Gaze Tracking Enabled Automatic Robot Error Detection

Background Reading Presentation

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My Project: Gaze Tracking Enabled Automatic Robot Error Detection

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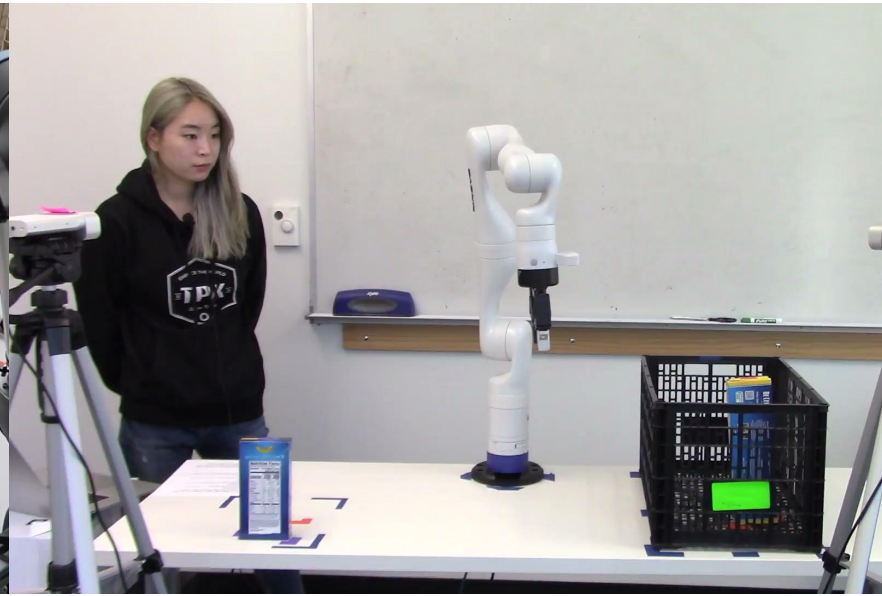

Gaze for Error Detection During Human-Robot Shared Manipulation

Aronson, R. M., & Admoni, H. (2018). Gaze for error detection during human-robot shared manipulation. In *Fundamentals of Joint Action workshop, Robotics: Science and Systems*.

- Different task (assistive feeding manipulation)
- Same intended understanding with gaze data

Background

- Real-time human-robot collaboration is an ongoing challenge
- Learn people’s mental state through non-verbal behavior
- Gaze can provide additional insights
    - Gaze behaviors are often task/goal oriented

Experiment - Food Spearing Task

- 24 able-bodied participants to use robotic manipulator
- 4 different assistive conditions
  - Fully teleoperated
  - Autonomous condition with joystick only for goal selection
  - Intermediate assistance level #1
  - Intermediate assistance level #2
- Captured gaze, focal point, and video

Experiment - Gaze for anomaly detection

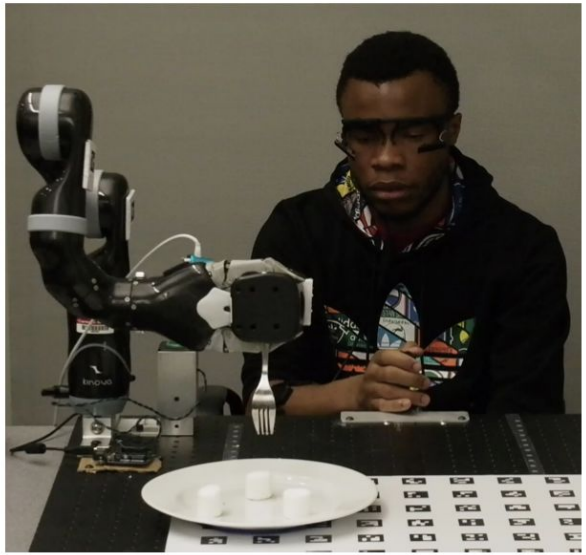

Fig. 1: In this assistive manipulation task, a participant controls the robot manipulator to spear a marshmallow, using the joystick to provide input. A Pupil Labs Pupil eye tracker [13] captures the participant's gaze information.

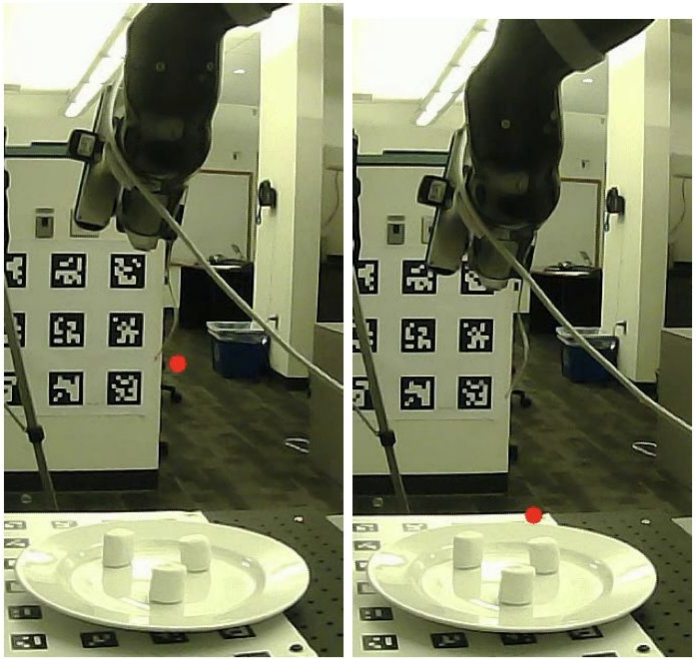

Fig. 2: In ordinary operation, people look only at the robot end-effector tool tip (left) or the spearing target (right).

(1/2) Robot Occlusion

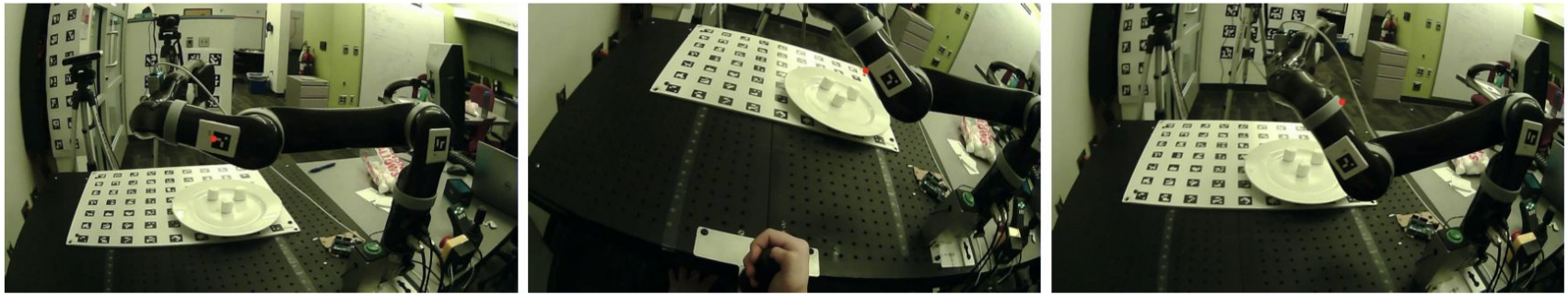

Fig. 3: When the robot occludes the robot end-effector, the user must move their head to get a better view. This behavior can be detected from the egocentric video data, shown here in a three-frame sequence.

(2/2) Kinematic Configurations

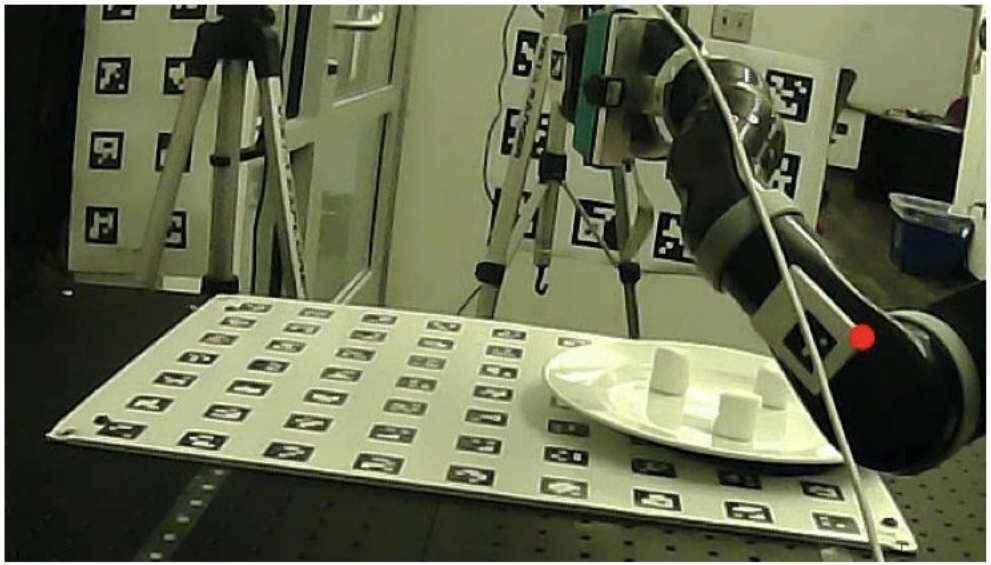

Fig. 4: The participant's gaze location, as indicated by the red circle, covers the robot joint as they maneuver through a bad kinematic configuration.

Assessment

Strengths

- Collected human gaze data showed a pattern of gaze data across participants (examples occurring at least 5 times)

Weakness

- Small dataset, only 24 participants
- Only 2 case studies / types of errors
- Not an intentional error scenario - noticed the error afterwards

Relevance

- Same intended gaze application and similar collection of data
    - Eye tracking glasses from same company (core vs invisible)

Questions?