

Robot Telekinesis: An Interactive Showcase

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ABSTRACT

Unlike large and dangerous industrial robots on production lines in factories that are strictly fenced off, collaborative robots are smaller and safer, and can be installed adjacent to human workers and collaborate with them. However, controlling and teaching new moves to collaborative robots can be difficult and time-consuming when using existing methods such as pressing buttons on a teaching pendant or directly grabbing and moving the robot by force (direct teaching). We present Robot Telekinesis, a novel robot-interaction technique that allows the user to remotely control the movement of the end effector of a robot arm with unimanual and bimanual hand gestures that closely resemble handling a physical object. Robot Telekinesis is as intuitive and fast as direct teaching, without the physical demands of direct teaching.

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1 INTRODUCTION

A new breed of small and safe robot arms called collaborative robots are entering the workplace. Unlike their large and dangerous industrial cousins in factories, which must be strictly fenced off, collaborative robots can be installed in close proximity to human workers and work with them side by side. These robots can perform repetitive tasks with high speed, precision, and endurance, so that the human workers can better focus on creativity and critical decision-making [Shah et al. 2011; Sheridan 1996].

Collaborative robots are expected to reach new, complex, and ever-changing workplaces where application of robotics was previously infeasible, such as a cramped workshop or the busy kitchen of a large restaurant. Unlike factories, the configurations and tasks in these environments may change frequently, so a way to quickly program new routines for new tasks is needed. However, controlling and teaching spatial moves can be difficult and time-consuming when using existing methods, especially for non-experts.



Figure 1: Robot Telekinesis [Lee et al. 2020] allows the user to remotely control the movement of the end effector of a robot arm with hand gestures that closely resemble handling a physical object.

Controlling the spatial movement of a robot with many DOFs in real time is an inherently difficult task. Within the robotics community, a common approach has been capturing real-time movements of a human user (master) and mapping them to those of a robot (slave). These master-slave techniques, coupled with immersive visual and haptic sensors and displays, can convincingly simulate the first-person experience of stepping inside the robot's body [Fernando et al. 2012]. The ability to perceive and control the robot as a part of one's own body can improve the performance of mission-critical tasks such as nuclear reactor maintenance [Sheridan 1989] and remote medical surgery [Sung and Gill 2001].

However, with collaborative robots, the user needs to control and teach a robot that directly interacts with him or her from his or her own point of view, requiring the user to step outside the robot's body and perceive and control the robot as a remote object. Within the human-computer interaction (HCI) community, interaction techniques for manipulating virtual remote objects, such as CAD models, that closely resemble handling a physical object have been known to be intuitive and effective [Mapes and Moshell 1995; Ware and Jessome 1988]. Feng et al. presented a detailed survey of such unimanual and bimanual manipulation techniques [Feng et al. 2015].

In this interactive showcase, we present Robot Telekinesis [Lee et al. 2020], a novel interaction technique that allows the user to move the end effector of a robot arm with hand gestures that closely resemble handling a physical object (Figure 1). Using our technique, the user can quickly and easily control the robot from a distance, as if physically grabbing and moving the robot, without actually making physical contact or exerting physical effort.

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