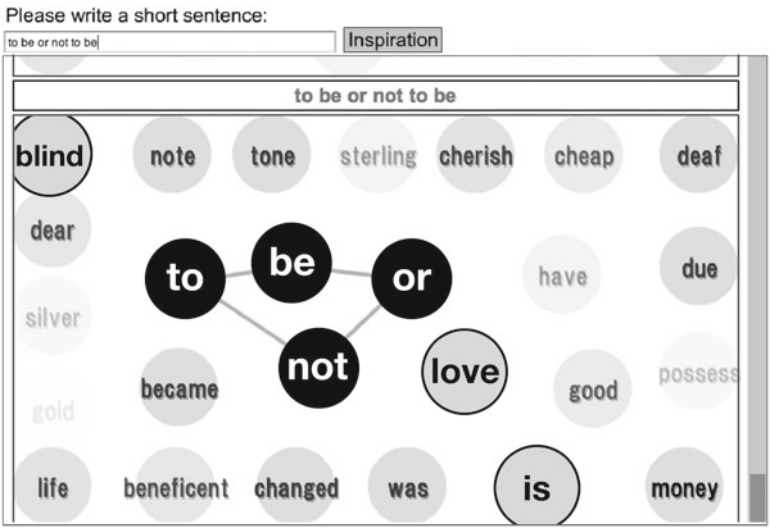

Fig. 4.25 “i.plot” showing words related to the input “To be or not to be”

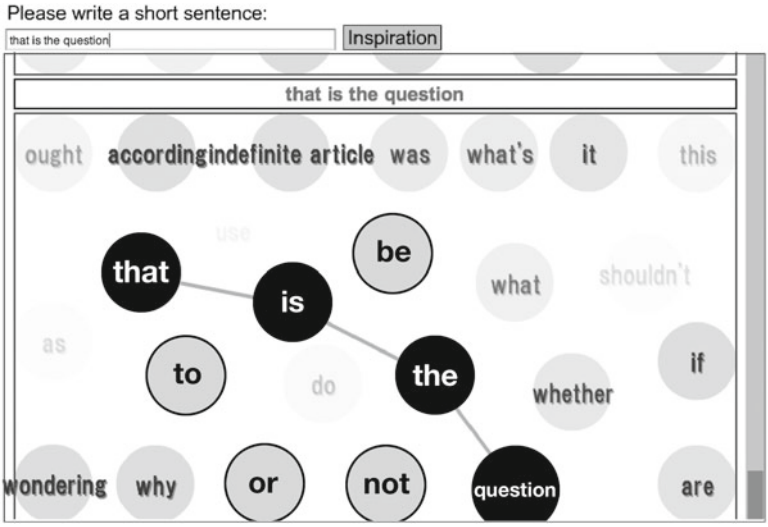

Fig. 4.26 “i.plot” showing words related to the input “That is the question”

Finally, if we input 3. “That is the question,” the computer displays the flow of the context considering the two sentences input before. Let us compare these three results (Fig. 4.26). How did the context shift?

You may have noticed that the ‘situation’ expressed by the context of the three sentences is visualized, and it can be read. In the first sentence “Love is blind,” the computer created an atmosphere of sweetness and with plenty of room, but if the sentence proceeds to “That is the question,” the words are replaced by more serious words.

Thus, computers can give humor, knowledge, and inspiration to the users by considering the clue to inspiration. “i.plot” was the result of my attempt to create an inspiration engine that can stimulate the images in our brains with plenty of vocabulary, using the logical meanings of language, cultural structures, and original images of kanji.

You may have noticed that when I explained culture as existing between texts and images or between texts and texts, secondary meanings emerged around them. In the next section, I will discuss these meanings in the context of haiku poetry as a realization of the “intertextuality (Kristeva 1980; Allen 2011)” proposed by Julia Kristeva.

France Telecom sponsored this research and the system was developed with their funding. I exhibited and demonstrated this software in the emerging technology sector of ACM SIGGRAPH.

4.7 “Hitch Haiku” of Tree Peony and Foo Dog

Using the inspiration computer, I tried to connect words and images and to describe the situation between the lines from connections of sentences to visualize our inner images. As a next step, I set myself the challenge to generate haiku because it has unique Japanese rhythms and involves plenty of cultural concepts like Kireji, Utamakura or Honka-dori, which are specific to haiku. I will introduce my cultural computing project named “Hitch Haiku,” which takes (hitches) Kanji from books around the world and makes associations in the form of Haiku.

4.7.1 Hitching the Kanji

Haiku is a form of old Japanese poetry that contains 5, 7, and 5 Japanese syllables; it is the world’s shortest style of poem. Haiku includes ‘Kigo,’ which specifies the season, be it the new year, spring, summer, autumn, or winter. Haiku also includes ‘Kireji,” for example, “ya,” “kana,” or “keri,” that connect phrases. The original form of haiku is Renga, in which two parts are sung alternatively, which originated in the Muromachi era.

In the seventeenth century, Matsuo Basho (1967) picked up Hokku, the first part of Renga, and created haiku. When we make a haiku or a small composition, some-

times we cannot find good words, because we are fixated on certain ideas. Professionals refer to the Saijiki and relevant associated words from it, but most of us cannot do that. However, “Hitch Haiku” takes phrases from the contexts of books, connects them to the associative Saijiki, and generates a haiku automatically. I tried to construct a haiku composition-supporting tool.

I will refer to the process of generating haiku in Sect. 4.7.3, but before that I must give an overview of the system. A user selects relevant words from e-books to be used in the haiku. Then the computer takes phrases from a Kigo database that includes a large number of haiku from Saijiki and generates a haiku.

4.7.2 “Hitch Haiku” Interactions

4.7.2.1 Select Your Favorite Phrases

The user visits one of e-books stored for this project on the Internet and finds favorite phrases that are linked to each book.

4.7.2.2 Select Words to Create Your Haiku

The user highlights several words he or she likes using the pen icon from the text (Fig. 4.27). The first marking color is green, which represents that the words are the temporary selection. If the user highlights one or two words among the green-colored words to use in their haiku then the words are marked in red, and determined to be used for the haiku generation. The system then generates a haiku by

Fig. 4.27 Several key words highlighted by a user

selecting related phrases using all the words marked in green or red. Note that the weight of red-colored words is greater than that of green-colored ones. The user can use the eraser function to cancel the highlighting of words and reselect words.

4.7.2.3 Connect the Kireji

To keep the format of Haiku, appropriate particles and auxiliary verbs (Kireji), like ya, kana, or keri, are inserted after words to act as word separators.

4.7.2.4 Select a Kigo (Season Word) and Generate the Haiku

To obtain maximum quality, the computer searches for a Kigo (season word) associated with the input words in a Saijiki, a dictionary of haiku, and an example-based database of any haiku poets. After that, the computer selects words related to the Kigo from texts of the book the user selected in step 3. Then the system generates a haiku related to the book. The computer does not directly use the input words, but selects high-ranked words from a large number of words related to the input words.

4.7.2.5 Display the Haiku Animation and Select Sound Effects

The created haiku is displayed with a design determined by the image of the selected book. The design of characters (Japanese/English, layout, and display animation), the background movie, and the music are selected from this design (Fig. 4.28). As a variation function of the Haiku display, the user can click [Next] at bottom-right to generate another haiku with the same input words. The user can also click [Enter] to view the haiku translated into English (Fig. 4.29).

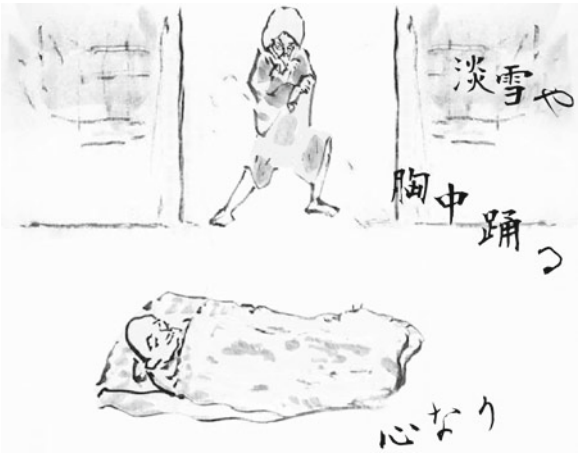

Fig. 4.28 An example of generated Haiku

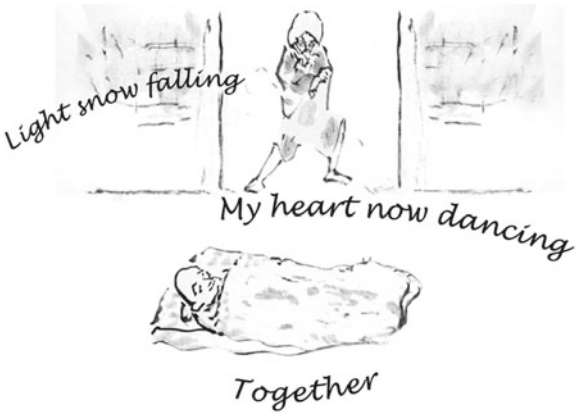

Fig. 4.29 English translation of the generated Haiku

4.7.2.6 Castigation

The user can overwrite the generated haiku to brush up the expression so that it looks better.

4.7.3 Haiku Generation Process

In this section, I refer to the processes of the interaction system I described earlier (Fig. 4.30). The main processes like morphological analysis and searching for related words are performed in Japanese, and some processes are performed in English, if required. Here are my step-by-step instructions for the inner processes of my interaction system:

1. The user inputs several words by marking them.
2. The system processes the input words for their syllable counts. Kireji like 'zo' and 'ya' and particles are inserted after the words, or before the words for adverbs like 'geni.' Depending on the conjugation of the words, additional modifying words are added before or after the input words.
3. At the same time, the system picks out nouns, verbs, adjectives, or adverbs by dividing the input words to morphemes, using the morphological analyzer.
4. The system searches related words to each morpheme from its seven databases of related words: Thesaurus DB, Haiku thesaurus DB, Kigo DB, Idiom DB, Case frame DB, Onomatopoeia DB, and Learning DB. Each database has multiple words with each classification name. Note that the 'related words' to the word 'S' is a set of all words with the same classification as 'S,' except 'S,' in a database.
5. When the generating haiku phrase has a Kigo word, the system searches haiku phrase databases that do not contain the Kigo, and when not, the system searches from the Kigo phrase database. When two or more phrases are found, the system obtains one phrase by weighting them.

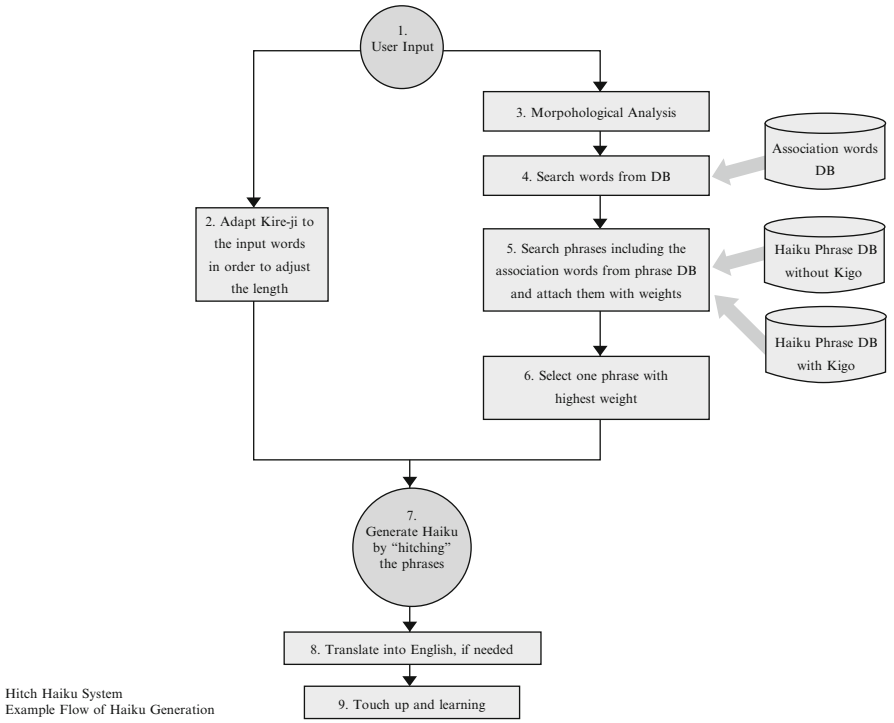

Fig. 4.30 Haiku generation process

6. The system selects the highest weighted phrase as the related phrase to the user input words.
7. The system generates a haiku by connecting the modified phrases or related phrases to form sets of syllables as 5–7–5.
8. When the language is English, the system translates the phrases. Phrases generated by this system include many old Japanese words, so this system includes a special 'Old Japanese–Modern Japanese Dictionary' and 'Japanese Onomatopoeia–English Onomatopoeia Dictionary' in order to translate old Japanese words into the current language before translating them to English. For example, the phrase '来ぬ' must be translated into 'has come,' but an average translator translates it as 'does not come.'
9. The system uses a learning function to upgrade the quality of haiku generation by learning the result of the user's castigation to the generated phrase. At first, the castigated phrases are inserted into the haiku phrase database. Then, the system assumes that the user input words are related to the castigated phrases and registers the relation between input words and the castigated phrases into the database of related words. Figure 4.31 shows an example of haiku generation using the input words, 'heart' and 'light snow.'

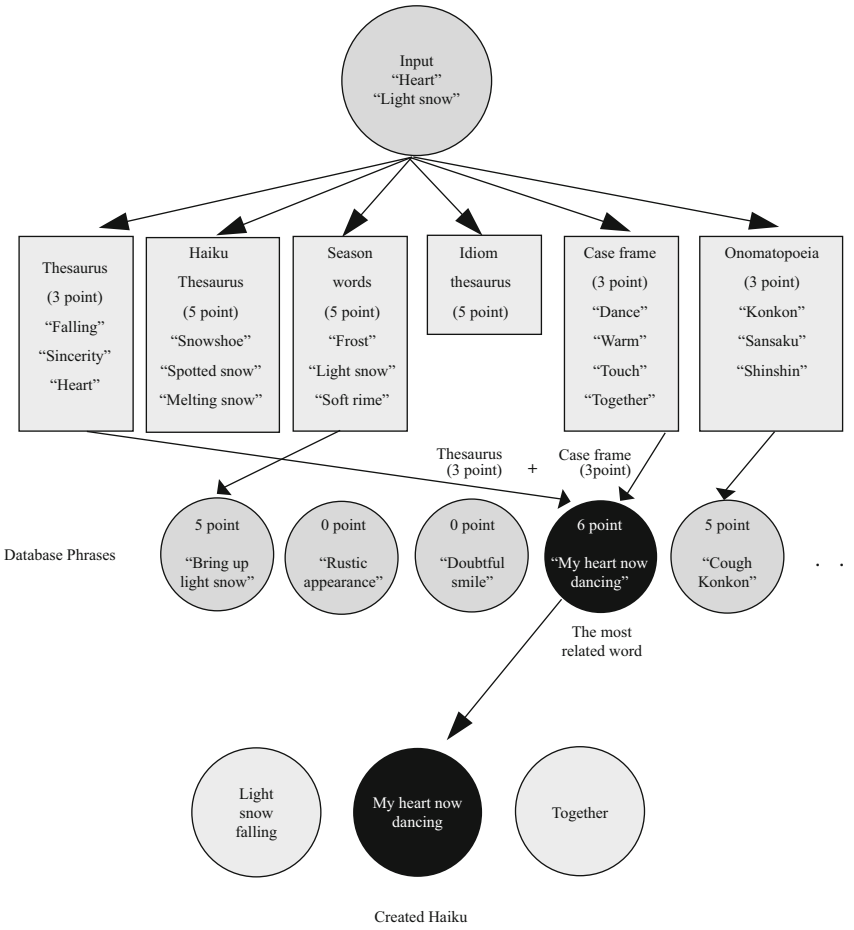

Fig. 4.31 An example of Haiku generation corresponding to the input “Heart” and “Light snow”

(a) By adding some modifying words to ‘heart’ and ‘light snow,’ the system adjusts the phrase to make the length of the line 5 or 7 syllables.
(b) Then, the computer searches the related words ‘heart’ and ‘light snow.’ For example, in the haiku thesaurus database, the system finds ‘mottled snow,’ ‘melting snow,’ and so on.
(c) Because they include ‘snow,’ a Kigo of winter, the system searches phrases that include related words from a haiku phrase database without any Kigo.
(d) A phrase ‘my heart is now dancing’ includes two related phrases, ‘my heart’ and ‘dancing,’ so the weighting of the phrase increases. As a result, the phrase is selected as the most related phrase to the input words and is used in the haiku.
(e) A Haiku ‘Light snow falling/My heart is now dancing/Together’ is generated.

(f) If an English translation is required, the haiku is translated into English at this stage.
(g) When the user corrected the phrase ‘dancing’ to ‘rising,’ the corrected phrase registered in the haiku phrase database. Then, the system morphologically analyzes the phrase and obtains ‘my heart’ and ‘rising.’ Finally, the system registers them in the learning database so that a classification named ‘heart’ relates to ‘my heart’ and ‘rising,’ and also, ‘light snow’ relates to ‘my heart’ and ‘rising.’

4.7.4 Database

In constructing the system, I prepared several databases. There are seven databases for related words: Thesaurus, Haiku thesaurus, Kigo, Idiom, Case frame, Onomatopoeia, and Learning. There are two types of haiku phrase databases. The haiku phrase database with Kigo includes Kigo and phrases, and the haiku phrase database without Kigo includes only phrases. The Thesaurus is a set of words that have similar meanings, and the Thesaurus database includes classification names and words from the Thesaurus Dictionary of the National Language Laboratory. The Thesaurus database includes about 32,000 records. For example, a classification named ‘The amount, limit’ contains ‘extreme,’ ‘culminate,’ ‘climax,’ and ‘satisfy.’

The Haiku thesaurus includes the relationships between haiku terms and the morphemes of the descriptions from a haiku dictionary. The Haiku thesaurus database is constructed with terms using the classification names and the morphemes of the descriptions as the words. This database includes about 2500 words. For example, a classification name ‘love’ contains ‘courting,’ ‘tender love,’ ‘mature love,’ ‘smothering love,’ and ‘affection.’

The Kigo determines the season of a phrase. The Kigo database includes Kigo as words and seasons as classification names. The Kigo database includes about 13,000 records. For example, a classification ‘spring climate’ contains ‘spring rain,’ ‘the first thunder of the year,’ ‘mottled snow mountain,’ ‘east wind,’ and ‘heat haze.’

Idioms are phrases that have fixed meanings. The idiom database has direction words from the Idiom dictionary as classification names, morphemes of the direction words as the words, and morphemes of the descriptions as columns. The Idiom database includes about 1300 records. For example, a classification named ‘cry’ contains ‘nearly cry,’ ‘between tears,’ ‘burst into tears,’ and ‘inner corner of one’s eyes.’

Case frames include words and related nouns or verbs. The Case frame database includes constructs of nouns and verbs in columns, using these words as the classification names. The database includes about 31,000 records. For example, a classification named ‘smile’ includes ‘you,’ ‘man,’ ‘the apple of one’s eye,’ ‘face,’ and ‘goddess.’

Onomatopoeia includes imitative words. The Onomatopoeia database uses direction words from the haiku imitative words dictionary as the classification names, with morphemes of the descriptions as the words. The Onomatopoeia database

includes about 8800 records. For example, a classification name 'Uh-uh' contains 'strain,' 'assent,' 'permit,' 'agree,' and 'a voice.'

The Learning database contains the learning data from user's castigation to the generated haiku. The Learning database has the input words as the classification names, and the morphemes of corrected phrases as the words. The number of records increases as the system learns.

The Haiku phrase database with Kigo includes about 13,000 records, and the data is from a Saijiki. The Haiku phrase database without Kigo includes about 25,000 records from the haiku thesaurus, haiku idiom, and imitative words dictionaries.

4.7.5 Discovery of Digital Haiku Aficionados

In the previous sections, I introduced a haiku composition supporting system that automatically generates a haiku from user input words by modeling the structure of Japanese haiku as an example of cultural computing.

"Hitch Haiku" was exhibited at ACM SIGGRAPH held in America in 2007. I investigated the feedback of viewers from around the world. Nowadays, blogs and media on smartphones are popular, and linguistic expressions on digital media are gathering attention. Therefore, many people were interested in the connection between haiku, as a traditional culture, and IT. I was surprised that many young people had an interest in this system, because I thought that elderly people cared more for haiku than did younger people.

Younger people were enjoying haiku not only as poems, but also with music and videos. From a different perspective, they viewed haiku as something with different grammar, structures, and relations than present blogs or e-mails. They may have felt the birth of something like "intertextuality" as described by Julia Kristeva in the combination of the text data.

4.7.6 Haiku Generation with Lasting Impressions

I aimed to develop a system based on learning by imitation, (this is the basis of Japanese culture), in this Haiku system by assuming that the right way is to imitate the structure of human thought and association during the composition of haiku. However, the system did not achieve the capability for haiku generation. To find the haiku phrases, the system searches huge databases for existing associations. To generate tasteful haiku, the system uses some rules of haiku such as associations with Kigo, Kireji, Uta-makura, and Kakari-musubi.[21] The system is now at the stage of providing haiku using chosen words and phrases into a haiku model of 5–7–5 syllables.

[21] Kakari-musubi is a special way of connecting two Japanese phrases; usually a subject phrase and a verb phrase. When connecting these two phrases one of several simple postpositional particles are used. Sometimes, however, when the author wants to emphasize a subject phrase, he/she can

We should research methods to remedy the fragility of human minds in composing haiku, for example, the feelings of 'yearning,' 'involvement,' 'playful sprit,' or 'blushing' from the perspective of cultural computing. In addition, unique Japanese feelings, language, and characteristics also need to be investigated. For example, we should research how people use words like 'Wabi-sabi',[22] 'Utsuroi'[23] or 'Okashi',[24]" in Haiku and Waka. We should also compute the use of Honka-dori,[25] which is something like 'cut and paste' in haiku, or the use of Uta-makura or Makura-kotoba,[26] which represent beauty spots, and the relation of the Kakari-musubi connection.

In its current stage, this system plays the role of an association dictionary that provides people with a more fluent vocabulary when they write. Therefore, making the usability of this system as one that widens the creativity of human vocabulary is reasonably adequate.

4.7.7 Appearance of Haiku Media

While I was selecting relevant books from a huge amount of e-books for haiku generation, I realized something. At first, I thought that I could create a system that can generate haiku similar to those by Basho that I learned in school. But when I tried to generate haiku from a book by Kepler, Plato, Minsky (a researcher of AI), Giacometti (a sculptor), and a book of craftworks by a German electro-pop musician, the generated haiku, of course, would include text that represented concepts and

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use one of the specific postpositional particles. In this case a succeeding verb phrase should be changed in specific form according to the postpositional particle. In ancient Japan such as the Heian era (ninth to twelfth century) the use of Kakari-musubi was very popular but nowadays it has mostly disappeared.

[22] Wabi-sabi is a Japanese aesthetic feeling that became apparent in the late Muromachi period and became shared by many Japanese throughout the Edo period. The thought such as "everything has to change" or "nothing is eternal" is the basis of Wabi-sabi. Based on such thought, Wabi-sabi emphasizes the beauty existing in something simple, old, small, and sometimes poor contrary to beauty in huge, gorgeous, new, and luxury objects.

[23] In Buddhism there is a basic concept that everything is not eternal, and will change and pass away. Utsuroi means the process of things to change and pass away. The basic attitude to accept Utsuroi, even to appreciate it has been the core part of the aesthetics of Japanese people.

[24] Okashi is archaic Japanese, meaning that there is a taste which deeply appeals to one's heart when one sees nature or people's behaviors surrounding him/her. The word was mainly used by women in the high court in the Heian period. The word is considered one of the representative words expressing Japanese woman's aesthetics in the old days.

[25] Honka-dori is one form of Waka composition in which an old famous Waka is treated as a reference and a part of the referred Waka is used in a newly composed Waka. By doing it, it is believed that the composed Waka would deepen its meaning and become more valuable by expanding the imagination of listeners.

[26] Makurakotoba, literally "pillow word", are a set of words or phrases used in Japanese Waka poetry, where epithets are used in association with certain words. Their usage is akin to the "grey-eyed Athena" in the Ancient Greek epics of Homer. The set phrase can be thought of as a "pillow" for the noun or verb it describes.

thoughts from these books. I was troubled over this phenomenon because these texts would prevent the generated haiku from being Japanese, or from even being sentimental, like the works of Basho. Suddenly, I noticed that it may be wrong to forcibly create haiku like the works of Basho for any book in all categories. For example, it is wrong to describe steamed egg hotchpotch molded in a pudding pan as a 'pudding.' Like that, if we generate haiku from the texts of a book by Goethe, it would not be the same as a classical haiku. It would be a haiku created using Japanese cultural computing haiku media as a compromise between the East and West.

Research of haiku media should focus on the original concept of haiku and Renga. Then, we should understand that these media are the starting point of Chanoyu,[27] and notice that the target of these media was to realize Ichiza-konryu,[28] the meaning of which is that they share several relaxed hours. Someone who is not satisfied with the current blog and Facebook interfaces may prefer new types of networked haiku-generation environments. Basho[29] is said to have liked 'love haiku' like a love letter; someone may start to compose love haiku using the love poems of Shakespeare as a source.

Research to generate movies or music that matches the generated haiku is needed for multimedia haiku research. The translation of Japanese haiku to English also needs to be more precise. Through such research, I would like to etherealize the system to generate haiku with impressive digital content that call to the depths of our memories, consciousness, and ethnicities.

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[27] Chano-yu is the Japanese tea ceremony, also called the Way of Tea. Chano-yu is one of the core parts of Japanese cultural activity involving the ceremonial preparation and presentation of Macha, powdered green tea. The sophisticated manner in which it is performed was required for noble men or high-ranked people in the Edo period. Zen Buddhism was a great influence in the development of the tea ceremony.

[28] In the tea ceremony, a master should do the best he/she can for the invited guests to enjoy and appreciate the ceremony. Also the invited guests are required to graciously enjoy the tea ceremony corresponding to the effort of the master. Then the group joining the tea ceremony can share an atmosphere that they are one united group even for a short time and can enjoy this one-time meeting in their life, which is called Ichiza-konryuu. Another well known phrase "Ichigoichie" has the same meaning.

[29] Matsuo Bashō (1644–28 November 1694) was the most famous Haiku poet of the Edo period in Japan. During his lifetime, Bashō was recognized for his works in Renga, collaboratively created continuous Waka. As Basho treated the first part of Renga independently and it became a new short poem form called Haiku, today he is recognized as the greatest master of Haiku. His poetry is internationally renowned, and in Japan many of his poems are reproduced on monuments and traditional sites.

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Chapter 5
Cultures, Subconscious and Creativity Software

5.1 Cultures from an Engineering Perspective

"While ensuring the free flow of ideas by word and image, care should be exercised that all cultures can express themselves and make themselves known. Freedom of expression, media pluralism, multilingualism, equal access to art and to scientific and technological knowledge, including in digital form, and the possibility for all cultures to have access to the means of expression and dissemination are the guarantees of cultural diversity (Hanania 2014)."

In a broad sense, but on a small scale, cultural computing has already begun in various fields (Tosa et al. 2005; Tosa 2010; Rauterberg et al. 2010; Hu et al. 2008). Through VR technology, countries with long histories such as Italy and China have created various virtual walkthroughs of their architecture that showcase their traditional culture (Gaitatzes et al. 2001; Hu et al. 2003; Ronchi 2009). These countries are now discussing the possibilities of interactions with their historical cultures at museums and international conferences worldwide.

For example, in the opening of the Beijing Olympics in summer 2008, many elements of traditional Chinese culture were exhibited at the Beijing 2008 Opening Ceremony (Cook and Miles 2010). Rendered by Zhang Yimou, the Chinese cinematographer, historical Chinese percussion instruments with 3000 year histories were played, and a huge picture scroll was projected on a special screen. Several things that represent Chinese culture were used—for example, paper used on folding fans, the stage of the Beijing opera, ink brushes, kites, and the clothes of the performers. Computers controlled the entire process. I was taken in and impressed by the power of Chinese culture created through a demonstration of their history.

N. Tosa, *Cross-Cultural Computing: An Artist's Journey*, Springer Series on Cultural Computing, DOI 10.1007/978-1-4471-6512-5_5

5.1.1 Interactive Digital Archives

Let us now explore how to connect culture and technology. Digital archive technologies digitalize and save physical and nonphysical cultural resources such as history exhibitions, and art museums, public records offices, or libraries. These are intended to preserve visual heritage, to record culture, and to create regional visual libraries or regional industrial archives. These are mostly expressed by text, sounds, pictures, and videos (Hu et al. 2003; Ronchi 2009). The Japanese Ministry of Education, Culture, Sports, Science, and Technology (MEXT) has budgeted for this, and the archive has grown enormously (Kaneko 2012). However, MEXT cannot find an effective use for the archive, and because of this, the project has been viewed with suspicion (Digital Content Association 2012).

A problem is the potential attractiveness of the digital archive. The system preserves documented information with explanations or voices and can be searched by computers. Showing an audience an archive in this way is considered not very interesting by the IT society where people use various kinds of interactive media. Interactive cultural computing that adds cultural models or stories to cultural information would increase the attractiveness of the digital archive as a system.

5.1.2 Media that Preserves Culture for Future Children

World heritage and intangible cultural assets exist all around the world. Westerners often preserve them, validate them, and pass them on to future generations, even if such processes need a lot of effort and energy. We should note that the Japanese language is easily changed and therefore it could disappear within 100 years if we are not conscious of the need to preserve it (McMahon 1994; Aitchison 2000).

Can we pass these important cultural aspects on to our children? There are computer works that feature these cultural aspects, but not many media can use the deep structures of Japanese culture in current computer technology. Many people have focused only on surface Japanese culture, and regarded the Japanese culture as a sum of superficial Japanese expressions. However, the basic structure and thought of Japanese culture is universal. By extracting this content of Japanese culture, modeling them, and making various kinds of interactive tools from them, the media content is expected to deepen, which would send the unique structure and architecture of Japanese culture to the world (Tosa 2010).

It is possible to apply such methods to the constructs of local or global media arts. Additionally, new techniques that contain Japanese and Western methods can be discovered. Cultural computing is thus expected to greatly advance media content in the future.

I felt that “Art of Zen” (Tosa et al. 2005), which I developed, contributes something new to the field of media arts. During the development process of this system, I felt like I was stumbling around in the dark. When the system was nearly complete

and I looked back at my research, I suddenly understood that this kind of system has never existed before.

When a user approaches objects like mountains or water that represent his or her own Sansui picture, icons like mountains, rivers, and the moon turned into a related vision (for example, a river is related to the Zen riddle, "Hyonen Zu"). When he or she approaches a flower, a haiku related to the flower is displayed and is read out. The associative interaction of allegories and symbols related to Sansui pictures and the trumpet played by Toshinori Kondo[1] made a deep impression on my heart, it had 'quite an impact.' It was beyond self-aware feelings or consciousness. I was wrapped in something larger, which made me remember my hometown and recall many memories. This feeling was produced by the power of analogy. Racial and historical memories have constructed analogies in allegories and symbols. I understood that this interaction of allegory and symbols expanded the association between words and images and created a story. During the exhibition, many spectators commented, "Wow! I realized that each of the interactions had its own meaning," after seeing the user's interactions.

Richard Dawkins, a biologist, said that when we are talking about the evolution of modern people, characteristics of culture are conveyed through imitation. The meme proposed by Dawkins (2006), is a metaphorical gene that acts as a unit for carrying cultural ideas, symbols or practices. He thought that meme is inherited through the exchange of thoughts or ideas among humans, from brain to brain. Conversely, present computer technologies are becoming more interactive. The Internet connects the world. Robots are becoming humanoid, enabling them to interact with people.

However, there is no cultural layer in technology yet, which is the reason why we do not feel the depth of communication, even when we are interacting with such systems or media. One of the missions of cultural computing is to insert a layer of culture that adds depth to the communications between human and computer. This research field has only just begun. The area that cultural computers affect will expand, taking in many artists, engineers, sociologists, and folklorists.

5.1.3 Cultural Infrastructure

To explore the traditional culture of a foreign country, there has been no other real way except by visiting the country and 'seeing' it as a tourist for a short time. There may be too much of a language barrier when we try to see other cultures by reading a book. At the same time, these books are written about a specific cultural condition, so people from other cultures can find it difficult to understand the culture. People say that a culture is a global entity, but it is deeply related to the mechanism of each

[1] Toshinori Kondo (born 15 December 1948) is a world famous free electric trumpeter. In addition to solo trumpet performance, he is well known for doing collaboration with artists in different areas such as painters, video artists, etc.

country's political system, so there is a national barrier, as well. Of course, this national barrier is important in preserving the uniqueness of each culture. A simplistic globalization would destroy each culture's uniqueness and, as a result, cover the entire world with a simple, 'average' culture.

Then, is it possible for each culture to be able to preserve its uniqueness, behind a national barrier, and at the same time for us to be able to truly touch these other cultures and understand them? Due to the complexity of the present age, using models of cultural anthropology and structure is not enough. Cultural computing, which views the culture from an engineering perspective, hints at the potential of new communication that will make a breakthrough towards this goal.

The engineering perspective of a culture enables us to analyze its structure and quantify it. We can dismantle what makes up the culture and see its elements. In doing this, we can discover new structures or models from the various allegories or symbols of the culture and its existing history. We can change our perspective and see new directionality by re-editing and changing the models. As this process continues, we notice that digital technologies could play an important role in creating new media. This experience allows us an easier understanding of other cultures, which were previously difficult to understand. To determine the common structures between different cultures, each culture becomes included in media that people in various cultures can access and note similarities and differences. By these methods, these media can enable us to cross national barriers and understand and appreciate other cultures, while still keeping each culture unique.

What is the purpose of this? I think that through this process we are creating a new infrastructure for a cultural layer in computer networks. This cultural layer infrastructure has the potential to perform cross-cultural translations among different cultures worldwide, which used to have difficulty in understanding each other, through cultural computing in each country.

For example, language translation software (Koehn 2010; Wilks 2009) is grammar-based, but it does not consider hidden cultural content. This is partly why computer language translation software sometimes outputs misleading text. A smoother translation would be possible by adding a cultural translation function. Not only verbal information, but also multimedia information will be able to be translated by this cultural translation method in the future.

The ways of recognition, thought, expression, and action will largely change by extracting the formats from a structure of a specific culture and utilizing them in the form of a 'model template.' A new culture would be created by first using these 'formats,' then breaking the 'formats,' and finally leaving the 'formats.' For example, the Japanese compromise between the East and West was created by the entry of American culture after World War II. However, as the Americans themselves gradually left Japan, this mixed culture remained and became a core of pop culture in present-day Japan. The exchange of different cultural information will create new cultural information using computer networks. Designing this new, culture-based media leads to cultural computing, which interactively exchanges cultural information, beyond Web 2.0 (O'Reilly 2009; Shelly and Frydenberg 2010).

5.2 What Computers Are Missing

5.2.1 Recognition of Computer Without Senses

We can feel various stimuli from our eyes, ears, nose, tongue, somatic senses, and balance senses, and we create meanings from these inputs like 'hot,' 'heavy,' and 'hard.' Above those, we can recognize and express feelings like 'happy' and 'sad' (Damasio 2005; Jenkins et al. 1996). Using these capabilities, we can also recognize external information.

Technology for recognition of the external world from input, especially voices, images, or videos, has been actively studied (Duda and Hart 1998; Rosenthal et al. 1995). As for voices, studies have advanced quickly, because the structure of a language is relatively apparent, so voice-recognition technology is already mature. Now people can generate text using voice recognition or control a car navigation system by voice (Sadun and Sande 2013), however image or video recognition are not yet very common, because of the variations in the external world. Conversely, when we have a specific application we desire to realize, many of these are established as rather concrete technology (for example, facial recognition functions are now preinstalled in new digital cameras) (Costache et al. 2006). As for emotions, I studied feeling recognition when I produced "Neuro-Baby" (Tosa et al. 1994; Tosa 1993). Since computers do not have senses I let it learn using a logical method that humans would never use. Through this process, computers have learned voice feelings as if they are symbols. However, humans need to speak by following what computers have learned to ascertain recognition rates. I spoke with the computer and felt it to be an odd conversation. I tried to understand that computers are like robots, and that I was talking to something alive. Talking with computers for a long time may be boring because the conversation does not flow well. However, technical research into feeling recognition by computers is actively being pursued. There are currently no significant advances in the field because of the uncertainty of structure and the changing appearance of feelings that depends on the situation, such as relationships or time and place.

Feelings of 'hotness' or 'heaviness' are not confusing because there are apparently corresponding information about them, such as temperature and weight. However, there has been little research about the relationship between these feelings and our basic attributes, such as our temperament. In reality, this basic information and these processes are deeply related to cultures. They have deep direct effects to our higher recognition functions. Past studies considered only higher information processing, without observing basic information processing (Pierce 1980; Stone 2015).

As basic and higher information processes are deeply related, studies of higher information alone may not be enough to clarify the mechanism of emotion of feeling. To complement past research results and approaches to properly analyzing culture, the advancement of research in this field should be accelerated.

5.2.2 *Illiterate Computers*

What is information literacy (Lanning 2012)? In an information society, it is the ability to acquire, memorize, and process information and to determine social, cultural, and philosophical situations or effects of information. In the field of acquiring information, we have made great advancements led by the development of huge clouds of knowledge databases on the Internet and progress in search technologies, like Google. In the field of memorization of information, most of our memory has been kept outside of our brain and stored in various types of computers. In reality, little advancement has been made regarding the problem of how to process information. It is true that a few research fields are developing technology like language processing, translating, or data mining, but these are only individual developments.

The main problem is that developers have explored or designed technology based on their interests without considering the 'meanings' of information (Ivers 2003). What is needed is research based on a deep consideration of human consciousness: how and why do we process information? The information that we process daily must have something to do with the common knowledge of our race and cultures. Now, let us explore how to process culture using computers.

5.3 Why Computers Must Move Towards Culture

Much research has been undertaken in the history of computer information processing, which I refer to from an engineering perspective. I want to show that computers will converge to processing cultural information.

5.3.1 *Cybernetics*

In the field of cybernetics (Wiener 1965; Ashby 2012), Gregory Bateson, who was a cultural anthropologist in his early career scientifically analyzed phenomena through relations and patterns. He propounded that we can analyze various systems in the form of messages, communications, information, and feedback (Bateson 2002). Cybernetics won great attention as a general science that included fields like communication, controlling, systems, and bionomics. It was actively researched, and the discovery of the mechanism of feedback proved to be one of the basic systems of life and was included in many systems as a basic mechanism.

However, because of the abstract definition of systems and the widened range of subjects, little advancement as an engineering study was taken after that, even though the concept was solid. Nevertheless, feedback functions were a great discovery in that they gave a great push towards advancement in technology like information engineering and control engineering.

Cybernetics and cultural computing are in some ways alike in their positions. Cultural computing will be a general science that covers many fields, including information processing. It has an attractive methodology in which computers can process cultures by importing the idea of a 'structure' of the culture. However, at the same time, researchers should constantly clarify the position of their research because cultures are a complicated phenomenon. They should not simply label it as part of the field of cultural computing.

5.3.2 AI

Research into the computing of human-level intellectual processing abilities such as reasoning, analogical inference, and judgment have been actively carried out with the aim to give computers senses. To realize human-level intellectual processing with computers is, in some way, akin to realizing human brains with a computer. This research field is called 'AI' (Russell and Norvig 2009; Warwick 2011). Initially, it seemed that research into AI would go well because there was an optimistic idea that most parts of human intellectual processes are logical and, therefore, could be programed.

It is true that the AI field partly succeeded. For example, computer chess programs have been developed and have even been able to beat a human chess grandmaster. A program named 'Expert System (Joseph and Riley 2014)' that replaces a part of a doctor's judgment with computer output by embedding the knowledge of experts was developed and put into practice.

However, AI research slowly approached its limit. Only extremely logical processes of human-level intellectual processes are easily programmable because humans have intellectual processing such as 'commonsensical judgments,' 'intuitions,' and 'emotional judgments' and they are currently impossible to compute. We cannot clearly say what process is running and why we can obtain a result.

AI researchers tried a method in which computers learned based on a database of actual human judgments. What became clear, however, is that real situations have a great deal of variation, so it was difficult to collect enough data. Moreover, there is considerable knowledge like 'commonsense' or 'culture' hidden within these situations that support the mental processes. Ultimately, AI researchers had underestimated humans. They had not noticed that real human intelligence used, in practice, a number of illogical processes such as 'intuitions,' 'commonsense,' or 'culture.' Therefore, AI researchers should be taking two different directions. One of these is to further study logical processes and slowly try to introduce the illogical processes. The other direction is to approach illogical processes such as 'emotions,' 'commonsense,' and 'intuition' directly. It is clear that these processes have a close relationship with culture. That is, cultural computing has potential to be a new research area complementing traditional AI research (Copeland 1993; Shanahan 1997).

5.3.3 *Artificial Life*

In the 1990s, artificial life was actively researched to simulate living phenomena with a computer. This research duplicates the evolutionary progress of life (Adami 1997; Levy 1993). Indeed, this ambitious research approached the field of biology from an information-processing perspective using computers. Parts of it, like the genetic program that duplicated the process of a genetic process, were greatly successful. Some results were sensational; for example, the duplication of the evolution process from unicellular to multicellular lives, or the duplication of the process in which a child slowly learns speech. Nowadays, the numbers of researchers and topics have decreased. What was the problem? I think the answer is again that researchers simplified living phenomena too much.

Living phenomena have great variety and complexity, as well as close relationships with the environments where each organism lives. It might be reckless to tackle this huge problem with a single algorithm called the 'genetic algorithm.' It is not strange that a trial to treat living phenomena only by computer simulations without more cooperation with related fields like biology, genetics, and earth sciences, would become stuck.

However, the history of artificial life suggests many points to consider when we challenge cultural computing, as in the case of cybernetics. A 'culture' is also an extremely complex phenomenon. At the same time, it is an extremely attractive area for the information-processing field. There are several research themes that remain undeveloped. ultural computing ais a growing field awith many research themes. It is important to remember that cultures are extremely complex phenomena and have close relationships with anthropology, history, and folklore.

5.4 Computing Culture

5.4.1 *Japanese Culture with Structures*

Japanese culture matches computing well because it has relatively quantifiable 'structures': models, types, templates, modes, and styles. As we can see in Gengo[2] by Miura Baien,[3] 'A pair (一対)' is not contradistinctive like positive and negative.

[2] Gengo is Baien Miura's key philosophical works. He believed that behind every natural object and natural phenomenon there is 'Jori,' that gives groundings for the existence of these objects and phenomena. The concept Jori is similar to the western concept of logic. Based on this he had some conscious method for philosophy like modern western philosophers, he called it 'Hankan-gouitzu'. According to the Jori principle he thought that we should observe natural objects from the point of pair-relations. Every object can be considered to be one side of a pair-relation, for example [water-fire] or [heaven-earth]. He insisted that we cannot recognize any essence of beings without understanding this pair-relation.

[3] Baien Miura (1 September 1723–9 April 1789) was a Japanese philosopher of the Tokugawa era. Most Japanese thinkers and philosophers tried to follow philosophies established by old Chinese

What is characteristic of Gengo is that two things complement each other to be one, like yin and yang, or the ground and the figure. Omote-senke (表千家)[4] and ura-senke (裏千家),[5] duty and sentiment are also examples of 'a pair.'

After two comparative values are formed, they are classified by types like 'method (式),' 'rating (格),' 'flow (流),' and 'wind (風).' Haiku has styles of Basho (芭蕉)[6] or Buson (蕪村),[7] and a template of 5, 7, and 5 figures. Under the classification of 'types,' there are stereotype, prototype, archetype, and so on. The prototype of a haiku is bahu (芭風: Basho style), which was made by Basho. Renga (連歌)[8] is the archetype haiku. Similarly, models, templates, types, and styles bring great advancement to human recognition, thoughts, expressions, and actions. Humans remember important things associatively as forms of structures, and these have been traditionally passed down.

Models are similar to matrices. Templates are similar to molds, types to forms, modes to modalities, and styles are similar to tastes. According to Matsuoka Seigou, a Japanese cultural researcher, structures in Japan are derived from katashiro (形代).[9] Seigou says they had been important for the Japanese as being something

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philosophers such as Confucius, Laozi, Zhuanguzi, etc., whose teachings focus on the way of living, the way of thinking, etc. and had no interest in analyzing objects or phenomenon surrounding people. On the other hand Baien Miura was interested in the basic structure of the nature surrounding people.

[4] Omotesenke (表千家 "front Sen house/family") is the name of one of the three houses or families (家) that count their family founder as Sen Rikyū and are dedicated to carrying forward the Way of Tea developed by him. The other two are Urasenke and Mushakōjisenke. As Sen Rikyū is highly respected as a founder of the Way of Tea in Japan, these three families still keep their strong influence in Japanese society today.

[5] See footnote 4.

[6] Matsuo Bashō (1644–28 November 1694) was the most famous Haiku poet of the Edo period in Japan. During his lifetime, Bashō was recognized for his works in Renga. As Basho treated the first part of Renga independently and it became a new short poem form called Haiku, today he is recognized as the greatest master of Haiku. His poetry is internationally renowned, and in Japan many of his poems are reproduced on monuments and traditional sites.

[7] Yosa Buson (1716–January 17, 1784) was a Japanese poet and painter of the Edo period. Along with Matsuo Bashō and Kobayashi Issa, Buson is considered among the greatest poets of the Edo Period. Buson was born in a village near Osaka. Around the age of 20, Buson moved to Edo (now Tokyo) and learned poetry under the Haikai master Hayano Hajin. After Hajin died, Buson moved to Shimōsa Province near Edo. Following in the footsteps of his idol, Matsuo Bashō, Buson traveled through the wilds of northern Japan. He published his notes from the trip in 1744.

[8] Renga (collaborative poetry) is a genre of Japanese collaborative poetry. The origin of Renga is Waka which consists of five phrases containing 5, 7, 5, 7, 7 Japanese syllables respectively. Based on Waka in late Heian period new type of collaborative Waka composition (called Renga) became popular. First form of Renga is Waka composition by two persons; former 5, 7, 5 syllables by one person and latter 7, 7 syllables by another. Then the form was extended so that following a Waka another Waka was created by different two persons and so on.
The opening 5, 7, 5 syllables of a Renga, called the Hokku, became the basis for the modern Haiku form of poetry.

[9] Katashiro is a physical object used as an emblem of the presence of a spirit in the rites of worship. The term also refers to an object representing the human figure, used in rites of purification to represent the subject of the rite, in which case the subject rubs the object on his body or blows

synonymous with the gods. Aratama (荒魂) and nigitama (和魂)[10] is a paired concept that gods in Shinto Buddhism share. In Japan, there are some paired concepts that represent separate worlds. For example, this world and the other world (彼岸此岸), time and space, heaven and hell, ten'en chi'hou (the round sky and the square earth), utsu and utsutsu (absence and existence), godai (the five elements) and gogyo (Wu Xing), the spiritual and physical views of the world, and so on.

The are some pairs of concepts about places, for example, achi (there) and kochi (here), shime (しめ) and yui (ゆい), daigoku (大極) and choudou (朝堂), East and West jodo (浄土), yamato (大和) and kawachi (河内), a bad place (that is, hell) and a good place (heaven), omoya (main house) and hanare (guest house), azumaya (kiosk) and yorozuya (general store), etc.

For spirits, some pairs are material and ghost, miare (royal birth) and iware (reason), raigyuo (reception by Amitabha) and Kangyo (God's return to the shrine), yugen (spiritual beauty) and meihaku (clarity), kibutsuchinshi (writing feelings in comparison with something) and seijutsushinsho (writing feelings directly), suki (tasteful spirit) and mujo (absence of absolutes), marriage and divorce (縁結 and 縁切り), yuso and mujo (有惜 and 無常), sacred and profane (ハレ and ケ: sacred–profane dichotomy), asobi (play) and susabi (abandon), and so on.

For symbols, there are Iemoto (master) and ryuha (team), sights and magnificent scenes, kamon (family emblem) and monsho (coat of arms), katado-ru (assuming the figure of something) and kizasu (to show signs of), nari (appearance) and furi (action), vairocana and acala, and so on.

Regarding trinities, there are motenasi (hospitality), shitsurai (room conditioning), and furumai (action), sin-gyo-so (regular, semicursive, and cursive scripts), jo-ha-kyu (slow, break and fast), Gautama Buddha, Amitabha, and Maitreya, yo (look) and shiki (method), and fu (like), yorishiro (God's spirit) and katashiro (the replacement of God) and yashiro (shrine), and so on.

These 'structures' strongly affect one's sense of recognition, literacy, and expressions. Application of these structures may enable us to create a 'media of Japanese culture' on the computer, beyond superficial Japanese-content media art.

It is possible to create an interface with the media of Japanese culture, extracting the 'structures'—the basic elements like art structure, the figure of a spirit, the style of beauty—in Japanese culture with computers. By making the interface a tool for digital expression, editing or constructing the interactive system will be supported.

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breath upon it, thus transferring transgressions and pollutions to the object, which is later cast into a river or another body of water. Katashiro were also used when casting spells or curses. Most Katashiro seen today are made of paper, but in the past they were also made of gold, silver, iron, wood, rice straw or miscanthus reeds.

[10] In Japanese Shinto, Kami (god or spirit) has two faces. The aratama is the rough and violent side of a spirit. A Kami's first appearance is as an Aratama, which must be pacified with appropriate pacification rites and worship so that the Nigitama can appear. The Nigitama is the normal state of the Kami, its functional side, while the Aratama appears in times of war or natural disasters.

Fragile Japanese feelings, like aware (あはれ),[11] wabi-sabi,[12] and utsuroi (うつろい),[13] will be modeled and turned into interfaces.

By extracting and computing basic structures that comprise Noh or Kabuki culture, we can create an interactive system that has reasonable plots to be used in stories. These 'media of Japanese culture' are expected to be used in media-creation abroad and in museum events, movies, and international expositions, as well as inside the Japanese cultural region. They enable us to create Japanese culture models that affect the world.

5.4.2 A Deeply Asian View of the Uncovered World

A foundation of Japanese culture resides in Japanese poems, also known as Waka.[14] Japanese poems starting at Man'yoshu (万葉集)[15] were written in kanji. Though they have the appearance of classical Chinese, they were written with a Japanese word order. There are various Waka styles: Waka written in ideographical Kanji; Waka written in phonographic Kanji; Waka with both ideographical and phonographic kanji; and Waka with no character expression.

However, kana characters had not yet been invented when these Waka were edited, so the poems used their unique notation, called Manyo-kana (万葉仮名).[16] Poets tried to write Japanese poetry using phonographic kanji, without using any

[11] Mono no Aware is a Japanese aesthetic feeling that frequently appears in Japanese literature in the Heian period (794–1185). Direct translation of Mono no Aware is deep and sentimental feeling when looking at or listening to something. In the Heian period based on Buddhism's teaching about the end of the world, such thoughts as "everything has to change" or "nothing is eternal" became common. The feeling of Mono no Aware is tightly connected to such a thought.

[12] Wabi-sabi is a Japanese aesthetic feeling that became apparent in the late Muromachi period and became shared by many Japanese throughout the Edo period. The thought such as "everything has to change" or "nothing is eternal" is the basis of Wabi-sabi. Based on such thought, Wabi-sabi emphasizes the beauty existing in something simple, old, small, and sometimes poor contrary to beauty in huge, gorgeous, new, and luxury objects.

[13] In Buddhism there is a basic concept that everything is not eternal, and will change and pass away. Utsuroi means the process of things to change and pass away. The basic attitude to accept Utsuroi, even to appreciate it has been core part of aesthetics of Japanese people.

[14] Waka (literally, "Japanese poem") is a type of poetry in classical Japanese literature. In contrast to the Chinese style of poetry that is composed using only Chinese characters and are called Kanshi, Waka consists of 5 phrases each of which involves 5, 7, 5, 7, 7 Japanese syllables respectively.

[15] Man'yōshū is the oldest existing collection of Japanese poetry, compiled sometime during the Nara period. The anthology is one of the most revered of Japan's poetic compilations. The compiler is today widely believed to be Ōtomo no Yakamochi. The collection contains more than 4500 poems whose composers range from Emperor, noblemen to soldiers staying far away at the front, ordinary people, etc. Therefore the names of many of the poem composers are unknown.

[16] It is believed that until Kanji (Chinese characters) were introduced from China, that the Japanese culture did not have characters. When Kanji was imported from China around third century, firstly the pronunciation of each Kanji was linked to adequate Japanese syllables to express it. Then it

ideographic parts. In this sense, Manyo-kana are the first Japanese characters created by the Japanese, although they had used kanji already.

All characters that had been invented in ancient civilizations were ideographs. Hieroglyphs and sphenograms have been long disused, but kanji are still being used. Kanji have historical memories in themselves. Their worth is their cultural heritage, which is deeply rooted in Asia. Ideographs work best when they can easily be associated with sound; this relationship between sound and image is one of the reasons why kanji has persisted in Japan for such a long time.

Kanji characters originated from geometrical, cultural backgrounds. The shape and structure of ideographical Kanji characters are based on these cultural statuses. According to several books by Shizuka Sirakawa (2007, 2012), the character '文' (letter) meant a tattoo at first. '文' is an ideograph that represents a human with a tattoo on his chest. This means this character has a cultural and historical background, which was formed in a region where people were tattooed. Customs related to the tattoo are widely spread among Pacific races, especially among Eastern Asian races. Kanji are also analogies that collect human associations, which can help us understand the Asian culture. Then, what about Western analogies?

5.4.3 Western Visual Analogies

Contemporary Western analogies derived from ideographs are, for example, desktop metaphors of a PC, various icons of the Internet, and operation icons of Microsoft Office. For future computing of memory recall, we can use analogies that have existed since the age of Plato. An analogy is a link between two different things. By analogizing two different things as a predicate, we can connect them. Moreover, we can represent the figures with them. These are the characteristics of analogies.

The visual rhetoric of art will obtain richer expressions in intermedia by treating these analogies as the subject of recognition computing. We can obtain deeper understandingof nonverbal signals by using this method in fields like image recognition, which processes and recognizes visible objects with a computer. We can understand that cultural information is formed by crossing from the worldwide study of brains and consciousness to informatics and cultural fields.

Gottfried Wilhelm Leibniz would have noticed that his "art of combinations (Dascal 2008)," in which experiences were represented as ideographs, was required for analogies in this era of instant searches. Leibniz's Monad, which is the substance of something—or subject in the context of subject-verb, in other words—is pioneering a visual language tool that helps us find what words or images are appropriate in a given context, or what the best combination of words is to discover a meaning. If you want to know the data format of computers or the method to edit data, you

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became possible for Japanese sentences to be described as a series of Kanji characters. These Kanji characters are called Manyo-kana.

should learn from the "art of combinations" of Leibniz. In Japan, there is a similar system named 'Gengo' (玄語) in which Baien wrote down his dichotomy of phenomena based on yin and yang, I-Ching, and Confucianism, in the spirit of hankan-goitsu (反観合一), which combines two complementary phenomena (Fig. 5.1).

Ideographic kanji characters that are used in 'Gengo' by Baien can be analogies to deepen our imagination and thinking. The predicative property of analogies have relations with Leibniz's Monad and have the potential to realize parallel processing, which processes both global and local information. We can add visual analogies of cultural information to global communication by using this method. Minor media and intellectual content will add to their potential contexts and depth with current digital information. We should know how Westerners have seen Japan in history before we design this tool.

5.4.4 Western View of Japan

Many foreigners say that the word 'Japan' is likened to concepts like video games, manga, and anime. Also they say that, without the contribution of Japan, computer games would not be like the current stage (Aoyama and Izushi 2003).

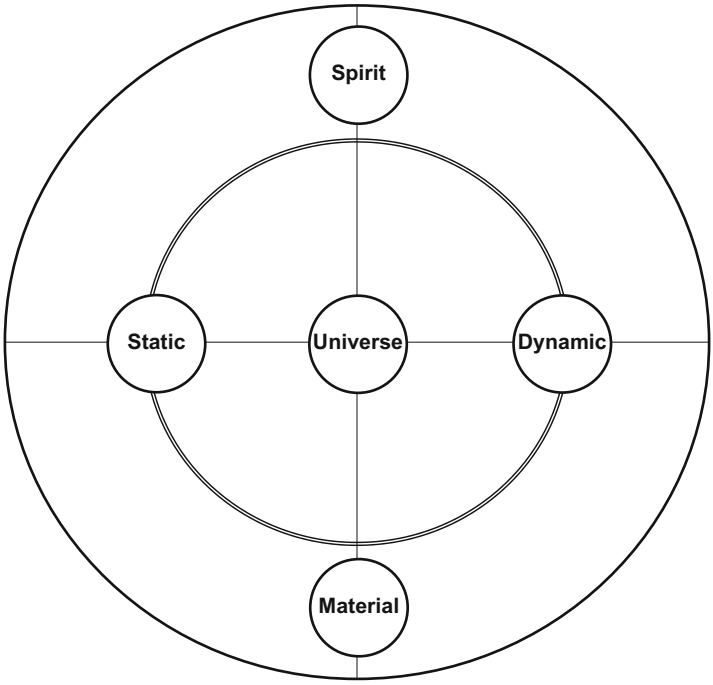

Fig. 5.1 One example of "Hankan-Goitsu" figures

Japonisms won great popularity in Europe triggered by an international exhibition held in Paris in 1867, when Japan participated for the first time. Japonism was a long-standing movement that had continued for more than 30 years in the advanced countries, and was seen as a big movement similar to the Renaissance. Though the sense of beauty was clearly different, French impressionists in the latter half of the nineteenth century assimilated the Japanese Ukiyo-e (Harris 2011; Calza and Carpenter 2007), which had been painted by artists like Katsushika Hokusai,[17] and Kitagawa Utamaro.[18] Artists empathized with the asymmetry that contributed to the blankness of Ukiyo-e and with the Japanese spirituality that existed under fresh composition and bright colors. For example, Vincent van Gogh longed for the clear, bright coloring of Japanese art, and tried to use it in his paintings. He wrote that he recollected Japan's warm beauty with the idea that they could see a small flower on the ground if they wanted to paint a flower.

Monet pointed out that the chromatic sensations of impressionists were changing to the Japanese ones, which were based on the nature-view of Ukiyo-e. Monet said that he himself was influenced by the nature-view of Utagawa Hiroshige[19] in painting landscapes. He bought a large piece of land, and constructed a garden, in order to paint the landscape, and hired many outdoor workmen and made them build a Japanese arched bridge on the pond. Monet's great work "Bridge over a Pond of Water Lilies" was made there in his later years. They say its horizontally long composition was influenced by the effect of Japanese picture scrolls or the Japanese wind wall picture.

The American philosopher and Orientalist Ernest Fenollosa (Pound and Fenollosa 1979; Fenollosa 1999), whose work focused on Japanese art history that had played an important role in Japanese culture, highly evaluated Buddhist pictures from the Heian era that were abandoned when the Haibutsu Kishaku[20] movements occurred in the early Meiji era, Yamato-e (Japanese pictures) from the

[17] Katsushika Hokusai (31 October 1760–10 May 10 1849) was a Japanese artist, Ukiyo-e painter and printmaker of the late Edo period. Born in Edo (now Tokyo), Hokusai is best known as the author of the woodblock print series Thirty-six Views of Mount Fuji (Fugaku Sanjūroku-kei, 1831), The Great Wave off Kanagawa, created during the 1820s and others.

[18] Kitagawa Utamaro (1753–October 31, 1806) was a Japanese printmaker and painter, who is considered one of the greatest artists of woodblock prints (Ukiyo-e). He is known especially for his masterfully composed studies of women, known as Bijinga. He also produced nature studies, particularly illustrated books of insects. His work reached Europe in the mid-nineteenth century and became very popular, especially in France. He influenced the European Impressionists, particularly with his use of partial views and his emphasis on light and shade.

[19] Hirosige (1797–12 October 1858) was a Japanese Ukiyo-e artist, and one of the last great artists in that tradition. Legend has it that Hiroshige determined to become a Ukiyo-e artist when he saw the prints of Hokusai. From then to Hokusai's death in 1849, they were rival Ukiyo-e artists.

[20] Haibutsu Kishaku (廃仏毀釈) is a movement against Buddhism that occurred in the early Meiji period. Haibutsu means destroying Buddha statues and Kishaku means throwing away the Buddhism principle. Along with the power shift from Shogun to Emperor, there was a tendency to respect Shinto (Japanese original religion) and to dismiss Buddhism. Because of this for a while in Japan there was a movement to destroy Buddhism temples, statues, etc. During that period many valuable Buddhist heritage artefacts were broken or exported to foreign countries.

Kamakura era, and ink and wash paintings from the Muromachi era. He introduced the value of Japanese arts to the wider world. Tenshin Okakura (Bharucha 2009),[21] who helped the Americans put the Japanese art collection into the Boston museum, followed Fenollosa, and the value of Japanese culture rose within the country. Japanese culture has since become popular in foreign countries.

Today, Japanese manga and cartoon animations are very popular even outside of Japan. I would like to call this 'present-day Japonism.' The Damier Canvas and Monogram Canvas by Louis Vuitton were affected by the Japanese gothic taste, Art Nouveau, and Ichimatsu (check design) or Kamon (family emblem) designs.[22]

5.5 Visual Analogies of Kanji Connect the World

In Japonism, Westerners were influenced by the natural freshness and feelings hidden behind their artistic logic, which overcame many problems. Not only Japanese cartoon animations and manga, but also Kanji as a visual letter sparks images within our brain. We associate a Kanji character with both the word that it means and images within our brain related to its ideographic characteristic (Nakamura et al. 2000). We can visually understand the broad meanings of a Japanese sentence from kanji and kana at a glance, showing that we visually understand the kanji, and that we autonomously recall the kana or alphabet. In fact, we sometimes notice that we remember kanji with its 'shape,' which shows that kanji has visual analogies.

There had been ideographic images within the brain from the time of Egyptian hieroglyphs and sphenograms in Babylon. However, those became phonograms used by other systems of language. Ancient Egyptian characters also turned into an alphabet; 'A' means A. 'A' is not 'B.' This phonogram is the starting point of Western logistics that classify phenomena. Westerners constructed Polis in the Greek era, formed Nomos (rules) and Oikous (house communities) and lived with a strong literacy that can be called left-brained. Most Westerners have considered that the function of the right side of the brain is only for artistic activities. However, I think Westerners are also looking back, based on the above-mentioned present-day Japonism. I have noticed that recently behaviors of Westerners and Japanese are becoming similar. For example, Westerners used to say that a person with a camera

[21] Tenshin Okakura (26 December 1863–2 September 1913) was a Japanese scholar who contributed to the development of arts in Japan. Outside of Japan, he is chiefly remembered as the author of "The Book of Tea." Although his original name was Kakuzo Okakura, in Japan he is well known by his poet name: Tenshin Okakura. He was invited to the Museum of Fine Arts, Boston in 1904 and became the first head of the Asian art division in 1910. He is also known as one of the founders of the Tokyo University of the Arts.

[22] Kamon or Mon are Japanese emblems used to decorate and identify an individual or family. While Mon is used to refer to either an individual or family, Kamon refers specifically to emblems used to identify a family. Kamon and Mon are similar to the badges and coats of arms in European heraldic tradition, which likewise are used to identify individuals and families.

at a sightseeing spot should be a Japanese. However recently I meet many Westerners who take pictures with as little hesitation as the Japanese. What is this?

One of the answers might be that emotions or feelings, which have not been well evaluated in Western culture since the Greek-era have now moved beyond Western individualism and are becoming the basis of Westerners' ways of thinking and behaving. The trigger might be technology. Technology brings about our innate nostalgia. Technology as we think of it now is as old as the invention of telephones or movies in the nineteenth century. Westerners listened to moral voices, watched the impressive images of movies, and unconsciously started to think back. I guess that we can deduce that telephones and movies have something to do with the relation between phonographic and ideographic characters.

Foreigners nowadays learn kanji by using their PC's translation function to translate roman letters to Kanji. In reality, this operation is the change from the phonogram to the ideograph. Kanji, which is a visual language, has both images within our brains like movies and the logic of phonograms. While we compare Kanji and Manyo-kana sentences in Man'yoshu, the impression is largely different. Kana give us a feeling of voice, and Kanji give us a visual impression. Kanji includes plenty of culture in their background. Neighboring icons have fused into a word with a new sense, and imaginations move ahead.

Torahiko Terada says in his book that the changes in movie scenes and connections of parts of Renku are alike because they are unconsciously connected (Terada 1996). To make this connection universal, we should use the ideographic and logical aspects of kanji.

The following statement is only my supposition as to the relation between cultures and computers, but we can create a universal interface that connects local and global parts of the world, by connecting early Kanji characters that show the construction of Kanji and Western metaphors or visual analogies as described above. There is no software to collect all of the chaotic information on the Internet, which is a huge accumulation system of images, icons, and texts. We have not obtained a key to the analogies that connect this information. However, the key is the cultural accumulation of ideographical images within our brains over history. These images have possibilities as analogies that connect Western and Eastern people using computer software, by stimulating their subconscious.

What is important in communication between different cultures using a computer is to make it interactive. To realize deeper communication, we should compose cultural interactivity within software, while acknowledging how Westerners think of Japan.

The Islamic and Asian view of the world will come under review because global capitalism—the control of the global market by capitalist countries led by America—magnifies the negative aspects of wars and capital economics across the globe. We need to communicate globally without losing our underlying ethnicity. We cannot take our culture off as if it were clothing. The true value of cultural computing is to create media to properly represent these cultures to each other.

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