The "Hors d'Oeuvres, Anyone?" Event

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■ The first Hors d'Oeuvres, Anyone? event at the American Association for Artificial Intelligence Mobile Robot Competition was held in 1997. Five teams entered their robotic waiters into the contest. After a preliminary round to judge the safety of the robots, the robots served conference attendees at the opening reception of the Fourteenth National Conference on Artificial Intelligence.

The Hors d'Oeuvres, Anyone? event was held for the first time at the 1997 American Association for Artificial Intelligence (AAAI) Mobile Robot Competition and Exhibition. Robots from five teams acted as waiters, serving snacks to the AAAI conference attendees at the opening reception. The robots served a variety of food items, including sandwiches, pretzels, peanuts, and candy. The primary criterion for food selection was that no item could be messy, preventing potential damage to the robotic hardware.

Safety, efficiency, and entertainment were all part of the final scoring algorithm. The event had two phases: (1) a preliminary technical round and (2) a reception round. In the technical round, only the robot competition judges interacted with the robots. This phase was used as a preliminary to ensure the safety of each system and judge the research components of the entries. In the interaction round, AAAI attendees judged the robots that were serving them. Entertainment value counted during this phase; people voted for their favorite entry.

The event was held in a large square penned area allowing the robots to be kept in one area of the exhibition hall and preventing them from wandering into an area where wires were lying on the ground (a common sight in exhibition halls). It also kept the robots from being damaged by drinks or messy snacks that were available at the reception. A person stationed at the entrance to the pen asked people to leave these potentially damaging items behind. The pen also allowed the event organizers to control the crowds around the robots. If the crowds were too thick, the robots would be unable to move around the ring because they were not allowed to touch people.

Brandeis University won the overall event (see sidebar). The overall winner was determined by combining the technical phase (40 percent) and the audience phase (60 percent). In addition, there were rankings for each phase (table 1).

Robot Teams

Brandeis University entered with three robots: BEN, MAE, and ULLANTA THE ROBOT LEVIN (figure 1). The robots served people peanuts from toys (a teddy bear with a honey pot, Snoopy on his dog house, and a fish) attached to poles on the short pioneer robots. As the arm of the pioneer robot was raised and lowered, the serving containers would rock back and forth, bringing peanuts to the front scoop to serve people. The robots carried signs to explain their "robotic love triangle" to observers. Two of the three robots would "look into each other's eyes," and the third robot would "storm off." After a short time, the third robot would return, and another would leave.

The Colorado School of Mines entry, CRISBOT, used a NOMAD robot base (figure 2). To find people, the robot's vision system searched for the largest flesh-colored regions. A speech synthesizer allowed the robot to introduce itself and offer appetizers to the crowd. A sign reading "Will Demo for Food" was attached to the side of the robot.

The Navy Center for Applied Research in Artificial Intelligence brought COYOTE, another

Technical Merit
1. Navy Center for Applied Research in Artificial Intelligence
2. Texas Robotics and Automation Center Labs (TracLabs)
3. Colorado School of Mines

People's Choice
1. Brandeis University
2. Navy Center for Applied Research in Artificial Intelligence
3. Colorado School of Mines

Overall (60% People's Choice, 40% Technical Merit)
1. Brandeis University
2. Navy Center for Applied Research in Artificial Intelligence
3. Colorado School of Mines

Table 1. Final Standings.

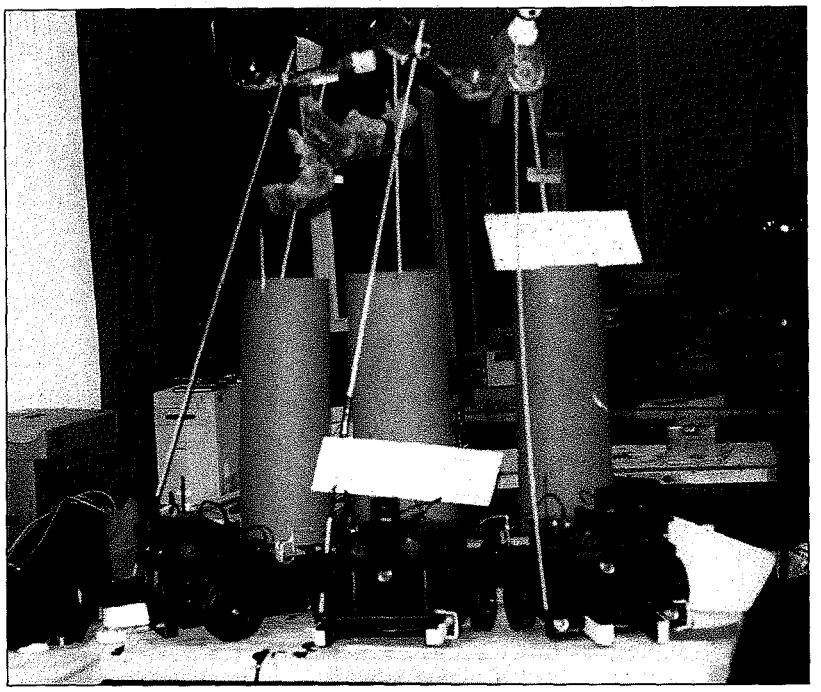

Figure 1. BEN, MAE, and ULLANTA THE ROBOT LEVIN from Brandeis University.

NOMAD robot, to the event (figure 3). COYOTE uses frontier-based exploration to build maps; the robot explores unknown frontiers in the current map by moving to the closest frontier, sweeping its sensors, and adding the new information to the map. A sensor placed to the side of the tray detected when a person was reaching for food. A speech synthesizer on the robot allowed it to talk to the crowd. Additionally, COYOTE wore a bow tie for more formal service.

Texas Robotics and Automation Center Labs (TracLabs) created SERVERDROID for the event (figure 4). The robot had a notebook computer mounted on a cardboard tower above a PIONEER base. A pyroelectric sensor was used to differentiate people from inanimate objects. To attract and entertain people, the robot used a multimedia presentation. People were invited to touch the computer screen to view and listen to movie trailers. The robot also had a short welcome video.

LOBOTOMOUS was a home-built robot entry from the University of New Mexico (UNM) (figure 5). LOBOTOMOUS is a round robot (that looks suspiciously like a 3-1/2–foot section of PVC sewer pipe) that is propelled by 2 drive motors on the centerline and kept in balance with 2 casters. It has a ring of 12 Polaroid ultrasonic sensors to sense the environment, a 16-bit Soundblaster-compatible audio card to talk, and a 486 PC-104 format processor board to think. For the competition, LOBOTOMOUS was outfitted with a stylish UNM barbecue apron and a large silver serving tray on top.

Technical Round

In the technical phase, robots were judged on their abilities to serve food safely and efficiently. This preliminary round ensured that the robots were safe and would not harm the attendees or themselves. The judges for this phase were experienced roboticists. Each robot team needed to demonstrate the following behaviors:

First, the robot would not charge into people at high speed. Safety was crucial; it would not be acceptable for a robot to injure a conference attendee. A low-speed bump could be allowed at the judges' discretion.

Second, the robot could carry a supply of food on a stable tray, and the food would stay on the tray under the mild bumps that might be expected at a cocktail party.

Third, the robot had a method for an escort to turn it away from a forbidden area. The robot could not be moved by hand.

Fourth, the robot would move around and would only stay still when offering food. The robots were not required to cover the entire ring, just a reasonable portion of it. Robots that were able to seek out and interact with people, determine when they needed to get a food refill, or actively hand food to people were awarded extra points.

In this round, first place went to COYOTE from the Navy Center for Applied Research in Artificial Intelligence. Its robot had a tray weight sensor that allowed it to detect when the food supply was low. SERVERDROID from TracLabs took second place, and CRISBOT from the Colorado School of Mines took third.

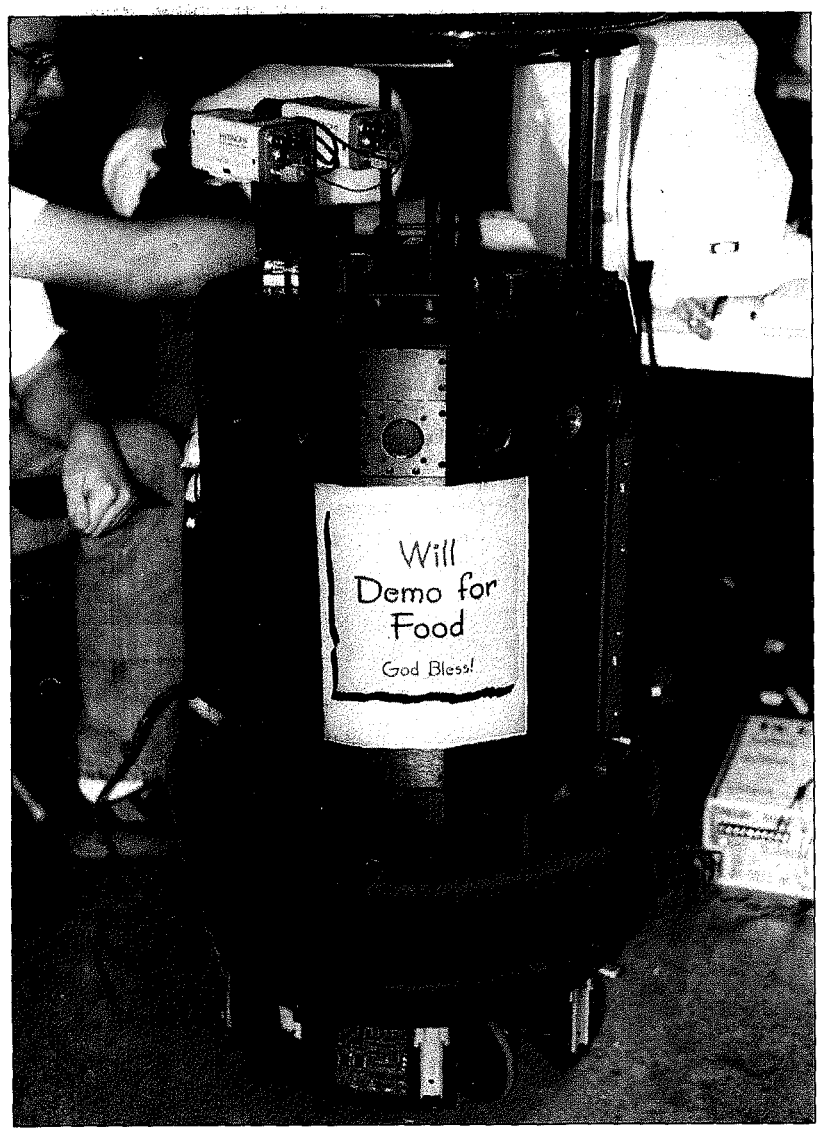

Figure 2. CRISBOT from the Colorado School of Mines.

Reception Round

In this phase, human interaction was the key to success. Entertainment value and personality counted heavily in this phase. Each conference attendee was given a gold token when he/she entered the reception hall to be served by the robots. After leaving the ring, each attendee voted for the winner of this phase by dropping his/her gold coin in the tip box of the favorite robot server.

The winner in this phase was Brandeis University with its three-robot entry. The story of the robotic love triangle encouraged participants to interact with the robots. People would try to herd them together when they had inadvertently been separated by the crowd. Additionally, the food containers drew people to the robots; the rocking teddy bear, Snoopy, and fish containers were crowd pleasers.

COYOTE from the Navy Center for Applied Research in Artificial Intelligence took second place in this phase, and CRISBOT from the Colorado School of Mines took third. COYOTE would stay in place while people were reaching for appetizers because of the sensor placed near the tray. The flesh-tone algorithm of CRISBOT's vision system caused it to approach people to offer appetizers, seeming like a real waiter.

LOBOTOMOUS tried to interact with the crowd through the use of a number of humorous sound clips. The sound clips were grouped by appropriateness to the current state of the program and were selected by a weighted randomization within the groups. As an example, when LOBOTOMOUS had closed on a person, it might have Homer Simpson say "Mmm...free goo!" Similarly, when it had been in one location too long, it might say "*boring!*" and wander off. If its path were blocked, it could say, "I wish to register a complaint!"

Despite its multimedia crowd interaction, SERVERDROID did not place in the second phase of the competition. The crowded and noisy atmosphere of the reception hall made it difficult for attendees to hear the robot. The lighting in the exhibit hall also made it difficult to see the video screen. A server of this type might perform better in a much smaller and more intimate reception. Additionally, Pete Bonasso of TracLabs believes that "a careful robot is not very entertaining. Because the update cycle of the commercial software was limited to about 2 Hz, SERVERDROID was gated to move at about .24 meters a second to avoid running into people as they walked across its path. But the faster moving robots were more popular even though they would bump into people often because they appeared to be more animated, more interesting."

Conclusions

This event was very successful but also offered lessons for future competitions. All entries were affected by the high density of people at the reception. It was far more difficult for the robots to move through the crowd than anticipated. Because robots were prohibited from touching people, it was often difficult for a robot to move to another area. At the 1998 AAAI Mobile Robot Competition and Exhibition, robots will be allowed to nudge people, much as a human server would touch a person's arm to move through a dense crowd.

The event also suggested that technical scoring should have more impact in future versions of the event. Roboticists want to be judged on

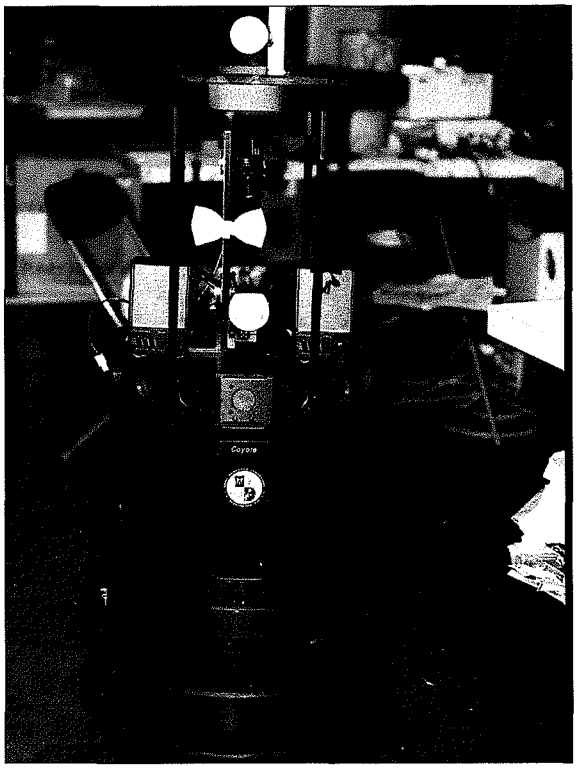

Figure 3. COYOTE from the Navy Center for Applied Research in AI.

the technical merit of their entries. Although it is important to engage the crowd, especially in a serving task, it is also important to have systems that can competently serve.

Acknowledgments

The rules committee for the event was Kurt Konolige and Marcus Huber. Pete Bonasso (TracLabs), Dan Stormont (University of New Mexico), and Barry Werger (Brandeis University) provided information on their entries.

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Barry Brian Werger is director of Ullanta Performance Robotics, a theater troup in which all actors are autonomous mobile robots, and a Ph.D. student at the USC's Robotics Research Lab.

Figure 4. SERVERDROID from TracLabs.

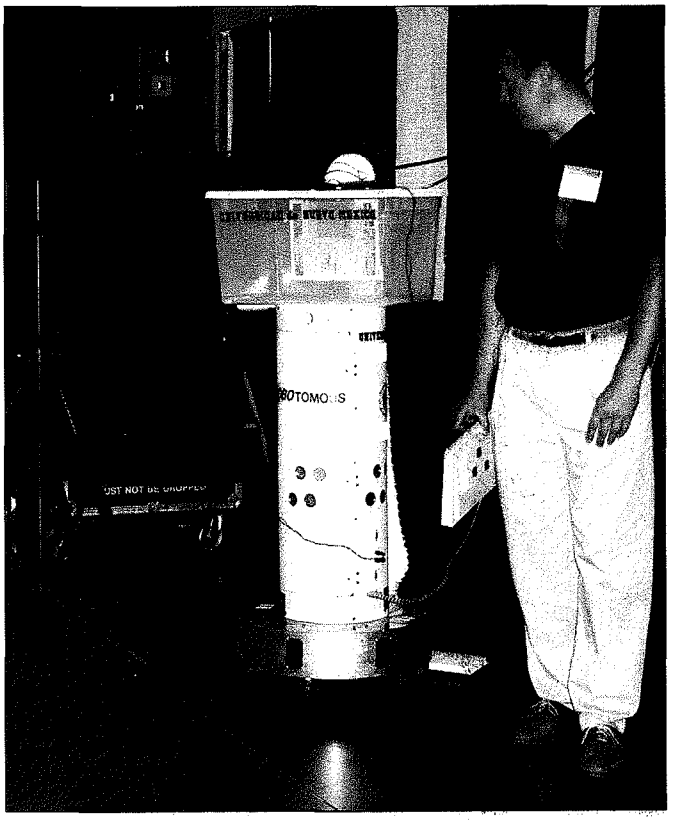

Figure 5. LOBOTOMOUS from the University of New Mexico.