CoMRoS: Cooperative Mobile Robots Stuttgart

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Project CoMRoS has the goal to develop intelligent cooperating mobile robots. Several different vehicles are to solve a single task autonomously by exchanging plans without a central control (Levi, Bräunl, Muscholl, Rausch. 1994).

We use "Robuter II" vehicles from Robosoft France, adapted to our needs. The standard vehicle has very little local intelligence (VME bus system) and is controlled remotely by wireless Ethernet for sending steering commands and receiving sonar sensor data. A wireless video link is used to transmit camera images. Data exchange between vehicles is then performed among the corresponding workstations. The remote control is basically used to simplify testing and debugging of robot programs. However, each vehicle can also be driven completely autonomous by using a laptop PC. (Bayer, Bräunl, Rausch, Sommerau, Levi 1995).
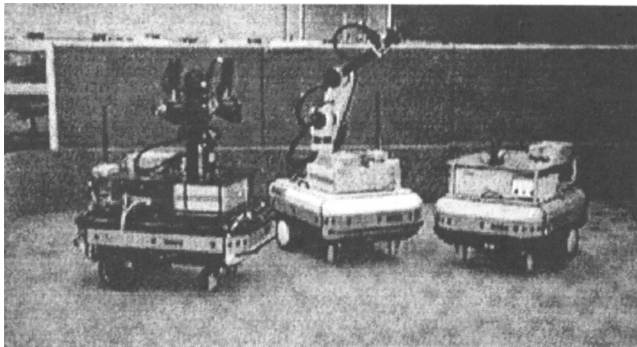

Figure: The three CoMRoS "musketeers"

On the PC, we are using the Linux version of Unix as operating system, while the robot itself has a real-time operating system (Albatros or D'nia Oberon). Quite a number of libraries for Ethernet connection, polling sonar sensor data, and digitizing video frames have been implemented by members of our group for various tasks on various machines, including our massively parallel MasPar MP-1216 system. We also implemented a physically-based simulation and animation system for our vehicles (Stolz, Bräunl, Levi 1995).

For the robot competition tasks, we configured one of our robots completely autonomous. For event 1, "call a meeting", we will almost exclusively rely on a belt of 24 sonar sensors around the robot, to detect walls, doors, hallways, and obstacles. However, it is planned to use a simple vision difference algorithm to determine whether a conference room is empty by asking any people inside the room to wave their hands. An alternative being investigated is implementing voice input. The Floyd algorithm is used to determine shortest driving paths. Using standard sound tools, the robot will tell the audience about its actions and plans.

For event 2, "clean up the tennis court", we first intended to use a robot with an on-board manipulator. However, this approach required a lot of time consuming image processing and manipulator control. Then, we took on an approach similar to a harvester machine. We developed a rotating cylinder to be mounted in front of the vehicle, in order to pick up any balls in the drive path of the robot. With this device, the ball collecting task is reduced to an area filling algorithm. Collected balls are being unloaded by reversing the rotation direction of the harvester. Only in a subsequent step will image processing be used to look for balls missed (e.g. the "squiggle ball"). The vehicle will then drive directly towards remaining balls and pick them up.

Acknowledgments

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