E90 TOPIC SELECTION MEMO

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Topic: Autonomous behaviors for robotic Urban Search and Rescue (USR)
Date: Friday, September 23, 2005

For my E90 project, I will attempt to develop intelligent autonomous behaviors to supplement Swarthmore's USR robot teleoperation interface. In a USR scenario, a mobile robot is dispatched to a disaster scene, and is controlled remotely by a human operator, located a safe distance away. The operator uses a computer terminal, a joystick, and a software interface to get sensory information from the robot (sonar range readings, live video), and drive it in search of victims. The communication between the operator terminal and the robot is carried over a wireless link, which makes the system very flexible, but also introduces a critical weakness: in a disaster situation, it is very likely that the wireless link between the operator and robot will be temporarily or permanently interrupted due to range limitations or interference, and the robot will be stranded, effectively disabling the system. This is an important limitation that has to be overcome before such systems become practical.

The problem could be tackled on the network side, with work on network penetration and range extension, but for this project I will work on the robot side, where intelligent autonomous behaviors can be developed to deal with loss of connectivity. Once the network connection is lost, the robot switches from teleoperation to autonomous mode and selects from a set of pre-defined behaviors, including tentatively:

- wander through the environment, attempting to construct a map, while taking snapshots of interesting objects
- attempt to retrace its movement to the last location, where a wireless connection was established successfully.

This project will be integrated with Swarthmore's existing USR infrastructure, including the Rune interface, developed by Nick Ward '05, and the Robomon module management software, developed by Fritz Heckel '05. Both of these pieces were built with the intention of eventually integrating autonomous capability, but a practical solution was never implemented. Work on the project will proceed in approximately the following order: debug the existing module communications environment, debug support for module capabilities, develop an autonomous module, develop behaviors for the autonomous module.

The project will use existing equipment, so the budget will be minimal. The one potential exception would be in case the project progresses quickly enough, so a lot of time can be dedicated to the development of sophisticated mapping: in this case some expensive sensors may need to be purchased (including a stereo video camera setup, or the equivalent of a laser range-finder). In this case, the cost may be split between the department and Prof. Maxwell's own project funds.