Issues and Strategies for Robotic Object Manipulation in Domestic Settings

Danica Kragic, Mårten Björkman, Henrik I Christensen and Jan-Olof Eklundh
Computer Vision and Active Perception Lab
Centre for Autonomous Systems
Numerical Analysis and Computer Science
Royal Institute of Technology, Stockholm, Sweden
Email:{danik, celle, hic}@nada.kth.se

"Pick Up ..."		WHERE *(location)*	
		known	unknown
WHAT *(identity)*	known	*"This Cup"*	*"The Cup"*
	unknown	*"This Object"*	*"Something"*

Fig. 1
ROBOTIC MANIPULATION SCENARIOS.

***Abstract*— Many robotic tasks such as autonomous navigation, human-machine collaboration, object manipulation and grasping facilitate visual information. Some of the major reasearch and system design issues in terms of visual systems are robustness and flexibility.**

In this paper, we present a number of visual strategies for robotic object manipulation tasks in natural, domestic environments. Given a complex fetch-and-carry type of tasks, the issues related to the whole *detect-approach-grasp* loop are considered. Our vision system integrates a number of algorithms using monocular and binocular cues to achieve robustness in realistic settings. The cues are considered and used in connection to both foveal and peripheral vision to provide depth information, segment the object(s) of interest in the scene, object recognition, tracking and pose estimation. One important property of the system is that the step from object recognition to pose estimation is completely automatic combining both appearance and geometric models. Rather than concentrating on the integration issues, our primary goal is to investigate the importance and effect of camera configuration, their number and type, to the choice and design of the underlying visual algorithms. Experimental evaluation is performed in a realistic indoor environment with occlusions, clutter, changing lighting and background conditions.

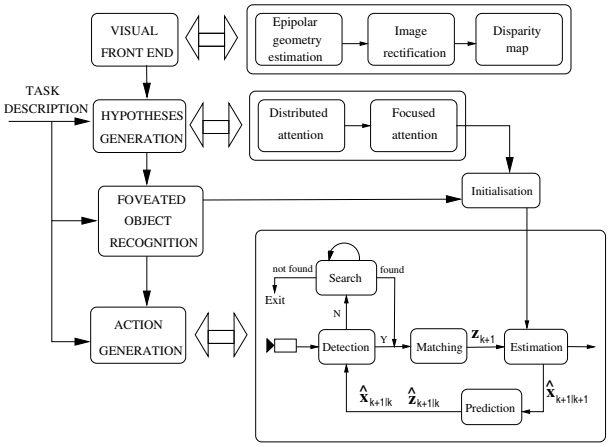

Fig. 3
BASIC BUILDING BLOCKS OF THE SYSTEM.

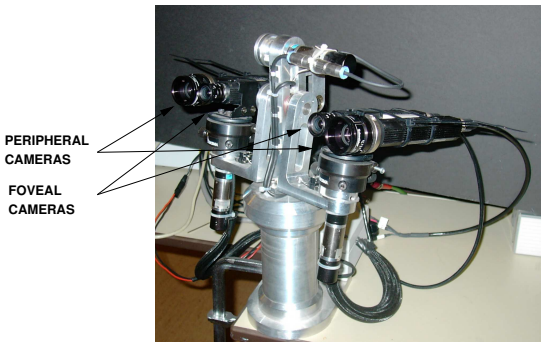

Fig. 4
THE YORICK STEREO-HEAD.

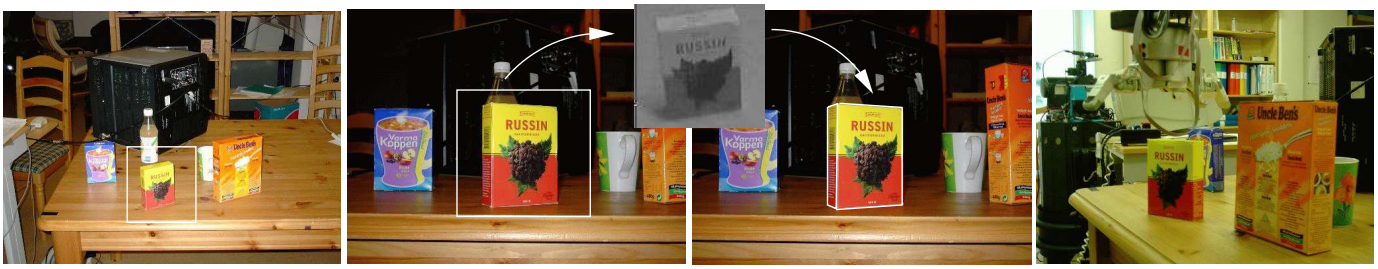

Fig. 2

DETECT-APPROACH-GRASP EXAMPLE.

Fig. 5

THE EFFECT OF LARGE ROTATIONS ON POSE INITIALISATION.