

R&D Theme

R&D of AI for human-robot coevolution

Progress until FY2022

1. Outline of the project

The objective of this research theme is to design AI robots that do not provide excessive support but rather encourage people to act on their own, making use of their remaining and latent abilities. The robot will induce independent actions by making a user feel that I can do it by myself if the robots support it, and will eventually make me feel that I can do it by myself even without the robots, thereby creating vitality to challenge various things.

For this purpose, we are conducting research focusing on "self-efficacy," subjective perception of the possibility of one's own actions. We are developing an AI robot that improves an individual's sense of self-efficacy and encourages him or her to challenge various actions and tasks.

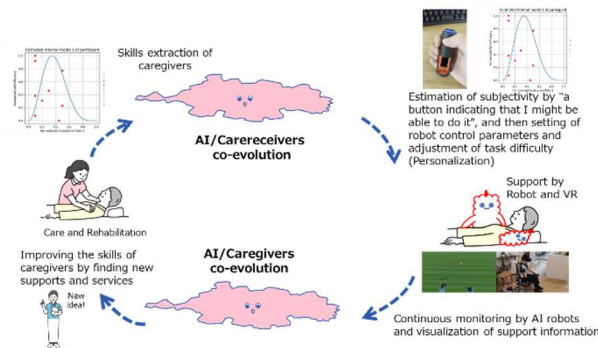
2. Outcome so far

In FY2022, we have aimed to develop a training system to improve the self-efficacy of caregivers and challenge them to perform various tasks and rehabilitation for the purpose of utilizing the system in the nursing care field. Support for improving a person's sense of self-efficacy can be effectively achieved by formalizing the tacit knowledge of caregiver skills and realizing it with a robot. In addition, it is necessary to appropriately understand the subjectivity of the individual (e.g., self-efficacy) and adjust the support parameters of the robot and training system.

On the other hand, estimating an individual's subjectivity and adapting the support parameters of the system to the individual based on that subjectivity is a very challenging and difficult task. In addition, self-efficacy cannot be improved by simply providing successful experiences in task realization. It is necessary to repeat "good successes," which can be achieved without being too

easy, and to generate "good failures," which are just barely short of success, at appropriate times. For this purpose, the realization of a training system that can appropriately adjust success/failure experiences is a very challenging R&D issue.

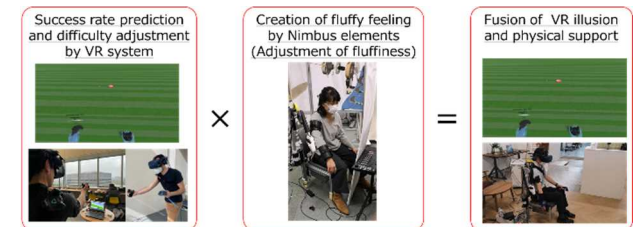
In this theme, we have developed an "AI/Caregivers co-evolution" framework that first formalizes the tacit knowledge of caregivers' skills, then adapts to individuals based on their subjective estimation, and then provides support by robots. In particular, to estimate a person's subjectivity, we developed a simple interface, "a button indicating that I may be able to do the task," to grasp the user's "confidence in the task. This enables us to estimate individual subjectivity in real time without relying on post-task questionnaires, etc., and to construct a framework for determining AI robot control parameters that can be appropriately adapted to the individual.



In addition, we developed a training system that can create good success/failure experiences by linking physical assistance using the elemental technology of Robotic Nimbus (cloud-like fluffy feeling creation technology) which is being developed under R&D item 2 and Virtual Reality (VR). By adjusting physical support parameters appropriately and providing moderate support without excessive support, we developed a technology to give the user the feeling

that he/she is moving his/her own body and to improve the success rate of tasks. In addition, we were able to develop a technique for estimating an individual's task success rate and adjusting the task difficulty freely in a task in a VR system.

Such a training system that combines the visual illusion of VR and the tactile illusion of physical support, and adjusts the control parameters while estimating the person's subjective feelings, is an epoch-making approach that has not yet been realized in current rehabilitation.



3. Future plans

Using the AI/Caregivers co-evolution framework and the VR/physics-assisted fusion training system constructed in FY2022, the following will be achieved in several tasks.

- Develop assistive technology that improves self-efficacy by adjusting task difficulty appropriately and adjusting success probability according to each user.
- Integrate the developed assistive technology appropriately with the Robotics Nimbus prototype to be developed in R&D item 2.
- We will construct an AI/Caregivers co-evolution framework that improves the skills of caregivers through the discovery of support and services that they had not noticed before by means of continuous monitoring by AI robots and visualization of assistive technologies. And then we will realize a virtuous circle loop with the "AI/Caregivers co-evolution" proposed in FY2022.