Virtual laboratories with mobile robots

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The virtual laboratories for robot control are developed and used in the education process of FernUniversity since 1997. Now, a new virtual laboratory has been developed for teleoperation and remote control of a mobile robot PIONEER 3-AT (from ActivMedia). This lab extends the range of existing labs by advanced experiments typical for mobile robot missions like 'labyrinth crossing' or 'room exploring and mapping'. In this lab, the students are able to develop and evaluate algorithms for robot path planning, reactive control, sensor data processing, map generation, etc.

The PIONEER 3-AT is a wheeled all-terrain experimental mobile robot. It can be equipped with various types of sensors, including front and rear sonar, a laser rangefinder, bumpers, a pan-tilt-zoom colour camera and GPS receiver. Robot motion is controlled by an embedded microprocessor, which communicates with a PC client. This communication is used for sending motion commands to the microcontroller and for data transfer between microcontroller and a PC client. The PC client is mounted on the robot and running under Linux OS. It is equipped with a wireless radio modem and thereby accessible through our network, which makes it an ideal platform for remote control. Delivered software enables to program the robot on various levels, ranging from simple microcontroller commands to complex actions. The PIONEER 3-AT mobile robot is shown in Figure 1.
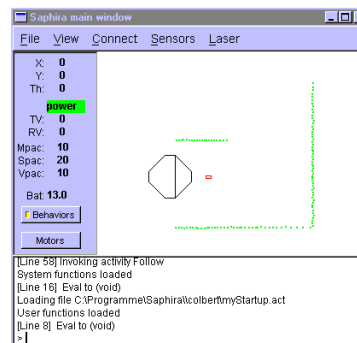

Figure 1: Pioneer 3-AT   Figure 2: Robot simulator

Because the proposed experiments require a high level of students' skills and time to practice, the students are able to use a robot simulator (see Figure 2) with specific data at home to develop their algorithms. Thereafter, they are testing and evaluating the designed strategies in the virtual laboratory. The algorithms are loaded onto the real mobile robot and the students observe it remotely. They are also able to adapt the robot control program according to its behaviour in the real world. For the remote control of the robot, a Web-browser with a user interface including multimedia stream processing, reservation system, and remote access control is used.

[1] I. Masár, A. Bischoff, M. Gerke: Remote Experimentation in Distance Education for Control Engineers, Virtual University 2004, Bratislava, Slovakia, December 2004