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A Review: Intelligent Pick and Place System by Using Practical Robotic Minimal Grasper

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Abstract: The proposed system introduces a technology for the grasping of components, which is flexible and proposed for pick-and-place tasks with low manipulation complexity for industrial applications. Here it having two main characteristics: self adaptively and flexibility. Self-adaptively says that the proposed grasper can grip an object in a self-adaptive way such that various process complexities (e.g., sensing, force control, and sensor-motor coordination) are significantly reduced. In flexibility means by using a flexible material, a stable grip can be implemented.

Keywords - Grasping, Pick and place, Self adaptivity, Flexibility, Sensor motor coordination.

I. INTRODUCTION

The human hand has approximately 20 Degree Of Freedom (D.O.F) and more than 17,000 tactile sensors are distributed over the outer skin of the hand. Moreover about 40% of the motor cortex of the brain is contributed to management of the control of the hands. Different types of graspers have been proposed to improve manipulability of the robotic hands for grasping tasks [6]. The robot Hand is a very complicated system composed of a large number of joints. Also, there are limitations of size and weight in the development of the robot because of these reasons, to manufacture an useful robot hand is a difficult work. Because of these reasons, to manufacture a useful robot hand is a difficult work. Firstly, define several requirements of a robot hand in the sense of structure and function. Although it is difficult to satisfy all of the requirements. Performance is the ability to perform fine manipulation in stable and robust ways. Simplicity means mechanical, control, and computational simplicity, which directly relates to the cost of products. These are the two main disadvantage performed here.

There have lots of grasping technologies which has developed and implemented on the industrial technologies but for the future implements there is need for more manipulated and accurate technologies. For that this will be the more and efficient method for grasping in the human hand has 17000 tactile sensors distributed over the outer skin of the hand. Like that other systems use several sensors for this sensing., A number of studies have been performed to develop anthropomorphic dexterous hands. Anthropomorphic robotic hands are advantageous in that both a precision grasp and a power grasp are possible[6].

II. RELATED WORK

"Grasping" indicates an action of a hand on an object consisting in preventing its motions relative to the hand, possibly in the face of disturbance forces acting on the object itself. The task of grasping is therefore, at least in some sense, converse to that of manipulation, and it can be expected that in the design of a hand, tradeoffs between dexterity and grasping robustness have to be seeked [5].The previous studies can be categorized into four groups as shown following:

1 Complexity
2 Safety
3 Flexibility
4 Simplicity

J. Butterfa *et.al.* worked on DLR-Hand II: Next Generation of a Dextrous Robot Hand. It outlines the 2nd generation of multisensory hand design at DLR[1]. The results of the use of DLR's Hand I were analysed and enabled in addition to the big efforts made in grasping technology to design the next generation of dextrous robot hands. Newly designed sensors as the 6 DOF fingertip force torque sensor and integrated electronics together with the new communication architecture.

Fig 1. DLR's Hand I

In 1997 DLR developed one of the first articulated hands with completely integrated actuators and electronics(see fig. no.1) . DLR's Hand I use for several years and has been a very useful tool for research and development of grasping. The experiences with Hand I accumulated to a level that enabled us to design a new hand according to a fully integrated mechatronics concept which yields a reasonably better performance in grasping and manipulation and therefore accelerates further developments.

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Robert O. Ambrose *et.al.* worked on Robonaut: NASA's Space Humanoid. Over the years, NASA has experimented with humanoid robots, mainly to use with space hardware and tools designed for astronaut use[2]. In 1973, the Johnson Space Centre built a robot with two arms, grippers, and stereo head cameras mounted on a movable base. More recently JSC's Dexterous Anthropomorphic Robotic Testbed has found that astronaut tasks once thought impossible for robots can be performed with multifingered robotic hands. NASA's latest effort in humanoid robotics is Robonaut(see fig. no. 2).

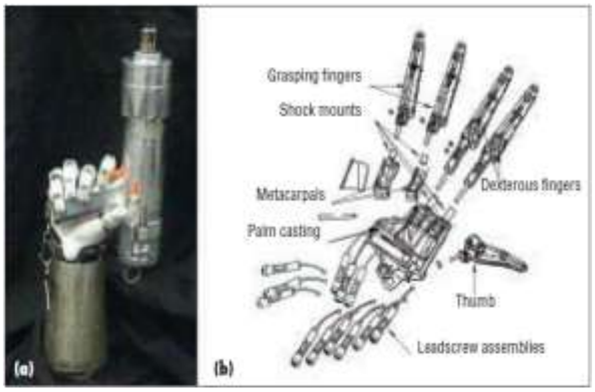

Fig. 2. Robonaut's (a) hand, holding a space torque tool; (b) hand parts, showing the dexterous and grasping sets.

With a human form and scale, Robonaut can use many astronaut tools and can work in the same tight corridors as astronauts. This is an important accomplishment in humanoid systems, but it is even more significant considering NASA's need for a system that can operate in the extreme environments of space. To meet this challenge, the Robonaut team focused on the upper body, designing an arm and hand offering greater dexterity, strength, sensing abilities, and thermal endurance than any other system packaged in human form.

Tae-Yong Choi , Ju-Jang Lee et.al. studied on Control of Manipulator Using Pneumatic Muscles for Enhanced Safety[3].In this the authors studied on the safety of humans who work with robots. Many studies have addressed related methods, but fundamental limits to meet safety requirements have been encountered owing to the absence of compliance in robot actuators. Pneumatic muscle (PM) is considered to be a basic actuator and offers the advantage of intrinsic elasticity to achieve joint compliance. In this paper, joint compliance actuated by PM is actively utilized to enhance human safety during collisions. To this end, the authors present a novel approach to control compliance and associated positions independently with no cross-performance effects using PMs. The proposed method is verified by experiments using a physical robot. In addition, methods to decrease damage from collisions between robots and humans due to operational faults are evaluated through experiments. The effectiveness of the proposed method is verified by measuring the impact impulse in collisions[3].

Kazuya. Yoshida *et.al.* worked on The TAKO (Target Collaborative) Flyer: a New Concept for Future Satellite Servicing. This paper proposes the idea of the satellite servicing system named "The TAKO-Flyer." This system embraces a target adaptively with a multiple articulated gripper named "TAKO-Gripper," then makes the target collaborative [4].

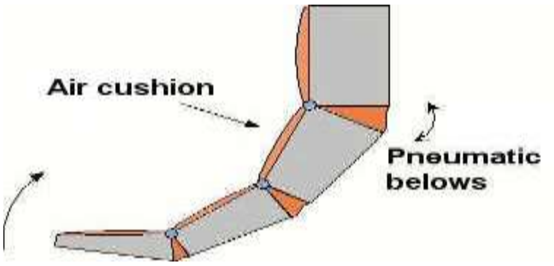

Fig .3. Concept of TAKO-finger

In order to keep the orbital environment safe and clean, free from collisions, the technology for satellite retrieval by robotic devices is highly expected. However, targets are requested to have specific fixtures to be grasped and optical cue markers for vision based control. Such targets are called collaborative. On the contrary, most of satellites in trouble are non-collaborative. The technology for the robotic capture of a non collaborative satellite has not been established yet. The word "TAKO" means octopus in Japanese. The TAKO-Gripper is featured by multiple articulated fingers that work as octopus tentacles. The finger is driven by a fewer number of actuators than articulated joint [4]. It makes adaptive envelope grasp to an object with arbitrary shape and tumbling motion. In this proposal, the TAKO-Gripper is designed driven by gas pressure. Instead of massive motors and complex wirepulley mechanisms, the finger system makes bending motion by pneumatic bellows. Gas pressure is also useful for the air cushions inside the fingers to hold the target softly. Fig. no.3 shows a concept of TAKO-finger.

Antonio Bicchi *et.al.* worked on Hands for Dexterous Manipulation and Robust Grasping: A Difficult Road Toward Simplicity [5]. In this paper, a review of some of the work being done in robotic manipulation has been provided, and trends have been highlighted that, in the author's view, might allow those devices to find larger applications in the real world. A main distinction has been made among anthropomorphic design, and design according to some engineering criterion optimization. While the first style of design finds motivations in teleportation, domestic and humanoid robotics. The latter is more oriented toward applications in the factories and in unstructured environments. Due to space limitations, many other important aspects could not be discussed, such as tactile sensing. It is noted in passing that also in those fields, a trend toward simplification of hardware by application of more sophisticated analysis can be recognized.

The survey is focused mainly on three types of functional requirements a machine hand can be assigned in an artificial system, namely, manipulative dexterity, grasp robustness, and human operability. A basic distinction is made between hands designed for mimicking the human anatomy and physiology, and hands designed to meet restricted, practical requirements. In the latter domain, arguments are presented in favour of a “minimalistic” attitude in the design of hands for practical applications, i.e., use the least number of actuators, the simplest set of sensors, etc., for a given task. To achieve this rather obvious engineering goal is a challenge to our community. The paper illustrates some of the new, sometimes difficult, problems that are brought about by building and controlling simpler, more practical devices.

From observation of the human example, it can be easily seen that we use our hand in very different ways depending on the task. When finely manipulating objects, we mostly use our fingertips and distal phalanges. On the other hand, in human and animal grasping, the fundamental role played by the inner parts of the hand (palm and proximal phalanges) to enhance both the stability of the grip and the versatility of operation, can be frequently observed. To transfer this enhanced robustness into robotic devices, researchers have conceived hands with the ability of using inner surfaces for contacting the object, and capable of sensing contact interactions [5].

Fig. 4 Example of power grasping (courtesy of Barret Technologies, Inc.).

By the term “power grasping,” or the equivalent expressions “enveloping grasping” and “whole-hand manipulation”, the action of a hand holding an object by using not only its fingertips, but also the internal phalanges and the palm is denoted. Ulrich designed a medium-complexity hand capable of several grasp modes, including power grasping. An example of such grasp is depicted in Fig no.4 which shows the largely increased holding capability of a robot hand exploiting its inner links and palm for grasping, given limits on the actuator torques, and built the digits system to experimentally assess such grasping style. A hand whose design was integrally thought for whole-hand manipulation was described. To the same philosophy was inspired the hand realized at the University of Bologna by Bonivento *et al.*. The hand described was also designed to manipulate objects by using its inner surfaces [5].

III. PROPOSED METHODOLOGY

In this approach Grasping is conducted in three steps: 1) The target object is positioned by the grasper; 2) inserting the grasper from top to bottom of the object; and 3) squeezing the loop to establish an enveloping grip. The proposed grasper has the features self adaptivity, i.e., the grasper adapts itself to the shape of the grasped object and also by using flexible material, the friction between the target object increases because of the increased contact force. Due to these features, the grasper was designed in a minimal way: one direct current (dc) servomotor as an actuator and force-sensing resistor (FSR) sensor. The system Can be controlled by the wireless system by using ARM controller and also by zigbee transceiver.

CONCLUSION

By using this minimal grasper there can be prevention on current robotic hands from being commercialized and have considered the various approaches taken by many researches to overcome the difficulties. The grasper can give good success rates by performing various real time objects with two features self -adaptivity and flexibility. In industrial fields every mechanical part in the proposed grasper is used. This is a advantage over other robotic hand with respect to mass production, with considerable reduction in manufacturing cost. In this it has many merits about its size, light weight and also simple hardware implementation and control algorithms at very less cost compared to the human like robotic hands.

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