

# Development of Cellphone-type Tele-operated Android

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## ABSTRACT

This paper presents a newly developed portable human-like robotic avatar “Elfoid” which can be a novel communication medium in that a user can talk with another person in a remote location in such a way that they feel each other’s presence. It is designed to convey individuals’ presence using voice, human-like appearance, and touch. Thanks to its cellphone capability, it can be used at anytime, anywhere. The paper describes the design concept of Elfoid and argues research issues on this communication medium.

## Author Keywords

Communication media; minimal design; human’s presence.

## ACM Classification Keywords

H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

## General Terms

Human Factors; Design.

## INTRODUCTION

Current advanced technologies of communication media allow us to connect with distant people in various modalities. The progress of the communication technologies may reflect people’s aspiration to have natural communication (like face-to-face talk) with distant people. The current communication media rely on visual and sound information; however, more human-like interface is expected to bring more natural communication.

One approach to make a natural tele-communication is to convey individuals’ presence to remote locations. If people can feel each other’s presence in the tele-communications, they can talk in a face-to-face-like manner. One idea is to endow communication media with a human-like shape. The android “Geminoid” [1] is one of such a medium, which



Figure 1. The prototype of cellphone-type tele-operated android “Elfoid”

closely resembles an actual person and can reproduce person’s speech and motions. It works as a robotic communication medium by operating it from a remote place. The important finding in this study is that a person operating Geminoid feels its body is his/her own body and another person facing the operated Geminoid also feels it is possessed by the operator, that is, the operator’s presence can be transferred. However, Geminoid is not an easy-to-use medium like cellphones because of less portability. A portable (cellphone-size) Geminoid is desirable, but it is hard to implement a realistic human-like shape, numbers of actuators to provide human-like motions, and various sensors in a small body. A minimal design of the shape and motions to convey human’s presence is necessary to develop a portable presence-transmitting medium.

The tele-operated android “Telenoid” has been developed based on the minimal design of humans [2]. It has a simplified human shape, holdable body, several actuators to express some human-like gestural motions. Ogawa et al. [2] have reported that people prefer communication with Telenoid rather than cellphones. Based on the same concept, we have developed “Elfoid” (Figure 1) as a portable tele-operated android. It has also simplified human shape and is designed to transfer a speaker’s voice (and motions in the future) using the cellphone networks and talk to other person in the fashion shown in Figure 1.

Some studies have tried to transmit individuals’ presence using tele-operated robots (e.g., [3]). Our study differs from the existing studies in that we focus on exploring minimum requirements to transmit individuals’ presence.

## THE CONCEPT OF THE DEVELOPMENT OF ELFOID

The concept of Elfoid is that anyone can transfer his/her presence to a remote place at anytime, anywhere.

### *Anytime, anywhere*

A small 3G cellphone unit is embedded (Figure 2), and people can talk with other people in remote places in the same

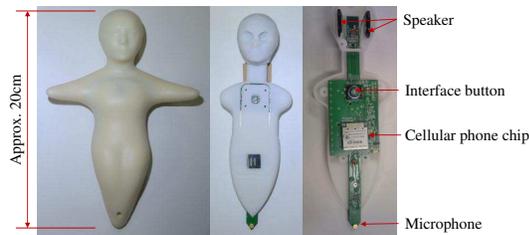


Figure 2. The details of internal mechanism

manner as cellphones. The prototype can register one telephone number in the memory, and users can call the number by pushing a button on the chest of Elfoid. Elfoid also has own telephone number and can receive a phone call.

#### Anyone

The shape is designed as easily recognizable at first glance to be nothing but a human, capable of being interpreted equally as male or female, old or young, that is, neutral human shape. The completely symmetrical face provides neutral gender. Mixing the child-like body proportion with the adult-like face proportion results in age-free appearance. These features enable it to be an avatar of anyone, differing from Geminoid which closely resembles the original person.

#### Transferring individuals' presence

Ogawa et al. [2] have reported that the holdability of Telenoid contributes conveyance of individuals' presence (that is, physical (tactile) interaction with the communication media is important) through the experiments with Telenoid. Elfoid has soft, pleasant-to-touch exterior and transfers individuals' presence not only by voice and human-like appearance but human-like tactile impression.

## RESEARCH ISSUES

### System development

The first prototype of Elfoid shown in Figure 2 does not have actuators. It is difficult to embed numbers of actuators due to its small size; therefore, the future work needs to explore the minimum degrees of freedom of motion to transfer individuals' presence. The alternative way to express the speaker's (operator's) motion in Elfoid is to use light, sound, and vibration. We are trying to produce visual illusory motion of Elfoid by blinking a number of LED embedded in the body.

When people use Elfoid in the manner of right figure in Figure 1, Elfoid of the speaker-side needs sensors to measure the speaker's motion in order to express his/her motion in Elfoid of the listener-side. The first prototype does not have sensors, and the future work explores which sensors is necessary to transfer human's presence.

### System evaluation

Elfoid is designed to transfer human's presence, and we need to verify that it can actually transfer the presence through experiments. Here, an important issue is to establish a method to evaluate whether users feel other's presence or not. The future work explores a measurement of presence based on

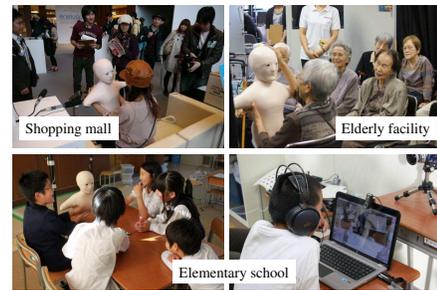


Figure 3. The example scenes of experiments with Telenoid

the user's behaviors, brain activities, and physiological responses. We will test that the user can feel the speaker's presence in Elfoid while exploring essential factors or minimum requirements to transmit human's presence.

We will also try to reveal the impact of Elfoid by investigating how people adapt the communication with Elfoid and how people's communication style is changed by Elfoid through social experiments. This study uses Telenoid as well as Elfoid, whose design is similar to Elfoid. Our research group already have conducted experiments to evaluate people's impression on Telenoid and people's adaptation to Telenoid in shopping malls, facilities for the elderly, and elementary schools [2] (Figure 3). These experiments have revealed that people quickly adapt conversation with Telenoid and are impressed by its shape and tactile feeling, and same results are expected on Elfoid.

## CONCLUSION

This paper presented a novel robotic communication medium "Elfoid" which provides new communication style in which a user can talk with another person while feeling each other's presence. The developmental concept of Elfoid and its prototype were shown and research issues on Elfoid were discussed. It can be a powerful communication tool beyond the existing cellphones. For example, aged persons can intimately connect with their children or grandchildren living in distant places by using Elfoid, and it is supposed to provide a sense of ease in their daily life. We will have a demonstration of Elfoid at the poster session.

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