Teaching a robot what to do by showing in virtual reality how to solve the task: a new game is ready?

Giuseppina Gini, DEI,
Politecnico di Milano
Piazza L. da Vinci 32
20133 Milano, Italy
gini@elet.polimi.it
fax: +39-02-23993411

Keywords:
Virtual reality, remote control, skills

Abstract:

One of the common expectations of children when playing with electronic games is that they want to teach the machine. Often they do not appreciate the idea that the machine behave in its own way, without using the skill they want to teach.

How to develop toys able to do that?

Some answers are already integrated into some commercial systems, but we may wonder whether new opportunities can be derived from the existent research in robotics and manipulation.

Programming a robot is a long and tedious task in the industrial practice. The operator able to perform the task may find it difficult to write program in the low-level languages used on most of the robots. To take an advantage of the operator skills in making the job we may try to extract the program from a manual example of the job.

This idea has been developed, for instance, in APO (Assembly Plan from Observation) by Katsushi Ikeuchi at Carnegie-Mellon University. In this approach, a human programs a robot by performing assembly operations in front of the APO observation system, which includes a camera. The APO system recognizes the observed assembly operations and generates an assembly plan for the robot to replicate the assembly task. During observation, the system takes two static images, one before and one after each assembly operation. It then extracts face contact relations from recovered object poses. By consulting the abstract task models, the system associates an extracted relation transition with the operation necessary to achieve the transition.
Problems with this approach are still many: the obtained program has imprecisions in the locations, it has no knowledge to make path computation, and the need of an active vision system to get the relevant features is costly and unreliable in natural light.

From those considerations we have developed an approach to robot programming where .the user interacts with a monitor. He can play with a virtual reality system, than can ask the real robot to do the same job.

The needed technologies to make the system able to work both in the world model and in the real world are now developed, and can be integrate:
- 3D reconstruction of the scene is possible
- realistic program interface is available
- cheap sensors can be used.
- remote robot control is enough developed.
- skill libraries, associated with each manipulation, can be created Each skill library encapsulates the robot motion and sensory strategies necessary to execute an operation, such as turning a screw into a hole …

In the poster we will show some of our virtual world (at present developed for nuclear inspection or manufacturing tasks) and discuss about their role in games.