Method for interconnecting robots

Field and context

The present invention concerns the field of communication between connected devices (movable robots, sensors, etc.), and of interoperability of these connected devices.

It is known to use movable robots of different types, such as humanoid robots, movable carriages, with or without a manipulator arm, drones, etc. Quite often, these robots are associated with different sensors for acquiring surrounding data, and provided with an ad-hoc communication and different operating and monitor-control systems. The implementation of these different objects, substantially autonomous, to make them execute complex operations, by organizing a distribution of the tasks to be completed and a cooperation between these objects, requires means for communications and exchanges of information between hardware and software equipment that are often quite heterogeneous.

To date, there is no interface software or program, also called middleware, that is generic enough to ensure the desired communication and interoperability between these movable objects (robots and/or other data sensors), which are heterogeneous both by their physical characteristics and by their respective operating software, while allowing in particular opening of high-level application services, as well as an easy and unified integration of third-party software bricks.

Hence, the problem to be solved consists in designing an interface software capable of bringing together heterogeneous movable objects, by allowing in particular interconnecting these objects which may belong to one or several fleet(s) of objects for the completion of specified tasks, possibly remotely, together and/or by one or several operator(s).

Hence, the invention aims at providing a solution to all or part of this problem.

Description of the invention

To this end, the present invention concerns a method for interconnecting a first robot with at least one second robot, and a method for managing the cooperation between a plurality of robots, as well as at least one computer program comprising the instructions configured to execute said methods.

An aspect of ~~The~~ the present invention concerns a method for interconnecting a first robot with at least one second robot, each robot comprising at least:

- a monitor-control unit, the monitor-control unit comprising at least one processor and at least one memory module;
- at least one peripheral equipment such as an actuator or a sensor;

– at least one communication equipment ~~connected to at least one communication network~~;

– a first program P1, configured to pilot the at least one communication equipment, and comprising a plurality of first software modules executed on the at least one processor;

– a second program P2, comprising a plurality of second software modules executed on the at least one processor, the configuration of said second program being determined by a setup file including a field typ_service indicating a sending mode amongst the interpret or direct modes, said sending mode characterizing the messages transmitted by said second program;

– a third program P3, configured to control the at least one actuator and/or the at least one sensor, and comprising a plurality of third software modules executed on the at least one processor;

the method comprising the following steps, implemented by the second program within each of the robots, after reception by the second program of a first message originating from the third program:

– conversion of the first message into a second message, the second message being formatted according to a predefined object structure comprising a field typ_msg indicating a type of said message amongst the types: command, query, or information;

– transmission of the second message to at least one program amongst: a first program belonging to the same robot, a second program of another robot;

the interconnection method further comprising the following steps, implemented by the second program within each of the robots, after reception by the second program of a third message, formatted according to said predefined object structure, originating from at least one program amongst: a first program belonging to the same robot, a second program of another robot, when the field typ_msg of said third message indicates the command type or the query type:

– translation of the third message into a program portion adapted to be implemented by the third program when the field typ_service of the setup file associated to said third message indicates the direct sending mode; and/or

– transmission according to a second transport protocol, of at least one portion of said third message, or of said program portion, to the third program.

Advantageously, the predefined and generic object structure through which the second program P2 can ensure~~s~~ the formatting of the information and/or instructions to be transmitted, is composed by the following fields:

– message type: command, information or query;

According to an aspect of the invention, the wireless communication means comprises at least one module amongst: a WIFI type module, a RFID type module, a Bluetooth type module, a GSM type module.

According to an aspect of the invention, the second program of the first robot encrypts the second message before transmitting it if the addressee is the at least one second robot, and the second program of the first robot decrypts the third message before translating or transmitting it, if the sender is the at least one second robot.

Thus, within each robot, the second program is adapted to smartly encrypt and/or decrypt the messages depending on their origin and their destination.

According to an aspect of the invention, the at least one second robot comprises a remote operator connected to an Internet server.

According to an aspect of the invention, the third program comprises the operating system of the robot on which it is installed and a driver program of at least one actuator and/or of at least one sensor.

The invention also concerns a method for managing the cooperation between a plurality of robots, each robot of the plurality of robots comprising at least:

– a monitor-control unit, the monitor-control unit comprising at least one processor and at least one memory module;

– at least one peripheral equipment such as an actuator or a sensor;

– at least one communication equipment connected to at least one communication network;

– a first program, configured to pilot the at least one communication equipment, and comprising a plurality of first software modules executed on the at least one processor;

– a second program, comprising a plurality of second software modules executed on the at least one processor;

– a third program, configured to control the at least one actuator and/or the at least one sensor, and comprising a plurality of third software modules executed on the at least one processor;

the method comprising the following steps:

– emission by an application layer hosted by a server or accessible through the Internet, of a mission file, said mission file comprising a list of planned elementary tasks and the sequencing thereof, and of an identification and prioritization file of the peripheral equipment,

– reception of said mission file and of said identification and prioritization file, by an equipment service of the first program of each robot of the plurality of robots,

CLAIMS

1. A method for interconnecting a first robot ~~(1)~~ with at least one second robot ~~(2, 21)~~, each robot ~~(1, 2, 21)~~ comprising at least:

– a monitor-control unit, the monitor-control unit comprising at least one processor (4) and at least one memory module ~~(M)~~;

– at least one peripheral equipment such as an actuator or a sensor;

– at least one communication equipment;

– a first program ~~(P1)~~, configured to pilot the at least one communication equipment, and comprising a plurality of first software modules executed on the at least one processor;

– a second program ~~(P2)~~, comprising a plurality of second software modules executed on the at least one processor, the configuration of said second program ~~(P2)~~ being determined by a setup file including a field typ_service indicating a sending mode amongst the interpret or direct modes, said sending mode characterizing the messages transmitted by said second program ~~(P2)~~;

– a third program ~~(P3)~~, configured to control the at least one actuator and/or the at least one sensor, and comprising a plurality of third software modules executed on the at least one processor;

the method comprising the following steps, implemented by the second program ~~(P2)~~ within each of the robots ~~(1, 2, 21)~~, after reception by the second program ~~(P2)~~ of a first message originating from the third program ~~(P3)~~:

– conversion of the first message into a second message, the second message being formatted according to a predefined object structure comprising a field typ_msg indicating a type of said message amongst the types: command, query, or information;

– transmission of the second message to at least one program amongst: a first program ~~(P1)~~ belonging to the same robot, a second program ~~(P2)~~ of another robot;

the interconnection method further comprising the following steps, implemented by the second program ~~(P2)~~ within each of the robots ~~(1, 2, 21)~~, after reception by the second program ~~(P2)~~ of a third message, formatted according to said predefined object structure, originating from at least one program amongst: a first program ~~(P1)~~ belonging to the same robot, a second program ~~(P2)~~ of another robot, when the field typ_msg of said third message indicates the command type or the query type:

– translation of the third message into a program portion adapted to be implemented by the third program (P3) when the field typ_service of the setup file associated to said third message indicates the direct sending mode; and/or

– transmission according to a second transport protocol, of at least one portion of said third message, or of said program portion, to the third program (P3).

2. The interconnection method according to claim 1, wherein the translation step comprises access within the second program to a configuration file recorded in the at least one memory module (M), said configuration file providing the second program with the program portion adapted to be implemented by the third program (P3).

3. The interconnection method according to any of claims 1 or 2, wherein the step of transmitting at least one portion of said third message, or of said program portion, comprises at least:

- a first transmission, according to a second transport protocol, of a fourth message from the second program (P2) towards a fourth program (P4),
- a second transmission of a fifth message from said fourth program (P4) to the third program (P3).

4. The interconnection method according to any of the preceding claims, wherein a first transport protocol is used for the transmission of a sixth message between the second program P2 of the first robot (1, 2, 21) and the second program P2 of the second robot (1, 2, 21).

5. The interconnection method according to any of the preceding claims, wherein the first, second, third, fourth, fifth and sixth exchanged messages are in JSON format.

6. The interconnection method according to any of claims 3 to 5, wherein the first protocol is of the UDP type.

7. The interconnection method according to any of claims 1 to 6, wherein the second protocol is of the TCP type.

8. The interconnection method according to any of the preceding claims, wherein the at least one telecommunication equipment comprises a wireless communication means.

9. The interconnection method according to any of the preceding claims, wherein the wireless communication means comprises at least one module amongst: a WIFI type module, a RFID type module, a Bluetooth type module, a GSM type module.

10. The interconnection method according to any of the preceding claims, wherein the second program (P2) encrypts the second message before transmitting it if the addressee is the at least one second robot (2), and wherein the second

program (P2) decrypts the third message before translating or transmitting it, if the sender is the at least one second robot (2).

11. The interconnection method according to any of the preceding claims, wherein the at least one second robot comprises a remote operator connected to an Internet server.

12. The interconnection method according to any of the preceding claims, wherein the third program (P3) comprises the operating system of the robot and a driver program of at least one actuator (A1, A2) and/or of at least one sensor (C).

13. A method for managing the cooperation between a plurality of robots (1, 2, 21), each robot of the plurality of robots (1, 2, 21) comprising at least:

– a monitor-control unit, the monitor-control unit comprising at least one processor (4) and at least one memory module (M);

– at least one peripheral equipment such as an actuator (A1, A2) or a sensor (C);

– at least one communication equipment connected to at least one communication network;

– a first program (P1), configured to pilot the at least one communication equipment, and comprising a plurality of first software modules executed on the at least one processor;

– a second program (P2), comprising a plurality of second software modules executed on the at least one processor;

– a third program (P3), configured to control the at least one actuator and/or the at least one sensor, and comprising a plurality of third software modules executed on the at least one processor;

the method comprising the following steps:

– emission by an application layer hosted by a server (3) or accessible through the Internet, of a mission file, said mission file comprising a list of planned elementary tasks and the sequencing thereof, and of an identification and prioritization file of the peripheral equipment,

– reception of said mission file and of said identification and prioritization file, by an equipment service of the first program (P1) of each robot of the plurality of robots,

– transmission, by the first program (P1) of each robot of the plurality of robots, of a first query-type message to its second program (P2), to determine an identifier of each available peripheral (A1, A2, C) of the at least one peripheral of each robot of the plurality of robots (1, 2, 21),

– implementation, by the second program (P2) of each robot of the plurality of robots (1, 2, 21), of the method for interconnecting robots according to any

of the preceding claims to request from the third program ~~(P3)~~ and transmit to the first program ~~(P1)~~ the identifiers of the peripherals ~~(A1, A2, C)~~ available on each robot of the plurality of robots ~~(1, 2, 21)~~;

– processing by the equipment service of the first program ~~(P1)~~ of each robot of the plurality of robots ~~(1, 2, 21)~~ of the identifiers of the available peripherals ~~(A1, A2, C)~~ to generate a list of tasks feasible by each robot ~~(1, 2, 21)~~ of the plurality of robots ~~(1, 2, 21)~~,

– transmission to each robot ~~(1, 2, 21)~~ of the plurality of robots ~~(1, 2, 21)~~ and/or to a centralized service of the server, by each negotiation/election service of the first program ~~P1~~ of said list of the tasks feasible by each robot of the plurality of robots ~~(1, 2, 21)~~,

– production by a centralized service of the server and/or following a process of communication between each negotiation/election service of the robots ~~(1, 2, 21)~~, based on the identification and prioritization file of the peripherals and on the list of feasible tasks, of a list of robots participating in the mission,

– execution of the mission,

– synchronization of the robots,

– supervision of the execution of the mission.

14. A computer program comprising a set of instructions configured to execute the method for interconnecting robots according to any of claims 1 to 12.

15. A computer program comprising a set of instructions configured to execute the cooperation management method according to claim 13.