
Tele Echo Tube: beyond Cultural and Imaginable Boundaries

Hill Hiroki Kobayashi

Project Assistant Professor
Center for Spatial Information Science,
The University of Tokyo, Japan
kobayashi@csis.u-tokyo.ac.jp

Kaoru Saito

Professor
Graduate School of Frontier Sciences,
The University of Tokyo, Japan
kaoru@nenv.k.u-tokyo.ac.jp

Akio Fujiwara

Assistant Professor
Graduate School of Agricultural and Life Sciences,
The University of Tokyo, Japan
akio@uf.a.u-tokyo.ac.jp

Abstract

Tele Echo Tube (TET) is a speaking tube installation that acoustically interacts with a deep mountain echo through the slightly vibrating lampshade like interface. TET allows users to interact with the mountain echo in real time through an augmented echo sounding experience with the vibration over satellite data network. This novel interactive system can create an imaginable presence of the mythological creature in the undeveloped natural locations beyond our cultural and imaginable boundaries.

Author Keywords

HCBI (Human-Computer-Biosphere Interaction), Nature Interface, Sustainability, Sustainable Design

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous. See:

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Introduction



Figure 1. Tele Echo Tube (TET, island version) beyond Cultural and Imaginable Boundaries. ARTECH Exhibition in National Museum of Emerging Science and Innovation 2009 @ Hill Hiroki Kobayashi

Tele Echo Tube (TET), shown in **Figure 1**, is a speaking tube that acoustically interacts with a deep mountain echo through the slightly vibrating lampshade like interface. It is based on the HCBI concept described [1], which is an extension of human-computer interaction (HCI) and human-computer-pet interaction (HCPI) [2]. TET allows users to interact with the mountain echo in real time through an augmented echo sounding experience with the vibration over satellite network, experiencing a distant mountain forest soundscape in immersive and ambient ways even in the midst of a modern city as shown in **Figure 1**



Figure 2. Mr. Yamabiko, ECHO in Japanese mythology. Left: "Yamabiko" in a collection of pictures "Hyakkai-Zukan" [4]. Right: The Illustrated Night Parade of A Hundred Demons [5] Natural communities contain a spectrum of life forms that interact with each other. Many scientists agree with the judgment that the essence of ecology is the study of interactions among species in their native habitat [3]. Moreover, in Japanese mythology, it was believed that there are many *Yokai* (妖怪 *literally demon, spirit, or monster*). ECHO, Mountain Nymph in Greek mythology) living with other animals in the mountain forest environment. Japanese folklorists and historians mention *Yokai* as "supernatural or unaccountable phenomena to their informants" because *yōkai* generally have a sort of spiritual or supernatural powers. In 1737, Sawaki Suushi, a Japanese artist in Edo Period Japanese published a picture of a monster called "Mr. Yamabiko" in a collection of pictures "Hyakkai-Zukan" [4] as shown in **Figure 2**. This is a well-known *Yokai* who creates mountain echo. Based on this Cultural and Imaginable metaphors, TET creates cultural collaboration with "Mr. Yamabiko" and provides echo sounding experience to users in an imaginable way. TET aims to increase the mythological awareness in a traditional Japanese way of Human Computer Interaction.

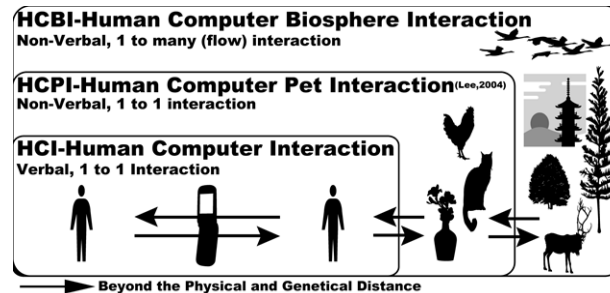


Figure 3. Human-computer-biosphere interaction (HCBI) concept, an extension of HCI and HCPI. © 2008 Hiroki Kobayashi, Ryoko Uueoka

Concept Overview

The field of computer-supported cooperative work (CSCW) is based on such computer-interaction paradigms to support specific activities. For instance, we exchange our ideas, thoughts, theories, and messages by encoding them into transferable words, communicating them through computer systems, and decoding them. However, in our daily lives, we implicitly exchange and share a great deal of additional non-verbal information, such as the presence and moods of others, to maintain our social relationships [6]. The consideration of implicit (background) information opens up new possibilities for interaction through non-linguistic, ubiquitous forms and non-verbal, remote communication among different species. HCPI, as described in **Figure 3**, is a novel type of physical interaction paradigm that proposes to create symbiosis between humans and pets through a computer and the Internet as a new form of media. "Botanicals"[7] was developed to provide a new way for plants and people to interact in order to develop better, longer-lasting relationships that go beyond physical and genetic

distance [7]. Thus, computer systems become a medium to express telepresence among different species in the biosphere through their non-linguistic expression as perceived and understood by individuals, violating the rules of linguistic science [8].

However, no matter how advanced the technologies are, these are human-centric interactions. We expect some perceivable feedback from others in response to our command before we end an interaction. On the contrary, in our daily lives, there are many non-human-centric interactions. The sounds of singing birds, buzzing insects, swaying leaves, and trickling water in a beautiful forest implicitly imprint the beauty of nature in our minds. When we are emotionally stressed, recalling the beauty of nature can help us recover a sense of well-being. The crucial factor is not the means of conveyance (words or language), but "something" hovering around, or an atmosphere that we cannot exactly identify. This type of Non-human-centric interaction is reflected in the semiotic theories of Jakob von Uexküll [9]. Von Uexküll established the concept of Umwelt, from the German word meaning "environment" or "surrounding world," and suggested that all animals, from the simplest to the most complex, fit into their unique worlds with equal completeness. A simple world corresponds to a simple animal, a well-articulated world to a complex one. Jakob von Uexküll stated that relations between subject and object are the "biological foundations that lie at the very epicenter of the study of both communication and signification in the human [and non-human] animal" [9]. This relationship is illustrated in the functional cycle diagram presented in Figure 4.

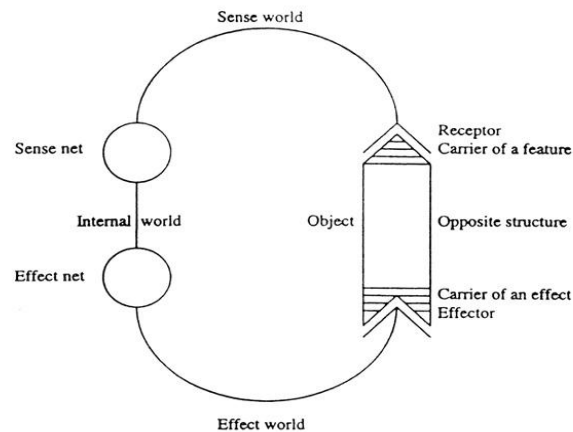


Figure 4. Functional cycle from von Uexküll's Umwelt theory

The authors propose TET (mountain version) which extends the subject of interaction from countable objects, pets, and plants to their surrounding environment, which is an uncountable, complex, non-linguistic, "something" surrounding, much like mythological elements in the Japanese case.

In previous studies, the author developed a Wearable Forest system[10] and the first version of TET (island version) in **Figure 5** by which users are able to feel a sense of belonging to a sub-tropical forest on Iriomote Island, Japan from Los Angeles, USA, Vancouver, Canada and Mexico City[11,12], Mexico over 10000 km distance in real time. This system, TET (mountain version), presents the possibility of more spatial interaction: remote interaction with a mountain echo located 1,200 m above sea level through a communication satellite at 36,000 km above sea level as a global-scale HCI with cultural emphasis.



Figure 5. TET (Island Version) remote system placed in an uninhabited subtropical forest on Iriomote Island, Japan (24°41'90.57"N,123°78'72.47"E). (note: the chair is not a part of this art work)

Tele Echo Tube: Description

TET (mountain version) also consists of local and remote speaking tube systems in Figure 3 with one-way echo canceller through a full duplex audio I/O system over the globe in **Figure 5**.

The remote and local systems perform a remote interaction to create an echo sounding and experience with "Mr. Yamabiko" (ECHO, Mountain Nymph in Greek mythology) in **Figure 2** through its live sound pipe through the satellite networked internet. The remote system, shown in **Figure 5** is placed in an uninhabited mountain forest on Chichibu University Forest, The University of Tokyo in Japan (35°56'17.28"N, 138°48'11.04"E, 150 km from Tokyo). The songs of small birds, the trickling of a stream, and the sounds of insects moving about in the mountain forest represent of the arrival of spring on the mountain area in **Figure 6**. However, in those remote areas, such as the home



Figure 6. TET (Mountain Version) placed in Cyber Forest project site, located 1,200 m above sea, The University of Tokyo Forests, Japan (35°56'17.28"N, 138°48'11.04"E).

range of the "Mr. Yamabiko", the availability of electric power and information infrastructures for monitoring wild animals is either limited or nonexistent. This is primarily because the profitability generated by infrastructure-based services is usually low in areas such as sanctuary forest where the number of users is small in **Figure 7**. Thus, it was necessary to develop methods that make TET happen while using the fewest possible resources.

The environmental sound and video in the mountain forest has been recorded and monitored by a landscape monitoring system since year 1995. In addition, the real-time sound and video archives have been broadcasted through an Internet website as "Cyber Forest Project" The University of Tokyo's website Cyberforest[13], for 365 days since year 2009. The real-time streaming system has been improved several



Figure 7. The home range of the "Mr. Yamabiko" in Cyber Forest project site.

times to achieve long-period stability under unmanned operating conditions.

The remote system, shown in **Figure 5** is placed in an uninhabited mountain forest at the Cyber Forest Project site. Networked microphones and speakers were placed to create the echo sounding experience for 24 hours in 365 days. The weatherproof microphone consists of a non-directional microphone wrapped by a sheet of thick waterproof sponge and a plastic hard mesh. The joint part of the microphone and an audio cable connector is shielded by waterproof putty and tape to protect it from outside moisture. The microphone is tied on a trunk of a tower in **Figure 8**.

An A/D device converts the analog audio signal of the microphone (speaker) to digital audio signal, and transfers the signal to Audio Processing System with extremely low noises. The digital signal cable can be



Figure 8. Audio system, Weatherproof digital camera and solar panels placed in Cyber Forest project site

extended up to 10 kilometers without any digital distortion. Next, the digital audio signal is connected to the audio processing system. This audio signal is digitally processed to enhance its quality by remotely controlled real time audio processing software. The processed audio signal is sent to the en-recording system, encoded into MP3 live stream, and recorded as WAVE sound format files. The MP3 live stream is sent to a stream server at the Data Archive System directly through the Internet. The MP3 live stream is played on various MP3 based audio software at different locations in all around the world simultaneously. The storage/analysis system stores WAVE sound format files which are sent from an audio encoding/recording system into its storage system: It is capable to store audio files which are recorded continuously for several decades.

Data Communication System provides a satellite based internal computer network in the audio



Figure 9. Data Communication System: Satellite internet dish, solar panels, and control house in Cyber Forest project site

digitizing/streaming/recording system, and also provides Internet accessibility to/from the system. Thus, all systems are remotely controllable through Internet. Furthermore, a remotely placed monitoring system keeps track of all the system information through SYSLOG and SNMP software continuously. This management capability allows us to keep monitoring all the system information, from the input level on the microphone to data traffic delay on the Internet connection over the satellite from Data Communication System in **Figure 9**. The system continuously captures and transfers the live soundscape to a local system over the Internet within several seconds.

The local speaking tube system consists of networked microphones, speakers with a vibrator, and echo canceller as described in **Figure 10**. An embedded CPU system receives the live soundscape data from the remote mountain the satellite network, immediately performs echo cancelling on the sound signal, and

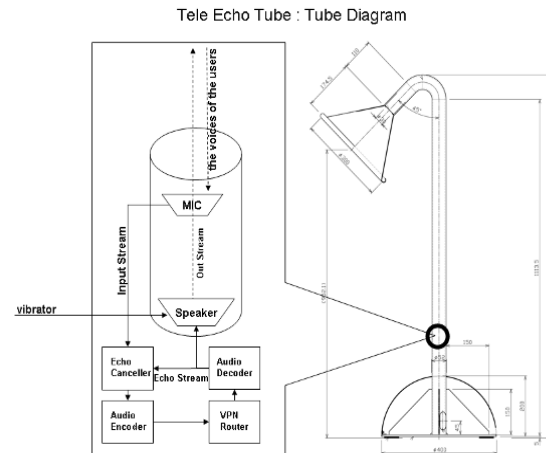


Figure 10. TET System Diagram. Using Speex1.3 C Library (1.2 beta2) and ALSA driver (1.0.4) with CCRMA Linux

sends it back to the remote side immediately in **Figure 11**. TET (mountain version) runs on a full-duplex audio pipe over the Internet and uses an echo cancelling process for preventing the audio feedback in the loop.

To interact with the “Mr. Yamabiko”, users can sing out “YO-HOOOOO!” very lively from the local speaking tube to the speakers on the mountain on the remote site, as described in **Figure 12**. The loopback call at the remote host occurs because the playback sound from the speaker is captured and transferred to the user by the remote host with spontaneous network delay. When the users hear the loopback call, “their voices within the soundscape” from the mountain with the slight vibration by their hands through the interface in **Figure 13-14**, they recognize that the initial voices did actually travel through the mountain environment. This echo-sounding loop, which transfers live sounds

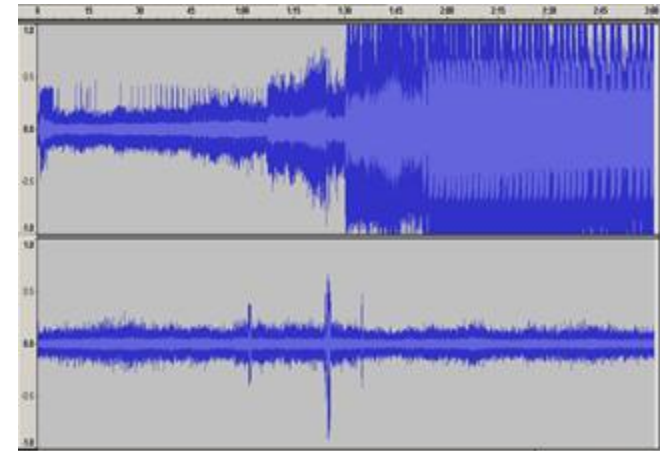


Figure 11. Result of echo cancelling process on Amplitude vs time period. TOP: Mic feedback occurs without echo cancelling. Bottom: Mic feedback did not occurs with echo cancelling.

bidirectionally from the remote and local sites, creates an echo sounding effect, and in doing so, gives the user the opportunity to interact with the presence of “a fickle ECHO” on the deep mountain remotely.

Those acoustic interactions indicate the non-linguistic believability in a form of mythological metaphor of the mountain echo. This echo-like experience of believable interaction in augmented reality between a human and gave the users an imaginable presence of “Mr. Yamabiko” with high degree of excitement in the country and overseas in **Figure 13-14**.

Tele Echo Tube: Discussions

Tele Echo Tube (TET), shown in **Figure 1**, is a speaking tube that acoustically interacts with a deep mountain echo through the slightly vibrating lampshade like interface. It allows users to interact with “a

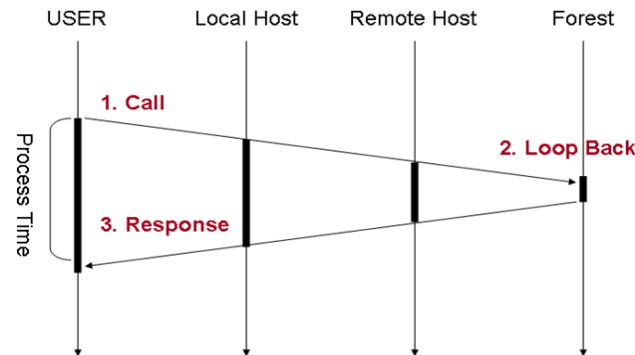


Figure 12. TET (island and mountain version) Diagram of non-verbal Interaction between user and echo @ 2009 Hiroki Kobayashi

mountain ECHO" in a deep mountain forest in real time through an augmented echo sounding experience beyond Cultural and Imaginable Boundaries.

Before human beings became capable of leveling mountains with heavy construction vehicles, Japanese farmers prayed to gods in seasonal festivals for the weather conditions needed to ensure successful crop production and the general population was taught to respect the gods that resided in and protected the mountains. The sounds of singing birds, buzzing insects, swaying leaves, and trickling water in a mountain forest implicitly imprint the presence of nature in our cultural way. When we are away from the mountain, recalling the memory of a mountain takes us back to the same place. The crucial factor here is not the means of conveyance (words or language), but the "something" that hovers around; an atmosphere that we cannot identify exactly but that lasts beyond Cultural and Imaginable Boundaries.



Figure 13. TET (mountain version) , Selected Work for BASAL Exhibition, Museo Universitario de Arte Contemporáneo (MUAC), Mexico, (2010)@ [11,12]

Recent technological and information advancements, including satellite imaging, have been unable to confirm the presence of mythological creatures in undeveloped natural locations, and very few humans now believe in the existence of gods that control weather or other farming conditions. However, because we no longer embrace the presence of such cultural and imaginable metaphors in our daily lives, especially in city life, there has been little outcry at the severe deforestation brought about by the urbanization process.

Contribution to CHI community

Kobayashi initially introduced the concept of HCBI at HCI venues discussing environmental sustainability in 2009 [1]. The theory, method, and evaluation of human and wildlife interaction were not discussed in detail because the research was not sufficiently well developed. However, the future direction of HCBI has been suggested by several researchers. In 2010, DiSalvo et al. stated [14] that HCBI points out the inherent contradiction in attempting to use technology

to create more intimate connections with nature and Pereira et al. cited HCBI as an example of sustainable computing [15]. Giannachi [16] stated that HCBI clothing, for example the Wearable Forest system [10], facilitates the creation of a human-computer environment that enables new forms of communication. Interestingly, Mancini explored animal-computer interaction that aims to foster the relationship between humans and animals by enabling communication and promoting understanding between them and emphasized that the study of interactions between animals and computing technology has never entered the mainstream of computer science [17]. Mancini also organized CHI 2012 and hosted a Special Interest Group on Animal-Computing “non-human centric” Interaction at CHI 2012. As mentioned previously, the missing factors that would facilitate more robust studies of interactions between animals and computing technology are not knowledge or technologies. The missing factor is an interface that can facilitate human interaction with remote and the environment in a manner similar to the interactions with pets and their surrounding environment at home.

Conclusions

Recent technological and information advancements, including satellite imaging, have been unable to confirm the presence of mythological creatures. Tele Echo Tube (TET) aims to increase the mythological awareness in the midst of a modern city beyond our cultural and imaginable boundaries. It is a speaking tube installation that acoustically interacts with a deep mountain ECHO through a networked remote-controlled speaker and microphone. It allows users to interact with the ECHO in a sanctuary forest in real time through an augmented echo sounding experience. In doing so, this



Figure 14. TET (Island Version) The remote system placed in an uninhabited subtropical forest on Iriomote Island, Japan (24°41'90.57"N,123°78'72.47"E). (*note: the chair is not a part of this art work*)

novel interactive system can create an imaginable presence of the mythological creature in undeveloped natural locations.

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