Continuous Vocalization Control of A Full-Scale Assistive Robot

Mike. Chung[1]*, Eric Rombokas[1]*, Qi An[1], Yoky Matuoka[1], and Jeff Bilmes[2]

[1]Neurobotics Lab, Department of Computer Science and Engineering, University of Washington, Seattle, USA
[2]SSLI Lab, Department of Electrical Engineering, University of Washington, Seattle, USA

Major Contributions:

► Demonstrates the first instance of a full-scale robotic arm being controlled by non-verbal vocalizations to perform real world tasks.

► Introduces three different control methods. One of the control methods, inspired by the "synergy hypothesis" of neuroscience, is particularly novel.

► Studies nine users using the system to perform two real-world tasks, namely an empty bottle trashing task and a bag moving task.

Methods:

► *Direct Joint Angle Control:* the user controls two joint DoFs at any given time. Discrete vocal sounds (e.g. [k] as in 'kick') switch currently active joints.
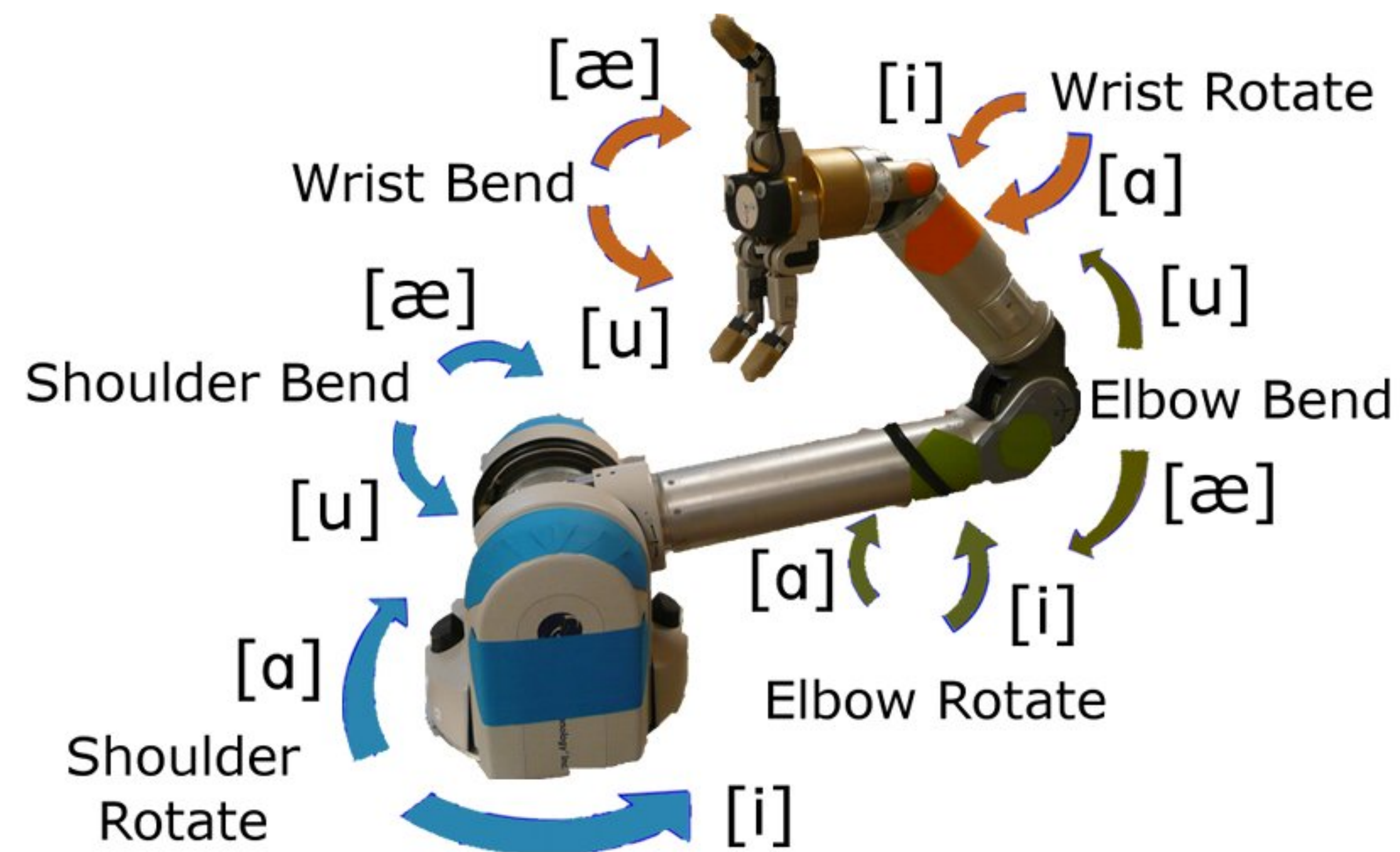

► *Inverse Kinematics Control:* two modes are available for this method, manipulation mode and position mode. Manipulation mode provides fine control over hand and wrist, while position mode moves effector position in cartesian coordinates.
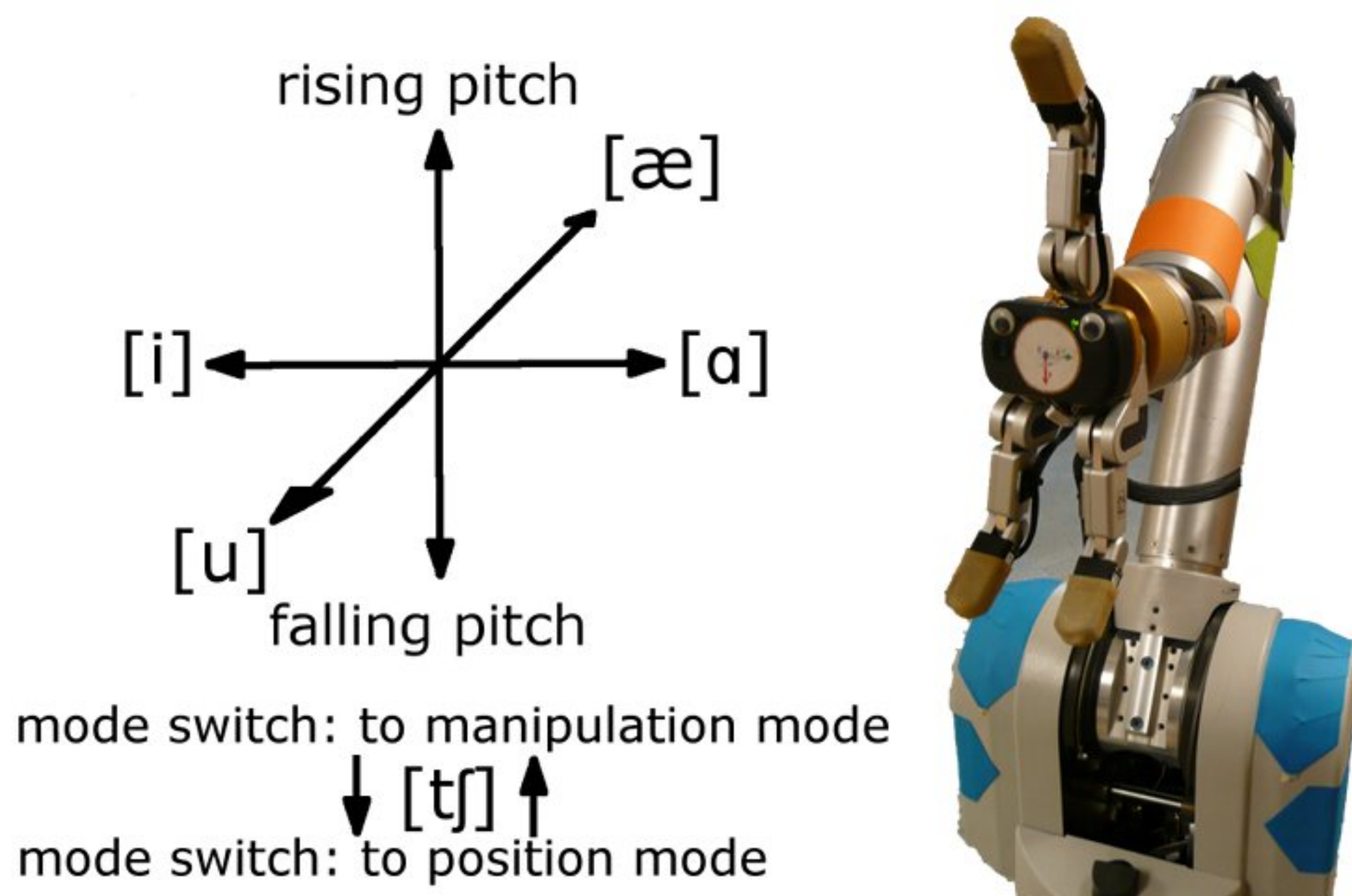
► *Synergy Control:* The synergy control method is based on movement primitives. Each primitive is a weighting of the joints that is tailored to the task. The weightings are constructed automatically from a recording of a user completing the task using the direct joint control mode.


User Study:

(a)   (b)
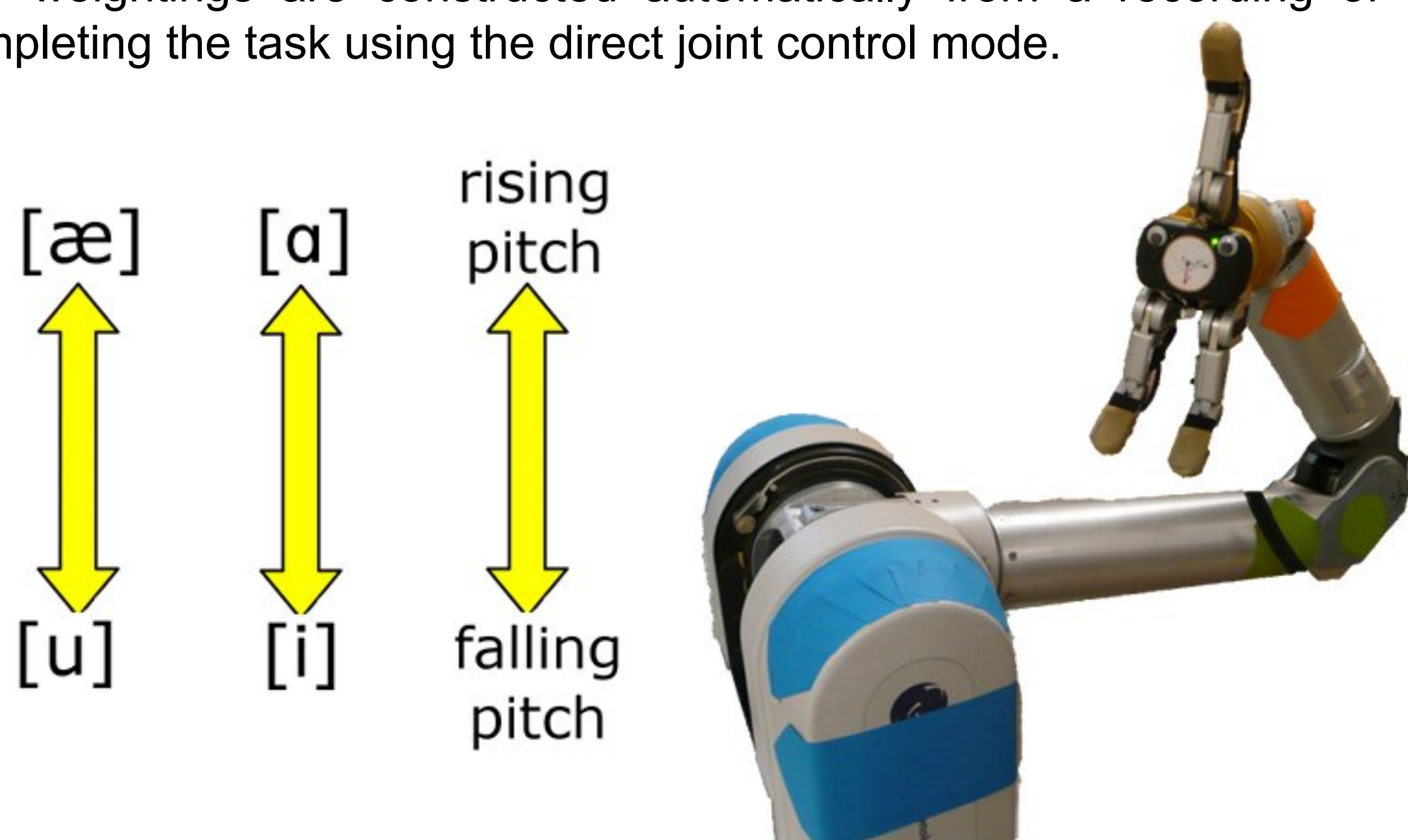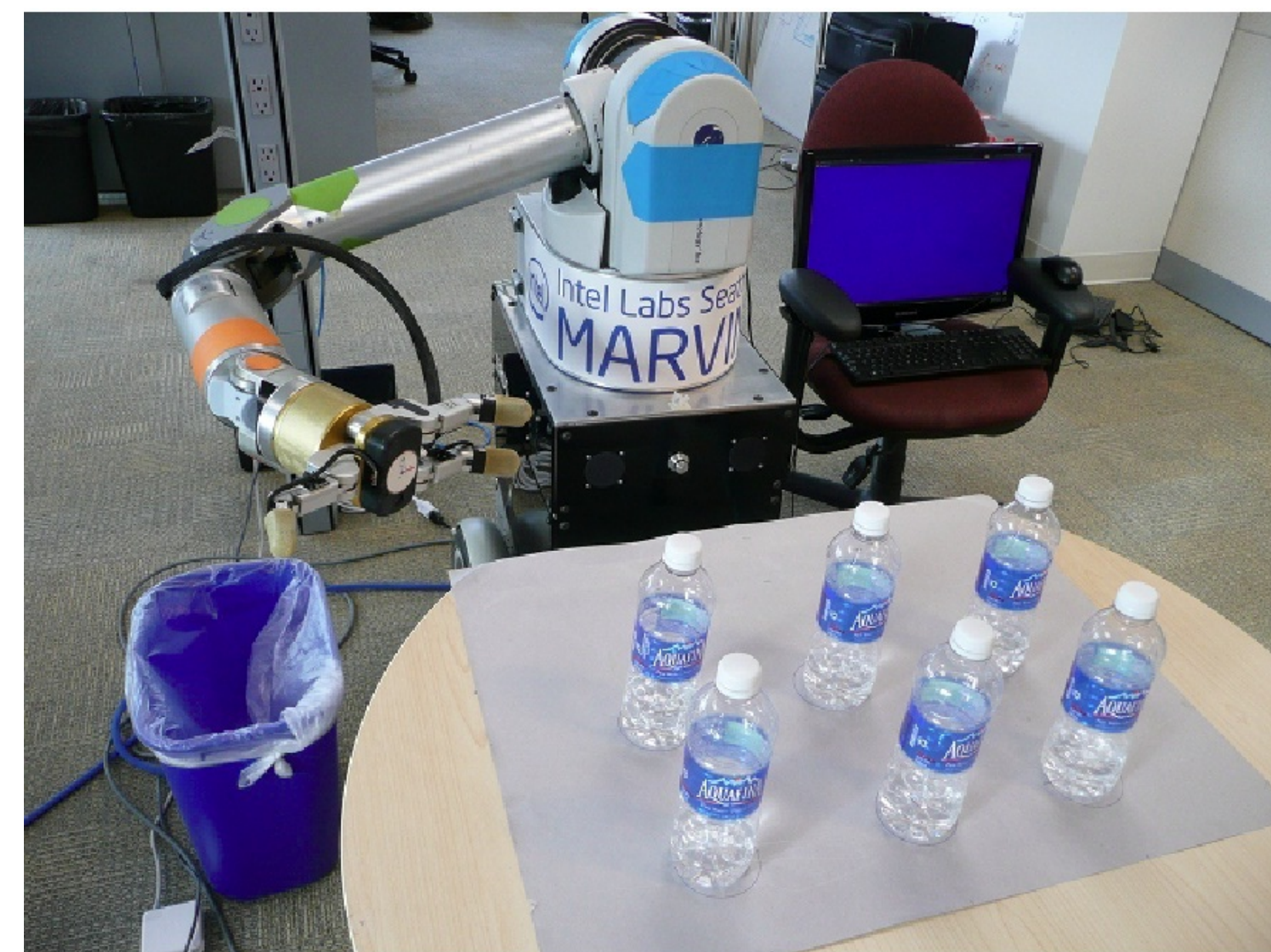
► Task (a) – Empty bottle trashing: six nearly empty water bottles were placed at pre-assigned positions on the table. Users' task is to deliver bottles from the table to the trashcan.

► Task (b) – Bag moving task: Users' task is to move the grocery bag weighted 3kg with a flexible handle from the first tabletop to the next tabletop.

► Nine users were(delete this word) participated in four trials of each task in random ordering over two days.

Results:

(a)

(b)

(c)
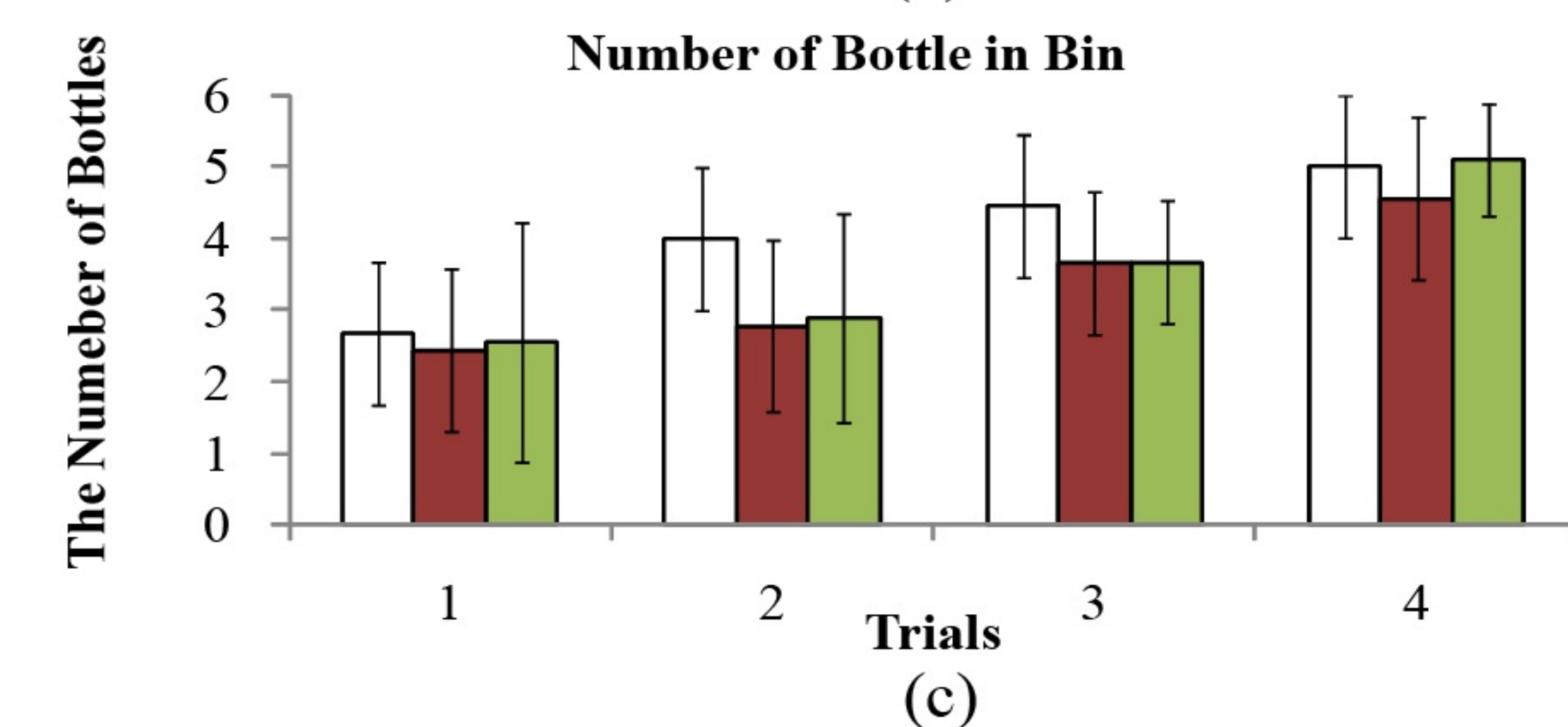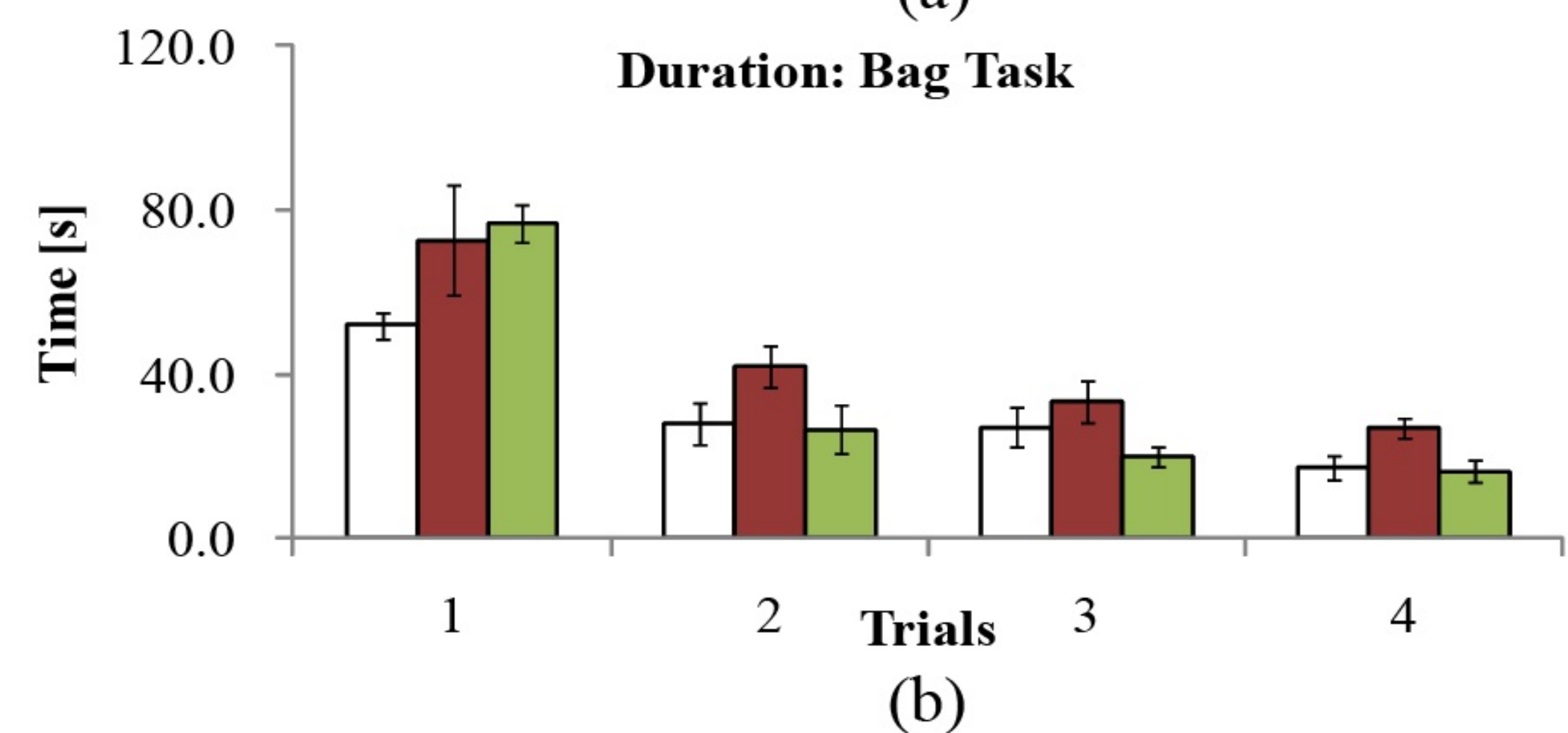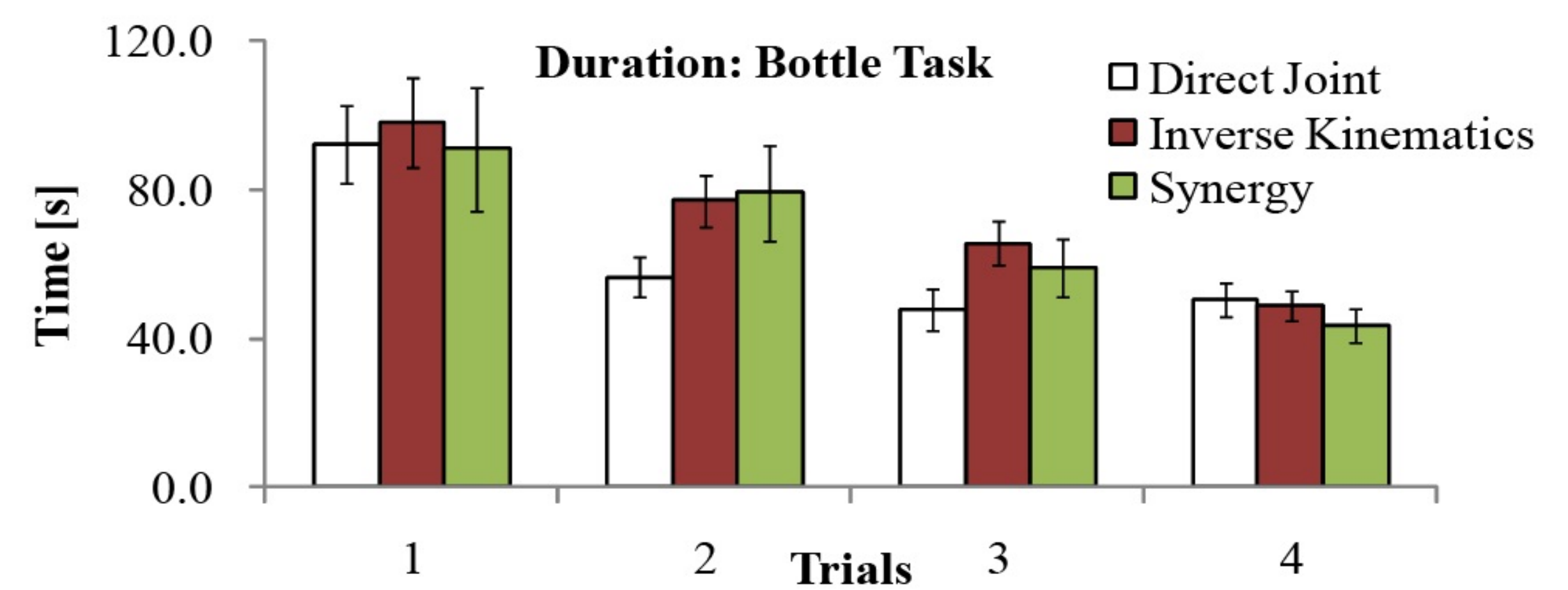
► (a) The mean time taken per bottle. The users are able to improve their speed for all control methods.

► (b) time taken to complete the bag task. All users are successful and able to improve their speed with practice.

► © total number of bottles trashed in 5 minutes for the bottle task.