Transfantom: Transformation into bodies of various scale and structure in multiple spaces

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Figure 1: (L) The concept of Transfantom. User transforms into multiple bodies with various scale and geometry. Each body has separate sight, but virtual "Proxy Body" can continuously shift its size and position in the virtual environment(VE) so that the user can change bodies seamlessly. (R) Sample scene of this system. The user alternately uses two different "bodies."

ABSTRACT

Transfantom is a novel robot interaction in which the user seamlessly changes or simultaneously uses different "Bodies" of different sizes, structures, and positions. By combining various multiple bodies, we expand our range of power, dexterity, and the place we act, and it brings us unexplored experience or highly efficient work.

We map a virtual "Proxy Body" to the target physical "bodies" like miniature robots or huge construction machines and control them. By moving and scaling the Proxy Body in the virtual environment that reproduces the target bodies and their environment, we can smoothly change bodies which have separated view, size, and structure. As a result, we can handle various bodies together intuitively. For example, by using a powerful giant robot and a dextrous small one, it is possible to carry out the work like rescuing injured person while removing heavy debris efficiently and carefully.

CCS CONCEPTS

• **Computer systems organization** → **Robotic control**; • **Human-centered computing** → *Interaction paradigms*.

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KEYWORDS

Telepresence, Robot Interaction, VR, AR

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1 INTRODUCTION

There have been many research projects on robot interaction to create experiences as if they went to remote areas or danger zones, and to realize tasks impossible with the average human body [Kitagawa et al. 2005; Minsky 1980; Tachi et al. 2012]. There are also research projects to expand human capabilities by using robots [Mosher 1968; Sasaki et al. 2017]. In these studies, it seems that it has not been studied that one operator moves to multiple bodies with different sizes and structures.

[Komiya et al. 2017] made a technic to continuously move between multiple viewpoints of people there in the space generated by multiple depth cameras.

In the field of psychology, studies are being conducted to create a state in which the size of his/her body has changed, and to investigate how the size perception and self-recognition change.[Kim and Interrante 2017; Van Der Hoort et al. 2011] There are few cases

where it has been discussed that interacting with the world through limbs while changing the viewpoint and scale with the body.

2 CONCEPT AND SYSTEM

As robot and AI technology evolve, we believe that we will need to expand the range of activities and abilities that only human beings can perform and to improve efficiency. One body will not be enough for one person in the future.

There are “bodies” with diverse abilities such as construction machines, drones, and industrial robots. To make extensive use of them to enable us to do a broader range of activities, we propose an interaction called “Transfantom” that indirectly maps the movement of the user to the target body via the computational virtual “Proxy Body.” This technique enables us to transfer ourselves into robots with multiple sizes and different structures without losing immersive feeling or to handle them at the same time. (Figure 1-L)

By placing a stereo camera with an arbitrary baseline to the robot, mapping the head of Proxy Body to the stereo camera and the hand to the end-effector, the user operates robots indirectly by embodying Proxy Body. (Figure 1-R)

The user can perform various tasks continuously by changing the Proxy Body to the position, posture, and size appropriate for the work for each robot. For example, a single operator can transport a waste to workplace with a giant robot, and then collect precious materials using a small robot.

Even when using one robot, the user can obtain the appropriate accuracy, the reach, and the orientation to the work area by changing the size and position of the Proxy Body. (Figure 2)

Figure 2: The user can control your work area, view, and accuracy through Proxy Body.

When switching the body, it is important not to lose the identity of the body by the change of scale and viewpoint. Proxy Body in the VE can continuously shift the position, posture, and size to interpolate the separation of target real bodies, so the users can create a sense that they are smoothly transforming. (Figure 3)

You can even transform into multiple bodies simultaneously. Even for robots with different sizes and position and posture, by mapping one Proxy Body to them, the user can operate them at the same time in the same manner. In this case, the vision from the bodies are blended into one, and the blend ratio depends on your direction of intention or movement of the arms. [Saraiji et al. 2016]

3 USER EXPERIENCE

This system is effective in scenes where it requires force and reaches and needs detailed work at the same time. Rescuing people while removing rubble etc. in disaster zones or carrying out material

Figure 3: (L) Virtual view point trajectory. (R) VE complements two discontinuous real vision.

roughly on construction site, and performing dextrous assembly with a small body.

In the exhibition of SIGGRAPH Emerging Technologies, we will set up a space that shrinks and simulates the scenes like above. In that environment, we will demonstrate the size of the body changing continuously while transforming into a robot of about 1.5 times the size of a human and of about one-third. You can experience as if your body shrinks or enlarge. And using those bodies, you can grab and carry a large object, and handle small things.

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