



1 Care-O-bot® 3 in a home environment

Care-O-bot® 3

PRODUCT VISION AND INNOVATION PLATFORM

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Starting Point

For more than ten years, Fraunhofer IPA is working on the development of a mobile home assistant Care-O-bot® able to assist humans in their daily life. The meanwhile third generation of this successful development series is characterized by a product like system design and for the first time provides the potential to apply manipulating mobile service robots in everyday environments. Care-O-bot® 3 has already been operating successfully at numerous trade fairs and exhibitions. As an interactive butler it is able to move safely among humans, to detect and grasp typical household objects, and to safely exchange them with humans. This is accomplished specifically by the following key technologies:

Flexible, Autonomous Navigation

Care-O-bot® 3 has an omnidirectional platform with four steered and driven wheels. This kinematic system enables the robot to move in any desired direction and therefore also safely to pass through narrow passages. In doing so, Care-O-bot® 3 is also able to autonomously plan and follow an optimal, collision free path to a given target. Dynamic obstacles such as persons are detected by sensors and avoided automatically.

Manipulation and Grasping

Care-O-bot® 3 is equipped with a highly flexible, commercial arm with seven degrees of freedom as well as with a three-finger



hand. This makes it capable of grasping and operating a large number of different everyday objects. Using tactile sensors in the fingers, Care-O-bot® 3 is able to adjust the grasping force. By synchronizing arm and platform movements, Care-O-bot® 3 is additionally able to autonomously open doors that block its way to the target.

3D Environment Perception

A multiplicity of sensors enables Care-O-bot® 3 to detect the environment in which it is operating. These range from stereo colour cameras and laser scanners to a 3D range imaging camera. The sensors serve, for example, to detect and locate objects for manipulation as well as relevant obstacles in the robot's environment. Care-O-bot® 3 is additionally capable of learning new objects independently. Its 3D sensors enable it to monitor the manipulation operations in real-time, thereby increasing the safety and dependability of the manipulation process.

Safe Interaction

The primary interface between Care-O-bot® 3 and the user consists of a tray attached to the front of the robot, which carries objects for exchange between the human and the robot. The tray includes a touch screen and retracts automatically when not in use. The robot arm is only used to place objects on the tray or take them away from it. It is stopped immediately as soon as people are detected in the

vicinity of the robot. Combined with safety sensors for navigation this concept enables the safe operation of Care-O-bot® 3 in public places.

Functional Design

The novel design of Care-O-bot® 3 represents an intentional distance from existing humanoid service robots. Instead, the design of the robot has been adapted to its role as an interactive butler, which supports the human user in understanding the capabilities of the robot. Using flexible materials and composites, a soft and pliant form has been created for the cover of the robot. The cover adjusts to accommodate movements of the upper body and avoids any pinch and shear points. In addition, the flexible casing enables the expression of body gestures like bowing or nodding can be applied to give an intuitive feedback to the user.

Application Scenario

For the operation of Care-O-bot® 3 as an interactive butler serving drinks to visitors, the key technologies mentioned above have been integrated to a complex application scenario: Care-O-bot® 3 automatically moves towards people and using a graphical user interface on the tray and speech output asks the user to select a drink. This drink will be searched by the robot in the environment and after successful localization be grasped and finally be handed to the user via the tray. Currently, around 10 different drinks

can be selected which can also have different shapes. The scenario is constantly getting extended and getting adapted for application environments with raising complexity. Soon, Care-O-bot® 3 should be able to lay and clear a table or fetch a cool drink out of the fridge.

What we offer

You can as well position yourself within this fascinating context and thus take a stand in the future market of service robotics. As a research and development partner, use Care-O-bot® 3 to test and present your latest products and technologies. As a pilot user, surprise your customers and visitors by installing an interactive Care-O-bot® 3 with individual design and application specific programming in your company building. For this application the technologies and abilities of the robot mentioned above can be combined individually and application specific speech and image files can be integrated. Apart from building up a new Care-O-bot® 3 platform it is also possible to rent existing platforms for selected events.

Contact us to discuss your personal application scenario.

2 *Ordering a drink by touch-screen*

3 *Care-O-bot® 3 grasping a bottle*

4 *Care-O-bot® 3 serving a drink*