



A mobile manipulator robot that brings objects to assist people

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Purpose: The help provided by a mobile manipulator robot to an individual can be beneficial if the robot can understand the needs and adapt its actions to the behaviour of its user. This is especially true for elderly or disabled persons. When the user or the robot wishes to begin an action, the first phase is the choice of the object to bring using the context and a dialog with the robot. Then a trajectory must be planned for the robot and its arms. This trajectory must avoid collision, be safe and be legible by the human. The robot must realize the motion adapting the initial trajectory to the behaviour of its user. Finally the last phase of handing-over the object is carried out with physical interaction. In this paper we propose a complete example of such a task in a particular context.

Method: It has appeared in two research projects PHRIENDS and SAPHARI, that in aiming for comfort and safety of interactive tasks the architecture of the robot must take all these issues into account at all levels from mechanical design to software¹. To realize the assistance task in interaction with the user, it is required to equip the robot with reasoning on its own capability and on the human needs and abilities². Symbolic and mental models are used to define the task to be achieved^{3,4}. This task is then refined using planners and scene models to define the grasps, a trajectory and the associated control laws⁵. The choice of the grasp greatly influences the task. A path is computed to define the motions of the robot to move the object using RRT (Rapidly-exploring Random Trees) and stochastic optimization. Another research project, ASSIST, showed the necessity to take into account HRI constraints to generate a trajectory for which the speed is adapted to the human attitude. Different controllers are used along the trajectory to adapt the robot motions to the human movements and behaviour⁶. During the execution, the robot permanently checks the moves and replans the task to improve the solution. If a better trajectory is found, it is sent to the controller, which switches to the new trajectory. **Results & Discussion:** A such system is realized with a PR2 robot. The robot assists the individual by providing objects on request or by proposing to bring objects it supposes to be useful for the human user. The first results show the validity of the approach and the usefulness of each element to achieve the task.

References

1. De Santis, A., Siciliano, B., De Luca, A., & Bicchi, A. (2008). An atlas of physical human-robot interaction. *Mechanism and Machine Theory*, 43(3), 253-270.
2. F. Dehais et Al, (2011), Physiological and subjective evaluation of a human-robot object hand-over task, *Applied Ergonomics*, 42(6), 785-791.
3. Pandey, A. K., & Alami, R. (2014), Mightability: A Multi-state Visuo-spatial Reasoning for Human-Robot Interaction. In *Experimental Robotics* (pp. 49-63). Springer Berlin Heidelberg.
4. Sisbot, E. A., & Alami, R. (2012). A human-aware manipulation planner. *Robotics, IEEE Transactions on*, 28(5), 1045-1057.
5. Sisbot, E. A., et al, (2010), Synthesizing robot motions adapted to human presence, *International Journal of Social Robotics*, 2(3), 329-343.
6. He, W. & Sidobre, D. (2013). A Reactive Trajectory Controller for Object Manipulation in Human Robot Interaction, *ICINCO*, 19-28.

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Figure 1. The exchange is comfortable for the human user who sees the robot and can take the object safely. The robot watches the human user and monitors the exchange process.