Service Robots and Robotics:
Design and Application

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Chapter 12

Service Robots for Restoration of Goods of Cultural Heritage

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ABSTRACT

The preservation and benefit of goods of Cultural Heritage need careful surveying and restoration that can be understood as service tasks for suitable robotic systems. New service robots can be conceived once the specificity of the application in the Cultural Heritage area for architectural goods is carefully considered, both with technical aspects and from operators' viewpoints. In particular, in this chapter no technical aspects are discussed as fundamental for the acceptance and use by operators in the new field of service robot application for survey and restoration of architectonic goods of Cultural Heritage value. Examples are illustrated from authors' experience with the aim to stress the problems and challenges in applications for service robotic systems in Cultural Heritage frames.

INTRODUCTION

One of the most challenging activities in Robotics consists in looking for new designs and new applications for robots and robotic systems. New fields of applications are characterized by specific requirements that existing robot solutions may not be able to fulfil and therefore specific investigations and design activity are required. In addition, new applications are often related with new potential users, who may have not suitable technical background and attitude for operating tasks in their professional area with robotic systems. New applications and new robotic systems are today mainly focused for service robots with technical background and issues, such as for logistics, medical applications in rehabilitation issues and surgery assistance, fields in agricultural applications, surveillance and maintenance in museum applications, home service also in...
If any damage of the service robot occurs, the robot design with market components permits a simple substitution of the parts. Care for the interaction with the environment has been considered by designing leg feet as powered servo-controlled wheels, which give the possibility to regulate motion and force contact with pavement surface. In Figures 8 to 10 those main aspects of the designed survey service robot are shown as implemented in the Cassino Hexapod robot both with operation simulations and lab experiments. In Figure 8b a simulation output is reported for a survey operation on the cosmatesque pavement as known from sixty years ago. Features are identified in over passing obstacles and holes in the pavement as well as a not planar condition. In Figure 9a the prototype is shown in a lab test for motion capability by using only feet wheels. In Figure 9b the modular design for the leg structure is reported as obtained by repeated modules consisting each of a DC motor with switches on board as motion stops. A new simplified design for the leg design is outlined in Figure 9c as conceived after having experienced the excessive complexity of the operation of too many motors during the robot motion in most of the service situations. In Figure 10 an example of the operation strategy by using PLC is reported with Grafcet diagrams that can be used also for training the no-technical users in understanding the robot possibilities and programming.

Figure 10a describes the analysis with elementary actions for the leg motion as directed for a user-oriented programming. Thus, each action is indicated as referring to a signal for motor movement or for a sensor output. The corresponding programming is reported in the synthetic way through the Grafcet in Figure 10b where M indicates motor action with a counter wise rotation when with plus signal superscript and vice versa with minus sign superscript. The status of the sensors is indicate with corresponding small letters with digit 0 for no signal and 1 when activate by a signal.

The above peculiarities of the Cassino Hexapod robot as survey service robot still require better careful attention by considering constraints and peculiarities from Survey activity, together with an overall functionality and adaptability to specific Survey constraints of specific applications.

CONCLUSION

Development and design of service robots are challenging areas for further wide spreading robots in new applications. Fundamental issues and challenges have been discussed in the chapter as related to applications in Cultural Heritage frames with the aim to outline general guidelines for a successful design and operation with acceptance by operators and users, even when they are not technical experts, mainly for applications in survey and restoration activities of cultural goods. Thus, main aspects are indicated in the service operations and tasks as technical issues, which are nevertheless strongly influenced by the many no-technical issues and considerations that should be modeled properly for engineering activity both for R&D and system design. Human interaction in a broad sense is a key point aspect both for the use and acceptance of new solutions that more and more can be proposed as service robots even within frames of Cultural Heritage. Examples for restoration and survey of historical goods have been illustrated as from the direct experience of the authors with the aim to stress specific problems and challenges that can be approached for novel service robots in Cultural Heritage frames.

REFERENCES


