



1 Different versions of the Care-O-bot® 3 robotic home assistant.

## Care-O-bot® 3

### PRODUCT VISION OF A ROBOTIC HOME ASSISTANT

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[www.care-o-bot.de/english](http://www.care-o-bot.de/english)

#### Background

The idea of having a service robot to carry out those unpleasant and tedious tasks around the home is an enticing prospect for most people. Elderly or handicapped citizens stand to benefit especially from such an advanced domestic helper, as this can enable them to lead independent lives for longer in their own four walls.

#### Our solution

For over 15 years, Fraunhofer IPA has been working on the development of a mobile robot assistant "Care-O-bot®", which is designed to actively assist humans in their day-to-day lives. Now in its third generation, this successful development series features a product-oriented system design and is the first to offer the potential for the real-

world application of manipulating mobile service robots in everyday environments. As an interactive butler, Care-O-bot® 3 is able to execute simple assistive functions in a domestic setting. This is made possible in particular by the following key technologies:

#### Flexible, autonomous navigation

Care-O-bot® 3 has an omnidirectional platform with four steered and driven wheels. These kinematics allow the robot to move flexibly in any desired direction and thus also to safely negotiate narrow passages. Care-O-bot® 3 is also capable of autonomously calculating and following the optimum, collision-free path to a given destination. Dynamic obstacles, such as humans, are sensed and automatically avoided.



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## Manipulation and grasping

Care-O-bot® 3 is equipped with a highly flexible lightweight arm with seven degrees of freedom as well as with a three-finger hand. This allows the robot to grasp and operate a wide range of everyday objects. Using tactile sensors in its fingers, Care-O-bot® 3 is able to accurately adjust the grasping force it applies. By synchronizing its arm and platform movements, Care-O-bot® 3 is also capable of autonomously opening any door blocking the path to its destination.

## Environmental perception

Various sensors, more especially a sensor head equipped with stereo cameras and a 3D sensor, enable Care-O-bot® 3 to sense the environment in which it is operating. The sensors serve, for example, to detect and locate objects for manipulation as well as any obstacles in the robot's environment. All this information is collated in a 3D environment map that enables the robot to monitor the movements of its arm in real-time, thereby increasing the safety and dependability of the manipulation process. Care-O-bot® 3 is also capable of independently learning new objects.

## Safe interaction

The primary interface between Care-O-bot® 3 and the user consists of a height-adjustable tray that is attached to the front of the

robot. This tray is used for carrying objects to be exchanged between the human and the robot. It also includes a touch screen for inputting instructions to the robot and which retracts automatically when not in use. The robot uses its arm exclusively to place objects on its tray or to remove them from there. The motion of the arm is halted immediately if a human is detected in the vicinity of the robot. In combination with the use of safety-certified navigation sensors, this concept allows the safe operation of Care-O-bot® 3 in public spaces.

## Functional design

The novel design of Care-O-bot® 3 represents an intentional move away from existing humanoid service robots. Instead, the exterior design of the robot has been specifically adapted to its role as an interactive butler. This helps a human user to easily comprehend the capabilities of the robot.

## Application areas

Care-O-bot® 3 is able to automatically execute fetch-and-carry tasks, for example to serve a drink to a user. The user can easily place his or her order by using the robot's tray or an independent input device, such as a smartphone. Thereupon, the robot autonomously travels to the kitchen, where it detects the correct bottle, picks it up with its arm and puts it down on the tray before transporting and serving the drink to the user.

Care-O-bot® 3 can also be of assistance in an emergency, for example in the case of a fall. In such a scenario, the robot can serve as an interface to communicate with an emergency centre or to support other assistance measures.

## What we offer

You, too, can use Care-O-bot® 3 to associate yourself with the fascinating market of the future that is service robotics. Test out and show off your latest products and technologies on Care-O-bot® 3. Inform your customers and visitors about the latest development status as well as about future application areas for service robotics in a domestic environment by presenting a Care-O-bot® 3 on your company premises or at your trade fair stand. You can either have a new Care-O-bot® 3 platform constructed to meet your specific needs, or you can rent an existing robot. In either case, the above-described technologies and capabilities of the robot can be individually combined and the robot can be provided with application-specific speech and image outputs. Contact us to discuss your specific application scenario.

**2** Care-O-bot® 3 autonomously grasping a bottle on the kitchen counter.

**3** Care-O-bot® 3 serving a drink.

**4** Using the built-in monitor to communicate with the emergency centre after a fall.