A logistic device

INVENTORS: Garabini Manolo
Caporale Danilo
Settimi Alessandro
Pallottino Lucia
Catalano Manuel Giuseppe
Grioli Giorgio
Tincani Vittorio
Bicchi Antonio

PATENT STATUS: GRANTED

PRIORITY NUMBER: 102019000006474

GRANT DATE: 10/03/2021

PUBLISHED AS:: WO

Invention

The device developed is a **robotic transporter** that can be used for moving objects. The device consists of **one or more collaborative robotic arms (cobots) with gripping devices** able to pick up types of objects different in size, shape and weight.

In the case of the use of a single arm, an **adaptive gripping system** has been used that is able to passively adapt to the shape of the object. In the case of use with two arms, the second arm uses an end-effector that has the function of providing a support surface for the object taken. The device developed is moved by a control unit and will soon be mounted on an autonomous mobile base able to increase the working space of the gripping system. The system is integrated with a vision system for the recognition of objects and their position on the shelf. The objects to be moved are different in shape (for example parallelepipeds and cylinders) and dimensions and may present constraints that allow the grip only in points or with well-defined strategies.

Currently on the market there are no autonomous robotic devices able to carry out this type of operations without human intervention, unless there are ad hoc devices for a single type of product.

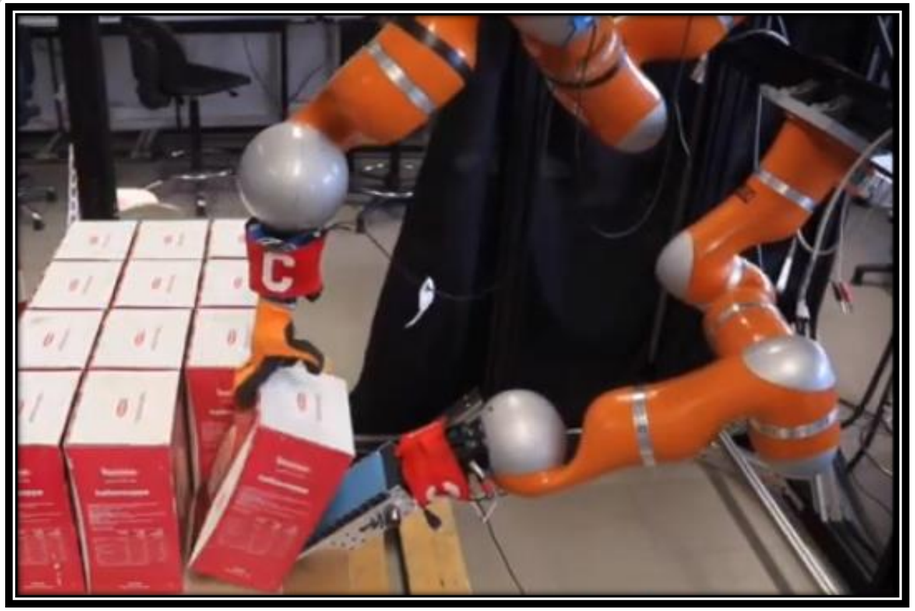
In addition, the existing systems are not designed for use in co-existence with human operators, they require the identification of a work area within which personnel cannot be present during the operation of the machinery for safety reasons.

The advantage of the device in question is to achieve a **high level of flexibility** by combining a manipulator with two robotic arms of the latest generation with the use of an **adaptive end-effector and an end-effector with conveyor belt implemented**.

In particular, the flexibility of the system allows the use **on a large number of packages of various shape and size**, in contrast to the rigidity of existing systems, taking inspiration from the way human operators perform this type of tasks.

IIT – ITALIAN INSTITUTE OF TECHNOLOGY is also a patent applicant.

Drawings & pictures



Industrial applications

The device can be use in the intra-logistic field, that takes care of handling and shunting of assets between the producers and the small distributors (as an example supermarkets). An autonomous object handling device has been created to be used in operations within a warehouse, in order to increase the level of automation.

The prototype realized aims to obtain a technological advance in the industry of the intra-logistics, where to date the great quantity and variety of goods to be handled often clashes with a rigidity of the systems and the need to use specialized personnel to carry out exhausting work, such as the **loading/unloading of objects from and on pallets and conveyor belts.**

In view of the recent technological developments in soft robotics and cobotics (coworking robots), the device aims to improve the level of autonomy of existing plants while allowing staff to continue to operate in the working environment, without having to introduce expensive plant adaptations and the construction of dedicated and inaccessible work cells.

Possible developments

A prototype laboratory of this device has been developed. A design of the hardware architecture and the integration of the two arms and their end-effectors in fixed configuration has been carried out. In addition, the hardware architecture for mounting on the mobile platform has already been studied.

Several control algorithms have been developed and implemented for an optimized movement of the arms, for a reactive motion planning in the case of end effector contacts with the environment. The arm movement planning part is based on a study of how the various objects are currently picked up by human operators.

A series of primitives of movement have been implemented on the robot that based on the object to be taken chooses the sequence of better primitives to carry out.

An algorithm based on machine learning has been used to determine the best grip configuration for the adaptive gripper based on the object to be taken and based on how the operator uses the same gripper to grab parallelepipeds of various sizes. After the integration of the various parts of the system in configuration to one or two arms, an extensive campaign of experiments was made to test the individual parts and the overall system.

A video demonstration of the technology is available at the following **LINK.**

For more information:

Tech Transfer Office of University of Pisa

Headquarters: Lungarno Pacinotti 43/44, Pisa (PI) 56126

Web site: www.unipi.it/index.php/trasferimento

E-mail: valorizzazionericerca@unipi.it

For more information:

Ufficio Regionale di Trasferimento Tecnologico

Headquarters: Via Luigi Carlo Farini, 8 50121 Firenze (FI)

E-mail: urtt@regione.toscana.it

UNIVERSITÀ DI PISA

REGIONE TOSCANA

urtt Ufficio Regionale di Trasferimento Tecnologico