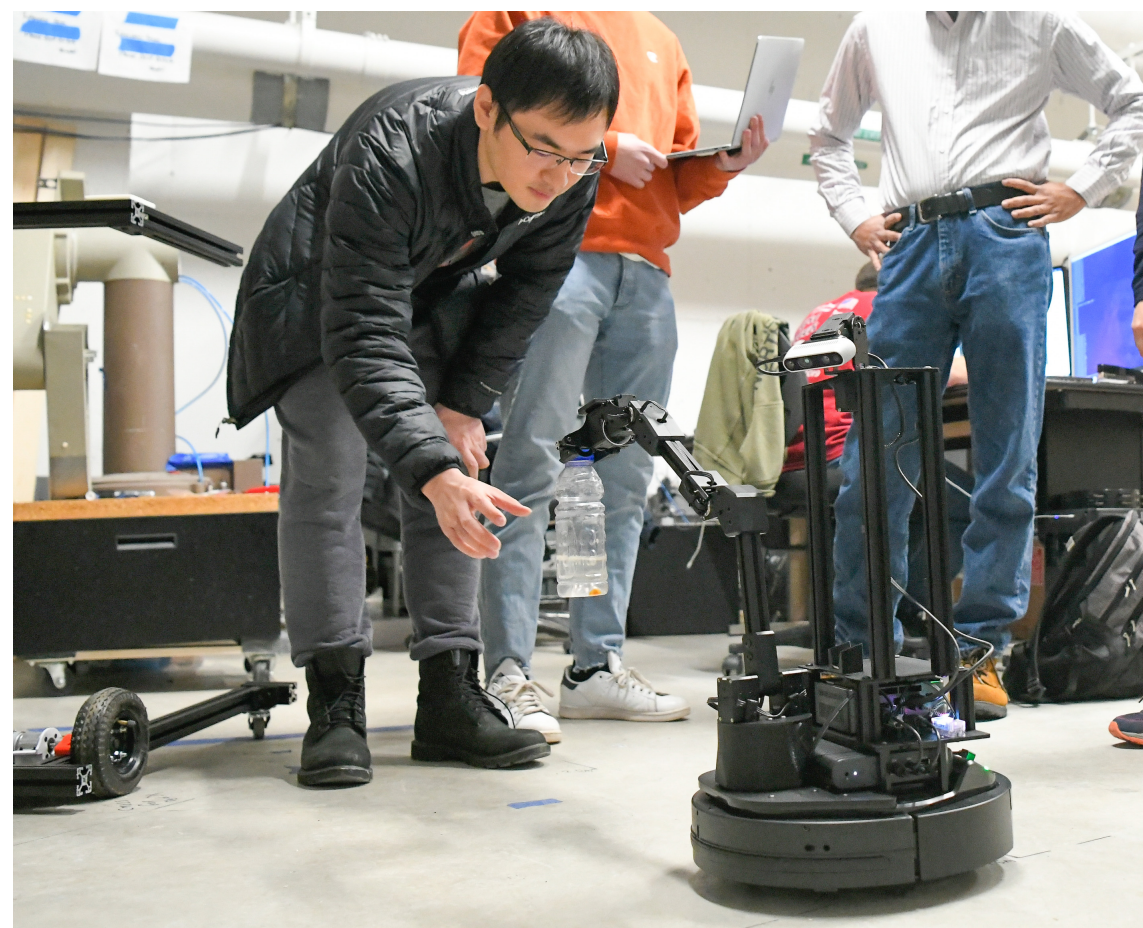


Using Multi-Modal Data to Enable Learning-Based Awareness of Human Grasp Preferences in Co-Robot Manipulators

NRI: FND: Using Multi-Modal Data to Make Robotic Grasp Algorithms Aware of Human Preferences for Safe Collaborative Robot-Human Handover Interactions with Novel Objects, Award Number: IIS-2023998

Start Date: 10/15/2020, PI: N. Banerjee, Co-PI: S. Banerjee, Clarkson University, Session 4, #21



Where? (Location)

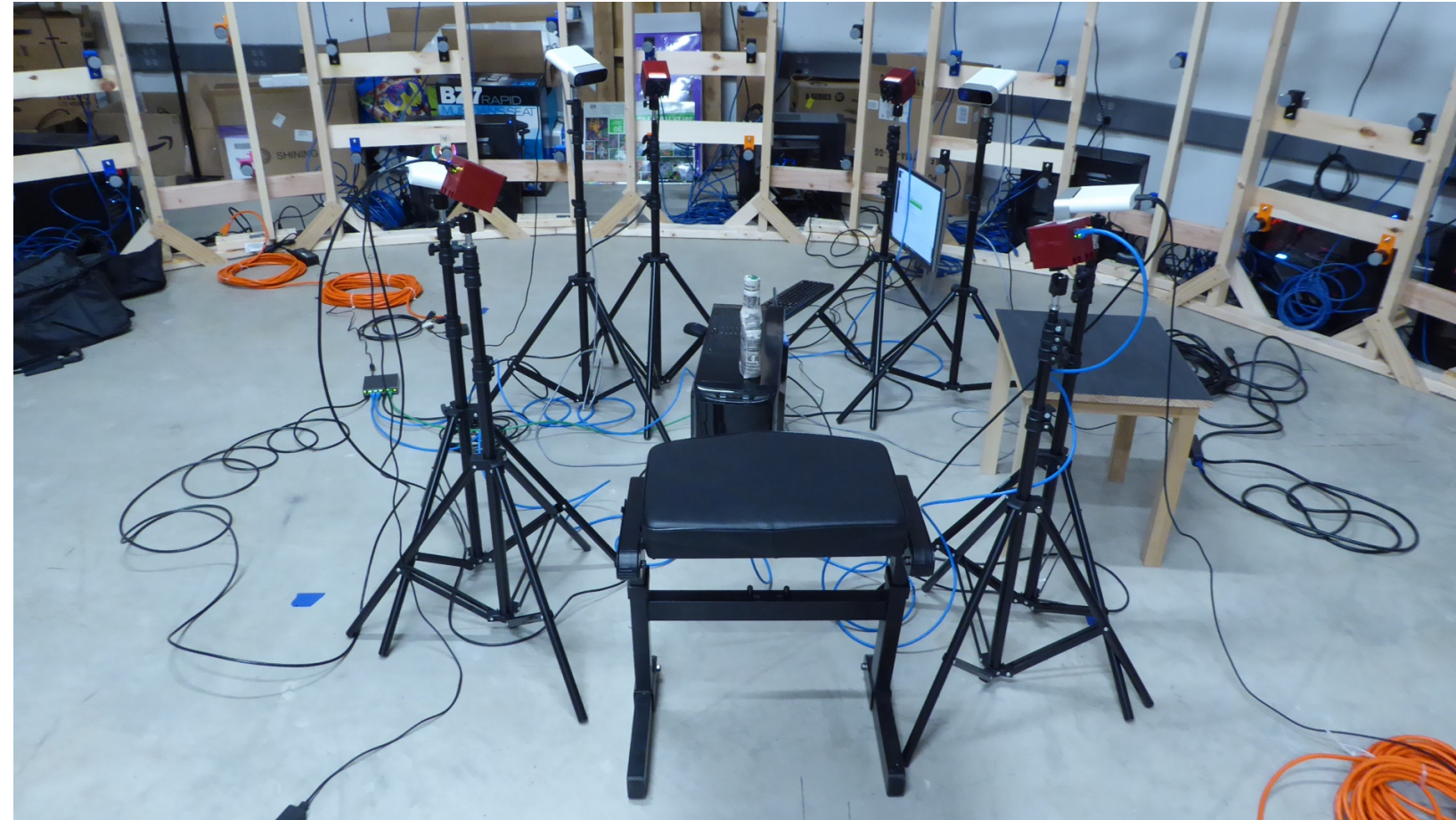
How? (End Pose)

When? (Release)

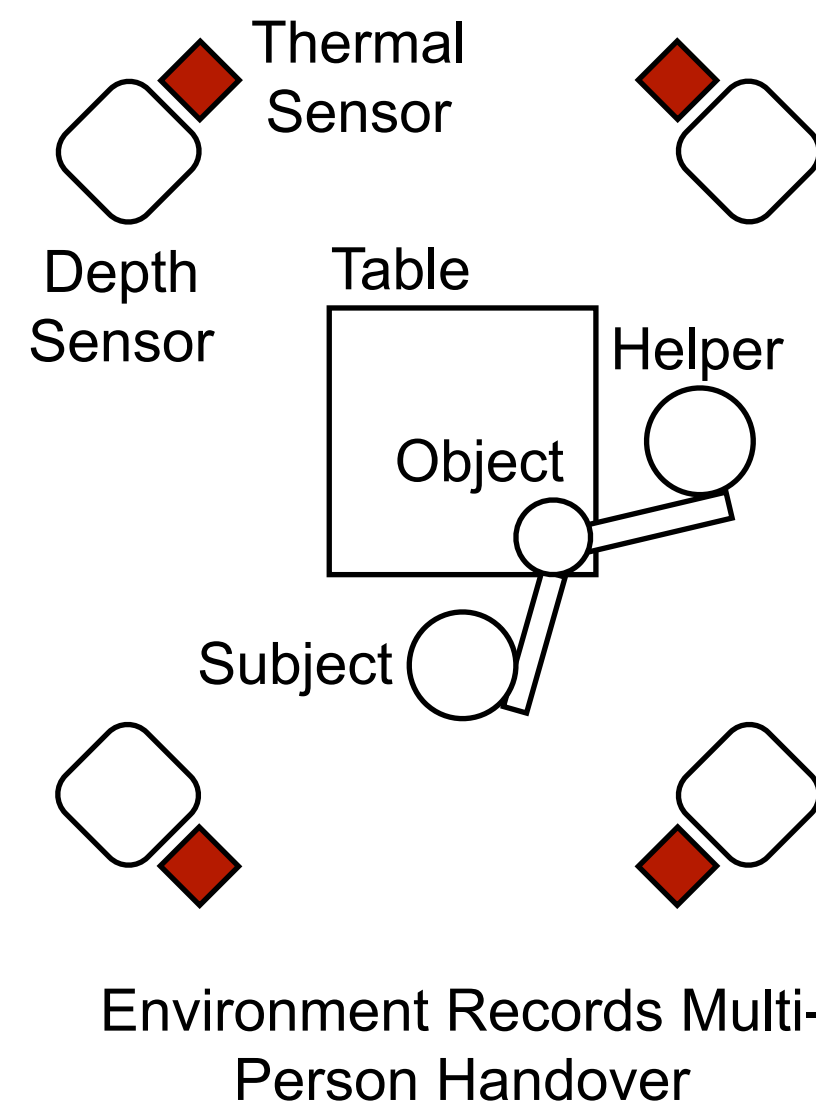
Key Problem: Imbibing robotic manipulators with understanding on human preferences for object handover

Significance: Enabling safe human-aware collaborative human-robot interactions in the wild

Solution: Use multi-modal data on multi-person handover of objects to learn human preferences on hold, end pose, and release time

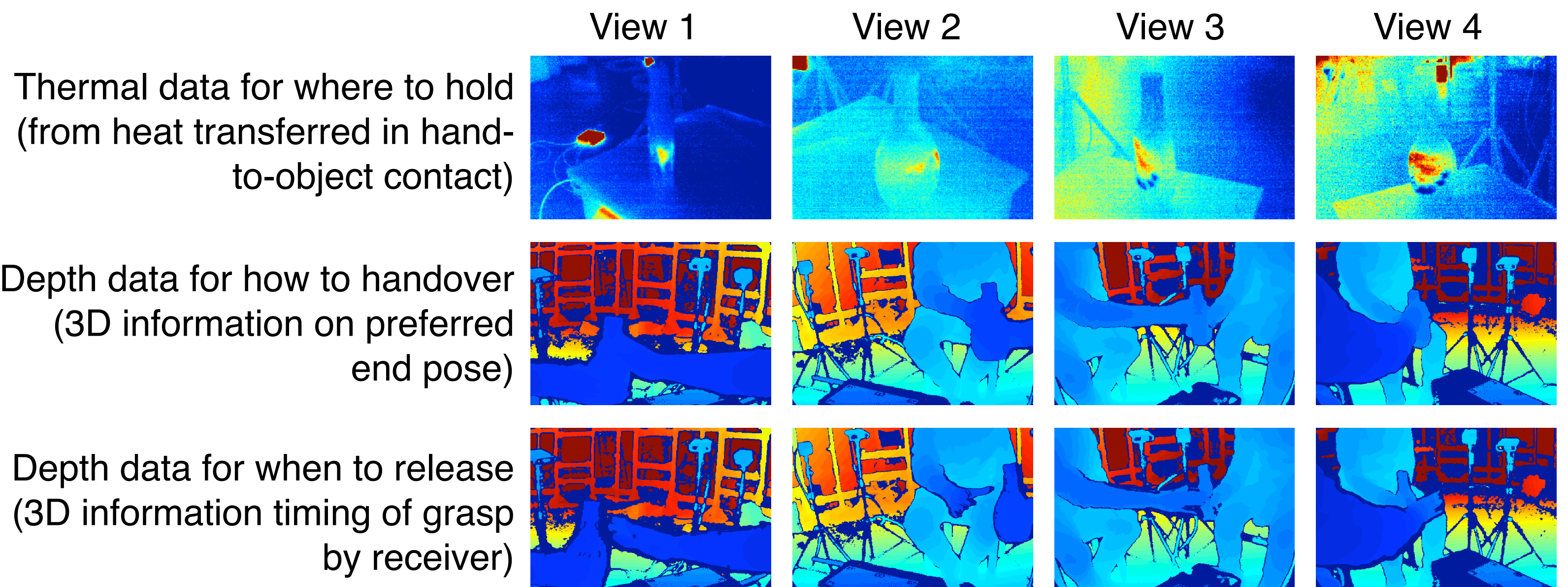


Multimodal Recording Environment



Key Innovations:

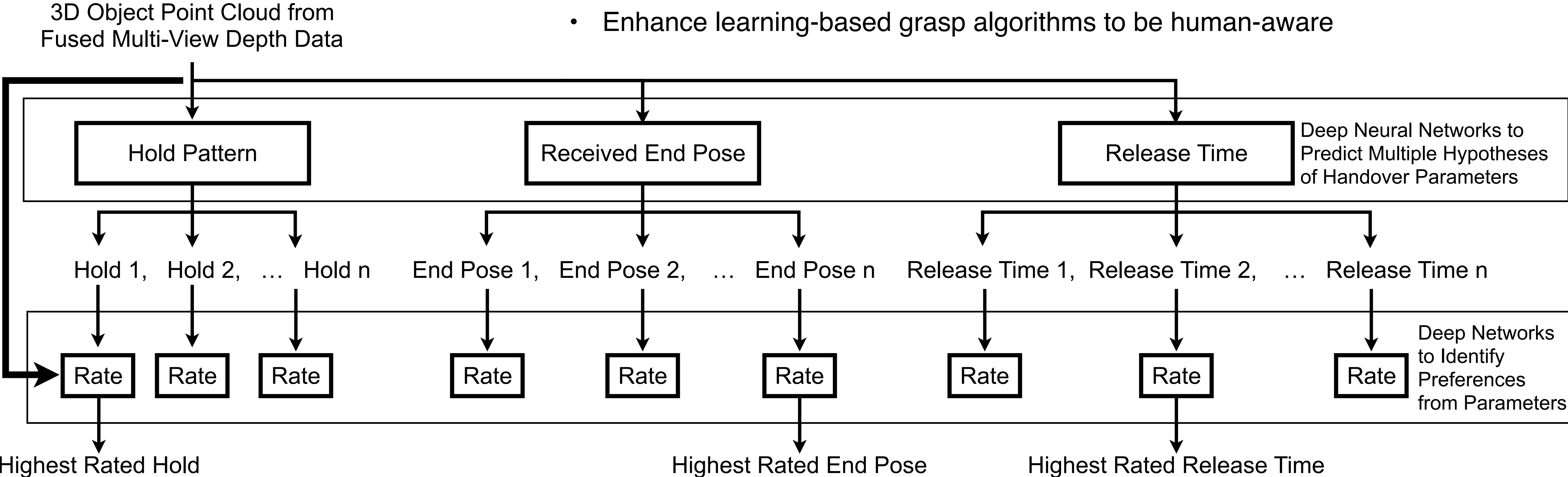
- **Lead 3D capture of 30 subjects performing handover interactions with 480 objects using calibrated multi-viewpoint multi-sensor environment**
- Provide deep learning algorithms to recognize human handover preferences from input 3D representations of objects as input
- Enhance learning-based grasp algorithms to be human-aware



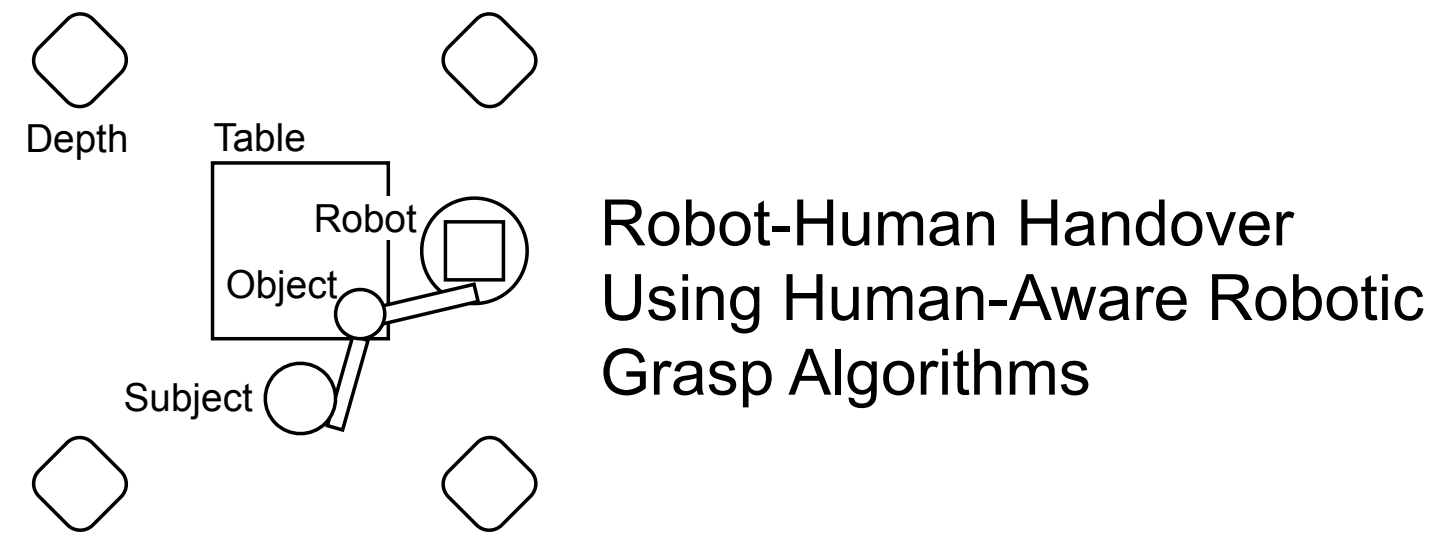
Solution: Use multi-modal data on multi-person handover of objects to learn human preferences on hold, end pose, and release time

Key Innovations:

- Lead 3D capture of 30 subjects performing handover interactions with 480 objects using calibrated multi-viewpoint multi-sensor environment
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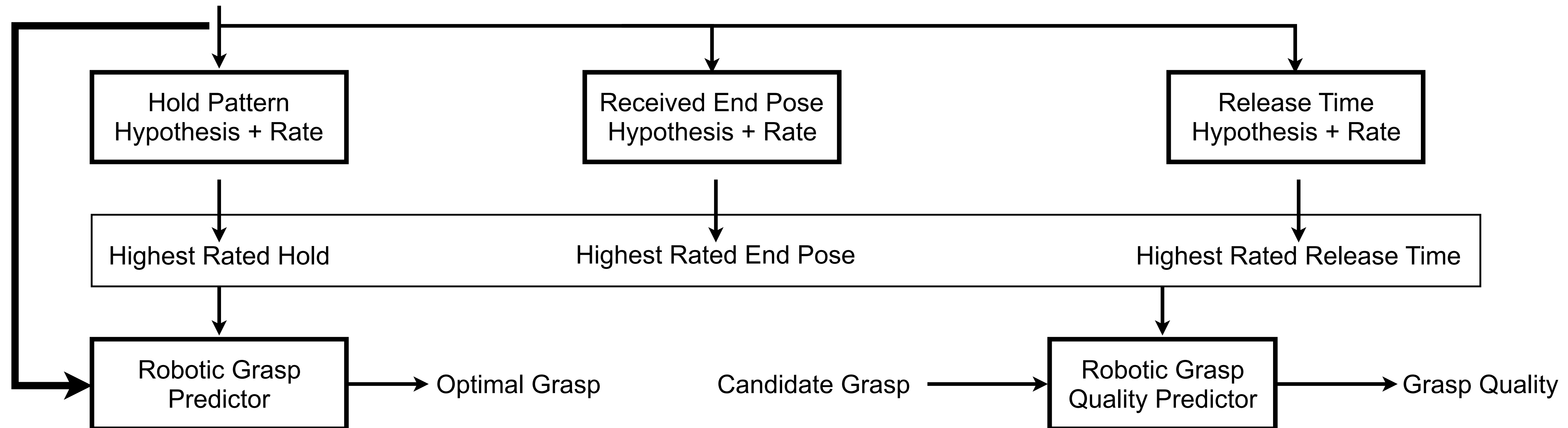
Solution: Use multi-modal data on multi-person handover of objects to learn human preferences on hold, end pose, and release time



Key Innovations:

- Lead 3D capture of 30 subjects performing handover interactions with 480 objects using calibrated multi-viewpoint multi-sensor environment
- Provide deep learning algorithms to recognize human handover preferences from input 3D representations of objects as input
- **Enhance learning-based grasp algorithms to be human-aware**

3D Object Point Cloud from Fused Multi-View Depth Data



Broader Impacts

- Enables co-robots to provide safe assistance in assisted living, warehousing, retail, assembly, and repair.
- We plan to evaluate human-aware grasp algorithms through studies with 64 subjects using three manipulators: 2 Kinova Gen3s and 1 LoCoBot.
- We will publicly release our multimodal dataset on multi-person handover interactions with 480 objects.
- The project will involve undergraduate researchers at Clarkson through directed study & undergraduate research credits, work-study, and summer research programs.
- We will demo the human-aware robots to perform outreach during Clarkson's Open House, Accepted Students' Day, Family Weekend, and Horizons Program.