Service Robotics – State of the Art in an Emerging Market

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Timeline of Robotics

1921

Karel Čapek

1941

Isaac Asimov

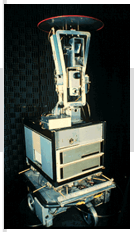
1954

Prog.Arm

1961

Unimation

1968



Shakey

1980

Service robots

1984

100,000 robots

Asimov's "Laws of Robotics"

- **Law One**
  - A robot may not injure a human being or, through inaction, allow a human being to come to harm.
- **Law Two**
  - A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
- **Law Three**
  - A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

Safety

Shared Control, Dependability

Availability

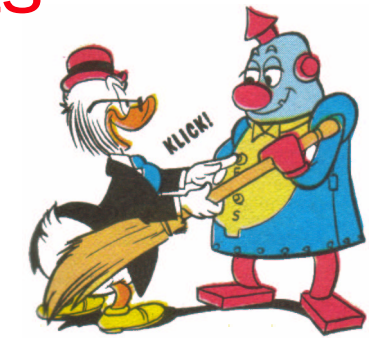
What are Service Robots?

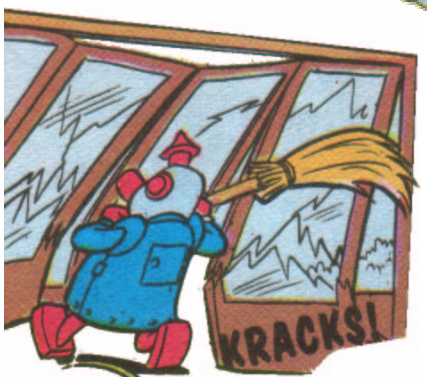
- Service robots refill vehicles, reconstruct nuclear power plants, take care of the elderly, observe museums, explore other planets or clean aircrafts. So what are service robots?
- Service robots form an intermediate stage in the evolution from the industrial robot to the personal robot, which might be an important part of our lives in 20 years.
- Service robots are mobile, manipulative, interact with human beings, or perform tasks autonomously that relieve the human being. They fulfill tasks for humans and facilities: They perform services.

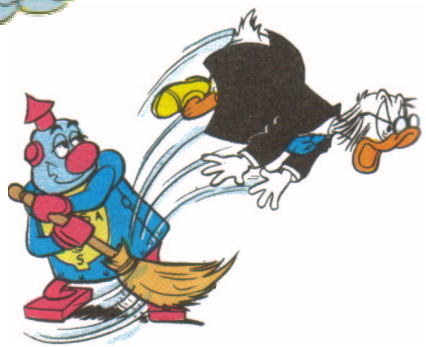
IEEE and IPA-FhG database on Service Robotics

Demands for Service Robots

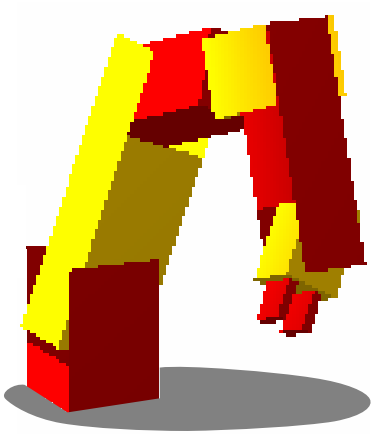
- **Usability**
  - Man-Machine-Interface
  - Usable by Laymen/Laywomen
- **Service on a High Level**
  - Robust
  - Efficient
  - Precise
  - Cost-Effective
- **Reliability**
  - Safety
  - Availability
  - Dependability







Safety in Service Robotics



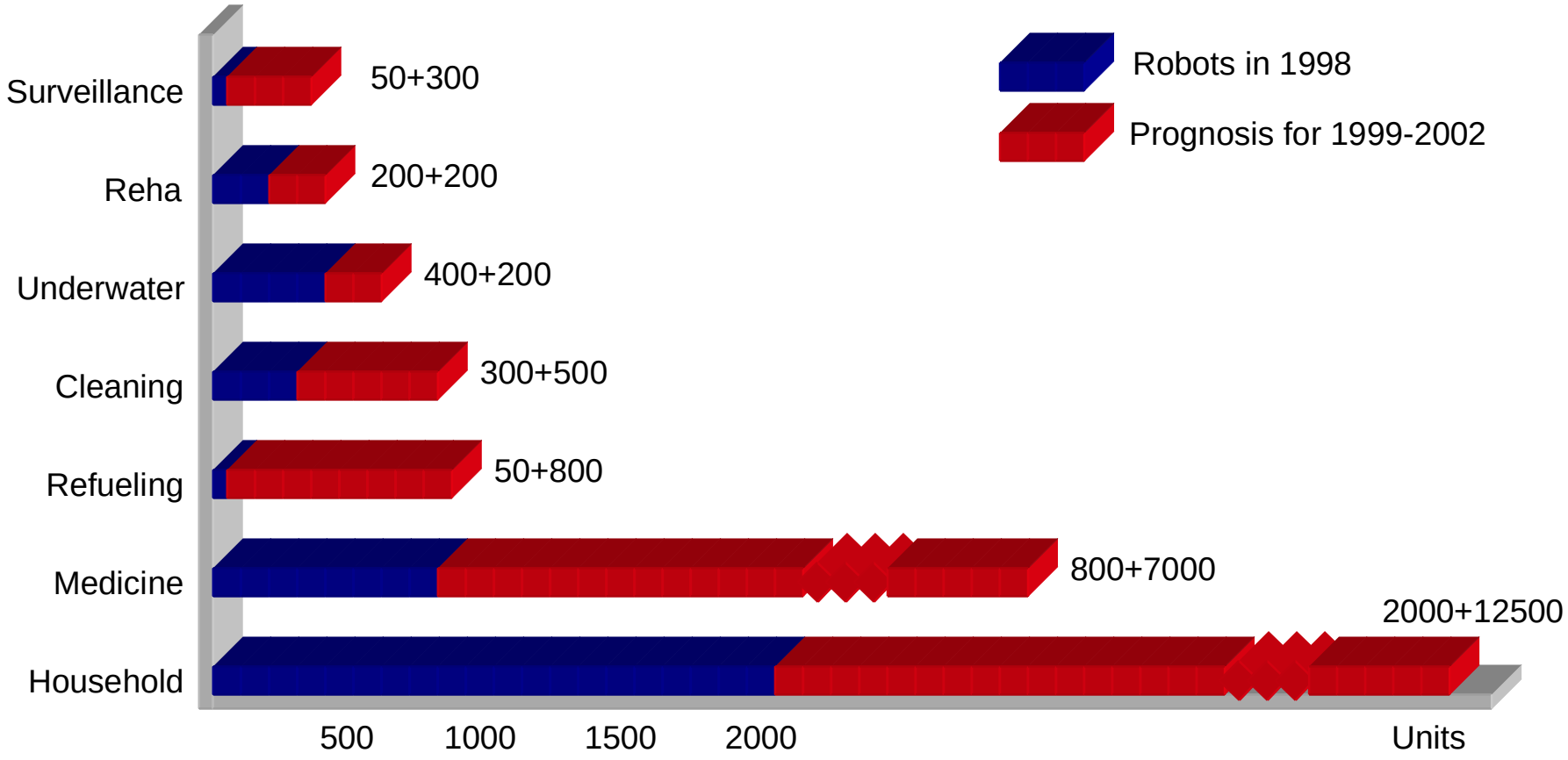
Increasing Safety Demands

Kinds of Service Robots

- Agriculture
- Care / Rehabilitation
- Cleaning
- Construction
- Demining
- Entertainment
- Fire-Fighting
- Hobby / Leisure Time
- Hotel / Restaurant
- Marketing
- Medical
- Mining
- Monitoring
- Office
- Reconstruction
- Refueling
- Sorting
- Space
- Underwater

IEEE and IPA-FhG database on Service Robotics

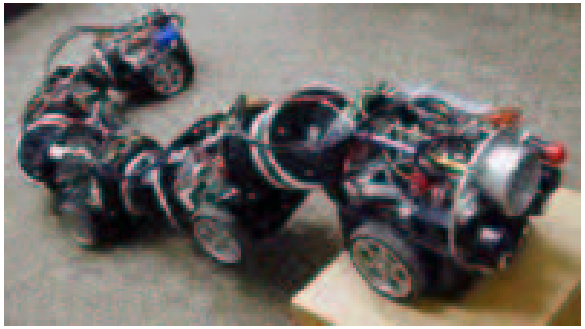
Market Analysis



UN/ECE and IFR (1999)

Surveillance and Inspection

- **Application Domains**
  - Inspection of Sewer Systems
  - Guarding Buildings, etc.
- **Demands**
  - Robust
  - Safe
- **Benefits**
  - Inspection of previously unreachable areas
  - Rationalization
- **Examples**
  - MAKRO (AiS-GMD, Germany)
  - CyberGuard (Cybermotion, France)

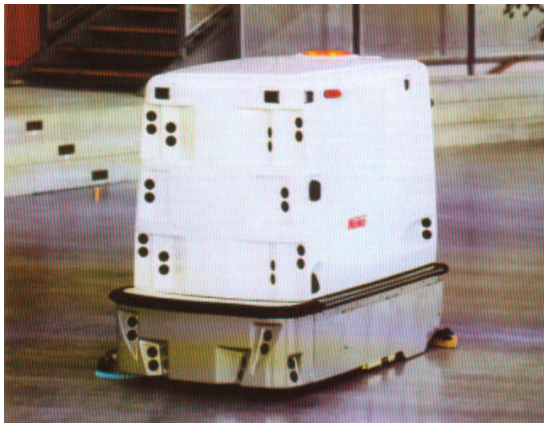


Rehabilitation

- **Application Domains**
  - Elderly, Ill, and Handicapped Persons
  - (Clinical) Rehabilitation
- **Demands**
  - Dependable and Safe
  - Easy to Use
  - Adaptable to the Individual
- **Benefits**
  - Improvements for the User‘s Mobility, Autonomy, and Quality of Life
- **Example**
  - Rolland (Bremen)

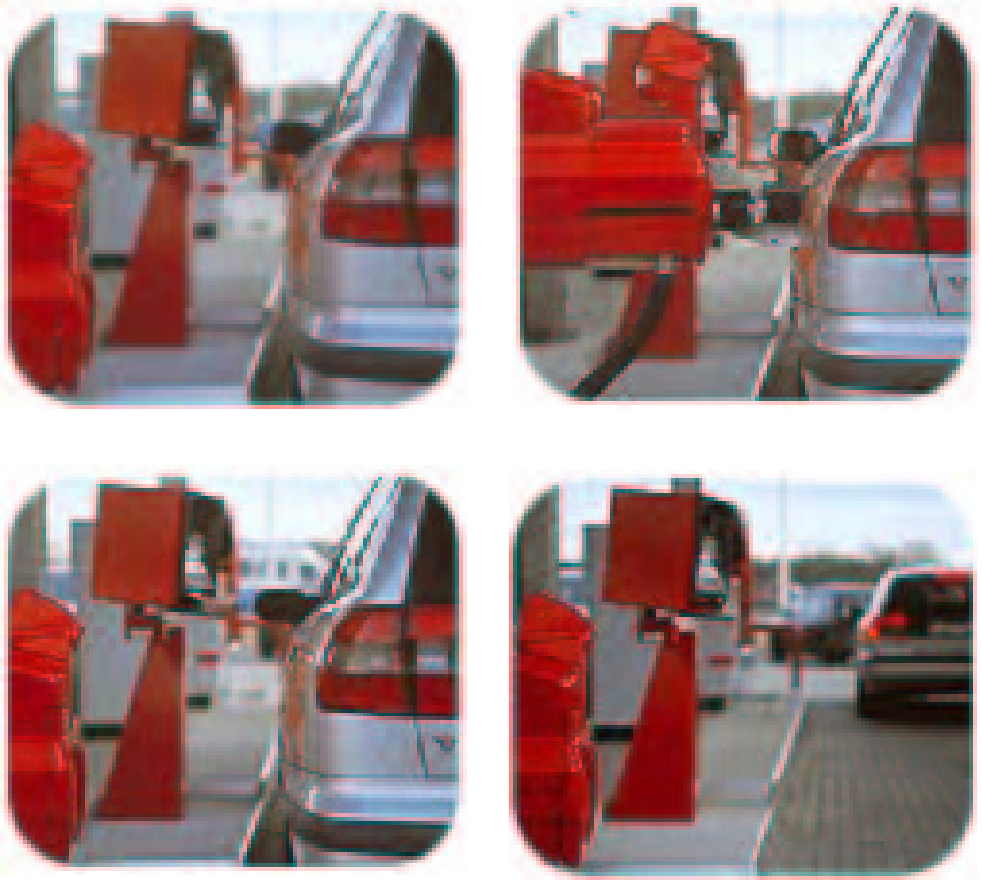
Cleaning

- **Application Domains**
  - Stations, Office Buildings
  - Planes, Boats, etc.
- **Demands**
  - Safe
  - Robust
- **Benefits**
  - Rationalization
  - Saving of Time
- **Examples**
  - ACROMATIC (Hako, Germany)
  - Skywash SW33 (Putzmeister, Germany)



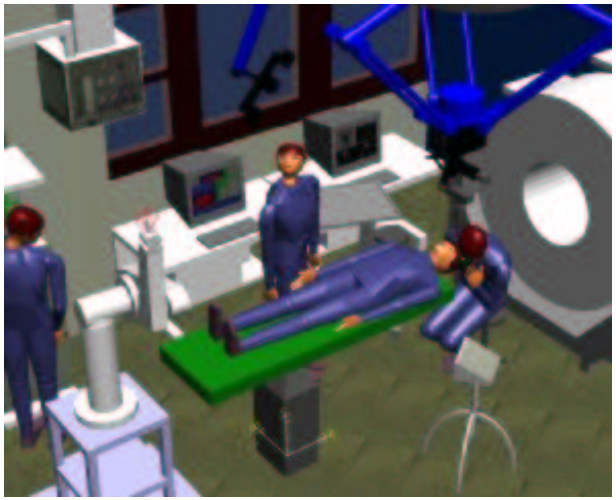
Refueling

- **Application Domain**
  - Automatic Gas Stations
- **Demands**
  - Robust and Fault-Tolerant
  - Precise
- **Benefits**
  - Saving of Time
  - Reducing Risks to Health
  - Correct Selection of Fuel
- **Example**
  - AutoFill (Sweden)



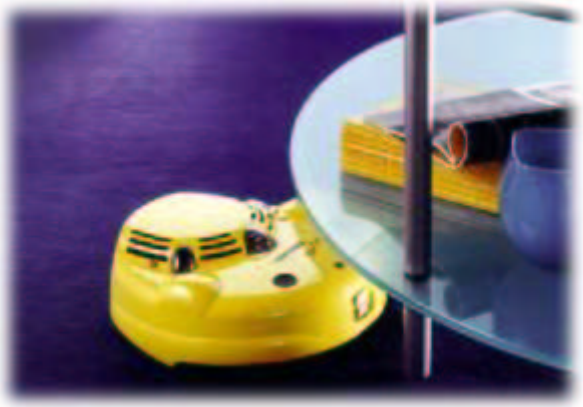
Medicine

- **Application Domains**
  - Support for Operations
  - (Minimal Invasive) Surgery
- **Demands**
  - Precise
  - Fail-Safe
- **Benefits**
  - Higher Precision during Operations
- **Example**
  - Surgical Robotics Lab (Charite, Berlin)



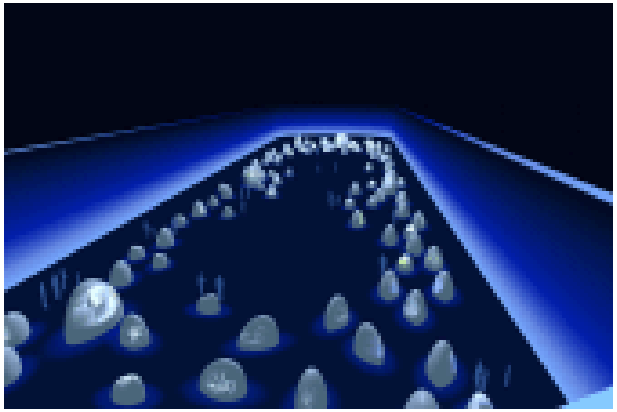
Household

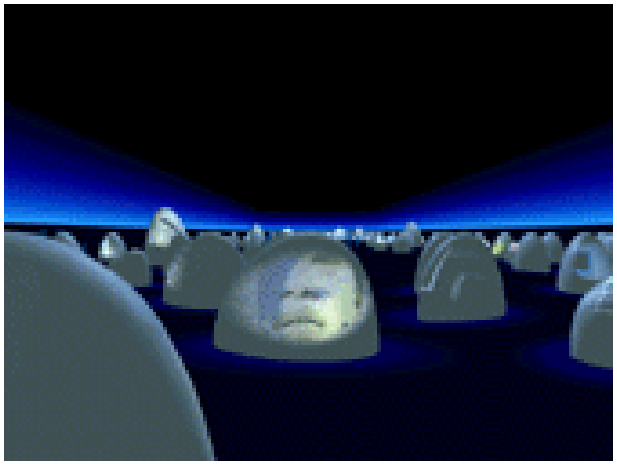
- **Application Domains**
  - House Keeping at Home or Gardening
- **Demands**
  - Safe
  - Easy to Use
  - Cheap
- **Benefits**
  - Automation of “Unpleasant” Tasks
  - Rationalization in Commercial Fields
- **Examples**
  - Vacuum-Cleaners (Kärcher, Germany)
  - Lawn-Mowers (Friendly Robots, Israel)



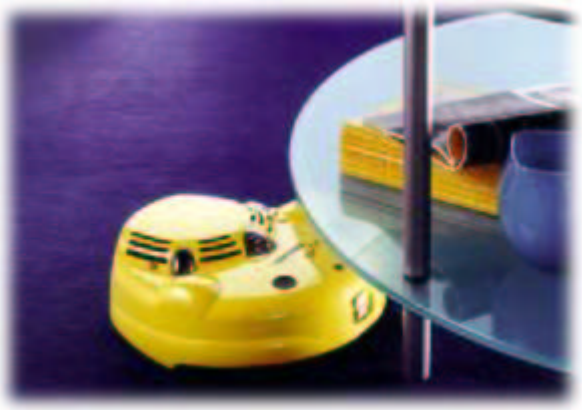
Entertainment

- **Application Domains**
  - Shows
  - Museums
  - Amusement Parks
- **Demands**
  - Safe
  - Robust
- **Benefits**
  - New Possibilities for Entertainment
- **Example**
  - EXPO Theme Park “Mobility” (ZKM / IML-FhG)





Future of Service Robotics



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