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An Anthropomorphic Hand with Five Fingers Controlled by a Motion Leap Device

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Abstract

This paper presents a new solution for command and control of the one anthropomorphic gripper with five fingers intended to be used in industrial robots equipment assemblies used for achieving low and medium complexity. The command solution is based on Motion Leap device and some software module: HandCommander, HandProcessor and HandSIM. The object to be gripped is recognized, using the SpatialVision application based on the image analysis, the 3D model is loaded in the GraspIT application. The user gesture is recognized and sent to the gripping test module and the RoboHand component to grip the objects preconfigured. The object is gripped in the physical environment by the RoboHand component, the anthropomorphic gripper with five fingers. We shown as example tennis ball gripping.

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Keywords: Anthropomorphic gripper; Motion Leap; Software; Simulation; Command; GraspIT.

1. Introduction

Anthropomorphic grippers are inspired from the human hand, having various constructive and functional features. Compared to other classes of grippers like jaw grippers [1,2] or tentacular grippers [2], they have obvious advantages because they are more similar to the human hand, both constructively and functionally, considering the human hand as the most perfected gripper [2]. Today there are more versions of anthropomorphic grippers, some of which only designed, others as prototype and some as commercial products [3,4,5,6]. An important issue is the choice of the command and control system for these grippers. After the study in the current stage, we consider that the optimization of the existing methods of grippers control, and research and implementation of new command and

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control techniques significantly facilitate anthropomorphic grippers operation. In addition, due to the relatively high costs of grippers' acquisition, virtual reality simulation can greatly reduce the time and cost associated with the implementation of a project. Starting from the current stage of research in the field, this paper identified components needed to create a command and control module for an anthropomorphic gripper, both virtually and physically. Compared to existing methods, it can reduce significantly costs associated to a project and it may allow natural interaction between human hand and gripper. In the development of the command and control module, we taken into account innovations in the field of digital image processing, based on which, we will develop an alternative to existing techniques for the command and control of the anthropomorphic grippers, using data gloves. As a result, we adopted as objective of the research presented in this paper the design and the implementation of an innovative command and control system for an anthropomorphic gripper, using innovations in the digital image processing and the development of specialized algorithms for the capture of hand movements and its gestures in videos. On this purpose, we suggest using the Motion Leap device, and in the paper we present briefly the necessary software modules for the command and control of an anthropomorphic gripper with five fingers, for which we also present the test results for gripping a tennis ball.

2. Design, implementing and use of the SpatialVISION application

Locating and classifying objects in a scene automatically is a difficult and current issue. A robot would benefit from the ability to classify unknown objects in object classes, which would be very useful in engineering or domestic applications. Currently, there are many ways of modelling objects and recognition techniques.

In many applications currently used to recognize objects, we use the concept of primitives [8,9], but this concept does not allow the recognition of complex objects. Because of this, we developed algorithms based on search of features in images [9] and [10] or classifiers [11].

For recognizing objects, in this paper we use algorithms based on search of features in images. We also use the research result of [12] to obtain invariance to noise by providing a smoothing filter on image and the research result of [13] to obtain invariance to illuminating conditions through the use of image derivatives reported to the level of gray.

To identify the features detection algorithm, we identified in the specialty literature the following major approaches: **SIFT** [14] – it is an algorithm used in image processing, by extracting features of objects; **GLOH** [15] – it is an algorithm that uses image descriptors that can be used in actions for objects recognition; **SURF** [16] – it is a way used to detect objects invariant under rotation; **HOG** [17] – it is an algorithm for detection of objects used in image processing.

To implement SpatialVISION application, we used the SIFT algorithm implementation. The SIFT algorithm implementation presented in this paper is our own approach in C # using EmguCV library for working with images.

To use the application SpatialVISION, we also conceived a utility called SVAdminUtility, which is used to populate a database of three-dimensional objects that will later be recognized. The software component for the database management of objects that can be recognized by SpatialVISION application is called SVAdminUtility. With this component, a knowledge database can be populated initially and subsequently enriched with new three-dimensional models and different physical properties.

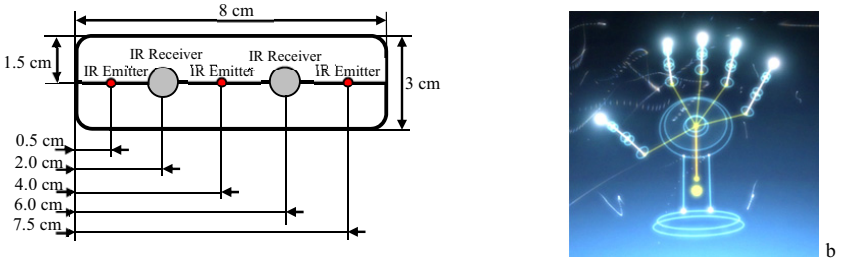

Fig.1. (a) Motion Leap sensor elements; (b) Human hand captured by using the Motion Leap device.