Chapter 51
Service Robots for Agriculture:
A Case of Study for Saffron Harvesting

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ABSTRACT

In general, service robots are described with different characteristics for different tasks. In this chapter service robots are analyzed as machines in the agricultural field. The mechanisation in agriculture is discussed and service robots are described for particular tasks. In particular, the harvesting and treatment of high commercial value products is discussed for robotized applications. A significant case study is described and discussed for a robotized system with the aim to harvest and separate the Saffron flower spice.

INTRODUCTION

Robots can do a lot of things humans can't. Since the beginning of the enthusiastic automation history, anthropomorphic robots have fascinated designers and inventors, since playwright Karel Capek, in his comedy, introduced the word "robot," from the Czech "robota" meaning heavy work.

Robotic systems perform many functions such as repetitive tasks. Depending on their function, robots can be classified in categories. The two major classes of robots are the industrial robots and service robots. Service robots can be classified into professional and personal robots. In Figure 1, the number of industrial robots for every 10,000 human workers is referred in 2000.

For Robotic Industries Association, an *industrial robot* is a machine reprogrammable and automatically controlled in different axes and degree of freedom, which may be in place or mobile for industrial applications.

According to the International Federation of Robotics, a *service robot* is a machine operating autonomously. Personal robots are service robots that assist people, as in domestic robots, carer robots, and robots for entertainment.

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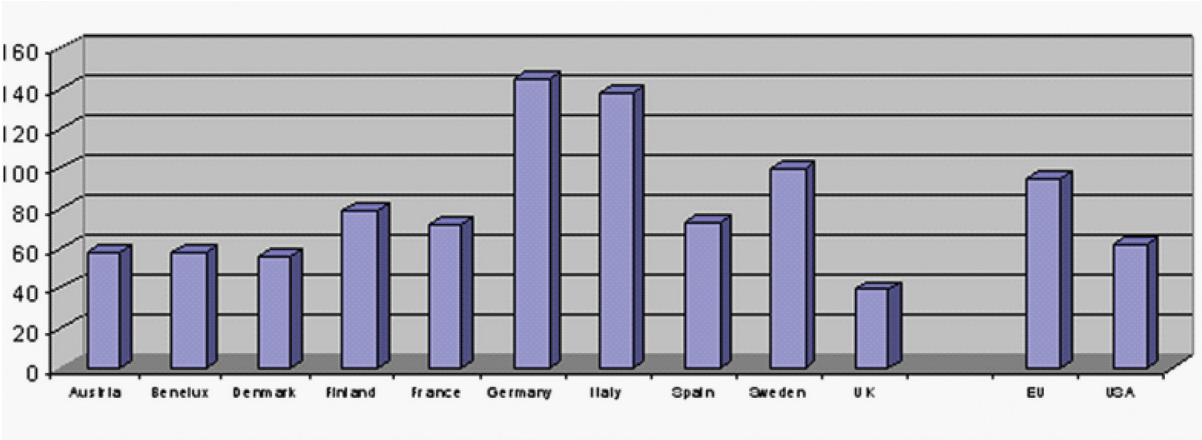
Figure 1. Number of industrial robots for every 10,000 human workers



In general, the challenges in service robotics activities include all the challenges relative to industrial. Dexterous manipulation and integration of sensing in support of manipulation is fundamental. In addition, mobility is a key challenge for service robotics. Many designers and researchers consider that robots find applications in the so-called "4D tasks," tasks that are dangerous, dull, dirty, or dumb.

For several years, service robots have been at work where people are at risk: in dangerous and hostile environments or where repetitive operations are done, difficult or disagreeable like under the sea, in nuclear plants, or in space. Today service robots are embarking on a multitude of new activities: picking agricultural products, taking care of the handicapped, cleaning buildings and public areas like parks, or sort plants for security of buildings, factories, and plants, or helping in actions in the presence of terrorist danger. Because service robots are often able to make actions under hazardous or hostile conditions, for example, they may deliver the increased productivity that has eluded the service sector. Another important force driving the advent of service robots is the increasing demand of service workers such as nurses and patient assistants. There are demographic pressures as well. Many service-robot suppliers aid the rapidly aging population: people over eighty are an important and fast growing segment of people in Europa, U.S.A., and Japan. Sophisticated control algorithms are used to perform kinetic and dynamic tasks in complex environments. In many settings as in space, in nuclear plants, or under the sea, cost savings are an important factor as well. Supporting deep-sea divers and the work of astronauts outside the spacecraft can cost hundreds euros an hour. When a nuclear plant shuts down, replacing the lost electricity can cost a utility an estimated one million euro a day. The military, whose primary concern is not economics, sees in the new service robots a way to maintain high-tech superiority.

Most service robots in space, under the sea, in nuclear plants are often operated from a distance by human workers in teleoperation. The robots are tethered by a cable to the control station allowing the transmittal of electrical and mechatronic signals and power. The service robotics industry has leveraged recent advances in mobility, sensoring, and algorithmic advances, allowing robots to localize in a world map environment. Robots are able to provide logistics support in structured and unstructured environments.

When service robots must be mobile, there are challenges for designing robots that are capable of carrying their own power source. Service robots, especially personal robots, will operate close to