Bus Inf Syst Eng 57(4):271–274 (2015)
DOI 10.1007/s12599-015-0389-x

CATCHWORD

Service Robots

Michaela Sprenger · Tobias Mettler

Received: 17 February 2015 / Accepted: 28 April 2015 / Published online: 22 May 2015

Keywords Automation of services · Autonomous systems · Human-centered environment · Service robots

1 What are Service Robots?

The focus of business and information systems engineering research is continuously shifting to a more user centered view (Brenner et al. 2014). This shift is enabled by technological developments (e.g., in the area of mobile technologies and sensors) as well as by the integration of IT into real life environments (e.g., the internet of things) leading to a design of digital-physical information systems (Hess et al. 2014).

One area of digital-physical information systems is service robotics. Service robots are technical devices that perform tasks useful to the well-being of humans in a semi or fully autonomous way (International Federation of Robotics 2015a). The differentiation between industrial and service robots is based on their area of application and closeness to end-users (Prestes et al. 2013). Since service robots have to operate and communicate in an unconstraint, human-centered environment, a high degree of autonomy is an inherent characteristic of them (Haidegger et al. 2013). For example, a service robot responsible for the cleaning of floors in a hospital has to autonomously navigate its way through the building. While navigating, the service robot has to react to its environment in a real time manner: it has to stop for patients, doctors, and other human beings that might block the robot's route as well as to independently circumnavigate any obstacles like patients' beds or wheelchairs.

2 Current Focus of Research

Originally, robots were applied in an industrial context as a means of automation. Automation allows for processes to be conducted in a reliable way while ensuring a constant quality level. Further advantages lie in the increased output, the reduction in personnel costs, and in relieving the workforce of dull, repetitive or dangerous tasks. Especially in the automotive industry, where automation levels are high, robots have been a driver for superior productivity and earnings (International Federation of Robotics 2015b).

Today, in addition to industrial robots, service robots have appeared on the scene. Thanks to advances in sensor technology, robots are no longer bound to an industrial context but can operate in unconstrained environments of everyday life (Haidegger et al. 2013). Hence, the key differentiator between an industrial robot and a service robot is not the robot itself but rather the context it is operating in. Service robots perform tasks in the human environment that serve human needs. This development is especially interesting against the background of the increasing importance of the service sector. As our economy relies more than ever on the value creation by services, they are the key to future competitive advantage. Analogously to the industrial context, automation through the employment of service robots becomes a means to increase the competitiveness of a service. However, in contrast to

Accepted after one revision by Prof. Dr. Sinz.

M. Sprenger · T. Mettler (✉)
Institute of Information Management, University of St. Gallen, Unterer Graben 21, 9000 St. Gallen, Switzerland
e-mail: tobias.mettler@unisg.ch

M. Sprenger
e-mail: michaela.sprenger@unisg.ch

manufacturing processes, the underlying process of a service can usually not be fully automated as services in general require human involvement. Nevertheless, the cooperation between humans and robots leads to a semi-automation of services. For example, a transportation robot that supports courier services within a building must still be operated by a human to get the information where to pick up and where to deliver a certain good to. The transportation itself is then automated and autonomously performed by the robot.

As service robots have become more versatile and diffuse to different areas of human life, they also have found their way into research. While extant research rather focuses on technical aspects of the robot itself, there is still a lack of context specific research on service robots (Garmann-Johnsen et al. 2014). Since service robots join the human environment, they must meet different requirements. To ensure a smooth human-robot interaction, technologies have to be used to help the robot blend in with the human-centered context. Advanced machine learning capabilities, which help the service robot to better understand and react to the environment and context in which it is acting, as well as fine motor skills, which aid the robot in mimicking human appearance and behavior, are just two examples where further research is needed.

3 Relevance of Service Robotics for Business and Information Systems Research

Regarding the lack of context specific research in the area of service robotics, investigations with a business and information systems focus could provide valuable insights. In contrast to industrial robots, service robots share per definition the human working environment and have to interact with people. The affordance of service robots, understood as a relational concept that connects the materiality of a technological artifact with the subjective goals and perceptions of its users, is therefore fundamentally different from that of industry robots.

Taking not only the technical but also the socio-technical perspective prevents that the development of robots is inappropriate to their social environment and that these consequently are rejected because of low acceptance or performance.

While the BISE community keeps an eye on business aspects when dealing with social-technical systems, its research also considers economic issues. The following challenges represent interesting research areas, as they consider social, technical, and economic implications of service robots (cf. Fig. 1).

3.1 Managing Resistance

Analogously to the introduction of robots into industrial contexts, automation and the corresponding need for change is not always socially appreciated. When service robots are integrated into processes, the employees of the organization have to adapt their way of working which is especially true for those employees who have to cooperate with the robot. A nurse who used to order drugs via telephone in the hospital's pharmacy and pick them up when she was not needed on the ward, now has to work with a technical device that triggers the drug delivery by the service robot. As the robot is now in charge of transporting the drugs form the pharmacy to the ward, it takes over

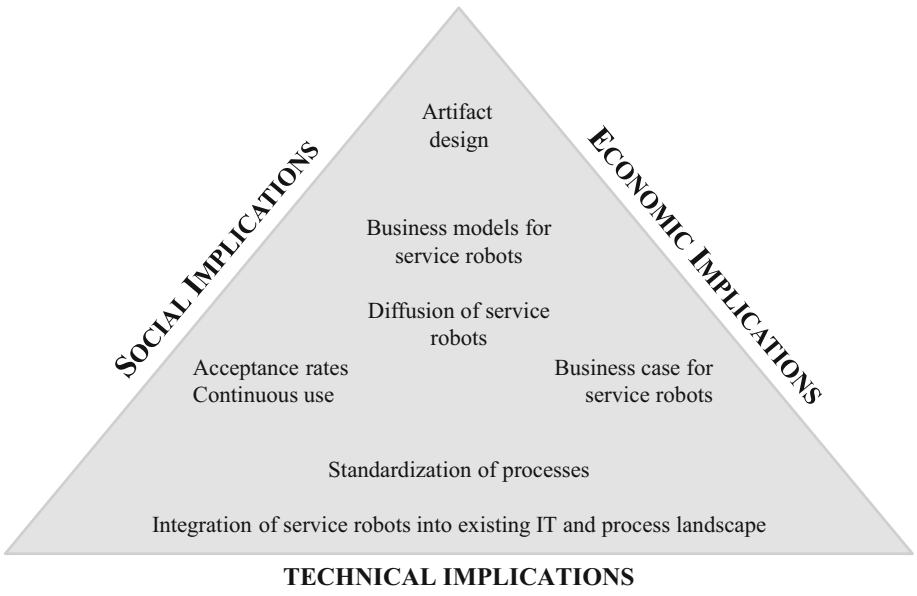

Fig. 1 Areas of service robotics research with interest for the BISE community

certain tasks that used to be executed by the nurse. This – in combination with the intended efficiency gains that usually accompany any kind of automation – often leads to a fear of job loss among the affected employees.

As resistance to change and reluctance usually result in low acceptance rates, a successful implementation of service robotics might be in jeopardy. Therefore, research should shed light on the factors determining user acceptance and continuous use.

These studies should moreover focus on customers who might also get in touch with the service robot. A customer who used to receive his shipment from a nice delivery man might be disappointed when facing a service robot. In this case, the robot dehumanizes the service which in turn might lead to low customer satisfaction levels.

Analyzing customers' response to service robots might help understand for which services robots are suitable and define adequate automation rates in customer facing processes.

3.2 Designing Service Robots for Continuous Use

As usage and acceptance rates also depend on the artifact, the design of the service robot is crucial, too. Insights are needed as to how to ensure an intuitive use of the service robot (e.g., through user-friendly interface design) as well as how to design the overall appearance of robots. Questions like "should the service robot have certain colors and sounds?" or "should the service robot have human characteristics?" have yet to be answered.

3.3 Integrating Service Robots in Human Working Environment

In addition to design aspects, also considerations with respect to the integration of service robots into the existing process landscape are needed. Service robots require clearly defined and standardized processes as they have difficulties in adapting to sudden changes in the workflow. Compared to a service robot's process, a process performed by a human being is rather flexible: a logistician working at an office building can decide where to put the goods for transportation, he can make detours and changes to his schedule if there is an unplanned delivery, and he can assist the recipient in unpacking the goods.

A service robot needs clear loading and unloading zones, it transports the goods to a given time with a predefined route and cannot take care of process steps, which do not belong to its area of responsibility. For the robot, processes need to be formalized. Once this is given, service robots can be a means for stable and optimized processes as they perform each process in a predictable manner. The key is to determine which processes (or rather process steps) are suitable for formalization as well as how to translate existing processes into formalized models. In this area, business and information systems engineers could make an important contribution.

3.4 Integrating Service Robots into Existing IT Landscape

The same is true for the IT integration of the service robot. When the service robot is fully integrated into the IT landscape, new information gained from the robot's operation may be exploited, such as for example in an enterprise resource planning system. A robot transporting goods can give insights into the material flows that take place between different departments as well as provide real-time information on changes in the stock of inventory. Hence, the service robot can be a means of transparency and a basis for data analytics revealing potential savings.

However, the integration of the service robot is also closely related to high costs as interfaces have to be defined and the service robot's hardware and software have to be compatible with existing IT systems. A structured approach of how far the IT integration should go and how the newly generated data could be used has yet to be defined.

3.5 Making a Business Case for Service Robots

Deploying service robotics usually requires high investment costs: Apart from the aforementioned costs of integrating the service robot into the process and IT landscape, the costs for the robot itself, for its infrastructure as well as potential alterations in the environment have to be considered. The latter is especially important when service robots are implemented into an existing building as they might not be able to operate in small hallways or staircases. In this connection, regulations have to be considered as well. For example, the healthcare regulations in certain countries allow service robots only behind the scenes in a hospital. In that case, service robots cannot share the same infrastructure with patients or visitors, but they must use dedicated hallways and elevators.

Since service robots do not have a direct impact on revenues, they have to save more costs than they create to be attractive from an economic perspective. These cost savings might result from an increase in efficiency. As service robots can operate 7 days a week at any time, they can outperform the alternative of employing a human being. However, the determinants and thresholds regarding the economic advantages of service robots are insufficiently researched. A thorough analysis might provide a method how to determine if a service can be performed more efficiently by a robot or by an employee.

3.6 Defining a Business Model for Service Robots

As mentioned above, social, technical and economic implications are not independent from each other. Therefore, business and information systems engineers could also provide valuable insights into the intersection of the three areas, e.g., by researching appropriate business models for service robots. Especially regarding contexts where service robots are not yet employed, questions related to business models are still open: what customer segments exist? What would be a compelling value proposition for each segment? What revenue mechanisms are appropriate? Only a well-researched business model can pave the way for the service robots' implementation and thus foster the diffusion of service robots into different industries and contexts.

The proposed research topics should be seen as non-exhaustive examples that could shed light on the social, technical and economic implications of service robots as well as on their intersections.

4 Conclusion

As robots are able to perform complex tasks, they are able to advance from the industrial to the service context. Today, service robots have multiple application areas: medical robots assist in surgeries, transportation robots support logistics, and maintenance robots inspect facilities and plants (International Federation of Robotics 2015c). For these application areas, service robots – as every form of automation – promise advantages in efficiency, reliability and quality. However, the downsides regarding loss in flexibility and fear of dehumanization might outweigh the benefits in situations where the human touch is priceless. Service robots are finding their way into the human centered environment, but how far they may progress has yet to be found out.

Only researchers capable of considering social, technical, and economic implications can derive future application areas of service robots as well as the corresponding requirements to introduce service robots into everyday life and to fully leverage the service robots' potential.

References

Brenner W, Karagiannis D, Kolbe L, Krüger J, Lamberti H-J, Leifer L, Leimeister JM, Österle H, Petrie C, Plattner H, Schwabe G, Uebernickel F, Winter R, Zarnekow R (2014) User, use and utility research – the digital user as new design perspective in business and information systems engineering. Bus Inf Syst Eng 6(1):55–61

Garmann-Johnsen NF, Mettler T, Sprenger M (2014) Service robotics in healthcare: a perspective for information systems researchers? Proc Int Conf Inf Syst, Auckland

Haidegger T, Barreto M, Goncalves P, Habib MK, Ragavan SKV, Li H et al (2013) Applied ontologies and standards for service robots. Robotics Auton Syst 61(11):1215–1223

Hess T, Legner C, Esswein W, Maaß W, Matt C, Österle H, Schlieter H, Richter P, Zarnekow R (2014) Digital life as a topic of business and information systems engineering? Bus Inf Syst Eng 6(4):247–253

International Federation of Robotics (2015a) Definition of service robots. http://www.ifr.org/service-robots/. Accessed 17 Feb 2015

International Federation of Robotics (2015b) Industrial robot statistics. http://www.ifr.org/industrial-robots/statistics/. Accessed 16 Feb 2015

International Federation of Robotics (2015c) Professional service robots. http://www.ifr.org/service-robots/products/. Accessed 16 Feb 2015

Prestes E, Carbonera JL, Fiorini SR, Jorge VAM, Abel M, Madhavan R et al (2013) Towards a core ontology for robotics and automation. Robotics Auton Syst 61(11):1193–1204