Doing tasks with multiple mini-robots

John Fischer and **Paul Rybski** and **Dirk Edmonds** and **Maria Gini**
Department of Computer Science, University of Minnesota
200 Union St SE, Minneapolis, MN 55455
{jfischer, rybski, dedmonds, gini}@cs.umn.edu

We are interested in building robots that are simple and have limited computing power yet are capable of surviving in an unstructured environment while achieving their assigned task. We have shown that even with limited computing small robots can learn how to achieve their task (Hougen *et al.* 1996), provided that the task is not extremely difficult and the learning algorithm is capable of fast learning.

One of our mini-robots, named Walleye, was built to pick up cups and cans for the Mobile Robot Competition that took place at IJCAI in August 1995 (Fischer & Gini 1996). Walleye, shown in Figure 1, is built out of a radio controlled car with the original electronics replaced by specially designed boards. All boards are built around the 68hc11 microcontroller, and have 16k of ROM and 32k of RAM. The vision system uses a CCD chip with digital output, a wide-angle lens, and a frame grabber board on which the vision processing is done. Two 7.2 volt rechargeable batteries are used, one for the motors, one for the computer boards. All software is written in C, with some routines in assembly. Walleye is built with off-the-shelf components at a cost of approximately $500.

The limited computing power has forced us to look for creative solutions that are simple and fast. This is particularly important considering that we do image processing on a 68hc11 with limited memory. Our image processing algorithms are specialized to the task at hand and so extremely fast. In nature specialization is often the key to survival.

One way of overcoming the limitations of a mini-robot is to construct a team of mini-robots. Unfortunately, there are a number of problems that come from having multiple robots. At the minimum, we have to ensure that the robots do not damage each other, do not interfere with each other, and can handle the presence of other moving robots in the same environment. Partitioning the task is not always easy, and a poor partitioning of the task might make the task unsolvable in the case a robot breaks down.

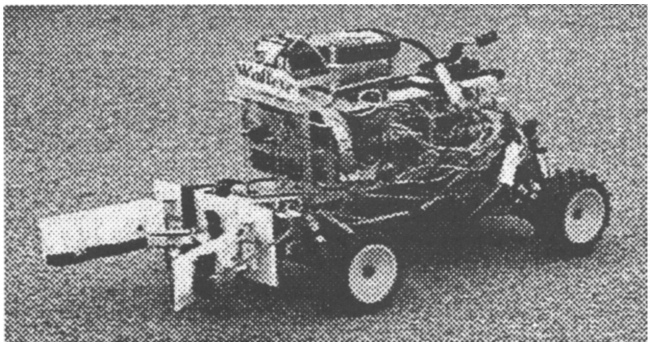

Figure 1: Walleye, the trash collecting mini-robot

The approach we are taking is to partition tasks in such a way that robots are independent of each other as much as possible and so have almost no need for communication. Take, for instance, a trash collecting task. Multiple independent robots are likely to work faster than a single robot, even though not as efficiently as robots that partition the space each has to cover. However, when each robot operates independently the overall system is more robust and less likely to fail catastrophically. We expect to demostrate multiple mini-robots at the 1996 competition.

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References

Fischer, J., and Gini, M. 1996. Vision-based mini-robots. *Robotics Practitioner.* (to appear).

Hougen, D.; Fischer, J.; Gini, M.; and Slagle, J. 1996. Fast connectionist learning for trailer backing using a real robot. In *Proc. IEEE International Conference on Robotics and Automation.*