Karlsruhe Institute of Technology

Autonomous Learning Robots (ALR)
Prof. Gerhard Neumann

Project Type

- [x] Master Thesis
- [ ] Bachelor Thesis
- [ ] Research Project

Supervisors

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Difficulty

Algorithmic

Math

Application

Requirements

- [x] Python
- [x] C++
- [x] C# & Unity

Immersive Vision-Based Teleoperation System via Virtual Reality

Description

In this project, the purpose is to develop a teleoperation system to control a robot arm with dexterous robot hand using VR (Virtual Reality). Teleoperation enables operators to remotely control and manipulate objects, machines, or devices over a distance using remote equipment or systems, which are widely used in various fields including industry and research. Research can also use teleoperation to create high-quality human demonstrations to teach robot skills. However, current teleoperation methods are less intuitive and not user-friendly for their 2D visualization interface cannot provide a stereoscopic view for users.
To solve these problems, VR Technology is involved to provide an intuitive 3D interface for users. By allowing users to interact with virtual environments as if they were physically present. VR makes immersive control and manipulation of robot possible. This technology relies on powerful computer graphics processing capabilities and is facilitated through specialized head-mounted devices such as VR headsets, which transport users into entirely new digital world.

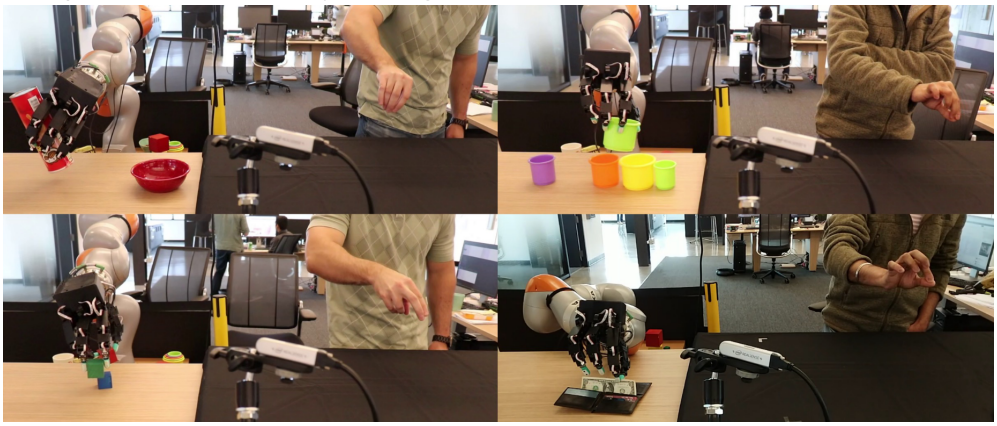

Figure 1: Vision-Based robot teleoperation by hand tracking[1]

Tasks

The tasks in this project will involve:

- Hardware & Software Framework: Integrate robot hands to our current teleoperation setting
- Multi-camera Hand Tracking: Apply human motion tracking to track the movement of users' hands
- Point Cloud Processing: Combine the point clouds of multiple depth cameras that is then visualized in our in virtual reality setup
- Motion Retargeting: Retarget human motion space to robotic hand position to control robot by human hand [2]
- System Evaluation: Integrate all subsystem and evaluate its performance

References

[1] Ankur Handa, Karl Van Wyk, Wei Yang, Jacky Liang, Yu-Wei Chao, Qian Wan, Stan Birchfield, Nathan Ratliff, and Dieter Fox. Dexpilot: Vision-based teleoperation of dexterous robotic hand-arm system. In *2020 IEEE International Conference on Robotics and Automation (ICRA)*, page 9164–9170, May 2020.

[2] Daniel Rakita, Bilge Mutlu, and Michael Gleicher. A motion retargeting method for effective mimicry-based teleoperation of robot arms. In *2017 12th ACM/IEEE International Conference on Human-Robot Interaction (HRI*, page 361–370, Mar 2017.