

R&D Item

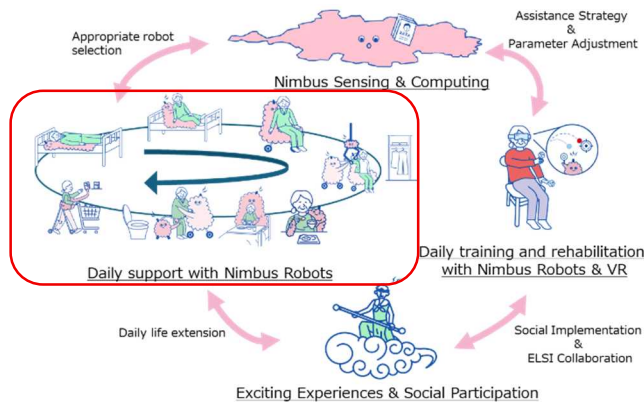
2. R&D of Adaptable AI-enabled robots

1. Outline of the project

This research theme aims to create robot hardware with actuators and mechanisms that can freely adapt their stiffness and flexibility. We're also developing corresponding sensing and control technologies to match this adaptable hardware.

We're advancing the development of adaptive AI robots that can estimate human intent and actions, and transform their shape and form based on a person's purpose, physique, or the degree of their disability. We've proposed the "Robotic Nimbus" concept: robots that can softly deform like a cloud and, like Kintoun (the Flying Nimbus), extend human motor functions based on human intent.

To accelerate real-world validation in elder care settings, this research and development theme envisions using various Robotic Nimbus types to provide daily life support, as outlined in the overall integrated research and development vision shown below.



2. Outcome so far

This research focuses on developing Nimbus Robots designed to assist with a variety of everyday tasks

and movements. Under the "like a cloud" concept, we've created the Nimbus Holder, which offers a gentle embrace that conforms to the human body while simultaneously providing robust torso support. We also developed Nimbus Wear, designed to maintain wearer comfort while providing the necessary rigidity to support the trunk, arms, and legs. Furthermore, the Nimbus Sheet combines remarkable flexibility with the ability to transport heavy objects, with the ultimate goal of assisting with human transfer. These innovations serve as foundational technologies for robots that gently conform to users' bodies and provide highly personalized support.

Meanwhile, following the "like Kintoun (Flying Nimbus)" concept, we developed Nimbus Limbs, which are telescopic and can support body weight based on a person's height and posture. We also developed the Flying Nimbus, a soft system capable of achieving complete weightlessness. These advancements enable groundbreaking support that expands user capabilities and opens new possibilities, addressing challenges that were previously difficult for traditional robots to overcome.

We've also made significant progress in developing hardware modules that can attach and detach like clouds. By integrating these modules with commercially available robotic arms or walkers, we've built systems capable of performing complex tasks, such as dressing assistance. This diverse range of developments demonstrates the adaptive AI robot group's remarkable flexibility in handling various tasks. It also embodies the core vision of this project: a robot whose form and function can change freely to match an individual's condition and purpose. Through demonstrations at various events, the exceptionally high expandability of these Nimbus Robots has been proven, marking a significant step toward their social implementation. This breaks

through the limitations of fixed functions and forms inherent in conventional robots, which is crucial for realizing truly human-adaptive support.



3. Future plans

In the future, we will further develop our existing elemental technologies and integrate them into a reconfigurable system. This will allow us to evolve into a versatile "Robotic Nimbus Group" capable of adapting to diverse purposes and situations. Specifically, we plan to develop and validate the effectiveness of several prototypes through real-world demonstrations: the human-adaptive Nimbus Holder, the environment-manipulating Nimbus Sheets, the task-specific Nimbus Wear, and the task-specific Nimbus Limbs.