A Point-and-Click Interface for the Real World: Laser Designation of Objects for Mobile Manipulation

By C. Kemp, C. Anderson, H. Nguyen, A. Trevor, and Z. Xu

Presented by Gal Peleg
CSCI2950-Z, Brown University
April 5, 2010

Human-Robot Interaction , pp. 241-248, 2008.

Presentation Outline

- Motivation & Problem Statement
- Demonstration (Video)
- Prior & Related Work
- Implementation
- Experiments
- Results
- Discussion & Future Work

Motivation & Problem Statement

- Robots need to be able to:
  - manipulate common hand-held objects
  - *do so by receiving direction from people*

- The authors' approach:
  - requires no instrumentation of the environment
  - makes use of everyday pointing devices
  - has low spatial error
  - is fully mobile

Demonstration (Videos)

- ELE, an assistant robot, performing object retrieval interacting with users through the clickable world interface

Prior & Related Work

- (Problems with) 2D point-and-click GUI
  - controlling from a remote location
  - display size, device usability, and comfort
  - requires that the user switch perspectives

- (Problems with) Natural Pointing
  - communicating a precise location is difficult
  - produces high uncertainty

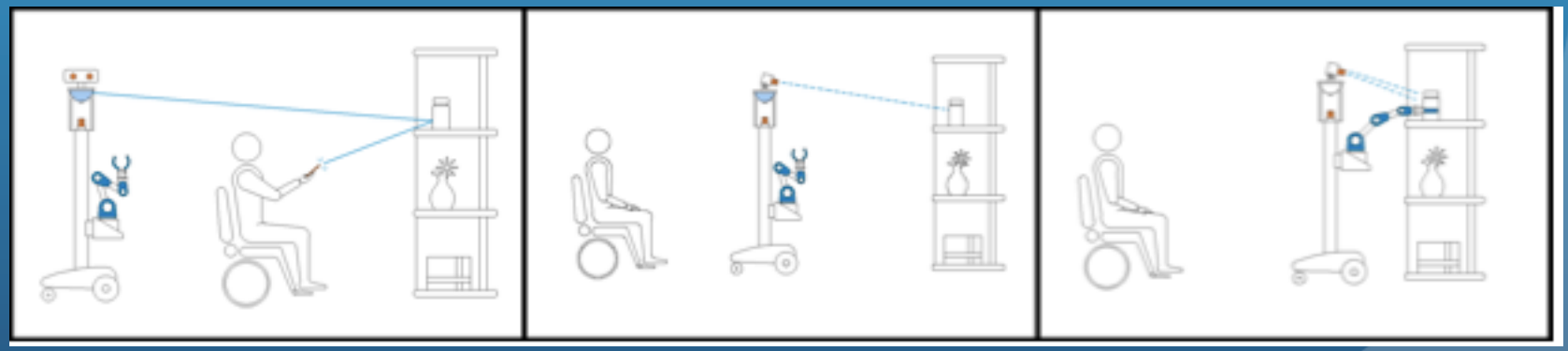
Prior & Related Work (Continued)

- (Problems with) Intelligent Devices
  - need specialized, networked, computer-operated, intelligent devices
  - can't interact with physical environment

- (Problems with) "Traditional" Laser Designation
  - tasks are constrained
  - few well-modeled objects

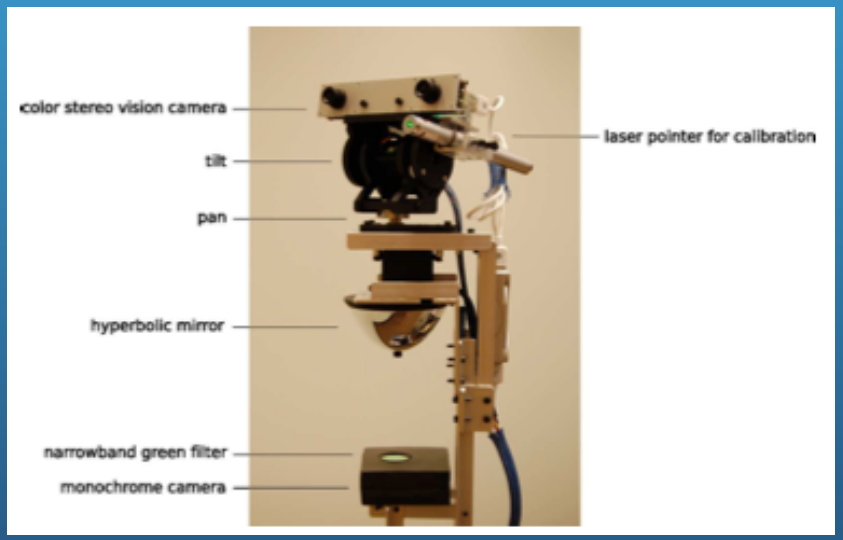
Implementation

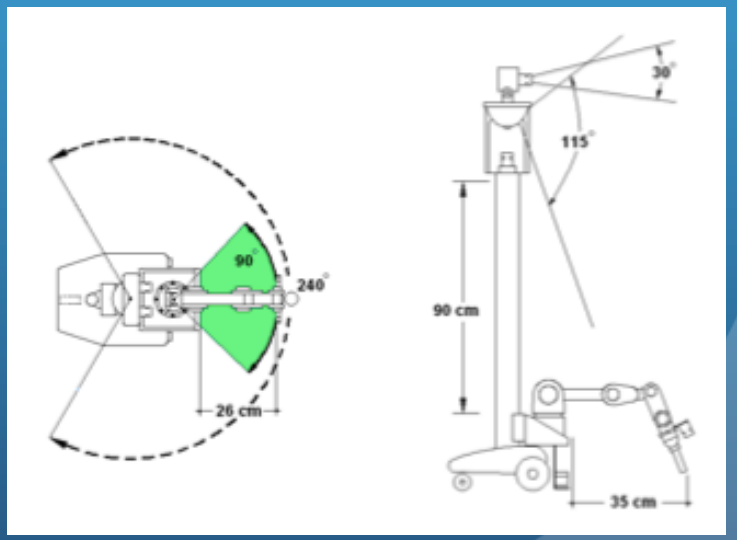
- Three main steps:
  - 1. detect the laser spot in field of view
  - 2. move stereo camera to look at the detected spot
  - 3. estimate 3D location of spot relative to robot's body
  - (4). move to, and grasp object



Implementation (Continued)

- Observing the environment
  - authors use a catadioptric, omnidirectional camera placed at 1.6m
  - well-matched to human environments





Implementation (Continued)

- Detecting the Laser Spot
  - high visibility: humans vs. robots using video cameras
  - use a monochrome camera with a narrow-band, green filter matched to the frequency of green laser pointers

- Estimating the 3D Location
  - detect laser spot and estimate its 3D location eight times, if successful, return average
  - else, keep looking

Experiment 1: Setup

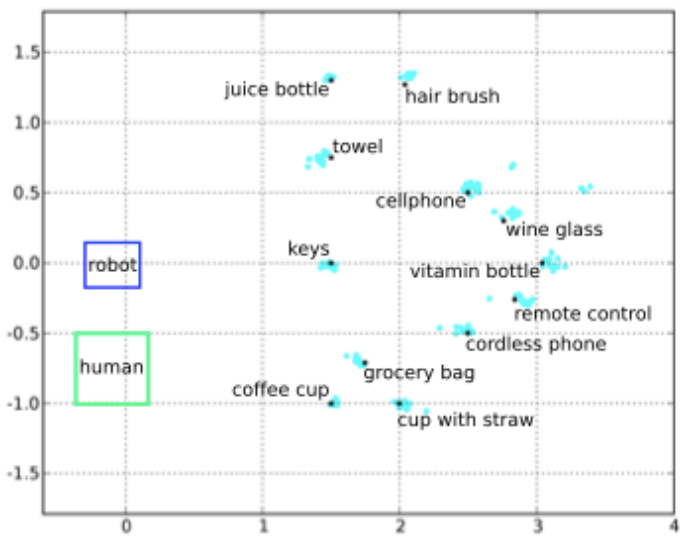
- Designating Positions of Objects
  - 9 different household objects
  - “Office” environment
  - 180 trials of the laser detection and position estimation

Figure 7: The experimental setup used for the laser-designation tests.

Figure 9: The set of objects used for the laser-designation tests.

Experiment 1: Results

- Test resulted in 178 successful “clicks” out of 179 attempts (99.4%)
- Average error of 9.75 cm with respect to hand-measured locations



Object Location	Object Name	Distance from robot (m)	Average Error (m)
Floor	Keys	1.50	0.05
	Cordless Phone	2.55	0.07
	Cell Phone	1.68	0.14
	Towel	1.68	0.10
	Grocery Bag	1.89	0.07
Desk	Remote Control	2.85	0.12
	Hair Brush	2.40	0.08
	Cup with Straw	2.24	0.07
	Wine Glass	2.78	0.30
	Juice Bottle	1.99	0.05
	Coffee Cup	1.80	0.04
Shelf	Vitamin Bottle	3.04	0.08

Experiment 2

- Mobile Manipulation: Grasping Selected Objects
  - here, robot also approaches, grasps, and lifts object
  - able to successfully grasp nine out of the ten objects

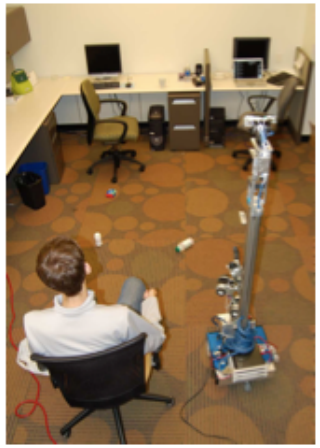
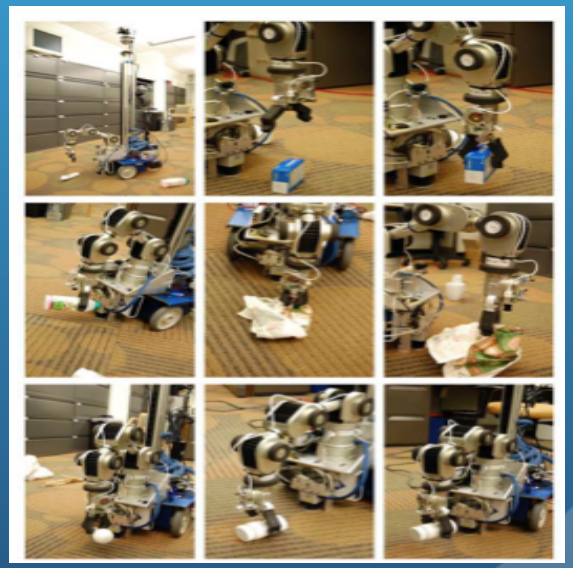


Figure 10: The experimental setup used for the object-acquisition tests.



Discussion & Future Work

- One Idea: combining laser pointer interface with speech
- One Problem: no studies conducted with non-expert users
- Claim: “The current laser pointer interface is robust enough for realistic applications”
- Your thoughts?