INTERCULTURAL COMMUNICATION

By integrating various media technologies into our everyday lives, we have created a communication sphere on a global scale. On the other hand, we are beginning to sense a danger that the more we rely on technology, the shallower our one-on-one communication becomes. In this situation, a new communications medium that will convey depth of personal feeling is rapidly becoming necessary.

Human communication is fostered in environments of regional communities and cultures and in different languages. Cultures are rooted in their unique histories. Communication media such as writing, music and film have developed to circulate these cultural characteristics [1]. Now, as the computing society spreads across the planet, computers must enable local and global cultures to communicate clearly and accurately. To that end, it is also necessary for those involved in computer technology to bring to life within the medium of computers local cultural ways of thinking.

In the research in intercultural communication from the perspective of engineering, there has been only one experiment in intercultural collaboration via machine translation [2]. This experiment found machine translation to be effective in cross-cultural collaborative research and development. Also, research into system design using an agent for intercultural communication in cyberspace [3] has produced a very interesting finding: that users' level of intimacy rises and communication becomes smoother if the agent breaks cultural taboos. For example, the use of slang words tends to elicit emotional response from users.

The above research is practical as a means of identifying characteristics latent in intercultural communication. However, in the extraction of these universal aspects, local communication aspects must be ignored in the process. Deep communication may actually be included in local cultural memories and symbols, but technological research into its expression and communication methods has yet to be pursued.

For intercultural communication research, in order to pursue local ethnic methods of expression and communication, and with backgrounds in editorial engineering [4] and art and technology [5] as a foundation, we researched methods for integrating nonverbal information such as feelings, symbols and allegories with verbal information. In addition, because it is necessary to guide the user through a story-based narrative interaction, we decided to pursue the possibilities of digital storytelling [6].

In the traditional relationship between culture and computers, advances have been made in the recording of decaying traditional cultures in digital archives [7], restoration of artifacts and computer graphics simulations recreating lost ruins [8]. In order to create a system that can reproduce the cultural stories that lie within us, we decided to research a method for interactively expressing the previously unquantifiable essential characteristics of culture within peo-

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ple—for example, subjectivity, feeling, emotion and cultural personality—by integrating nonverbal and verbal information. Furthermore, we produced a storytelling method reflecting differences of emotion, consciousness and memory indispensable in the future communication abilities of computers.

As intercultural communication is a very broad field, in order to produce a specific example, one must pick up a single historic and cultural image and use that as a basis for building a real system. In this case, we chose Zen, one of the paths of Buddhism, and developed ZENetic Computer, a system in which people can virtually experience Zen culture.

The ZENetic Computer Artistic Concept

ZENetic Computer was developed as a specific example of intercultural communication. We focused on the roots of our native Japanese culture, including Buddhism, kanji, waka (Japanese short poetry) and haiku [9]. We decided to focus especially on the unique communication space and imaging method created by Zen and sansui (landscape) ink painting.

A user of ZENetic Computer experiences the following scenario. First, the user builds a three-dimensional sansui ink painting on the display using an intuitive and easy-to-use interface, constructing her own virtual space.

The images used in this interface express the conceptions of nature and philosophy that characterize the history of Japanese Zen Buddhism, providing the user with a dramatic experience very different from the images of modern life [10]. Thus, in the introduction, the system brings about a kind of awakening within the user and encourages her unconscious imagination.

Next, as 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 to the user, drawing her through the display and into this alternate world.

In the story we include mechanisms meant to stimulate the user’s consciousness developed from haiku and Zen riddles (koan). The story built from these elements is not a complete linear story like those found in movies or novels, but rather a nonlinear collection of short story fragments. A user who experiences these inconclusive story fragments feels a kind of uncertainty and holds an expectation and desire to connect these fragments and build a complete story. Because of this desire, the user may feel some hesitancy in being asked questions without a “correct” answer, but she cannot help but try to answer these questions.

Through several such compelling events, the user connects these stories and builds her own unique narrative. Next, as 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 voice, the door to the realization of her consciousness begins to open further. As the user’s desire to connect the story fragments mixes with the system’s user interface, the distance between her everyday self and true, hidden self begins to shrink.

Main interaction plays an important role in the process of fusing these two selves. Ma is a very Japanese concept; it entails an emphasis on ephemeral events—the here-and-now within every experience.

Having thus traveled through several stages and scenes, at the end of the trip the user converses with a bull, an interaction used in Zen as a metaphor for expressing one’s true self. Through this dialogue, the user can experience a process through which the everyday self and the subconscious self fuse together and bring about a unified self-consciousness.

As the environment surrounding the system plays a very important role in the user’s experience, we decided to create an Eastern atmosphere for the ZENetic
THE FLOW OF THE STORY EXPERIENCE WITHIN SANSEI SPACE

The user walks through a story as follows (Fig. 1).
1. Generation of a sansui painting:
   The user selects a 2D hieroglyphic icon and drags it onto a virtual canvas. The 2D icon then changes into a 3D sansui object (Fig. 2). When the user finishes the sansui painting and selects the “Navigation” icon on the screen, the user can enter into his or her own 3D sansui picture using the 3D compass interface (Fig. 3).
2. Generation of haiku based on sansui icon composition: Each 2D hieroglyphic icon is associated with a haiku or Zen dialogue with a similar or related meaning. A haiku is generated according to how the 2D icon is selected and composed.
3. When the user approaches objects in the sansui painting, one of four associated Zen dialogues appears. For example, when the user approaches a river, the computer recognizes the meaning “water,” and the Zen dialogue “The Catfish and Gourd” appears.
4. Depending on which of the dialogues is generated, a form matching the user’s personality is assigned one of the following four Japanese cultural forms:
   - Kisei: comparative design
   - Mitate: choice and metaphor
   - Awaase: design in pairs
   - Sore: design based on sets

   Depending on the results of all the user’s Zen dialogue interactions, a Yuzen kimono pattern [1] is then selected.
5. In conclusion, a “Ten Ox Story” (10 steps leading to enlightenment) corresponding to the user’s interactions is displayed.

GENERATION OF THE SANSEI PAINTING

Composition of 2D Hieroglyphic Characters

We divided sansui painting into 12 hieroglyphic characters (rock, mountain, moon, traveler, bridge, bird, tree, flower, wise man, cloud and water) and prepared 2D icons symbolizing each of them. Hieroglyphic characters are a precursor of kanji. These icons are the basic material of sansui painting. Each 2D icon is connected to a 3D computer-graphics object. When the user drags any 2D icon and constructs a personalized 3D sansui painting, a 3D pixel map is overlaid onto that position. Figure 2 is an example of a user-constructed sansui painting.

Sansei Perspective in Sansui Painting

As can be seen in the sansui painting in Fig. 4, there is a unique perspective scheme in sansui paintings called sanseii. There are three perspectives within a sansui picture: koen, far away and viewed from below; heien, viewed straight on; and shinen, near and viewed from above. Depending on the position of the user’s icons, graphics corresponding to the sanseii area are displayed, increasing the realism of the user-created sansui painting. Each icon is categorized as koen, heien or shinen. Figure 5 shows part of a computer-recognized sanseii composition and distance within 3D space.

Generation of Haiku and Zen Dialogue from the Layout of the Sansui Icons

When the user finishes creating the sansui painting, she can walk through the 3D sansui space she created by operating a 3D compass in the rock garden interface.
As the user approaches any sansui painting icon within the space, a haiku poem or Zen dialogue is output based on the combination of sansui painting icons contained in the framed display, as shown in Table 1. Figure 6 shows the framing of the “mountain” and “moon” icons, as well as a generated haiku example.

**Interaction Using a Buddhist Human Recognition Model**

Buddhism, which has been followed for over 1,400 years, has developed a method of interaction between master and pupil for creating deep understanding between people. We applied part of this method as an interactive model for the system. Interaction based on such a deep understanding is an area not yet researched by Western science.

**Sansui World Expression Based on the Godai Model**

In Buddhism, the directions and the godai, or five elements (sky, water, fire, wind and earth) that compose the world, are closely related. As the user explores the sansui world, changes in the weather based on the godai occur depending on the direction of movement. For example, if one goes north, it snows (connoting earth); south, thunder appears (fire); cast, fog appears (wind); and west, it rains (water).

**Classification of User Personality**

Buddhist thought holds that five basic physical and mental elements, or goun, make up the world; in this interactive system, we apply these elements in the classification of personality. The five personality categories are as follows:

- **色 (Siki)**—One’s personality focuses on nature and materials that actually exist
- **受 (Jyu)**—One’s personality focuses on intuitive impression
- **想 (Sai)**—A focus on perceived visual images
- **行 (Gyou)**—A process of mind that activates behavior
- **識 (Shiki)**—A deep spiritual function reaching beyond the above processes

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<table>
<thead>
<tr>
<th>Table 2. Relationships between symbols, sanen perspective and goun.</th>
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</thead>
<tbody>
<tr>
<td><strong>Icon</strong></td>
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<tr>
<td>----------</td>
</tr>
<tr>
<td>Rock</td>
</tr>
<tr>
<td>Mountain</td>
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<tr>
<td>Moon</td>
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The 2D goun space is made up of 10 areas, with the above values along the vertical axis and their strength (positive or negative) along the horizontal axis. When the user generates a sansui landscape according to her preferences, the system classifies the user's individuality through the assignment of goun categories to the icons that make up the landscape (Table 2). Through this process, the user's individuality is expressed as a goun value, and its initial value is determined based on the above categories (Table 3).

**Zen Dialogue Interactions**

When the user approaches a certain object within the sansui painting, a Zen event occurs. Every event is constructed such that one can have an interactive virtual experience with a Zen koan. The User, Target and Zen Master agents exist within each interaction, and the content of the interaction changes based on their interrelationships.

For example, the koan “Dharma Anjin” (Fig. 7) is a dialogue in which, when a pupil complains, “Even after training, my inner spirit is still troubled,” Dharma replies, “Then show me your troubled

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**Table 3. Responses to Zen dialogue questions within goun space for each interaction.**

<table>
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<tr>
<th>Interaction</th>
<th>Goun Input to Target Chaos</th>
<th>Output from User Agent</th>
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</table>
| Dialogue: “The Catfish and the Gourd” | Change goun depending on part of catfish touched
Touch the head → rise (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                |
| 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; Kiso: sou; Soroe: gyou; Awasase: yu, siki | Kimono design is displayed based on Japanese cultural forms awase, kiso, soroe and mitate. |
| Ten Ox Story Finding the Ox | Change target based on the distance between first two points drawn (eyes)
Far apart → rise (toward shiki+)
Close together → fall (toward shiki–) | None |
| Ten Ox Story Catching the Ox | Change target based on how user pulls rope
Pull moderately → goun value rises
Pull strongly → goun value falls | Ox animation changes
Ox sound changes |
Zen *enso* (circle) is best. Also, in "The Lotus Smiles," the goun state rises with accuracy in matching images of Noh theater masks. Table 3 shows the rules used for the chaos model and how the system is affected (i.e. the chaos states changed) by the output data.

Finally, depending on the goun result of previous Zen dialogues, a Japanese cultural form represented by a kimono pattern is selected. The patterns are selected based on Japanese aesthetic categories: Mitate: shiki; Kiso: sou; Soroe: gyou; Awaso: jyu and siki, according to *Yuzen* kimono patterns (Fig. 10).

**EVALUATION AND FUTURE PROSPECTS**

In order to see if this system would be accepted by those versed in Buddhism, we had a Tibetan monk and other Buddhists use the system. Receiving an invitation to exhibit our work at Koto-ji Zen Temple in Kyoto, we accepted an opportunity for a month-long exhibition at the temple in May 2004. The same year, the project was selected for the ACM SIGGRAPH Emerging Technologies exhibition and received recognition as new digital content. Also in 2004, *ZENetic Computer* received second place in the UNESCO Nabi Digital Storytelling Competition "Intangible Heritage" [13].

As the processing power of computers, high-quality displays and input devices approach the limits of human perception, we expect that high technology will enter the spiritual domain. As seen from the West, Japanese Zen is an old and mysterious philosophy. Indeed, although there are books such as *Zen for Dummies*, one would be hard pressed to say that it is possible to understand Zen by reading alone. *ZENetic Computer* tries to convey the spirit of Japanese culture through experiences such as participation in Zen dialogues, exposure to haiku and exploration of kimono patterns. Intercultural understanding is more than just two-way cross-cultural communication.

In the future, there will likely be a strong demand for the conception and design of cultural computing that boldly makes this kind of cross-cultural connection. Everything in this research project was planned with this intent, and for its realization we used leading-edge game design, graphics and interactive displays. It is said that virtual reality would be an appropriate technology for expressing this content. If technology that can subtly express feelings were joined with VR technology, this combination would be
even more effective. We are certain that the methods used in ZENetic Computer will flourish in the broad field of education and will make experiential intercultural understanding possible.

References
2. K. Lobster et al., “Helper Agent: Designing Assis-
4. Editorial engineering is a method of improving various processes by editing. It derives from editing representative forms of editing, or editorial forms. It then applies these forms to various activities, such as work, play and adventure. S. Matsuoka, *Editorial Engineering of Knowledge* (Tokyo: Asahi Shinbunsha, 2001).
10. S. Matsuoka, *Sansui Thought* (Tokyo: Gogatsu-
shobo, 2003).
11. Yuzen dyeing was established about 300 years ago, when hand-painted patterns were transferred to silk fabrics for the first time in Japan. Yuzen dyeing en-
abled fabrics to be dyed in refreshingly variegated colors.
12. This technology is used for laser control. For ex-
ample, individual synchronization of chaos in a pair of lasers is executed by adjusting the optical fre-
quencies for injection locking between the corre-

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