**AI for simplifying the use of an assistive robotic arm for people with severe body impairments**

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**Purpose** Assistive robotic arms, e.g., the Kinova JACO, aim to assist people with upper-body disabilities in everyday tasks and thus increase their autonomy (Brose et al. 2010; Beaudoin et al.2019). A long-term survey with seven JACO users showed that they were satisfied with the technology and that JACO had a positive psychosocial impact. Still, the users had some difficulties performing daily activities with the arm, e.g., it took them some time to finish a task (Beaudoin et al. 2019). Herlant et al. claim that the main problem for a user is that mode switching is time-consuming and tiring (Herlant et al. 2017). To tackle this issue, deep neural network(s) will be developed to facilitate the use of the robotic arm. A sensor-based situation recognition will be combined with an algorithm-based control to form an adaptive AI-based control system. The project focuses on three main aspects: 1) A neural network providing suggestions for movement options based on training data generated in virtual reality. 2) Exploring data glasses as a possibility for displaying feedback in a user-centered design process. 3) Elicitation of requirements, risks and ethical system evaluation using a participatory approach. **Method** In a first step, everyday scenarios that are relevant for the user, like eating and drinking (Pascher et al. 2021), were identified. Based on the iterative, cyclical process of action research by Riel (2020), two workshops and six interviews with people from our target groups were conducted to learn about their care situations and needs. Four scenarios were elaborated and decided on together. The simulation system consists of these scenarios along with detailed movements and manipulations (Kronhardt & Rübner et al. 2022). The user controls the simulated robot's hand via a VR controller. This makes it possible to record movements quickly, which is necessary to achieve a large training data set. Thus, the generated data is used for training a neural network to provide an adaptive set of controls. In the next step, a novel control method and possible visual cues for the DoF mappings were developed. The objective is to explore how the novel adaptive control method performs in a 3D environment compared to the standard mode-switch approach with cardinal DoF mappings and whether changes in the visual cues impact the performance of the adaptive control method. The participants repeatedly performed a simple pick-and-place task, controlling a virtual robot arm using the three control types. **Results and Discussion** The everyday scenarios that most correspond to the needs of the target group are: "eating and drinking", "open and close doors", "supermarket shelf/pick up", and "microwave". Simulation of these scenarios enables the user to control the robot akin to a normal hand, allowing more direct motions which are not influenced by the limitations of the input device and thus offer the possibility of quickly recording extensive data. Results show that the number of mode switches necessary to complete a simple pick-and-place task decreases significantly when using an adaptive control type.

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**Figure 1** Scenario: User controls a robotic arm by head movements to eat and drink; Source: Own representation.

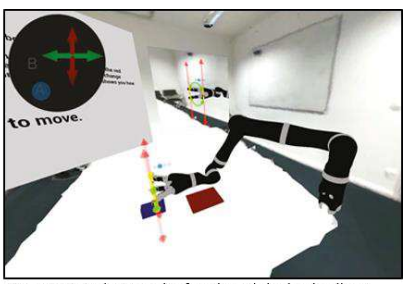


**Figure 2** VR Study: Screenshot from the study in virtual reality to evaluate the DoF mapping; Source: Own research.