

# Profile of a Winner: Brandeis University and Ullanta Performance Robotics' "Robotic Love Triangle"

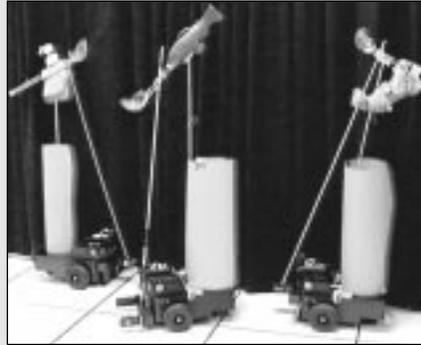
The Hors d'Oeuvres, Anyone? event tested robots' ability to perform an interactive task (hors d'oeuvres service) entertainingly and effectively in a dynamic, crowded environment. Effectiveness included safety, coverage of the reception area, recognition of humans, offering of hors d'oeuvres, and detection of need for refills; entertainment value was determined by popular vote. To fully exploit the talents of our team, drawn from Brandeis's multirobot Interaction Lab and robotic theater troupe Ullanta Performance Robotics, we entered a team of three dramatically interacting robots. Effective Service

Our PIONEER robots (BEN, MAE, and ULLANTA THE ROBOT LEVIN) are quite sturdy but only one foot tall. At this height, they could neither effectively serve nor avoid being tripped over in the crowd, and our participation in the Find-Life-on-Mars event dictated that we be able to switch software and hardware to turn a Mars exploration team into a domestic service staff in fewer than five minutes.

We contrived a simple manipulator able to physically offer snacks at a convenient height by attaching a 3-foot pole to the back of each robot. On top of this pole was hinged a rigid tube with a snack container at one end and a serving bowl at the other (see figure). A dowel connected the bowl to the robot's gripper; lowering the gripper caused the snack (peanuts) to flow into the bowl, which extended somewhat like an offering hand, and raising the gripper caused the bowl to empty back into the container.

Behavior-based control (Werger 1998) allowed the robots to respond rapidly to the environment. Separate behaviors controlled velocity to maintain a safe distance from walls, robots, and people; rotation for navigation; and snack offering (lowering of the gripper and motion inhibition) in response to "humanlike" sonar signatures.

Contest rules specified that only one team member could be present to ensure safety and reload hors d'oeuvres. This rule was a special challenge for us as the only multirobot entry: It was essential that the robots maintain a cohesive group in the dense crowd and that, in case of separation, they continue to perform safely



*The Event.*

while they attempt to reunite.

## Entertaining Interaction

Although all our competitors chose voice-synthesis or video-based interaction with the audience, our theatrical experience indicated that physical action would be more effective in the reception crowd. Our behavior-based approach leads to highly reactive lifelike behavior that is extremely compelling, and our use of vision (Sargent et. al. 1997) as the basis for robotic interaction results in a sense of "gaze" and "eye contact" to which observers can easily relate (Ullanta URL 1998).

The dramatic aspect of our entry was the "robotic love triangle." The robots were programmed to switch behavioral "moods": In 2 of three 30-second cycles, each robot would be "social," seeking the company of other robots and serving humans, but in the third, it would become "antisocial," avoiding robots and not acknowledging humans. The cycles were initialized so that a repeating pattern emerged: One robot would storm out as the others became intimate, then return affectionately as another left. Uncertainty of the real world would result in numerous variations, such as social robots running after antisocial ones instead of becoming involved with the other social robot. The guests, informed by signs on the robots that the love triangle not only caused the robots emotional strife but interfered with their service, were asked to step between the robots if they entered into long, intimate gazes with each other. This request had the effect of both drawing the audience into the drama and trig-

gering the obstacle avoidance to move the robots into more effective service configurations (this type of exploitation of the "environment" is a key principle of behavior-based robotics).

The robots were "costumed" through decoration of the snack containers as a bear holding a honey pot, Snoopy sitting on top of his doghouse, and a fish swallowing and regurgitating snacks.

## Performance

The group remained cohesive throughout the bulk of the hour-long event, and the pattern of social and antisocial behavior caused it to effectively cover the reception area. Our simple manipulator was indeed perceived as "offering" snacks. The guests both followed and entered into the robots' interactions, and on the occasions where one robot would get separated from the others, concerned guests took it on themselves to clear a path for it to regain visual contact. Enterprising children discovered that the color of a cheese served by another robot was similar to the neon orange of our robots' distinguishing marks and delighted in leading the robots around like hungry dogs.

## Applicability

A number of people were impressed enough by our contest performance to request similar ones for entertainment or advertising purposes. Although the dramatic interaction always differs in theme and complexity, Ullanta Performance Robotics has since used these techniques for various "wandering exhibitions" (Ullanta URL 1998) in crowded areas, including one that won a Best of Show Award at MacWorld San Francisco.

*Credits:* Directed by Barry Brian Werger. Manipulator construction by Dani Goldberg. Costume design by Betsy Rozier, Seth Landsman, Dan Griffin, and Andy Garland.

– Barry Brian Werger