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FINGER AND GRIPPING DEVICE FOR ROBOT ARM, AND ROBOT ARM EQUIPPED WITH SUCH A DEVICE

Abstract

A motorized finger includes a base for fastening to a plate connecting to a robotic arm, a first phalanx connected to the base by at least one first articulation, a second phalanx connected to the first phalanx by at least one second articulation, and a first actuator fastened to the base and connected at least to the first phalanx in order to move the phalanges between two end positions.

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Background/Summary

[0001] The present invention relates to the field of handling and more specifically, handling by robots, including cobots.
BACKGROUND OF THE INVENTION
[0002] Robot arms (or robotic arms) comprising a base are known, a first segment connected to the base by a first articulation, a second segment connected to the first segment by a second articulation, and a gripping device connected to the second segment by a third articulation commonly called wrist. The gripping device can comprise electromagnetic gripping means, suction cups connected to a suctioning device or articulated fingers connected to one single motor controlling the simultaneous actuation of the fingers.
[0003] Generally, the gripping device is made bespoke for the task to be accomplished and the shape of the objects to grip. This results in a lack of flexibility and significant costs, when this relates to adapting said device for gripping the objects to be gripped.
There are also robotic “hands” for universal use, but at the expense of a significant complexity and of a significant cost.
AIM OF THE INVENTION
[0004] The invention in particular aims to provide an at least partial solution to the problems above.
SUMMARY OF THE INVENTION
[0005] To this end, a motorised finger is provided, according to the invention, comprising a base for fastening to a plate for connecting to a robotic arm, a first phalanx connected to the base by at least one first articulation, a second phalanx connected to the first phalanx by at least one second articulation, a first actuator fastened to the base and connected at least to the first phalanx in order to move the phalanxes between two end positions, the base comprising a fixed part and a movable part which carries the first actuator and the phalanxes and which is connected to the fixed part by a bearing defining an orientation axis and enabling a rotation of the movable part with respect to the fixed part about said axis of orientation, the base comprising means for its fastening to the plate, such that the axis of orientation is substantially perpendicular to the plate, the motorised finger further comprising an individual control unit, secured to the base, which is connected to the first actuator to control it.
[0006] It is subsequently possible to rapidly produce a hand by assembling one or more fingers and a connecting plate according to the arrangement which is most suitable for the task to be performed and for the objects to be gripped. Each finger being autonomous regarding the motorisation of the phalanxes and controlling this motorisation, the synchronisation of the fingers together, when there are several of them, can be performed by controlling different fingers and not by a mechanical movement synchronisation device, which simplifies the structure of the gripping device thus produced.
[0007] For example, the synchronisation can be performed via a general control unit to which the actuators and/or the individual control units are connected.
[0008] In this case, it is understood that the first phalanx is connected to the movable part of the base.
[0009] Optionally, the individual control unit is secured to the fixed part of the base.
[0010] Optionally, the first actuator is an electric and/or hydraulic and/or pneumatic actuator.
[0011] Optionally, the first actuator is an at least partially electric actuator (and for example, electric and pneumatic or electric and hydraulic) or is an exclusively electric actuator.

[0012] Optionally, the individual control unit is at least partially an individual electronic control unit or is exclusively an individual electronic control unit. Optionally, the general control unit is at least partially a general electronic control unit or is exclusively a general electronic control unit.
[0013] Optionally, the motorised finger comprises a second actuator arranged to make the movable part pivot and adjust the angular orientation of the movable part with respect to the fixed part.
[0014] Optionally, the individual control unit controlling the first actuator, is also configured to control the second actuator.
[0015] Optionally, the second actuator is an electric and/or hydraulic and/or pneumatic actuator.
[0016] Optionally, the second actuator is an at least partially electric actuator (and for example, electric and pneumatic, or electric and hydraulic) or is an exclusively electric actuator.
[0017] The invention also aims for a gripping device comprising a connecting plate and at least one finger of the abovementioned type.
[0018] The invention also aims for a robot arm equipped with such a gripping device.
[0019] Other features and advantages of the invention will emerge upon reading the description below of particular and non-limiting embodiments of the invention.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0020] Reference will be made to the accompanying drawings, among which:
[0021] FIG. **1** is a schematic, side view of a robotic arm according to the invention;
[0022] FIG. **2** is a schematic, perspective view of a gripping device according to a first embodiment;
[0023] FIG. **3** is a schematic, perspective view of one of the fingers of the device;
[0024] FIG. **4** is a schematic, side view of this finger, showing the amplitude of possible movement;
[0025] FIG. **5** is a schematic, rear view of this finger;
[0026] FIG. **6** is a schematic, side view of the device showing a mode of powerfully gripping an object (rather suitable for relatively large objects);
[0027] FIG. **7** is a schematic, side view of the device showing a mode of delicately gripping the object (rather suitable for relatively small objects);
[0028] FIG. **8** is a schematic, perspective view of a finger according to a variant of an embodiment;
[0029] FIG. **9** is a schematic, perspective view of a gripping device according to a second embodiment;
[0030] FIG. **10** is a view similar to FIG. **9** of a first variant of the second embodiment;
[0031] FIG. **11** is a view similar to FIG. **9** of a second variant of the second embodiment;
[0032] FIG. **12** is a schematic, perspective view of a gripping device according to a third embodiment;
[0033] FIG. **13** is a schematic view illustrating, in a simplified manner, the mechanism of one of the fingers of the device;
[0034] FIG. **14** is a schematic, cross-sectional view of the upper part of one of the fingers according to the invention;
[0035] FIG. **15** is a view similar to FIG. **6** of a device according to a fourth embodiment;
[0036] FIG. **16** is a schematic, top, cross-sectional view illustrating, in a simplified manner, the gripping of a cylindrical object by a device according to the invention;
[0037] FIG. **17** is a schematic, top, cross-sectional view illustrating, in a simplified manner, the gripping of a spherical object by a device according to the invention;
[0038] FIG. **18** is a schematic, top, cross-sectional view illustrating, in a simplified manner, the gripping of a parallelepiped object by a device according to the invention;

[0039] FIG. **19** is a schematic, partially perspective view of a finger according to a variant of an embodiment of the invention;

[0040] FIG. **20** is a schematic, partially perspective view of a finger according to a variant of an embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0041] In reference to the figures, the invention is described, in this case, in application to a robotic arm generally referenced as **1**.

[0042] The robotic arm **1** comprises a base **10**, a first segment **11** connected to the base **10** by a first articulation **21**, a second segment **12** connected to the first segment **11** by a second articulation **22**, and an interface **13** which is connected to the second segment **12** by a third articulation **23** and which carries a gripping device generally referenced as **50** forming the free end of the robotic arm.

[0043] The robotic arm comprises actuators, in this case, such as motors, to move the elements connected to one same articulation **21**, **22**, **23** against one another. These actuators are not represented, in this case.

[0044] In a manner known in itself, each articulation **21**, **22**, **23** comprises a coder, not represented, arranged to measure the angle formed by the two elements connected by said articulation **21**, **22**, **23**.

[0045] The motors and the coders are connected to a general control unit. In the present case, the general control unit is a general electronic control unit called electronic control unit **30** below. Said unit comprises at least one processor and a memory containing a program executed by said processor to control the motors according to the instructions of the program, measurements provided by the coders and other sensors like current sensors in the motors making it possible to determine a force developed by each of the motors. The electronic control unit **30** is preferably connected to an electronic signal emitter/receiver, for example according to the standard called BLUETOOTH.

[0046] In reference to FIGS. **2** to **7**, **13** and **14**, and according to the first embodiment, the gripping device **50** comprises a plate **51** for connecting to the interface **13** of the robotic arm **1**. The plate **51** has the shape of a three-branch plate extending symmetrically with respect to a central portion secured to the interface **13**.

[0047] Each branch of the plate **51** is provided with a hole enabling the fastening of a finger generally referenced as **100**.

[0048] Each finger **100** comprises a base **110** for fastening to the plate **51**, a first phalanx **111** connected to the base **110** by at least one first articulation **121**, a second phalanx **112** connected to the first phalanx **111** by at least one second articulation **122**.

[0049] The first phalanx **111** has the shape of a deformable quadrilateral formed by a first side **111**.**1** opposite the base **110**, a second side **111**.**2** which is opposite the first side **111**.**1** facing it and is connected by the first articulation **121** to the base **110**, a third side **111**.**3** which is connected to the second side **111**.**2** by the first articulation **121** and to the first side **111**.**1** by the second articulation **122**, and a fourth side **111**.**4** connected by a third articulation **123** to the second side **111**.**2** and by a fourth articulation **124** to the first side **111**.**1**.

[0050] The second phalanx **112** is fastened onto the first side **111**.**1** of said quadrilateral. The third articulation **123** is free with respect to the base **110** and can therefore be moved in a circular arc around the first articulation **121**. The second articulation **122** is free with respect to the base **110** and can be moved in n a circular arc around the first articulation **121**. The third side **111**.**3**, and therefore the first phalanx **111**, can therefore pivot with respect to the base **110** between two end positions. The first side **111**.**1** can pivot around the second articulation **122**: the second phalanx **112** can therefore pivot with respect to the first phalanx **111** between two end positions. The movement of the fourth articulation **124** is conditioned by the movements of the third articulation **123** and of the second articulation **122**: the movement amplitude of the distal end of the second phalanx **112** (from one end position to another—see FIG. **4**) with respect to the base **110** therefore depends on the combination of the movement of the first phalanx **111** with respect to the base **110** and of the movement of the second phalanx **112** with respect to the first phalanx **111**.

[0051] The first phalanx **111** comprises a contact interface with the object to be gripped. The contact interface is, in this case, a support buffer **111.5** fastened onto the third side **111.3**. The support buffer **111.5** is, for example, made of elastomer or of silicone.

[0052] The second phalanx **112** has a distal end portion **112.1** elastically deformable when bending. The distal end portion **112.1** is, for example, a metal strip covered with a flexible layer, for example made of elastomer or of silicone.

[0053] The finger **100** comprises a first actuator **101** which is fastened to the base **110** to move the third articulation **123** in a circular arc around the second articulation **122**. The actuator **101** is, in this case, an electric actuator. The first actuator **101** is, in this case, a direct current rotary motor having an output shaft driving a screw/nut system (preferably, ball screw). The screw/nut system is, in this case, reversible, such that the force exerted by the finger **110** can be determined over its environment from a measurement of the supply current of the motor. The assembly formed of the actuator **101** and of the screw/nut system is thus an electromechanical, and more specifically, linear electromechanical actuation assembly.

[0054] If the actuator **101** pushes the third articulation **123** towards the third side **111.3**, the third side **111.3** is made to pivot around the second articulation **122** until the third side **111.3** meets an obstacle. Once the third side **111.3** is abutted, if the movement of the third articulation **123** is continued, the pivoting of the first side **111.1** around the second articulation **122** and therefore the movement of the second phalanx **112** is caused. The reverse movement makes it possible to return the first phalanx **111** and the second phalanx **112** into the initial position.

[0055] As the case may be, the actuator **101** can be controlled by position, by speed or by force. In the present embodiment, it is controlled by force. Preferably, if the shape and the mass of the objects to be gripped is always identical, the supply current of the motor will be monitored during gripping, in order to detect an operational anomaly or wear of the gripping device, and provide preventive maintenance operations.

[0056] The powerful gripping of a tube with a relatively large diameter by two fingers **100** can be seen in FIG. **6**. It is understood that the actuators **101** are controlled to close the fingers **100** on the tube. During the closure of the two fingers **100** on the tube, the first phalanxes **111** have pivoted towards the tube, the second phalanxes **112** remaining in the extension of the first phalanxes **111**, until the support buffers **111.5** come into contact with the tube blocking the pivoting of the first phalanxes **111**. The force of the actuator **101** being continued, the second phalanxes **112** pivot with respect to the first phalanxes until coming into contact with the tube. When the current measured at the motor of the actuator increases until reaching a threshold corresponding to the required gripping force. The fingers **110** are therefore in contact with the tube by the support buffers **111.5** and by the second phalanxes **112**. It will be noted that this movement of the phalanxes makes it possible to limit the risk of an ejection of the object during the gripping.

[0057] The delicate gripping of a tube of relatively small diameter by the distal end portions **112.1** of two fingers can be seen in FIG. **7**. It is understood that the actuators **101** are controlled to close the fingers **100** on the tube. During the closure of the two fingers **100** on the tube, the first phalanxes **111** have pivoted towards the tube, the second phalanxes **112** remaining in the extension of the first phalanxes **111**, until that distal end portions **112.1** come into contact with the tube blocking the pivoting of the first phalanxes **111**. With the force of the actuators **101** being continued, the distal end portions **112.1** are bent under the gripping force and the current measured at the motor of the actuator increases until reaching a threshold corresponding to the required gripping force. The fingers **110** are therefore in contact with the tube, only by the distal end portions **112.1** of the second phalanxes **112**. It will be noted that each distal end portion **112.1** has a textured surface to improve the retention of the gripped object between the distal end portions **112.1**

[0058] One single actuator therefore makes it possible to move the two phalanxes. Such a finger is called under-actuated, since it comprises less actuators than articulations.
[0059] Moreover, the base **110** comprises a fixed part **110**.**1** and a movable part **110**.**2** which carries the first motor and the phalanxes **111**, **112** and which is connected to the fixed part **110**.**1** by a bearing defining an axis of orientation A**1** and enabling a rotation of the movable part **110**.**2** with respect to the fixed part **110**.**1** about said axis of orientation A**1**. The base **110** comprises means for its fastening to the connecting plate, such that the axis of orientation A**1** is substantially perpendicular to the plate **51**. These fastening means can comprise screws screwed into the plate **51** by passing through lugs secured to the fixed part **110**.**1**, bolts, flanges, locks, a bayonet connection, etc.
[0060] The finger **100** comprises a second actuator **102** mounted between the fixed part **110**.**1** and the movable part **110**.**2** of the base **110** to make the movable part **110**.**2** pivot and adjust the angular orientation of the movable part **110**.**2** with respect to the fixed part **110**.**1**. The second actuator **102** is, for example, an electric actuator, such as an electric motor.
[0061] The two actuators **101**, **102** are, in this case, connected to one same individual control unit secured to the base **110**, and for example to its fixed part **110**.**1**. In the present case, the individual control unit is an individual electronic control unit called electronic control unit **103** below. The electronic control unit **103** comprises, in this case, an ASIC circuit programmed to ensure a controlling of the actuators **101**, **102** according to commands received by an electromagnetic signal emitter/receiver connected to the electronic control unit **103**. These commands originate, for example, from the electronic control unit **30**.
The base **110** is provided with a visual status indicator **52** (in this case, a light-emitting diode) and the electronic control unit **103** is connected to the indicator **52** to control said indicator **52** according to an operating status of the electronic control unit **103**. Preferably, the indicator **52** can be controlled to light up in several colours according to the operating status (for example, green for a normal operation, yellow for an initialisation phase and red for a defect), continuously or discontinuously according to which the electronic control unit **103** executes a command or receives a command, or any other achievable code. In the case where the electronic control unit **103** is programmed by learning, it will advantageously be provided that the indicator **52** can signal to the operator, that the control unit **103** is in learning mode, for example, by flashing.
[0062] In dirty, aggressive (physico-chemical aggressions, more specifically), humid and/or sterile environments, a sealed fingerstall will advantageously be provided, having an opening enabling its threading on each finger, so as to cover each finger. The fingerstall can be made of any flexible material suitable for the considered use, and for example, made of silicone. The fastening of the fingerstall on the finger can be done, for example, by pinching or clamping, around the base of the finger, of the part of the fingerstall bordering its opening. The fingerstall can also only cover a part of the finger, for example, the second phalanx or the two phalanxes.
[0063] In the variant of an embodiment of FIG. **8**, the support buffer **111**.**5** is replaced by a suction cup **111**.**6** connected by a fluid network to a vacuum generator.
[0064] According to the second embodiment represented in FIG. **9**, the plate **51** has the shape of a plate as above, but is, in this case, provided with a handle **53** which can be gripped by an operator to direct the free end of the robotic arm **1** in the scope of a collaborative task, for example.
[0065] Commands can be sent to the electronic control unit **30** or to the electronic control unit **103** by at least one control button **54**, which is mounted on the plate **51** in the proximity of the handle **53** and which is provided with an electromagnetic signal emitter connected to the emitter/receiver of the electronic control unit **103** and/or to that of the electronic control unit **30**. The electronic control units are thus programmed to perform a collaborative task.
[0066] In a first variant of the second embodiment, variant represented in FIG. **11**, the button **54** is replaced by a control interface **55** comprising a screen, a navigation button in a menu displayed on the screen, a button for selecting items from said menu, and one or more buttons directly

controlling actions of the fingers **100** (for example, a button to grip and a button to release). The control interface comprises an electromagnetic signal emitter/receiver connected to the emitter/receiver of the electronic control unit **103** and/or to that of the electronic control unit **30**.

[0067] As represented in FIG. **11** and according to a second variant of the second embodiment, the plate **51** has the shape of an elongated plate defining a longitudinal axis A**2** and carrying two fingers **100**′ at these two ends and two fingers **100**″ in its median part. The two fingers **100**″ are located on one same side of the axis A**2** by being oriented towards the axis A**2** and the two fingers **100**′ are located on the side of the axis A**2** opposite the fingers **100**″ being themselves also oriented towards the axis A**2**. It is subsequently possible to grip an elongated object between the fingers **100**′ on the one hand, and the fingers **100**″ on the other hand.

[0068] As in the preceding variant, the plate **51** is provided with a handle **53** and a control interface **55**.

[0069] According to the third embodiment represented in FIG. **12**, the gripping device can comprise at least one finger **100** and one abutment element **200** extending facing the finger **100**. The abutment element can be a rigid or elastically deformable element, but sufficiently rigid to be able to oppose the movement of an object, which would be applied against the abutment element **200** by the finger **100** in question. The abutment element **200** can have a shape complementary to that of a part of the object to be gripped.

[0070] In the embodiment of FIG. **15**, the device comprises a plate **51** provided with three fingers **100** each comprising a base with motorised orientation. A camera **57** is mounted under the plate **51**, between the fingers **100**, and is connected to the electronic control unit **30** to determine the shape of the object to be gripped and control the orientation of the fingers **100** in the configuration which is the most suitable for gripping the object. For example, the fingers can be controlled to perform an alternate gripping for an elongated or cylindrical object, as in FIG. **16**, a spherical gripping for a ball-shaped object, as in FIG. **17**, or a gripping with opposite fingers, in the case of a parallelepiped object, as in FIG. **18**. The programming of the configurations can be done by coding, or by learning via an operator, who orients the fingers **100** in the correct orientation for each type of part, or the program for controlling the orientation of the fingers can involve a classification algorithm (neural network) enabling the program to determine, in real time, the configuration which is best suited to the shape of the object to be gripped, the shapes of the objects to be gripped and to deduce.

[0071] The invention, in this case, also relates to a kit for manufacturing a gripping device, comprising: [0072] plates of different shapes (those represented in the figures), [0073] fingers of different types (with fixed orientation and with manually or automatically adjustable orientation), [0074] distal phalanxes of different shapes (as mentioned in the present description), [0075] interfaces of different shapes (like those represented in the figures).

[0076] The kit also preferably comprises: [0077] abutment elements of different shapes (as mentioned in the present description), and/or [0078] fingerstalls for covering at least the distal phalanx of the fingers, and/or [0079] proximity sensors (cameras, ultrasonic sensors), and/or [0080] contact sensors, etc.

[0081] In this way, it is possible to manufacture, on demand, a gripping device which is suitable for the objects to be gripped. This is made possible by the modularity of the gripping device. Naturally, the invention is not limited to the embodiment described, but comprises any variant entering into the field of the invention such as defined by the claims.

[0082] In particular, the fingers, the connecting plate and the robot arm can have structures different from those described.

[0083] The plate can have any shape which is suited to the gripping(s) to be performed and, for example, a shape with one or more branches, a circular, elliptic, rectangular, triangular or other shape.

[0084] The plate can also comprise two parts, the relative positions of which are adjustable, in a motorised manner or not, in order to adapt the configuration of the plate to the grippings to be

performed.
[0085] The number of phalanxes, segments, articulations can be modified to adapt it to the movements to be performed. The articulations can be pivots or ball joints.
[0086] The finger can comprise at least one telescopic phalanx. The arm can comprise at least one telescopic segment.
[0087] The parts constituting each finger, the connecting plate and the arm can be produced by any method: cutting, stamping, forging, moulding, mechanical welding, additive manufacture, etc.
[0088] The parts constituting each finger, the connecting plate and the arm can be made of any material, the mechanical properties of which are compatible with the use considered, and for example, made of metal (steel, aluminium, titanium or other), made of thermoplastic material (polyamide, polyaramide, polypropylene, polyethylene, polyarcylobutadiene styrene, polycarbonate or other), optionally fibre-reinforced (glass, carbon, polyaramide or other), or other.
[0089] Any type of actuator (whether the first actuator or the second actuator is considered) can be used: electric and/or pneumatic and/or hydraulic. Any type of actuator (whether the first actuator or the second actuator is considered) can be used: linear or rotary, with or without reducer, linked or not to a movement transmission member such as, for example, a screw/nut system, such that the assembly formed by the actuator and the movement transmission member is linear or rotary, etc. It is possible to also use cable actuators, like cable jacks.
[0090] According to a variant with motorised orientation, it is possible to have one single actuator for the orientation of several fingers with respect to the plate.
[0091] According to a variant with manual orientation, the base can comprise an annular-shaped fixed part, wherein a part which is manually orientable with respect to the fixed part is pivotingly received. It is, for example, provided to be able to block the rotation of the movable part with respect to the fixed part by means of a needle screw engaged transversally in the fixed part to bear on the movable part, of a lock transversally movably mounted on the fixed part between a retracted position and a position projecting into a housing of a series of housings angularly distributed over a perimeter of the movable part, or other.
[0092] With the orientable fingers, it is possible to orient the fingers back-to-back to grip an object from the inside.
[0093] The base can be mounted on the plate to be fastened in orientation.
[0094] It is also possible to have, on one same plate, fingers of different types and, for example, a finger rotatably fixed about the axis A**1**, a finger which is manually orientable about the axis A**1** and an axis with motorised orientation about the axis A**1**.
[0095] The contact interface of the first phalanx can have a structure different from those described or, on the contrary, have no contact interface.
[0096] The distal end portion of the second phalanx can have any shape which is suited to the gripping of the object to be gripped and, for example, a T-shape, a curved shape, or other. The distal end portion can comprise a contact interface like the first phalanx. Preferably, the distal end portion is removable to be able to be easily replaced when the objects to be gripped have shapes which can vary.
[0097] Contact sensors can be fastened onto the phalanxes, in order to be able to detect a sliding of the object.
[0098] Force sensors can also be added, for example, if at the output of the motor, a non-reversible movement transmission system is used. These force sensors are, for example, deformation gauges fastened onto the phalanxes or torque sensors disposed on the articulations. Using force sensors is advantageous when the object is fragile.
[0099] The support buffer can also have shapes favouring a blocking of the part, like for example a concave shape for centring the part (for example, forming a centring V, as represented in FIGS. **19** and **20**, the V of FIG. **19** ensuring a centring in a vertical plane, the V of FIG. **20** ensuring a centring in a horizontal plane).

[0100] At least one position sensor can be mounted on the phalanxes, on the movement transmission system or on the actuator to enable a controlling of the actuator in position.
[0101] Each finger can comprise an electromagnetic brake to avoid the gripped object falling, in particular during the accomplishment of a collaborative task.
[0102] It is possible to equip the robotic arm with a sensor for sensing the presence of an operator in the environment of the arm, for example an ultrasonic sensor or a camera. This proximity sensor can serve both to detect the part to take and its shape to define the gripping or to detect the irruption of a human in the working space of the finger.
[0103] The gripping device can comprise an electronic control unit controlling the fingers and connected to the control unit of the robotic arm.
[0104] The individual control unit of one of the fingers can be programmed to form a master control unit, the individual control units of the other fingers being programmed to form slave control units; or the individual control units of all the fingers are programmed to form slave control units and the general control unit of the robot or of the gripping device is programmed to form a master control unit.
[0105] Wired connections can naturally be used instead of all or some of the wireless connections mentioned.
The individual control unit can be secured to the fixed and/or movable part of the base.
[0106] The motorised finger can comprise one same individual control unit controlling the first actuator and the second actuator of said finger or can comprise two different individual units, controlling each of the two actuators. In this case, at least one of the two individual control units can be secured to the fixed part of the base and/or movable from the base. At least one of the two individual control units can be at least partially an individual electronic control unit or can be exclusively an individual electronic control unit. According to the type of actuator considered, the individual control unit can be exclusively or partially electronic. For example, the individual control unit can be a least partially electric and/or hydraulic and/or pneumatic.
[0107] The invention can be used for any type of handling: rigid objects (for example, mechanical parts) or soft objects (for example, sachets containing liquids or powders), natural or industrial products, clean or dirty environment and/or transported product, etc.

Claims

1. A motorized finger, comprising a base for fastening to a plate for connecting to a robotic arm, a first phalanx connected to the base by at least one first articulation, a second phalanx connected to the first phalanx by at least one second articulation, a first actuator fastened to the base and connected at least to the first phalanx to move the phalanxes between two end positions, wherein the base comprises a fixed part and a movable part which carries the first actuator and the phalanxes and which is connected to the fixed part by a bearing defining an axis of orientation and enabling a rotation of the movable part with respect to the fixed part about said axis of orientation, in that the base comprises means for its fastening to the plate, such that the axis of orientation is substantially perpendicular to the plate, the motorised finger further comprising an individual control unit, secured to the base, which is connected to the first actuator to control it.
2. The motorized finger according to claim 1, wherein the first actuator is an electric and/or hydraulic and/or pneumatic actuator.
3. The motorized finger according to claim 1, wherein the first actuator is an electric actuator and the individual control unit is an individual electronic control unit.
4. The motorized finger according to claim 1, wherein the individual control unit is secured to the fixed part of the base.
5. The motorized finger according to claim 1, wherein the base comprises a second actuator arranged to make the movable part pivot and adjust the angular orientation of the movable part with

respect to the fixed part.
6. The motorized finger (**100**) according to claim 5, wherein the individual control unit is also configured to control the second actuator.
7. The motorized finger according to claim 1, wherein the first phalanx has the shape of a deformable quadrilateral and the second phalanx is fastened onto a first side of said quadrilateral opposite the base, the quadrilateral comprising, opposite the first side, a second side which is connected by the first articulation to the base and to a third side and by a third articulation to a fourth side connected by a fourth articulation to the first side, the first actuator acting so as to move the third articulation with respect to the second articulation.
8. The motorized finger according to claim 1, wherein the first phalanx comprises a contact interface with the object to be gripped.
9. The motorized finger according to claim 8, wherein the contact interface is a support buffer.
10. The motorized finger according to claim 8, wherein the contact interface is a suction cup connected to a vacuum generator.
11. The motorized finger according to claim 1, wherein the control unit is arranged to ensure a controlling of the actuator in force return.
12. The motorized finger according to claim 1, wherein the control unit is connected to an electromagnetic signal emitter/receiver at least to receive commands.
13. The motorized finger according to claim 1, wherein the first actuator is reversible such that the force exerted by the finger on its environment can be determined from a measurement of the supply current of the first actuator.
14. The motorized finger according to claim 1, wherein a visual status indicator is carried by the base and the control unit is connected to the indicator to control said indicator according to an operating status of the control unit.
15. The motorized finger according to claim 1, wherein the second phalanx has a distal end portion elastically deformable when bending.
16. A gripping device, comprising a plate for connecting to a robot arm, on which are mounted at least one first motorized finger according to claim 1, having its base received in a hole of the plate, and at least one abutment element extending facing the motorized finger.
17. The gripping device according to claim 16, wherein the abutment element is a second motorized finger.
18. The gripping device according to claim 16, wherein each motorized finger comprises an individual control unit in communication with a master control unit.
19. The gripping device according to claim 16, wherein each motorized_finger comprises an individual control unit and one of the individual control units is programmed to form a master control unit, the other individual control units being programmed to form slave control units.
20. The gripping device_according to claim 16, comprising a general control unit in communication with at least one sensor of the external environment of the gripping device.
21. A robotic arm comprising a base, a first segment connected to the base by a first articulation, a second segment connected to the first segment by a second articulation, and an interface which is connected to the second segment by a third articulation and which carries a connecting plate of a gripping device according to claim 16.
22. A robotic arm according to claim 21, further comprising a general control unit programmed to control the arm during a collaborative task with an operator, the connecting plate comprising a handle which can be gripped by the operator to guide the robot.
23. A kit for manufacturing a gripping device, comprising plates of different shapes, the motorized fingers according to claim 1, distal phalanxes of different shapes, interfaces of different shapes.
24. The kit according to claim 23, further comprising abutment elements of different shapes.
25. The kit according to claim 23, further comprising fingerstalls to cover at least the distal phalanx of the motorized fingers.