

The 1997 AAAI Mobile Robot Competition and Exhibition

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■ In July 1997, the Sixth Annual American Association for Artificial Intelligence (AAAI) Mobile Robot Competition and Exhibition was held. The competition consisted of four new events: (1) Find Life on Mars; (2) Find the Remote; (3) Home Vacuum; and (4) Hors d'Oeuvres, Anyone? The robot exhibition was the largest in AAAI history. This article presents the history, motivation, and contributions for the event.

The Sixth Annual American Association for Artificial Intelligence (AAAI) Mobile Robot Competition and Exhibition was held in Providence, Rhode Island, on 27–31 July 1997. Based on the successes of the five earlier AAAI competitions, it was decided that introducing less structure into the competition venues would be more challenging, and indeed it was. Four new events were held: (1) Find Life on Mars; (2) Find the Remote; (3) Home Vacuum; and (4) Hors d'Oeuvres, Anyone? Each event posed new and different challenges to the robot team competitors than the office-environment tasks of past events.

In this issue of *AI Magazine*, a series of articles describes the individual events and their results, often with associated profiles of winners and highlights of the exhibition. In this article, I provide a brief history of the past AAAI competitions, followed by the rationale for the 1997 competition and a summary of some of the contributions that this rather large undertaking has provided.

First, let's review some history. The AAAI Mobile Robot Competition and Exhibition has just completed its sixth year, having been held at every AAAI conference since 1992 (Kortenkamp, Nourbakhsh, and Hinkle 1997; Hinkle, Kortenkamp, and Miller 1996; Simmons 1995; Konolige 1994; Dean and Bonasso 1993). In the first year, robot navigation alone was a sufficiently challenging task. The robots

moved about in an arena cluttered with boxes and struggled to identify specially marked objects (poles) (figure 1a). In years two through four, the focus moved to officelike environments (figure 1b), where a range of tasks of increasing complexity were conducted over the years: from simply getting out (escape from the office, 1993) to delivering from one room to another (1993–1995); rearranging the office itself by pushing boxes around (1993); cleaning up the office by picking up trash on the floor (1994–1995); and, finally, finding vacant rooms and calling a meeting among faculty (1996). These offices were venues of gradually increasing size and difficulty, but from outward appearances, they looked somewhat similar from year to year. The performance of the robots working in these office environments grew steadily better over time, and many viewed that at least in the context of the competition, these problems were solved.

Motivations for the 1997 Competition

In 1996, at the fifth AAAI contest, the tennis court cleanup event was held, where robots gathered tennis balls in an open area (figure 1c). This event moved the robots into a different task environment but not an overly challenging one. Although this new event was felt to be a step in the right direction of both increasing task utility and audience appeal, it was still felt that something was missing from several of the previous AAAI competitions, including relevance to real-world tasks, interaction with attendees, and challenging perceptual tasks. It was time to get out of the office! For the 1997 competition, a whole new series of events was constructed (figure 2).

Find Life on Mars: The National Aeronau-

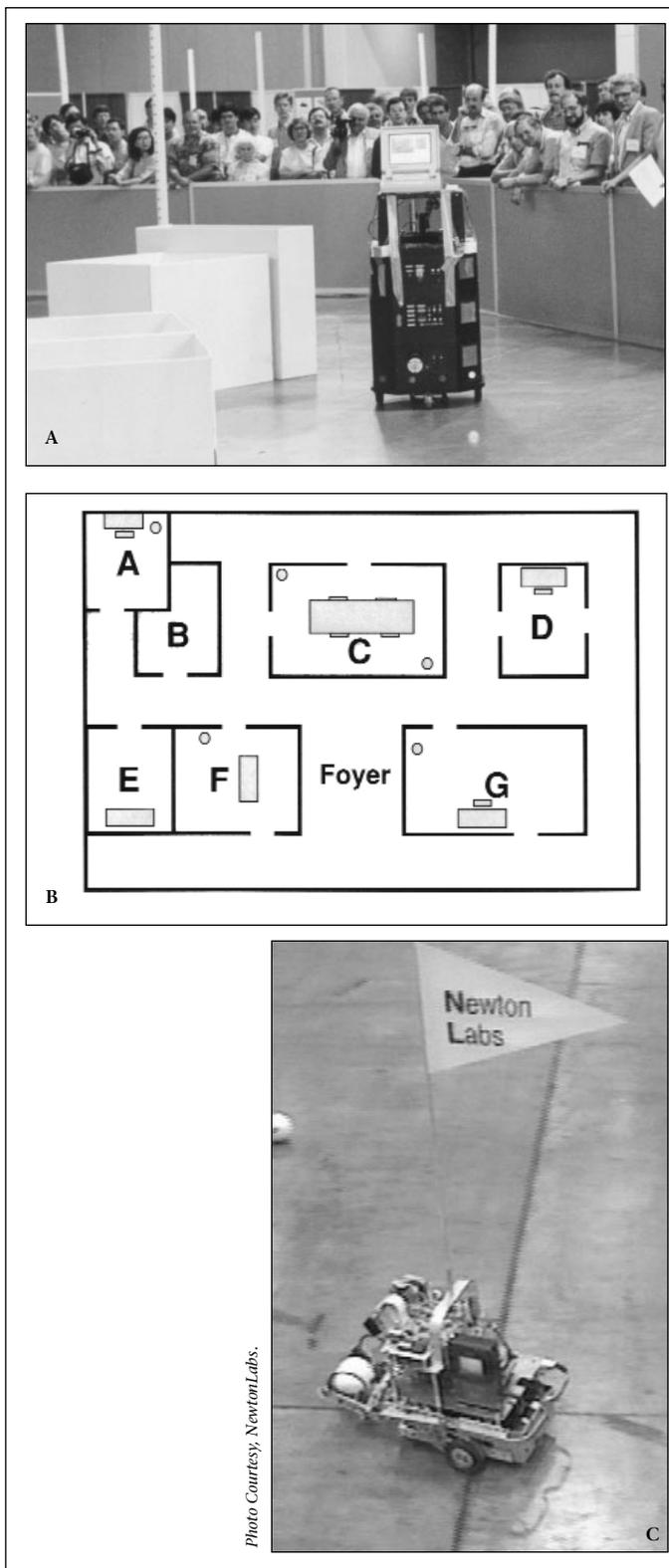


Figure 1. AAI Mobile Robot Competition and Exhibition over the Years.

- A. FLAKEY among poles in 1992. B. Office layout used in 1994.
C. NewtonLabs entry fetching tennis balls in 1996.

tics and Space Administration Pathfinder Mission was scheduled to land on Mars a little less than one month prior to the start of the competition. This event, coupled with the potential discovery of life on the planet based on recently found meteorite fragments, seemed natural to leverage into the competition. Based on the earlier popularity and success of the clean up the tennis court event, various “life forms” were introduced into a rock-strewn area, where the robots were tasked with finding these specially colored animate and inanimate objects and returning them to the planetary lander for analysis. The hope was that technology produced for answering the research questions posed by this event could ultimately lead to better and more intelligent generations of planetary rovers to succeed Sojourner.

Find the Remote Control: This event was motivated not by the organizers’ ineptitude at retrieving these objects in their own homes but, rather, by the goal of helping the physically challenged with the use of assistive robotics. A homelike venue was created using rented furniture in which a wide range of interesting objects to be retrieved were to be scattered throughout. This task was clearly the most difficult from a perceptual point of view, resulting, unfortunately, in few competitors willing to take the challenge.

Home Vacuum: This event also operated in a homelike world. Although companies such as Electrolux are almost ready to market robotic home vacuum cleaners, this task posed far more challenging problems than would be found in these near-term commercial types of system. The robots would need to respond to the presence of humans, detect messes, and perform a range of operations that would require significantly more intelligence than simple navigation and obstacle avoidance.

Hors d’Oeuvres, Anyone? One final event recognized that in the past there was literally a barrier between the conference attendees and the robots. It was felt that it was time to mainstream the robots with people by allowing them to interact with humans at the conference reception by serving hors d’oeuvres. This event was very popular: The attendees had a strong role in the judging process, and surprising things were learned about human-robot interaction as a by-product, such as the limitations of touch screens and speech as effective interface technology in a noisy cocktail party environment and the difficulty of circulating in a crowded room because of human reaction to a robotic servant.

Obviously, no one expected the perfor-



Courtesy, Fred Martin



Courtesy, Fred Martin



Courtesy, Fred Martin

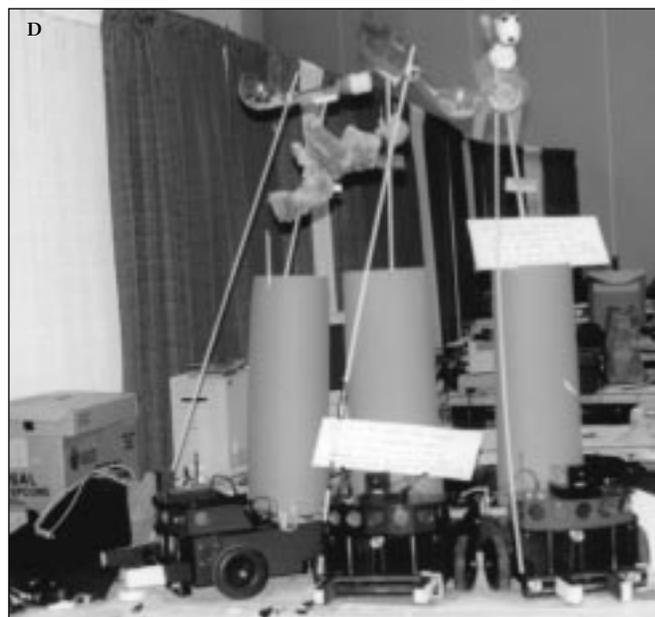


Figure 2. 1997 AAAI Mobile Robot Competition and Exhibition Entries.
A. Home vacuum. B. Find life on Mars. C. Find the remote. D. Hors d'oeuvres, anyone?

The AAI competition has, and continues to make, significant contributions to the robotics community in general.



Figure 3. Competition Participants at the 1997 Awards Ceremony.

mance of the robots on these first-time events to be as good as previous efforts in the earlier office tasks simply because they were completely new. The lack of predictable structure also complicated matters for the competitors. There were also four events in three different venues—twice as many as ever had been held in the past at a single competition. The hope was that of these many efforts, a few would provide durable challenges for the years to come. Indeed, this has happened because two of the events—Find Life on Mars and Hors d'Oeuvres, Anyone?—are being held at the 1998 competition.

On the noncompetitive side, the 1997 Mobile Robot Exhibition was the biggest in the history of the event. There were live demonstrations scheduled throughout the day concurrent with the competition. Many unique hardware and software ideas were displayed that are detailed by Holly Yanco in "The 1997 AAI Mobile Robot Exhibition," also in this issue. One goal was to have continual action in the event hall, so that long lulls in robotic activity that had occurred in times past could be avoided. The exhibition contributed significantly to both the intellectual content and excitement of the overall event.

The Competitors

A large number of organizations participated in the competition and exhibition (figure 3). The organizations are listed in table 1 with the events that the team was associated with.

Contributions

The AAI competition has, and continues to make, significant contributions to the robotics community in general. For the 1997 competition, contributions included (1) novel test domains outside a research group's own laboratory, which provides challenges to the generalizability and robustness of solutions developed for the events' problem domains; (2) this robot exhibition was the largest in AAI history; (3) the most events in the history of the competition were held; (4) the first interactive event with the audience debuted; (5) the first high school team at a AAI competition (Miamisburg High School) arrived with an ancient HERO robot and valiantly tried to get its system to compete but unfortunately could not; and (6) certainly remarkable were the experience and camaraderie gained by the team members putting in incredibly long hours, often all night long, readying their systems to work.

In the remainder of this issue, the reader will

Team	Mars	Find the Remote	Home Vacuum	Hors d'Oeuvres	Exhibition
Brandeis University	✓			✓	
Brown University	✓	(✓)			✓
Colorado School of Mines	✓			✓	✓
Dartmouth College			✓		
Georgia Institute of Technology	✓		✓		✓
Iowa State University					✓
Kansas State University		✓			
Kiss Institute					✓
McGill University	✓				
Miamisburg High School	(✓)				
Michigan State University					✓
Massachusetts Institute of Technology					✓
Naval Research Lab				✓	✓
Northwestern University					✓
Swarthmore College			✓		
TRAC Labs				✓	
University of Arkansas	✓				
University of Minnesota	✓				✓
University of New Mexico			✓	✓	
University of Texas at El Paso			✓	✓	
University of Virginia					✓
University of Waterloo					✓

Table 1. AAI-97 Robot Competition and Exhibition Participants (noncommercial teams). (✓) denotes intent but inability to compete in the event because of hardware-software problems.

find articles describing in more detail each of the individual events and their outcomes. The technical approaches used by the various teams can be found in the Proceedings of the Fourteenth National Conference on Artificial Intelligence; each group was allocated two pages to describe its approach. Finally, an overview of the highly successful robot exhibition is presented.

Acknowledgments

I would like to thank the Defense Advanced Research Projects Agency and AAI for providing sponsorship for student scholarships to the competition. Many thanks also to the event coordinators (Pete Bonasso, Ian Horswill, Kurt Konolige, and Reid Simmons), the coorganizers (Jim Firby, Holly Yanco, and Robin Murphy), the numerous judges, and the participants for their dedication in making the competition a success.

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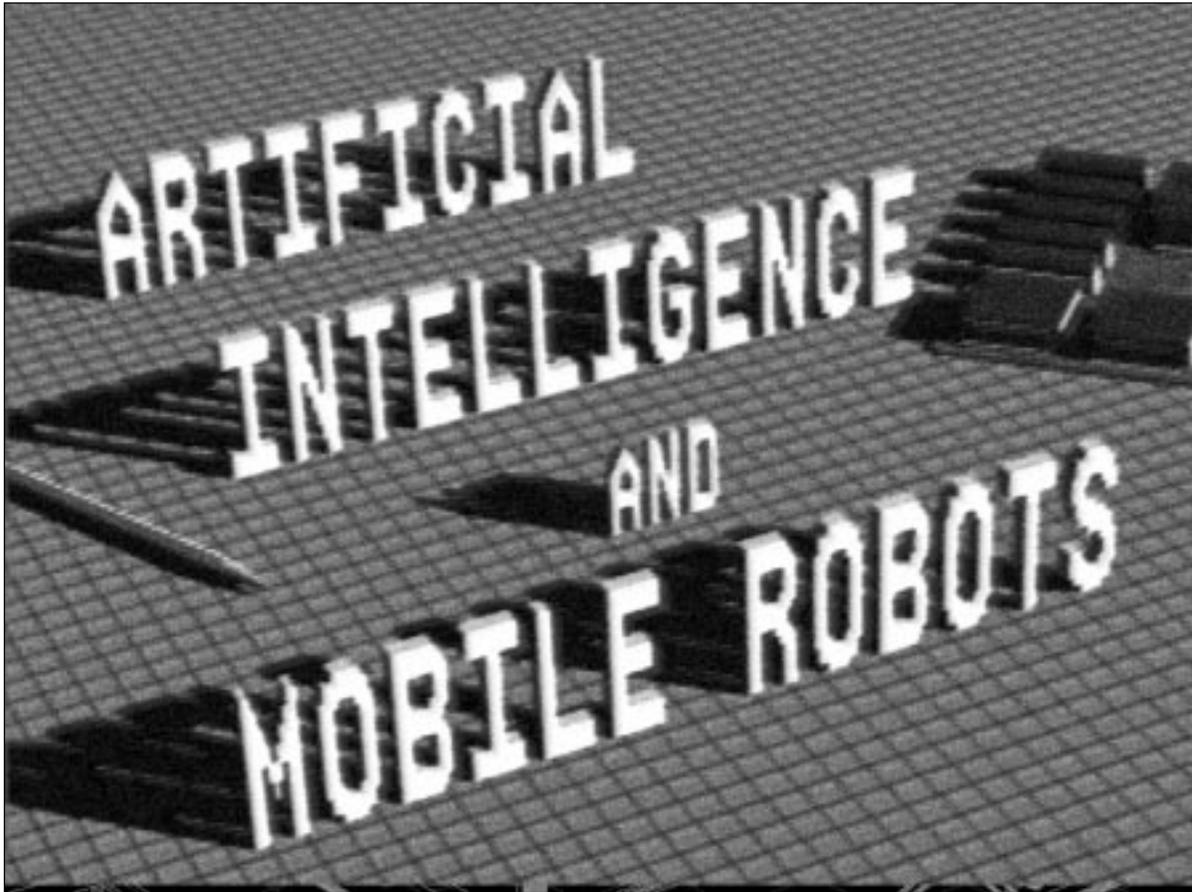
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