The Robutler: Towards Service Robots for the Human Environment

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Abstract— In this video we present a mobile hand-arm system with anthropomorphic features as well as some capability for autonomous behaviour. In the presented service robotics scenario the system is used in combination with basic navigation skills, realtime scene analysis by stereo vision, compliant motion control for the arm and the hand, and an intuitive man-machine interface. Convenient to the presented application, we have called this system the Robutler.

Index Terms— Service Robotics, Computer Vision, Impedance Control.

I. THE ROBUTLER SYSTEM

The Robutler system presented in this video consists of an omni-directional mobile platform (originally developed at the Technical University of Munich), the seven-dof DLR lightweight arm II, and the dexterous DLR four finger hand II (see Fig. 1). The robot, furthermore, is equipped with a vision system with three onboard cameras (DIGICLOPS) and a SICK laser scanner.

We use this system to execute manipulation tasks which are essential to many service robotics applications. Amongst the core technologies for autonomous robotic manipulation are vision based object recognition and impedance control of arms and hands. In particular the torque sensors of the DLR arm and hand allow for the design of highly sensitive torque and impedance controllers.

II. CONTENTS OF THE VIDEO

In the video a restricted but realistic domestic scenario is presented. In the first part, the robot's task is to prepare and offer drinks at a table. First the robot navigates to a table, where various bottles and glasses are freely arranged by a user. Then, an interpretation of a table-top scene is computed from the images taken by the three onboard cameras. The scene interpretation is based on methods adapted from fuzzy-set and probability theory [1]. When all the objects are recognized and located, the robot can autonomously execute several actions. For instance, it may unscrew the cap from a bottle (see Fig. 2), grasp the bottle, and pour a drink into a glass. All this is done according to high-level user commands. Furthermore, when these actions are finished, the robot can clean (i.e. wipe) the table.

Fig. 1.   The Robutler system.
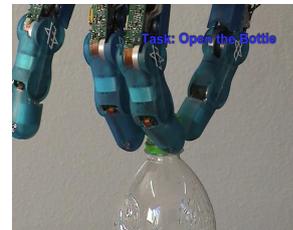
Fig. 2.   Opening a bottle by unscrewing the cap.

In the second part of the video, the robot's task is to open a door. In front of the door the position of the door handle is recognized using a 2D template matching algorithm based on image data from the three onboard cameras. In the following the door is opened by impedance controlled movements of the arm (in particular the door handle is pushed). When the mobile platform finally enters the room, the door is kept at a distance, again, by impedance control of the arm (using an appropriate potential function).

REFERENCES

[1] U. Hillenbrand, "On the relation between probabilistic inference and fuzzy sets in visual scene analysis.", Pattern Recognition Letters 25 (2004), pp. 1691-1699.