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The Robot Host Competition at the AAAI-2002 Mobile Robot Competition

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■ Robots in the Robot Host competition, part of the Eighteenth National Conference on Artificial Intelligence (AAAI-2002) Mobile Robot Competition faced two challenges: (1) a serving task that was similar to the Hors d'Oeuvres, Anyone? event of previous years and (2) a new information kiosk task. Both tasks required moving carefully among people, politely offering them information or hors d'oeuvres, recognizing when the people are making a request, and answering the request.

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Celebrating the sixth year for the Robot Host competition, a new task, the robot information kiosk, was added. Three entries took on the challenge of creating host robots who can both offer hors d'oeuvres to attendees of the robot exhibition and can serve as a source of information to attendees during breaks in the program. Such robots require the ability to move safely in a crowded environment, cover a serving area, find and stop at people to offer food or information, interact with them, answer questions about the AAAI convention schedule, and detect when more food is needed and take the actions necessary to refill the serving tray.

Interesting capabilities were demonstrated by all three entries. For example, the entry from Swarthmore College, which won the event two years ago, involved two robots. The entry from University of Rochester had a revolving food tray. The entry from Kansas State University used minimal hardware sensors but used a conversation utility with a limited database to engage in conversation with users. All three entries used voice synthesis and voice-recognition software.

Kansas State University

The entry from Kansas State University (figure 1) was developed by three exchange students from the Czech Republic. Their entry consisted of a PIONEER 2-DX robot, named BORIVOJ, which is an old Czech name. The robot had sonar sensors to provide obstacle avoidance and an infrared sensor to sense the presence of people by their temperature. Navigation was random and limited by *x-y* bounds.

In the information kiosk task, BORIVOJ used sonars to locate groups of people and the infrared sensor to determine if the object was a human. BORIVOJ approached people and rotated to position the microphone and keyboard toward the person. After a verbal greeting,

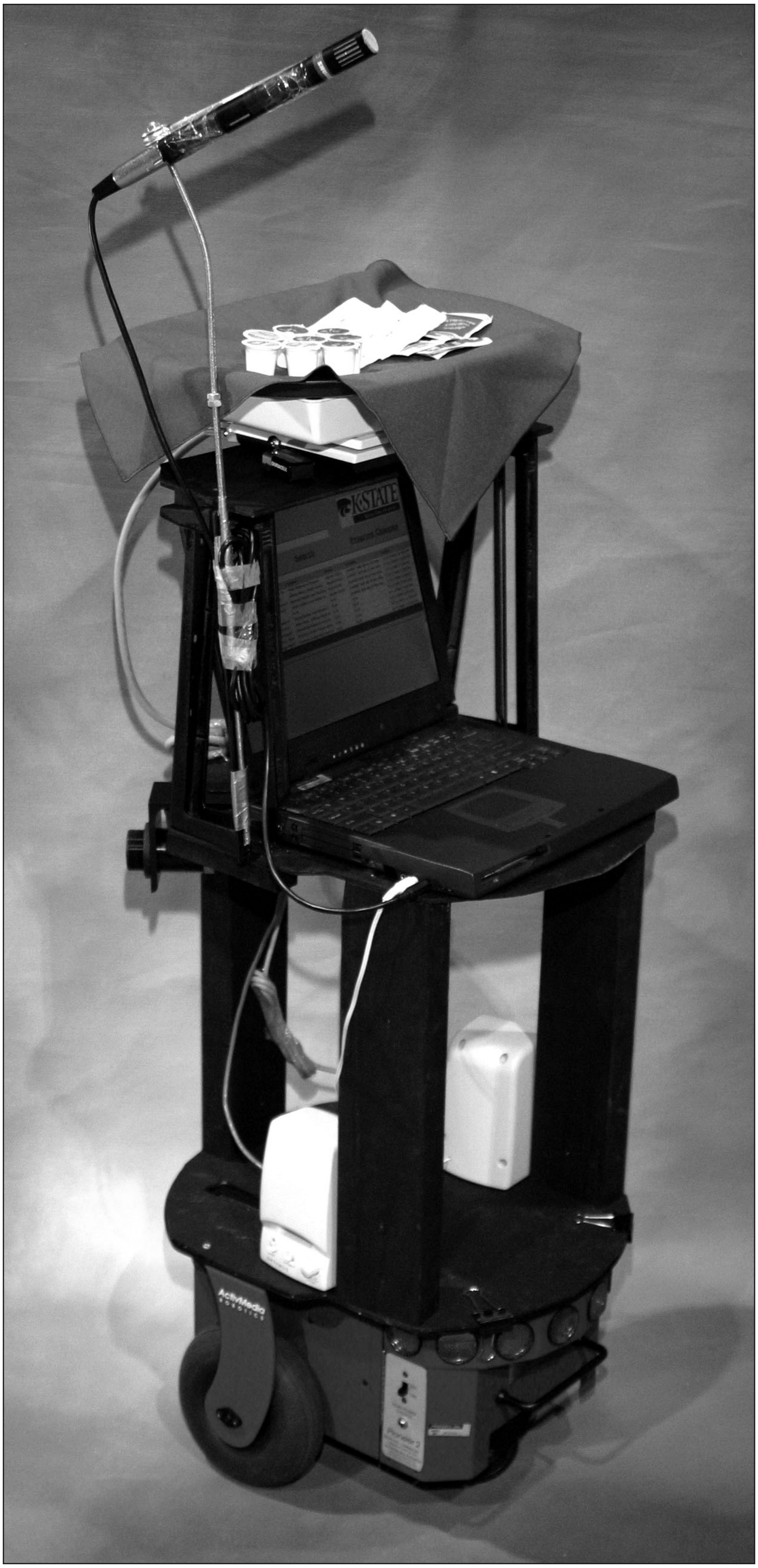

Figure 1. BORIVOJ *from Kansas State University.*

BORIVOJ waited for keyboard input to its search screen. BORIVOJ displayed the results and spoke the current information.

In the food-serving task, BORIVOJ used its sonars and infrared sensor to locate and approach people. It offered pizza to people and attempted to engage the person in a conversation based on a small dictionary. BORIVOJ responds to input from the keyboard.

The team from Swarthmore College used two RWI MAGELLAN PRO robots named FRODO and ROSE (figure 2). Their entry was built on the previous years' entries. The modularity of their design was particularly useful because for the two portions of the competition (information serving and dessert serving), they had separate interface modules that could be started; all the other modules functioned identically in both competitions. Because both interface modules send and listen for the same messages, the other modules do not need to know which interface is running.

The speech module had only four states: (1) idle, (2) mutter, (3) converse, and (4) quit. While a robot was serving, its speech module was set to idle. While wandering around the room, the robot stayed in mutter mode, where the robot is silent until it is passed the name of a text file. It then read randomly selected lines from the text file one at a time at a set interval.

In converse mode, the two robots actually appeared to interact with one another. When one robot spotted the other robot by detecting the Italian flag that each wore, it sent a message to the other robot requesting a conversation. Depending on the current activity of the second robot, it either accepted or denied the conversation request. If both robots were available for a conversation, then the conversation initiator read the first line from a conversation text file and sent a message to the other robot containing the line that the second robot should speak. The second robot spoke its line and then sent an acknowledgment back to the conversation initiator.

The vision system was useful for detecting people. The pink blob operator was trained to identify the pink ribbons that robot contest participants wore. The face operator looked for flesh-colored areas that could represent a human face. Once a robot approached a person, the motion-detection operator will help to ensure that its goal is, in fact, an animate object (and not a chair or a plant). During an interaction with a person, the AAAI badge-detection operator combined a pattern-based detection of the location of a badge with text recognition to identify a person's name. The shirt color operator looked for a solid area of color below a

Figure 2. FRODO *and* ROSE*.*

face; the robots could use the shirt information in conversation with conference participants.

University of Rochester

The entry from the undergraduate robot research team from the University of Rochester was called MABEL THE MOBILE TABLE (figure 3). MABEL responded to people using speech and rotations of a serving table. When people responded with their choice of food (strawberries, crackers, or cookies), the serving tray rotated to present the desired food in front of the person. The vision system allowed the detection of people, allowing the robot to come to them and offer them information or hors d'oeuvres. The camera was also used to keep an eye on how much food was gone from the service tray and locate the flag of the University of Rochester where it could go to reload its tray.

MABEL used a directed speech-recognition microphone, a SPHINX speech-recognition system, and specially designed parsing techniques to recognize the food choice. The system worked very well in noisy crowded settings.

Results

First place went to MABEL THE MOBILE TABLE from the University of Rochester. In second place was BORIVOJ from Kansas State University. Third place went to Swarthmore College.

People really enjoyed interacting with the robots during both events. The robot hosts rapidly become the center of attention. The most difficult part of the tasks is still the dynamic nature of groups of people, who were constantly moving and even interacting with the robots

Figure 3. MABEL*, the Mobile Table from the University of Rochester.*

in unanticipated ways (such as clustering around, asking questions, or purposefully foiling the robot's attempts to move). This situation also makes navigation more difficult for the robots. Also, being in such noisy environmental conditions, it was hard for the teams to demonstrate vocal interactions with people. However, because the robots still have some limitations to overcome before becoming real servants, vocalization helps people focus on what the robots are trying to do as part of the interaction. Such problems have to be taken into consideration when we move robots out of the controlled conditions of research labs. The Robot Host event is a great opportunity to experiment in such a context. The event also serves as a common evaluation test bed for the different approaches used to implement the intelligent decision-making processes required by the autonomous robot servants.

Acknowledgments

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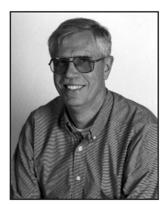

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