

Shared Control in Assistive Robotics: Characteristics Influencing User Acceptance

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Abstract

Robots used in care and daily life offer a new approach to addressing labor shortages in nursing professions. In this context, various types of robots are already available, or are being developed, to address different ongoing challenges. In this context, shared controls can be realized with different robotic systems and control strategies. This work provides an overview of the characteristics that influence current issues and the ways in which implementing these characteristics into robotic systems can be beneficial.

Keywords: Robotics, Health Care, Shared control, human-robot interaction, robot acceptance.

Introduction

The shortage of skilled workers in the nursing sector will significantly worsen in the coming decades. Forecasts show that by 2049 there could be a shortage of between 280,000 and 690,000 nursing staff [1]. This growing shortage highlights the urgent need for innovative solutions to maintain the quality and continuity of care. In this context, robotic systems and assistive technologies are gaining increasing importance, as they can support caregivers in physically demanding or repetitive tasks, enhance efficiency, and allow staff to focus more on direct human interaction [2].

With the rapid advancement of AI, new approaches to designing robotic controls are emerging. This work presents characteristics influencing robot acceptance in relation to shared controls. We discuss challenges by providing an overview of ongoing developments in the field.

Examples for varying robot application

The diversity of robotic systems reflects the wide variety of tasks and environments in which they can support humans. In this work, we provide characteristics describing articulated robots for people with physical disabilities, logistic robots in healthcare, and social robots. These robots differ greatly in their capabilities and reduce the workload of care staff in different ways.

Articulated robots, also known as wheelchair-mounted robotic arms or assistive robotic arms, directly assist users by enabling them to

perform everyday tasks. This capability provides users with greater independence in daily life, leading to a higher quality of life [3]. In contrast, logistic robots such as mobile robots are used in hospitals to transport bedding, equipment, and medical supplies. Their main purpose is to relieve care staff so that they can spend more time with patients. Social robots, such as Nao, Pepper, and Nao, are designed to interact with people. In care facilities, they motivate elderly individuals to exercise, play games, or engage in conversations [4]. This is particularly important as the number of lonely elderly people continues to rise.

Characteristics

The characteristics that influence the acceptance of these systems vary depending on the type of robot application. In previous work [5], we investigated factors influencing a gaze-driven control for articulated robots. Our evaluation showed that robot acceptance is a complex and multifaceted topic. It is strongly influenced by the following groups of characteristics: level of autonomy, abilities, user preferences, and other contextual factors.

Level of autonomy:

In shared control, the level of autonomy defines the degree to which the robot performs tasks independently. It can range from manually controlled to fully autonomous [6]. Major challenges arise when automating robots to perform a wide range of daily tasks in cluttered, unstructured environments [7], which

must be addressed as prerequisites for the application of such robots.

Depending on the system's performance, the user's sense of agency can vary significantly. Trust in the system and a stronger sense of agency develop when the robot behaves as expected, suggesting that increased autonomy does not necessarily lead to higher user acceptance [8].

Error rates can be reduced by shifting more control to the user. Experiments have shown that even when tasks take longer, users are generally more satisfied with the results [8]. However, other studies found that high levels of automation can lead to acceptance when the robot accurately predicts, recognizes, and respects human intent [3, 9]. Furthermore, the sense of agency is influenced by transparency [10]. In highly autonomous modes, it can be improved through artificial feedback. For example, Baptista et al. integrated mixed reality into their robotic system to provide users with visual feedback indicating whether their inputs were correctly registered [11]. The generated natural feel of the control can reduce cognitive load, making the system less tedious to operate [10, 12].

Abilities: The relevant characteristics differ among robot types. While the goal of articulated robots is to perform a wide range of everyday tasks sequentially [13], logistic and social robots are usually specialized for narrower domains. Performing these tasks robustly and reliably is crucial to maintaining safety standards. In shared control systems with varying levels of autonomy, grasping and trajectory planning can differ in realization. Studies have shown that even small details such as the way an object like a book is handed over can affect user acceptance [14].

User preferences: In assistive contexts, especially for people with disabilities, multimodal control adapted to the user's abilities is highly relevant for wheelchair-mounted robotic systems. Moreover, adapting the system to individual user preferences is a key factor in robot acceptance. Parameters such as robot velocity [8] and the level of automation can be adjusted using policy-blending formalisms [15]. Other aspects such as living arrangements, building architecture, and familiarity with technology can also influence acceptance [7].

Other factors: Finally, ethical considerations and regulatory requirements must be respected. In hospitals and private homes, user privacy must be protected, particularly when handling sensitive personal information [16]. Safety must be ensured, as humans and robots will share the same workspace. ISO

15066:2016 provides guidance for human-robot shared workspaces, while ISO 13482 defines safety requirements for personal care robots. Additionally, appearance, initial and maintenance costs, and everyday maintenance all influence acceptance among stakeholders who may not interact directly with the robot.

Conclusion

Established characteristics must be evaluated alongside new ones that have emerged from ongoing developments in AI and human-robot interaction (HRI). In this work, we provided an overview of the key characteristics influencing robot acceptance that should be considered during system design to enhance marketability and user satisfaction.

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