

# Intermirror : Mirror-Mediated Remote Affective Communication System

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## Abstract

This paper is focused on the Intermirror system that provides remote affective communication service mediated by an integrative device of digital display and mirror. Mirror has been a typical image reflection tool familiar to humans since pre-historic age. Intermirror provides an affective interface that could not be dealt with by text or other image based communication systems and this can be done through a simple and effective image representation mechanism of a mirror. In other words, Intermirror enables the conformity of the line of vision, image reappearance out of a rectangular frame and the picturing function to maintain a communication session. This paper suggests a novel futuristic way of affective communication mediated by mirror as an indispensable ubiquitous device in our everyday life.

**Keywords:** Telepresence, Video Conference, Ubiquitous Devices, Remote Communication

## 1. Introduction

Mirror is an old device reemerging image through physically reflecting light that hits its surface. It is a very simple but effective tool for reflecting one's own image or to sense the actions or appearances of others.

In fairy tales, mirror shows the past and future, reflects the image of a remote person, and emerges a dead person's face. Especially, in Snow White, mirror provides the function of communication with a human-

being through dialogue. This metaphor of dialogue with mirror illustrates the possibility of using it as a multimedia communicative mean among people by extending its original function. This conceptual exploration makes it possible to provide affective communication among people through using digital technology and mirror as an image reappearance tool that is familiar to humans from the distant past.

In this research, we propose a mirror-based physical interface and the Intermirror system that provides a new remote affective communication service through this interface (see Figure 1). Intermirror is equipped with visual components such as mirror, LCD display, camera as well as audio components including microphone and speaker for bi-directional telecommunication operations. Intermirror is designed to reveal the sense of space between the communication partners in the same fashion as actually talking through the mirror and this design solution reinforces the togetherness between the dialogue partners so that it enables affective communication based on the enhanced familiarity.

This paper consists of the following chapters: Chapter 2 describes the differences between the studies that are related to the image-based communication and the one described this research. Chapter 3 explains how to construct the Intermirror system and its affective interface, the way to establishing a sense of physical space between the dialogue partners through the conformity of the line of vision mediated by the mirror,

an atypical image, and the diversified visual experience reinforced by the display device. Finally, Chapter 4 concludes this study and suggests future direction.



Fig. 1 Intermirror: Affective communication system through a digitally augmented mirror

## 2. Related Works

Currently text-based chatting system such as MSN Messenger™ developed by Microsoft™ or Yahoo Messenger™ have been commercially successful and are being used as universal tools for dialogue this Internet age[1]. These products continuously added image related functions in accordance with the performance upgrades of PC's. Graphically representing communication partners using buddy icons or web-cam based video conferencing function are among these additions.

Nevertheless, these image transmission methods are supplementary means of the text-based communications, therefore, they are not the integrative image/voice oriented communication method that is investigated in this research. In terms of inputs and outputs, existing methods provide computerized communication means deprived of emotional aspect of human-being by simply using separated I/O devices such as monitor, camera, and keyboards. At the same time, the images of conversation partners separately positioned in the two windows do not provide natural communication channel in terms of user interface design.

Reflexion [2] at MIT Media Lab Europe is an interpersonal video communication system that overlaps the images of multiple people on one screen. This

system adopts the way of stressing the video images of the communication partners through analyzing audio signal transmissions in and out.

HyperMirror [3] projects multiple camera captured faces other than the self image on one screen based on allied multiple cameras.

## 3. Intermirror

### 3.1 System Architecture

Intermirror is a client–server based system that enables real mirror mediated affective video-audio communication with remote partners (see Figure 2). Each client provides video I/O functions by using mirror, LCD display, and camera. In other words, a user can see his/her own appearance reflected on the surface of a mirror and also can see the video output sent by the remote camera, transmitted to the client, and visualized through LCD display at another corner of the mirror. In this manner, the user could experience a natural interface that allows undifferentiated images between the remote partner and the self through a single mirror. Voice conversation also is provided through separately installed microphone and speakers.

Server provides the search function for locating available clients, selecting clients who want to communicate, and controls the connection between the two communication partners. In the future, Intermirror server will be extended to become a repository that contains various pieces of data including video clips and would provide multimedia service beyond a mere audio-visual communication tool.

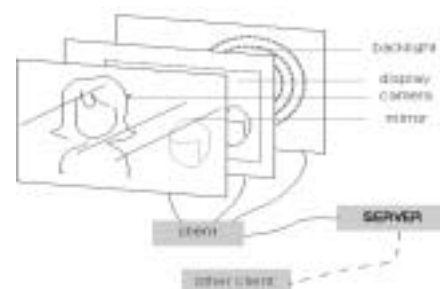


Fig. 2 Intermirror's system structure

### 3.2 Affective Interfaces

The following interface has been devised to maximize the transfer of the sense of closeness and the emotional state of the user who is using the Intermirror system.

#### Conformity of the line of vision through mirror

Conformity of the line of vision during conversation is a very effective way of delivering emotion. Mirror can easily provide this effect because of its dualism for seeing and being seen. Camera captures image centered on the user's line of vision by installing the camera at the point where the line of vision converges behind the half mirror. Then this image is sent to the remote client and is displayed at the converging point of the line of vision of the remote partner in a natural manner without being intruded by the camera. The communication partners can experience a face-to-face type conversation even though they are in remotely separated locations.

#### Establishing a sense of space through displays

Current image-based video conferencing systems place images on the same surface level of the monitor without differentiating subjects from objects. In other words, it is difficult to differentiate remote dialogue partner(s) from ourselves with this type of system (see Figure 3).

Intermirror is designed to present the user's image on the surface of the mirror and reveals the sense of physical space between the dialogue partners by placing the display of the other party's image farther back from the mirror surface. This allows to overcome the flatness that the existing monitor systems have. Adding depth to avoid the monotonous flatness is especially required to the communication system supported by the computers.

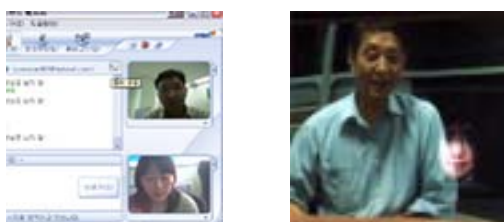


Fig. 3 MSN™ vs. Intermirror

#### Operation based on an irregular image frame

Image reappearances mediated by existing devices such as TV, monitor, or projector can only provide confined image within rectangular frames. To the contrary, human visual cognition is not necessarily confined within such rectangular frames. In other words interesting portion of an image is normally stressed while less interesting part would simply be remaining in the memory as a faint and abstract impression.

Intermirror eradicates rectangular frame in reemerging image to imitate such cognitive capability of humans and to extend affective context as is in a real face-to-face conversation. For this purpose, LCD display backlight is separated from the display itself to vary image reappearance scope and intensity according to the position and brightness of the backlight. The position and brightness of the backlight can currently be controlled through the button placed on either mirror or table but will be automated based on the image segmentation and image interpretation techniques in the future so that the system can naturally be adapted to the various contexts.

#### Processing and Archival of visual data

Intermirror system not only provides an affective communication channel but also enables processing and archiving of various visual data based on information technology. Currently adopted such functions include self-image archive similar to self-camera concept or the archive of remote partner image by controlling the remote camera as is done in real-life situation where two people take pictures of each other using their cameras. The stored visual data can later be reemerged as still images or video clips.

This functionality is usual in the sense that it could lead more natural facial expression of the remote partner while maintaining communication through using such a familiar device as mirror. It is an effective tool for recording the content of communication facilitated by

information technology. In addition to those, it also can derive a new tele-presence experience and can exchange various human senses through remote picture shooting assisted by the network environment.

#### **4. Conclusion**

Existing video communication means utilized in the dialogue style messenger services have weakness in acquiring emotion exchanges by simply showing images of the participating people. In this research, we propose Intermirror as a video –audio communication tool for remote affective communication service based on mirror as a commonly familiar and universal visual interface to humans. Intermirror uses such devices that existing audio-video communication method uses as camera, microphone, and display, but is designed to emphasize the sense of face-to-face conversation between remotely located two people by changing its way of displaying visual data. Furthermore, it provides diversified affective interfaces to accommodate real world conversation paradigm while adding useful functions facilitated by information technology.

Future extended research will include the development of visual expression and processing techniques to enhance image expression and display methods through the proposed mirror as a medium. Continuous research of a novel interactive interface using mirror is also required.

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