Object Transportation using the *Grasp*Alone
Technique

Ramon Soare de Melo

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November 7, 2013

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Perform transport of objects arranged in an environment using the technique *Grasp Alone* ¹, in order to lead them to a region previously known.

¹When the robot is able to hold the object to be transported ≥

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Transport of objects can be used in various situations, such as:

- Object manipulation;
 - Everyday things (Cook, Clean)
- Structures construction;
 - Assembly line:
 - Housing.
- Exploration, removing obstacles;
- Rescue.

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Related Work

A Fast Method for Mobile Robot Transportation in Life Science Automation. Liu, Hui, et al. I2MTC, 2013

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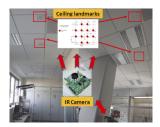
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References

Describes a technique for use robots in a life science laboratory. They need to walk inside the lab, transporting items based on users requests. Using ceiling landmarks for localization with systems for obstacle avoidance, path planning based on start and end points and a TCP/IP communication network.







Related Work

Planning pre-grasp manipulation for transport tasks. Chang, Lillian Y., et al. ICRA, 2010

Object Transportation using the *Grasp Alone* Technique

Shows a study of how a pre-grasp manipulation can improve the Grasp Technique itself. This manipulation is described as a change of the pose of the object, rotating it to archive a better position for the Grasp transportation.

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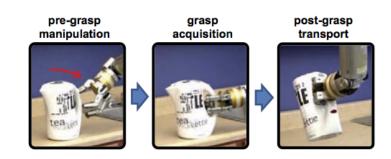
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Related Work

Capturing robot workspace structure: representing robot capabilities. Zacharias, Franziska, et al. RSJ, 2007

Object Transportation using the *Grasp Alone*Technique

Demonstrate how create a workspace structure for a robot arm in a form of a map, named capability map. Through this map, the manipulator can deduce places that are or not easy to reach.

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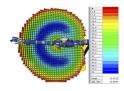
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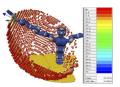
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(a) ROS - Hydro

(b) Gazebo

Figure: Software

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(a) iRobot Create



(b) AX-12A Arm



(c) Webcam

Figure: Hardware

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Methodology Localization

Object Transportation using the *Grasp Alone* Technique

A camera set above the scene will be used to locate items of interest, such as:

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Robot With a marker on it, enabling to recognize your pose;

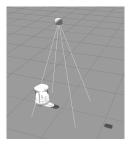
Objects Also with markers, to know your position and orientation;

Deposit Place A square around the start point of the robot;

Methodology Localization

Object Transportation using the Grasp Alone Technique

Localization







(a) Environment Simu- (b) lation

Ceiling View

Camera (c) iCreate with Marker

Figure: Localization

Methodology Transport

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Some steps will be undertaken to reach objects and perform your transport. A PID² controller will be implemented to achieve the objective.

Transport priority Objects closer to the base will be transported first. Ensuring that there is no need a system for obstacle avoidance.

Navigation Action The robot will move until the target object is within range of the robotic arm.

Hold Action The robotic arm holds the target object, and moves to the transport position.

Transport Action Robot moves to safe place and leaves the object.

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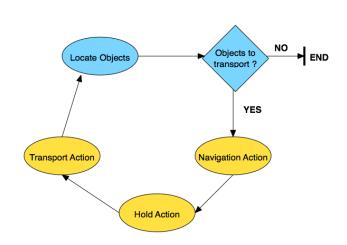


Figure : State Machine [■ Controller Action, ■ Robot Action]

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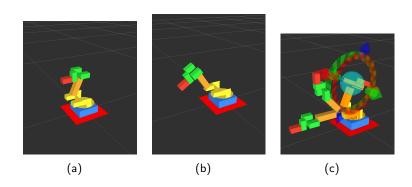
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Arm Controller Implemented in ROS, whereas previously there was only one controller for Player. A simulation model was also created in order to replicate all the actual movements of the arm.



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Simulation Environment Implemented in Gazebo, will represent the real environment of the experiment, including your metrics and possible noises.

Remote Control Setup configuration for remote control of the iRobot Create and the Robotic Arm.

Marker Detection Initial tests to detect de pose of a marker.

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- 1 Finish the simulation, attaching the arm on the robot;
- Detect the robot's pose by the marker;
- 3 Detect objects in the environment and your positions;
- 4 PID Controller;
- Grasp Strategy.

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Christoph Borst, and Gerd Hirzinger. "Capturing robot workspace structure: representing robot capabilities." Intelligent Robots and Systems, 2007. IROS 2007. IEEE/RSJ International Conference on. IEEE, 2007.