

## Kansas State Robotics

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The Computing and Information Sciences Department at Kansas State University has developed a software control laboratory for the purpose of exposing undergraduate students to the problems of developing software on real, moving equipment. The equipment in the laboratory consists of two Nomad200 robots and two Scout robots from Nomadic Technology, Inc. The main use of the equipment is in a capstone, two-semester software engineering sequence. In this course, selected teams of students develop software to control the robot in tasks such as maze running, object identification or environment mapping. In the last few AAAI robotic contests, the tasks have been similar to projects in the course.

### Introduction

The mobile robotics team from Kansas State University presently consists of five undergraduate students and a faculty advisor from the Department of Computing and Information Sciences. The group intends to compete in the Scavenger Hunt' event at this year's AAAI 99 Mobile Robotics Competition. Kansas State University has participated in five of the last six robotics competitions, placing teams in first, second and third place in events.

This year's team has two principal goals: to win the 'Scavenger Hunt' event and to extend the foundation on which future teams may build.

### Hardware

The group's test platform is a Nomad 200 mobile robot, a commercial system designed and built by Nomadic Technologies Inc. (Mountain View, CA). The Nomad consists of a base unit, capable of translation and steering motions, and a moveable turret, also capable of rotation, on which all sensors are mounted. An array of sixteen ultrasonic range sensors are mounted along the turret's

circumference, and provide information about the distance to any obstacles in the robot's vicinity. There are three CCD cameras mounted on top of the robot's turret; one is color, the other two are monochrome. A microphone is available for sensing sound. All processing is carried out on an Intel-based Pentium 233MHz single board computer, which is equipped with 128 megabytes of main memory, and a wireless Ethernet interface.

### Software

This year's team is using a model-based approach to object recognition, while using a simple reactive navigation scheme to guide the robot around obstacles and through the environment. One of the more difficult challenges is the efficient use of limited hardware resources, while successfully dealing with constraints imposed by the event rules. Machine vision requires a significant amount of processing power and is confined to object recognition and path planning. Most navigational activities can be adequately handled with information from the ultrasonic sensors; the reduced computational requirements will allow for quick reaction to obstacles, and a faster movement from one destination to another.

### Future Work

As was mentioned earlier, a second, and equally important goal of the group is to provide a solid base of reusable software on which future teams may build. To this end, object-oriented design techniques are being used to build classes that encapsulate not only the functionality of various hardware items (such as cameras, sonar sensors, and the robot itself), but also of behaviors (both low-level reactive, and higher-level deliberative), and more abstract concepts (for example, images and topological maps).