Service-Robots as Daily Helpers

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Service-Robots as Daily Helpers

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A Thesis about Service-Robots and Ethics

Service-Robots are ethically not problematic because they only do what a human operator wants them to do.

Open issue for fostering discussion...

My presentation: What does this mean more precisely?
Deutsche Servicerobotik-Initiative - DESIRE

DESIRE-Alltag
- Technologieplattform
- Anwendungen

Anwendungen Alltag
- Indoor-/Outdoor-Wachroboter
- Transportroboter für Krankenhäuser
- Reinigungsroboter für professionelles Reinigen
- Outdoor-Personentransport
- Komponente: Personenerkennung
- Komponente: RFID-Navigation

Technologieplattformen als Katalysator für die Konvergenz der Technologien

Alltagstaugliche Wahrnehmung
- Erkennen > 100 Objekte unter unkontrollierten Bedingungen
- Sichere Detektion und Modellierung von Hindernissen
- 3D-Kartographierung sehr großer Umgebungen
- Erkennen von Objektfunktionen

DESIRE-Grundlagen
- Referenzarchitektur
- Funktionalitäten
- Komponenten

Alltagstaugliche Manipulation
- Integriertes Hand-Arm-System
- Bewegungsführung komplexer Kinematiken
- Sicheres Greifen von einigen Dutzend Objekten
- Lernen und Adaption bei Manipulationsaufgaben (PdV)

Alltagstaugliche Interaktion und Kommunikation
- Robuste Zeigegesten
- Klassifizierung von Interaktionssituationen, Erkennung von Partnern
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The German Service Robotic Initiative

- A project funded by the German ministry of research
- Headed by Fraunhofer (IPA), with leading German robotic/electronic industry (KUKA, Siemens)
- Start 1.10.05, 3 Years duration
- Goals
  - Integrate leading edge technology
  - Provide functionality that works in daily life
  - Offer an open, extensible system architecture
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Application Scenarios

- “Clear-up the kitchen table”
  - all objects on top the kitchen table will be moved to where they belong

- “Fill the dish washer”
  the dirty dishes will be sorted correctly into the dish washer

- “Clear-up this room”
  - all objects that are not at their place will be moved to where they belong
Service-Robots and Human Operators

- If a robot only does what a human operator wants the robot to do
- makes the robot useful

Human Operator: Bring me my pills, I can’t move out of my bed

Service-Robot: Not now, I’m just watching TV
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Advantages of the Human Operator Concept

- If a robot only does what the humans wants it to do
  - Authority stays with the human operator
  - Responsibility stays with the human operator
  - Liability stays with the human operator

- Other example: Intelligent driving assistants in cars
- Other example: space robotics / mission on mars

Human Operator

Service-Robot

Bring me my pills, I can’t move out of my bed

O.K.
Predictability: An industrial proven concept

- A system/machine/robot is **predictable** if it delivers correct functionality according within a specified time.

- Well known concept from real-time systems and industrial robots

- Sometimes also called deterministic
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**Predictability and Autonomy**

- It should be sufficient to specify "what" the robot should do, but not "how".
- The specification of "what to do" must be at the "right" level of abstraction.
- There must be a model that allows to specify what the robot should do.

Human Operator | Service-Robot
--- | ---
Bring me my pills, I can’t move out of my bed | Where must I go? What are pills?
robot selects autonomously how to do it
# Service-Robots as Daily Helpers

## Examples of Models (at different layers)

<table>
<thead>
<tr>
<th>Layer</th>
<th>Abstraction „what to do“</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drives</td>
<td>Drive at speed $s$</td>
<td>Control loop that regulates output voltage (differential equation model)</td>
</tr>
<tr>
<td>Navigation</td>
<td>Move to position $(x,y)$ without hitting any obstacles</td>
<td>Navigation algorithm with in-built obstacle avoidance (model combining a map and sensor input)</td>
</tr>
</tbody>
</table>
| Service-Robot | „clear up room“                         | Room model (non movable objects) Object model  
|               |                                         | - picture of object  
|               |                                         | - where to put it normally  
|               |                                         | - how to grab it  
|               |                                         | - ...  
|               |                                         | Non-identifiable objects are just obstacles ...                      |

- well established model
- new, but understood
- lots of research needed here
Fault Tolerance

- A model must include the possibility that something goes wrong
  - robot does not recognize objects correctly
  - robot tries to grab an object, but looses it
  - robot has wrong estimation about its position in the room
  - ...
- A robot should recognize these faults and
  - try some recovery
  - or inform the human operator
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Summary

- Authority for Service-Robots stays with the human operator
- Predictability: Operator specifies what the robot does
- Autonomy: Robot selects how to do it
- Combining predictability and autonomy requires expressive models at reasonable abstraction levels.
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Discussion

„Service-Robots are ethically not problematic because they only do what a human operator wants them to do“

Open issue. Please discuss:

- what is the model for “take care of my child while I am away”
- can we leave a patient who needs pills alone with a service robot to bring those pills if needed?

I hope to have made this part of the statement a bit clear
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BMBF Projekt - Start 11/2005 - 3 + 1 Jahr

1. Fraunhofer-Institut Produktionstechnik und Automatisierung (IPA)
2. Fraunhofer-Institut Autonome Intelligente Systeme (AIS)
3. Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)
4. Siemens AG (Siemens)
5. Forschungszentrum Informatik Karlsruhe (FZI)
6. Albert-Ludwigs-Universität Freiburg (ALU)
7. Ruhr-Universität Bochum (RUB)
8. KUKA Roboter GmbH (KUKA)
9. Schunk GmbH & Co. KG (Schunk)
10. InMach Intelligente Maschinen GmbH (InMach)
11. Viisage Technology AG (Viisage)
12. Gesellschaft für Produktionssysteme GmbH/Neobotix (GPS/Neobotix)
13. Gesellschaft für Produktionssysteme GmbH/Projektmanagement (GPS)
Koordination von Subsystemen

- MMI
- Planer
- Ablaufsteuerung
- Weltmodell
- Objekt-erkennung
- Objekt-Datenbank

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Wahrnehmung → Armsteuerung

Armregelung

Compliant Motion?

Manipulator → Basis-Plattform

Navigation

Wahrnehmung

Motorsteuerung

Motorregelung

Armsteuerung