Summary 1:

Baxter's Homunculus: Virtual Reality Spaces for Teleoperation in Manufacturing

A low cost telerobotic system was developed using existing robot control interface and VR technology to let users supervise and control the robot from a different place. Previous teleoperating systems were generally based on Direct or Cyber-Physical models, both of which selectively maps parts of object's state between the user and the robot's frame of reference. This new system however, is based on the homunculus model of mind and "places the user in the robot's mind." The user interacts with displays and the object in a VRCR (VR control room) and these actions are then mapped on to the robot, providing sense of co-location. Similar to the idea of piloting, user obtains multiple sources of sensory information from the robot in the VRCR and controls the robot's movements through control orbs in the VRCR. Three types of mapping are available, allowing for selective engagement and dynamic mapping between the user and the robot. User study of this system indicated more success using the homunculus system as opposed to the direct system in a task to stack a randomly placed block on top of another block. In fact, users who were able to grab the blocks were also faster with this system. Over several manufacturing and assembly tasks, new users were consistantly faster and more accurate with this system.

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abstract={We demonstrate a low-cost telerobotic system that leverages commercial virtual reality (VR) technology and integrates it with existing robotics control infrastructure. The system runs on a commercial gaming engine using off-the-shelf VR hardware and can be deployed on multiple network architectures. The system is based on the homunculus model of mind wherein we embed the user in a VR control room. The control room allows for multiple sensor displays, and dynamic mapping between the user and robot. This dynamic mapping allows for selective engagement between the user and the robot. We compared our system with state-of-the-art automation algorithms and standard VR-based telepresence systems by performing a user study. The study showed that new users were faster and more accurate than the automation or a direct telepresence system. We also demonstrate that our system can be used for pick and place, assembly, and manufacturing tasks.},
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