



Robotic Vehicle

Public Safety

Below is HAZBOT III, a prototype teleoperated mobile robot designed for response to emergencies involving hazardous materials. Developed by Jet Propulsion Laboratory (JPL), HAZBOT III is part of an emergency response system that also includes an Operator Control Station (OCS); both elements have independent computer systems that communicate with each other via a tether.



The system is a product of a NASA-funded Emergency Response Robotics

Project, initiated by NASA as a five-year effort to apply and transfer to industry JPL's extensive robotic know-how, and to advance robotics technology for HAZMAT, nuclear, mining, law enforcement and other applications.

Teleoperated robots can contribute significantly to reducing human injury levels by performing hazardous tasks that would otherwise be handled by humans. An example is shown **below**, where HAZBOT III is sensing leaks from a cylinder of anhydrous ammonia under the supervision of Jerry Collins of the JPL Fire Department/HAZMAT Team (in actual use, Collins would operate the robot from a safe location away from the incident site).

JPL did not develop HAZBOT III from scratch, but used as a developmental departure point a commercially available ANDROS Mark V-A robot manufactured by REMOTEC®, Inc., Oak Ridge, Tennessee, a segment of Westinghouse Electronic Systems Group. In the course of developing the emergency response system, JPL extensively redesigned its ANDROS and added features based on feedback from JPL Fire Department personnel who tested the vehicle.





A major feature added was a new control panel, shown **above** being operated by Rick Welch, task manager of the Emergency Response Robotics Project. The original ANDROS control panel consisted of a simple bank of toggle switches, one to control each action of the robot, which made complex manipulation tasks difficult and tedious. The new, simplified control panel (shown **at right** above its predecessor) uses spring-loaded potentiometers placed on a side-view graphic of the robot. If a potentiometer is rotated clockwise, the corresponding joint moves in that direction; the potentiometers also provide velocity control for the different robot actions.

The JPL project achieved its first technology transfer to industry when REMOTEC reported to JPL that it was adopting some of the design concepts developed for HAZBOT III, in particular the control panel. Sammy L. Jones, field projects manager for REMOTEC, reported to JPL that "We anticipate this design change will enhance our operator control station and make our ANDROS vehicle easier and safer to operate." REMOTEC and JPL are looking at other technology developed in the Emergency Response Robotics Project that could be transferred.

HAZBOT III has exceptional mobility, contributed by its tanklike track drive with special articulated front and rear sections, which allow the vehicle to climb stairs and move over obstacles as well as negotiate rough terrain. On-board batteries give the vehicle enough power for missions longer than three hours.

A significant feature is the vehicle's unique design for safe operation within a combustible atmosphere; it employs solid state electronics and brushless DC motors to bar electrical arcing, and the chassis/manipulator design allows for positive pressurization of all areas containing electronics and motors so combustible gases cannot enter.

Among other features are the six-degree-of-freedom manipulator with a five-foot reach and a 30-pound lift capability; a 30-pound squeeze force parallel jaw gripper; two video cameras, one for general viewing and navigation, the other on the arm's wrist for manipulation/grasping; a gas sensor built into the manipulator forearm;

custom tools for unlocking and opening doors; and a small winch that serves a variety of mission functions.

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