Wearing Another's Personality: A Human-Surrogate System with a Telepresence Face

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ABSTRACT
ChameleonMask is a telepresence system that displays a remote user's face on another user's face. Whereas most telepresence systems are designed to provide the remote user with an existence via a teleoperated robot, the system uses a real human as a surrogate for the remote user. This is accomplished by the surrogate user wearing a mask-shaped display that shows the remote user's live face, and a voice channel transmitting the remote user's voice. The surrogate user mimics the remote user by following the remote user's directions. In initial experiments conducted, the surrogate tended to be regarded as the actual person (i.e., the remote user). We implemented applications the remote user gives the surrogate directions visually. We conducted user studies to determine how the remote user felt about giving directions to the surrogate and how the surrogate felt to be the body of the director. In the studies conducted, the director had the confidence to go outside with ChameleonMask and the surrogate tended to fulfill the director's requests and felt positive about being the surrogate.

Author Keywords
telepresence; augmented human; wearable system;

ACM Classification Keywords
H.5.3. Group and Organization Interfaces: Computer-supported cooperative work

INTRODUCTION
"If I had another body, I could go there." When we are heavily occupied with matters or have an uncontrollable urge to go somewhere, we often wish we had another body. Constrained by time and location, it is impossible to travel to another place anytime, anywhere. Therefore, teleconference systems are used in many companies. However, teleconference systems are usually installed in a room; consequently, in such scenarios, a remote user can only communicate with people in a fixed space. Many studies have been conducted with the objective of overcoming these limitations and accomplishing a sense of "being there." Autonomous robots[9] are telepresence systems that allow remote users to freely travel around an objective place by teleoperating the system. These systems display a human face on their screens and replace wheels with legs, which replicates the remote user's presence and mobility in a distant location. Autonomous robots have shown promise for use in many scenarios. For example, some companies have introduced these systems into their offices[1], and more researchers are using these systems at academic conferences[2]. These systems produce satisfaction and a feeling of physical presence. In addition, local users also have a more realistic sensation of the remote user's presence when an autonomous robot is used [17].

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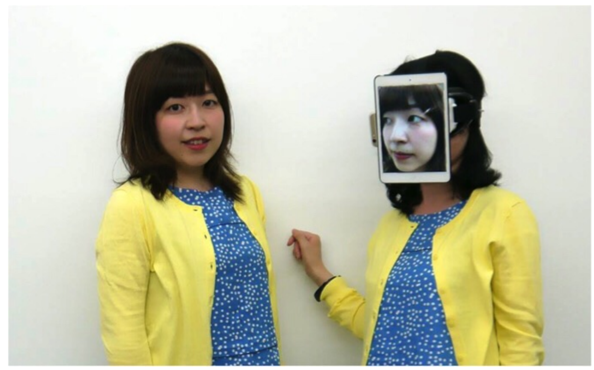

Figure 1. The remote user aquires his/her surrogate wearing ChameleonMask.

However, these systems are still imperfect. Substituting physical human existence in the real world is difficult, and many limitations exist: 1) A difference in appearance influences human communication [18]; however, in conventional systems, the physical appearance of the system and that of the remote user do not correspond. For example, although the system's height may be adjustable, in order to maintain its stability, the machine is often smaller than the user. 2) A mobile telepresence robot's volume control system must be adjusted to the environment [5]. For example, when a remote user asked a presenter a question, the robot's voice was too low, requiring

[1]Double robot, http://www.doublerobotics.com/business/

[2]Should I Attend a Conference Via a Telepresence Robot?, http://spectrum.ieee.org/automaton/robotics/industrial-robots/attending-conference-via-telepresence-robot

the staff to repeat the remote user's question instead. Another user reported a volume level that was too loud owing to a lack of available volume adjustment. 3) Even though a system is "autonomous," it may still need human help every time a problem occurs. Rae et al. [17] stated that tasks with high mobility requirements reduced the system's performance. In this scenario, special support is necessary in order to improve task performance. Furthermore, controlling these robots in a remote place is difficult. Autonomous robots frequently encounter obstacles on the floor or stairs. As a result, the system does not blend well into local environments. If multiple people simultaneously used autonomous robots, even large spaces would become crowded.

In order to address these problems, we propose a system called ChameleonMask that a surrogate human utilizes to embody a remote user's physical and social telepresence (Figure 1). Many telepresence systems use autonomous robots, or robots that behave like humans. By contrast, we propose the use of an actual human.

In this paper, we introduce our concept and system design. The main goal of this system is to have the surrogate regarded as the director. However, there are some remaining issues to be clarified beforehand: How do people react to the system? How do people feel to be someone's surrogate? Our initial field tests indicated that people tended to regard the masked person as the actual person. We hypothesized that the relationship between the surrogate and the director is important and determines whether people think the surrogate is the actual person. Therefore, we decided to investigate two other remaining key questions: (1) How does a remote user feel to use this system in comparison to a telepresence robot? (2) How does the surrogate feel to lend his/her body to a director? We conducted experiments to determine the feelings in the two kinds of roleshow remote users feel while using this system and how people feel to be someone's surrogate after experiencing being a surrogate.

RELATED WORK

There are several art performances[3][4][5] wears a display on his/her body or face in an original context [19]; however; a telepresence study in which a local user becomes the remote user's surrogate by wearing an iPad does not exist.

Human presence in telecommunication

Many telepresence systems for enhancing the remote user's presence have been proposed. Prior work has shown that movement [16], mobility [17] and gesture [1] are more engaging and enhanced in social telepresence. These systems usually comprise a tablet, a speaker, and a microphone representing the remote user. While the displays of these systems are 2D, some researchers have also focused on using 3D face-shaped displays[11, 12]. One reason is that a face-shaped screen aids in effective communication by facilitating eye contact [10]. Eye contact plays an important role in face-to-face communication; hence, many studies focused on how to make eye contacts during video communication [13, 14, 15]. Geminoid [21] is an android system that has a human-like avatar. Its appearance is substantially real, but its mechanical structure is complex, such that the motion is limited by the remote user's movement. Although there are telepresence systems that convey the haptic senses, in addition to vision and audio [22], and enable a full existence experience, they require an inordinate amount of resources. Our approach uses innate human abilities in order to achieve telepresence.

Leveraging human skill via the Internet

The ChameleonMask system relies on a surrogate to relay the remote user's presence. Some studies have also investigated remote user controls in order to share experiences with local users. Tele-Actor [4] is a system that is worn in order to communicate in a remote environment. Omnipresenz[6] offers a social service concept of visual sharing. Jackin is a system in which the local user transmits 360-degree vision to the remote user using a headset equipped with cameras [6]. ChameleonMask conveys not only the remote environment but also the remote user's presence on a mask. Teroos is a wearable system, placed on the shoulders, in which a remote user communicates with a local user through a small robot [7]. Even though, ChameleonMask is a wearable system in which the local user becomes a surrogate for the remote user and acts in response to the director's requests. Online marketplaces that allow users to outsource small jobs or buy and sell expert services [7][8] are increasing. We consider that ChameleonMask can be a physical body marketplace that is analogous to Amazon Mechanical Turk [9] being a brain marketplace.

CHAMELEONMASK

ChameleonMask is a wearable mask system that enables a remote user to be embodied through a surrogate. The face expression of the remote user is streamed and the mask is used as a display. The remote user can communicate with local persons by sharing the surrogate's eye sight and situation. The existence on the surrogate enables the remote user to show his/her physical and social presence in the local place.

In the ChameleonMask framework, we define three primary stakeholders: a remote user (the **director**), a local user (the **surrogate**), and local party members. They might be affected by the use of a telepresence system. The director is the person who wishes to participate from a remote place and gives his/her surrogate directions concerning where to go and how to act. The director acts as though he/she is present in the local place, but the surrogate operates within the location. We call the local user the surrogate. The surrogate is the user who receives directions from the director and acts on behalf of the director. The surrogate operates in accordance with the director as the director's remote body and shares the local environment and situation through video and voice. The surrogate does not talk with local party members but lends his or her body to the director. Therefore, the surrogate must mask

[3] Tablet man, http://www.damndigital.com/archives/74517
[4] Yamada Taro project., https://vimeo.com/82250584
[5] iPad Head Girl, https://youtu.be/fLPMLJgGsiA
[6] Omnipresenz, http://www.omnipresenz.com/
[7] Taskrabbit, https://www.taskrabbit.com/
[8] Fiverr, https://www.fiverr.com/
[9] Amazon Mechanical Turk, https://www.mturk.com

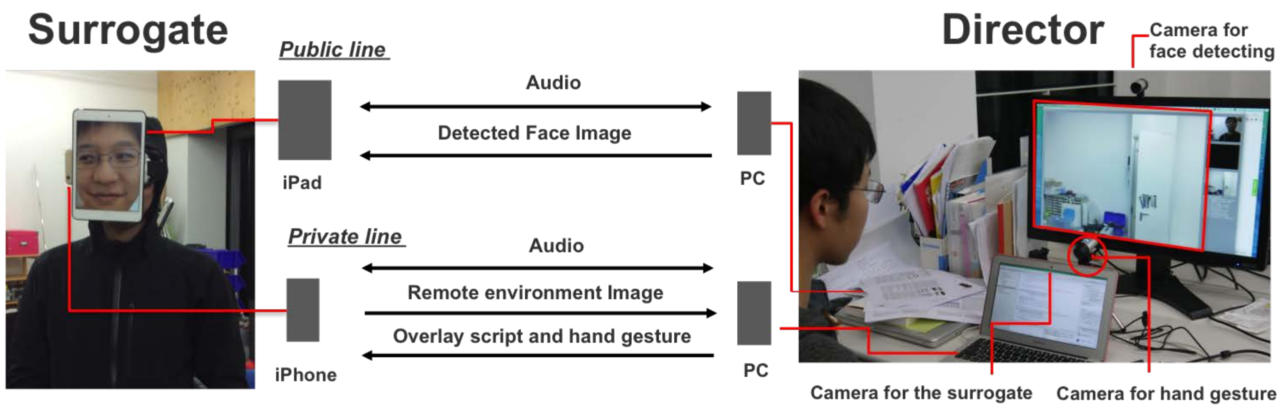

Figure 2. System overview of two communication lines: 1) Public line is a channel between a director and local party members. Audio and detected face Images are sent to the surrogate's iPad. 2)Private line is a channel between a surrogate and a director. The director gives the surrogate direction by some ways. Sharing surround environment from the surrogate to the director with eye sights and voices.

his or her character and presence in every way except bodily. Local party members are people who see the surrogate and talk with the director. For example, they could include the director's colleagues or other participants at a conference. The aim of ChameleonMask is for the remote user to communicate with them as if he/she was actually there.

Physical Presence and Face Display

Telecommunication must embody the remote user's existence. Further, a wearable system should be incorporated into fashion and fit the user in order for the degradation of social interaction to not occur [20]. Accordingly, ChameleonMask needs to balance technical function with the social weight of technology. We decided to show the director's face on the display worn by the surrogate to embody the remote user. In our system, the remote director's presence is produced using the surrogate's physical body. Then, we conducted field tests in order to investigate how much that technology affects communication and social interaction.

Social Presence

Facial recognition is the primary method humans use to visually distinguish one another. Therefore, the mask-shaped display must exhibit the director's live face, and a voice channel should transmit the director's voice. Methods for meeting these system requirements include face-mask projection. There are several examples of a rear-projection systems that project an image onto a face-shaped screen [10, 11, 12]. Projection enables a high level of expression, such as facial details and motion [2]. However, these techniques do not suitably apply to wearable systems because of their lack of projector placement. Willis et al. [23] introduced a three-dimensional (3D) printing custom optical element technique in which a curved 3D optical display can be projected onto an arbitrary place without interfering with the surrogate's face. However, a flexible display that can be molded to the shape of the face, which is a topic for future research, would improve this method. Before developing the mask, we constructed a prototype system in order to experiment and ascertain people's feelings regarding these kinds of systems.

Figure 3. The surrogate visited the city office on behalf of the director..

INITIAL FEASIBILITY STUDIES

We conducted two field tests to determine the feasibility of our system's distinctive features [3]. We wanted to ascertain the natural reactions and feelings when people see the surrogate wearing a prototype system. The first field test involved the surrogate going to city government's office to obtain a public document in place of the director(Figure 3). This test examined whether a stranger could confirm the identity of the director. The second field test was conducted to determine whether an acquaintance regarded the surrogate as the actual person. In the test, the surrogate showed up at a grandmother as her grandchild. The result was that people tended to regard the surrogate as the director. Participants wondered whether the actual person was the director wearing ChameleonMask and communicating through the iPad. They believed the actual person was there.

In addition, we obtained user feedbacks and design improvements for the mask. One such improvement was system weight. The prototype system was weighted to the front because the iPad was set on a monocular head-mounted display (HMD) consisting of a smartphone and a fresnel lens[10]. The structure of the HMD is made from cardboard. To counterbalance the weight, we utilized a full-face helmet. The mask fit on the head, but it was heavy and claustrophobic to wear for long time. Consequently, we needed to change the design of the mask. The second improvement needed was in

[10]Hacosco, http://hacosco.com/en/.

Figure 4. The surrogate looks the landscape from iPhone outside camera through HMD(Hacosco) and the director's face on the corner. This view is sent to the director. There is a fresnel lens on HMD.

the way how the surrogate is given the remote user's direction. The director could give the directions via oral instruction, and the surrogate was able to understand what to do. However, when the surrogate was in noisy surroundings, the direction did not carry clearly. Therefore, we considered that directions in script in combination with the oral one could be helpful. Finally, the gesture direction needed improvement. The surrogate could see the director in his/her peripheral vision on the HMD. The appearance of the director was small, but the surrogate said, *"The director's appearance made me feel relieved"*. The director's window showed his/her existence, but the size of the windows was too small to read any gesture. Therefore, we designed another way to show the director's gesture.

SYSTEM DESIGN

ChameleonMask requires a display showing the director's face and a monocular HMD and camera to capture the outside view for the surrogate. At the points on the human face that facilitate the size and weight for comfortable wear, we placed an iPad mini, which is 7.9 in tall, to display the director's face. We chose a Hacosco deluxe model HMD, which is made from plastic, with a rubber band in order to reduce the weight. An iPhone 6 was set in Hacosco in order to acquire the surrogates vision. The Hacosco HMD has a simple structure; therefore, we combined a goggles frame with the Hacosco HMD to add cushioning. Thus, the surrogate was able to view the outside on the iPhone display, captured by the rear-facing camera of the iPhone.

ChameleonMask has two communication lines. One is a public line and the second is a private line. The director switches from private to public channel when responding to conversation partners.

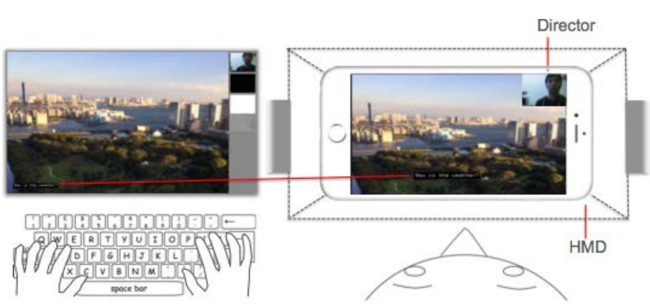

Figure 5. When the director send a message, the surrogate can see it overlaid on landscape.

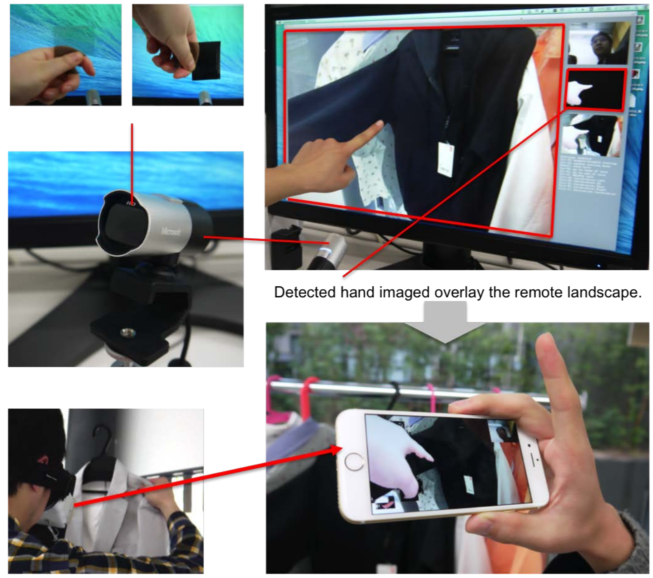

Figure 6. We use optical phenomenon on lcd display. A polarizing filter is attached on camera to detect hand from black background. Detected hand images are overlaid on the landscape the surrogate looks.

Public line

The remote director uses the public communication line in order to communicate with local party members with a live face image and voice communication (Figure 2). Further, we implemented an application that sends the director's face image at this size from the director's PC to the iPad. The face image is obtained via a USB camera with face recognition using Haar-like features. Voice communication is facilitated by Skype, which runs as an iPad application. If the volume of the voices is too low, the surrogate can adjust the volume on the iPad or use the private line to tell the director to raise his or her voice.

Private line

The private line relays communication between the surrogate and the director (Figure 2). Video images and a voice channel are sent from the surrogate. The director has to mute the public audio line before using the private line. The surrogate wears an earphone with a microphone in order to talk with the director, but does not speak when the director is speaking with local members. When the surrogate uses the private line, he/she has to speak at a lower volume. In addition, when the surrogate wears the mask, his/her vision is blocked. Consequently, to enable the surrogate to see, we attached a Hacosco VR tool to the iPad. Surrogates can see immersive outside images from an iPhone 6 camera placed on the Hacosco (Figure 4). The field of vision is narrower than that of human eyesight, but the view from the iPhone is sufficiently clear that the surrogate can see speech partners and walk around. The iPhone video stream that the surrogate sees is sent to the director's PC. Voice communication is conducted via Skype.

Giving directions

We considered that the basic method of communicating directions should be simple. A human-robot system requires preconfiguration and minute functions to accommodate high level requests, whereas a human does not have such a need because a human can understand the circumstance and the remote user's feelings via oral instructions. When the director notices that his/her surrogate is about to make a mistake, or misunderstands his direction, they can communicate. Second, the manner in which the direction is communicated depends on the contents of the task the director requests. Considering these points, we implemented a basic application function for directions.

Directions in script mode: Script mode can be used when people are in noisy environments where hearing is difficult. In addition, it can be useful when persons locally are facing the surrogate while the director is in private mode. When the director uses the private line, the director's voice is only heard by the surrogate. The voice is muted on the public line, but people can still see the director's lip moving, so they may feel uncomfortable in front of the surrogate. Therefore, we developed an application that allows the director to enter his/her directions via a script that overlays his/her surrogate's view (Figure 5).

Directions in hand gesture mode: This mode conveys the director's hand gesture to the monitor (Figure 6). The director sees the scene that the surrogate is viewing on his/her monitor. The surrogate can understand the director's pointing, visually and imitate the gesture. This mode is useful in situations where the director cannot explain well how to act. For example, oral directions such as "go straight" or "turn right" are simple to understand, whereas directions such as "stroke the horse" may be confusing because it does not state how to stroke, so that the surrogate needs to interpret it. We use a polarizing filter to detect hand gestures. It is well-known that the light from an LCD display is polarized in the horizontal direction. When the polarizing filter is attached to a camera perpendicular to the LCD light, the image from the LCD is blocked by the filter [8]. By a technique using this optical phenomenon, we can detect the director's hand gestures from the black background. The extracted hand images are overlaid on the surrogate's vision.

EX1: USER STUDY OF THE DIRECTOR ROLE

In the early field test, people tended to believe the surrogate was the actual person. To prepare for future experiments, we therefore needed to understand the experience and role of the director and the surrogate. Consequently, we conducted a user study to collect feedback from participants about the director's experience. Participants also teleoperated a telepresence robot for comparison. The task involved guiding the surrogate/telepresence robot through a pre-planned route in order to buy a product at a local fruit shop.

Purpose: To investigate how the director feels about using the body of the surrogate.

Participants: We recruited nine participants, four males and five females, aged 22-28 years old, from a local university to participate in our study. The participants had no prior associations or experience with our projects. They were all beginners of using telepresence system.

Figure 7. Participants tried to control the telepresence robot and the human surrogate outdoor.

Figure 8. Left: A director is talking with a store clerk. Right: A surrogate is entering into a fruit shop.

Experimental setup: We prepared the experimental test course for the telepresence robot and the surrogate in the room. When the telepresence robot went outside, we cleared the way to prevent interference from passersby. The surrogate wore a board with the word "Testing" written on it during the experiment and experienced no interference from passersby. We explained to the shop owner that the participants would come to buy some fruits in advance.

Task A: Teleoperation of the telepresence robot

Each participant teleoperated the Double robot[11] to test its usability. The robot weighs 6.8 kg and has an adjustable height in the range of 47-60 inches (101.6-152.4 cm). The Double screen was an iPad 2 tablet computer with a diagonal screen size of 9.7 inches (24.6 cm) and resolution 2048 $\times$1536 pixels. First, an operator instructed the participant on how to control the system. Then, following several trials, the actual tests were conducted. The route for the test course was prepared in advance. It started from the experimentation room, went through the hallway, and outside the building to the gate of the university. The time each participant took to complete the course was recorded to the second.

Task B: Teleoperation of the human surrogate

Each participant acted as a director and teleoperated an experimental surrogate. Each surrogate followed the same test course to the fruit shop and bought the fruit the director wanted. First, an operator instructed the participant on how to use and switch communication lines. Then, the operator gave the participant a map showing the route to the shop. The participant then guided the surrogate by reading the map.

Experimental design: The results of our preparatory experiment indicated that the respective character of the director and the surrogate has an effect on the impression of the experience. For example, the character of the director, such as cordial or rude, can give the surrogate different impressions.

[11] Double robot, http://www.doublerobotics.com/business/

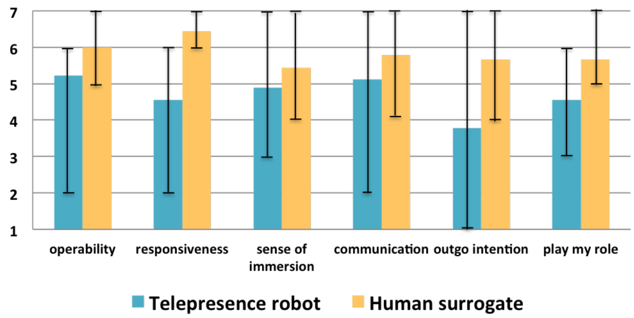

Figure 9. Results of Questionnaire

Therefore, we trained a female experimental surrogate to act at the same level of performance for all participants. In the experiment, the surrogate wore black unisex outfits. The surrogate was not known to any participant; thus, the relationship between the surrogate and the director was not affected by prior relationships. The user study consisted of four parts: 1) system introduction, 2) system evaluation, 3) post-test questionnaire, and 4) interview. Each participant performed both Tasks A and B, but the order was varied to exclude any learning effect.

Post-test questionnaire: We asked six questions via a questionnaire following the user study. The post-test questionnaire (seven point Likert scale, with seven being the best) comprised the following questions. Q1. Was it easy to teleoperate the robot/the surrogate? Q2. Did the robot/surrogate act in accordance with your requests? Q3. Did you feel a sense of immersion? Q4. Were you able to see the remote environment and communicate? Q5. Do you want to go outside using the robot/surrogate? Q6. Do you want to communicate and send the robot/the surrogate to a remote place?

Results and discussions: The results obtained are shown in Figure 9. There are significant variabilities among the answers for the telepresence robot compared to those for the human surrogate. For operability, Q1, participants enjoyed controlling the robot, while their expressions were very serious in the tests. They were careful about not crashing into walls and knocking over the system. The average time that participants teleoperate the robot in experimental course was 315 s (human surrogate had an average of 115s). Female participants tended to exert more careful control than the males. One participant made the following comment: "*I felt relieved that the surrogate walked along the street without detailed instructions from me.*" For responsibility, Q2, participants had trouble adjusting to moving and seeing underfoot. When the director wanted to see the underfoot of Double, the director had to switch the camera to underfoot. It was difficult for the director to see underfoot for both cases, but the human surrogate avoided obstacles without the director's instruction. For the sense of immersion, Q3, there was no major difference. One participant stated the following: "*I felt as if I was teleoperating the robot and the surrogate in a control room.*" Participants did not feel truly immersed. The answers to Q4 indicate that the human surrogate shared the environment more

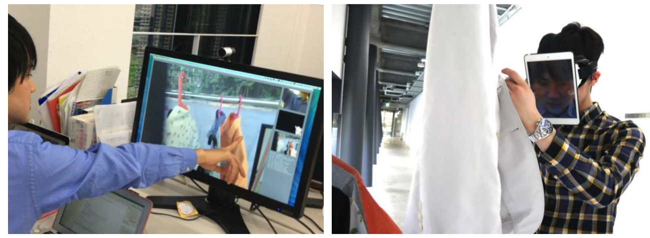

Figure 10. Left: A director is pointing the cloth he wants to look closely. Right: A surrogate is checking the clothes. The director's face is shown on the display.

than the telepresence robot. For example, the director did not notice an approaching ambulance before the surrogate turned her head toward the direction of the siren. There are large differences for Q5 and Q6. The telepresence robot has wheels, but a typical comment such as this was given: "*I don't have the confidence to go outside with a robot because I'm anxious about not crashing into other people.*"

EX2: USER STUDY OF THE SURROGATE ROLE

Our underlying concept is that human surrogates can replace telepresence robots in their roles like actuators in their work for their directors. However, there are fundamental questions. Do they want to help others (i.e., the director)? How do they feel when they lend their body as a surrogate? We consider these to be important questions to answer in order to develop our system framework for the future. Thus, we conducted a user study to collect feedback from participants acting as surrogates in order to understand the surrogate experience.

Experimental design: We designed a controlled laboratory experiment in which experimental directors gave directions to participants acting as surrogates. The user study consisted of four parts: 1) system introduction, 2) system evaluation, 3) post-test questionnaire, and 4) interview.

Participants: We recruited eight participants, four males and four females, aged 22-28 years, from the local university and a local office to participate in our study. The participants recruited had no prior associations or experience with our projects. In addition, we recruited a male director and a female director and trained them for the experiments.

Experimental setup: We wrote acting scripts so that the directors could give the same attitude to all surrogates. They communicated with the surrogates using audio, directions from the script and hand gestures. The male director was placed in charge of the male surrogate participants, while the female director was placed in charge of the female surrogate participants. The directors were known to the surrogates.

Experimental scenario: Each surrogate assisted in buying clothes for the director. The director was not able to go outside for some reason. He/she could buy the clothes on the Internet but he/she wanted to experience the pleasure of shopping in a store. Thus, the director asked the surrogate to assist with the shopping. After walking around the store, they selected five kinds of clothes. Finally, the surrogate was asked to help the director to make the final decision on what clothes the director should buy.

Post-test questionnaire: We asked eight questions via questionnaire after the user study. The post-test questionnaire results (seven point Likert scale) and mean and SD are shown in Table 1.

Results and discussion: All participants helped the directors very well according to the request. Many participants said hand gestures were easy to understand visually. We observed that the some participants opened the zipper of a parka when the director gave the gesture for unzipping. They seemed to understand what the director wanted to do. They did not feel that the tasks were difficult. We hypothesized that it is difficult for people to accept becoming someone's surrogate. Surprisingly, the participants tended to feel positive about being a surrogate. In addition, many participants tried to work voluntarily and wanted the director to give them more requests. One participant said, "*I wanted to hear the requests about what the director wanted to do.*" "The director did not ask me to, but I was willing to wear the parka to show the director the fit." In addition, many surrogates explained the texture to the respective director because the director could not touch the clothes and so they did not know the tactile sensation. In this user test, most participants did not need to be prepared with special training in advance. Some wanted to get accustomed to looking at the landscape through the VR because of its narrow field of vision. Finally, participants stated that they foresee the possibility of a job in which people become surrogates for others.

Table 1. Results of Questionnaire

No.	Question	Mean	SD
1	Did you understand the director's intention?	6.13	0.64
2	Was it difficult to carry out director's request?	3.38	2.39
3	Did you feel uneasy getting direction?	2	0.93
4	Were you willing to work for the director?	5.38	0.74
5	Did you prefer getting many requests from the director?	5.5	1.31
6	Did you feel like you were helping the director?	5.88	0.35
7	Do you think you would need to prepare in order to be the director?	4.25	1.67
8	Do you think the job of lending the body is possible as a part-time job?	5.63	0.52

DISCUSSION

Physical and Social Telepresence

In our system, the remote user teleoperates a human instead of a robot. In early field tests, we hypothesized that people would be skeptical of the mask, look at it in disbelief, and immediately request that the surrogate remove it in the experiments. However, we did not observe this reaction from the city officer. The city officer eventually asked the surrogate to take the mask off, but he talked to the surrogate for a while. We believe that this is because of the facial images displayed on the top of the surrogate's body. Local participants acknowledged the surrogate's humanity and thought they confirmed her identity. Therefore, they did not ignore the surrogate but treated her like a human being.

While we were testing the operation of the telepresence robot in EX1, we met some strangers who got interested in the telepresence robot and took a picture spontaneously with a smartphone without authorization. However, they did not take a picture of the surrogate wearing the mask, even though they stared and seemed to find it interesting. This incident appears to indicate that the strangers regarded the teleoperated target as a person or a thing.

Telepresence Robot vs Human Surrogate

Our comparison of the usability of the telepresence robot and the human surrogate is not about winning or losing. We believe that different systems are suitable for different purposes because various kinds of systems are developed. Therefore, there are tasks that human surrogates are useful for, such as the tasks in this study, and there are tasks that telepresence robots are more useful for. For instance, a participant said that he/she was ashamed to use the surrogate for easy tasks. In addition, when a director wants to talk with a local person about complicated private things, he/she should talk face-to-face without the surrogate. We therefore need to investigate what kinds of scenarios for which this system is most applicable.

What Happens When a Human Teleoperates a Human?

There is a concept that states that "using human is cheaper than developing robot," but a human is difficult and very sensitive to deal with. This is because some uncertainty elements interact in humans, such as character and the relationship between the director and the surrogate. We consider that it is better for the surrogate to look like the director, while the difference between them can complement each other. People should become the surrogate specialized for their strong points and abilities, or we should ask that of them. Tasks for which the surrogate needs to know the director well in advance should be assigned to their mutual friends. Professional tasks that require experts should be assigned to professionals. ChameleonMask has the potential to create new employment.

People felt positive being surrogates in our test. Of course, it depends on the tasks the directors wish to perform. However, participants were willing to help the director. They felt uneasy when the director did not give directions. It was very interesting that some participants felt easy and comfortable being surrogates. One participant stated, "*I didn't need to make my own decisions, I just had to do what the director wanted.*"

When do we use ChameleonMask?

The main goal of this study was to convey the director's existence to a remote place using a human. This system is therefore useful for many occasions. Furthermore, this system enables persons to borrow not only a body but also someone's face (in contrast to lending a face to someone). This is because a face and a body are separate. Example, borrowing a body: When I want to make an impact at a presentation, I borrow a bigger body to make a strong impression. Example, borrowing a face: When I want to have a lot of admirers among the ladies, I borrow an idol's face.

The present mask may be difficult to use in practical scenarios because of the weight, field of vision, and appearance. However, this study is simply an initiation to judge this concept prior to a 3D live face-shaped mask being produced.

CONCLUSIONS AND FUTURE PLANS

We hypothesized that a human surrogate can embody a remote user. In early experiments, the surrogate tended to be regarded as the actual person. As a precursor to making a 3D live face-shaped mask, we introduced the concept and the system requirements. We also conducted user studies to understand the experience of persons carrying out the directors role and the surrogate's role. The results indicate that ChameleonMask is feasible for use. The director had the confidence to go outside with ChameleonMask. Further, the surrogates tended to want the director's requests and felt positive about being a surrogate. In the future, we would like to conduct experiments in practical scenarios. Finally, we would like to make 3D live face-shaped masks to actualize this concept.

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