Semi-Autonomous Environment Mapping using GUI based Outline Operating Instructions

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Abstract— **There are many objects which have manipulable link in a household environment. A humanoid robot working in a household environment shared with humans needs to recognize and manipulate such objects like a refrigerator and a shelf.**

In order to automatically create a geometric model for recognition and manipulation, a geometric model with articulated link is constructed by a point cloud which observed by robot equipped 3D vision.

We propose the method for generating a map which contain a geometric model with articulated link, while robot working in the environment in accordance with human indicated outline operating instructions using GUI.

I. INTRODUCTION

There are many daily assistive tasks which need operations of furniture and tools with articulated link for a humanoid robot in a household environment shared with humans. A humanoid robot working in a household environment is required to recognize and manipulate objects which have articulated link. In order to perform a task operating object with articulated link, a robot needs to know about a geometric model which contains a kinematic model, joint type and position.

In this paper, we propose a human supervised semantic mapping. Human indicate clues to manipulate objects with articulated link such as a drawer or a refrigerator, then a robot autonomously manipulate objects using the clues and obtain geometric models which contain information for operation such as a handle position which can operate a link, haw to grasp the handle, and which direction a link move to.

II. GENERATING MAP FROM ROBOT MOTION

In order to automatically obtain environmental knowledge, robot have to acquire a geometric model and a kinematic model of object. As an example of environmental knowledge acquisition by a robot, Blodow*et al.* [1] created a map of the household environment with autonomously moving mobile robot. This map is a semantic map which contains such as the shelf position and the handle of the shelf that can be manipulated. Creating a symbol during the generating a semantic map has been determined by the number of knobs or handles and the location of each [2]. In this case, the geometric conditions were used for acquiring meaning, it is difficult to infer the meaning of the object on the map.

In the case of using the knowledge of objects and environmental manipulation that robot has obtained, it is need to share knowledge with humans. In addition, if you want to use that knowledge with with other intelligence systems such as task planner, you needs symbols of objects.

We propose a human supervised robot motion with obtaining object model. A operator indicates outline operating instructions for environment manipulation. A robot makes a manipulation plan based on a sensor observation of environment. The robot presented to the plan to the operator. The plan presented to the operator is approved or modified, the robot executes the motion in accordance with the plan. Outline the operating instructions shows place suitable for manipulation, handle position for grasping or the type of articulated mechanism. These outline operating instructions are provided through pointing points obtained from the 3D vision of robots using a GUI. A robot obtains a geometric model by observation from robot's 3D vision during robot motion.

III. CONCLUSION

A robot executing a motion and generating an environment model are performed at the same time. The former is executing the motion for environment manipulation by the human operating the robot for indicating outline operating instructions,. The latter is generating a geometric model, which is necessary for the autonomous robot behavior, updated by the observation during the robot motion.

Human indicated a clue for operating objects which have articulated link such as a shelf or a door. From this information, robot can operate articulated object and obtain the internal structure and characteristics of the object unless the robot try to manipulate it. We created a semantic map from these information which was obtained by observing robot motion indicated through outline operating instructions.

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