

Service Robots: Help is on the way!

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1 What is a Service Robot?

There is an International Standards Organization standard - ISO 8373 - that defines terms for manipulating robots. It states that a service robot is a robot that is able to perform useful tasks for humans. It should operate in two or more axes, and must also work with a degree of autonomy from human intervention. The term is used to describe robots that might be used in the home and some examples might include: a domestic service robot for home cleaning, or a robot that helps to exercise your pet. It also includes professional service robots that might be used in public spaces, for example to clean floors, or that operates as a delivery robot. Other examples might include a robot that performs dangerous tasks in fire fighting, or robots that provide help in a hospital or to the elderly.

In our homes today we already have limited forms of service robots that we call domestic appliances: washing machines, dishwashers, and vacuum cleaners. These devices don't quite qualify under the ISO standard because they only operate in one axis or they are not autonomous. However these domestic appliances highlight how useful a service robot could be. As an indication of how large a market opportunity we are looking at, over 70 million washing machines were produced last year alone.

2 Why do I not have a service robot today?

You can buy service robots today. A great example is the iRobot Roomba, which is an autonomous vacuuming robot. iRobot states on its website that over 10 million units had been sold as of February 2014. Lots of companies are working on products and we should expect to see a large number of new devices launched over the next few years.

3 What are some of the technology challenges in service robots?

One of the main reasons that 70 million washing machines ship each year is because you can buy a fully featured, low energy machine for less than \$400. Making service robots useful and affordable is the big technology challenge.

Making devices operate in more than two axes (also known as two degrees of freedom) requires multiple motors that all need to work together in concert. Making a device that can operate autonomously needs multiple sensors and complex programming that can provide a degree of intelligence. Making the device safe when it is operating in your home needs additional sensors and failsafe mechanisms that you can rely on – no one wants their robot vacuum to chase the dog.

Multiple axis motor control and precise motion control are two of the technology challenges. This complex technology needs to be highly integrated but also low cost so that service robots can be produced at affordable prices. Making the motors operate in lock step and able to maintain performance under different loads is critical. With the complex inverse kinematics motion control compute distributed to the motors themselves you can save on communications and reduce the central processor requirements.

One key aspect is being able to scale compute capability while making the system operate with precise real-time response. As you add sensors or actuators, you need the existing code to still operate the same and to maintain timing. When a sensor triggers for a safety event, the system must respond instantly and perform a precise set of steps.

4 Can service robots replace humans?

Humans are very good at assimilating information and working out what needs to be done, often working in a “probabilistic” way on the basis of data which would be insufficient for a machine to achieve the same task. They are able to sense small and subtle differences. They can quickly make decisions about what needs to change and can accurately manipulate a surface or device so that the task can be completed. Humans can cope with a large number of disparate tasks and will be able to perform these in a whole number of ways. Robots will not directly replace humans, but by focusing them on a specific task and limiting the context that they need to understand or the environments that they are expected to work in, service robots will be able to perform many useful tasks – and do them well.

Trying to emulate some level of human capabilities and adding a degree of intelligence becomes the next big challenge. You can make a robot vacuum that uses a few sensors to perform a basic ‘random walk’ around your room. However demanding customers will want to know that the autonomous robot is reaching all the corners and covering the whole floor in a meticulous way. Complex technology like ‘simultaneous localization and mapping’ (or SLAM) will be needed. These are algorithms that allow the robot to autonomously build up a picture of the environment and create a map of the area. It will need to keep this map updated as you move furniture in your room or to adjust for your pet when it is lying asleep in front of the fire.

By restricting the set of tasks you need a service robot to do and thus reducing the context that a robot needs to deal with, you can make this task a little easier. However, the ability to perform a set of tasks well will ultimately be the way that companies differentiate their products. Adding intelligence and sensing capability that makes the service robot better at performing its task could be the difference between a huge sustained sales success and a device that quickly falls out of favor.

5 When will we all have service robots?

Great technology strides are happening already. Intelligent multicore microcontrollers that can provide high levels of compute, which are scalable, and which provide precise timing and fast response are available now. New versions of these devices will add more capability and in the future will integrate more and more intelligence with machine learning capability.

Over the next few years we should expect to see massive advances in service robot capabilities while at the same time we will see prices reach affordable levels. Service robots will become a huge market and the companies that can lead this trend will achieve significant success.



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