



- (51) **International Patent Classification:** Not classified
- (21) **International Application Number:** PCT/IB2013/061176
- (22) **International Filing Date:** 20 December 2013 (20.12.2013)
- (25) **Filing Language:** Italian
- (26) **Publication Language:** English
- (30) **Priority Data:** BO2012A000705 21 December 2012 (21.12.2012) IT
- (71) **Applicant:** I.M.A. INDUSTRIA MACCHINE AUTOMATICHE S.P.A. [IT/IT]; Via Emilia 428-442, I-40064 Ozzano dell'Emilia (Bologna) (IT).
- (72) **Inventors:** MARCHI, Fabrizio; Via del Bosco 49, I-40065 Pianoro (Bologna) (IT). MAZZINI, Andrea; Via Darsena 152, I-44122 Ferrara (IT). PEDRONI, Antonio; Via Formignana 1/A, I-44100 Ferrara (IT). STEFANELLI, Cesare; Via D'Azeglio 71, I-40123 Bologna (IT). TORTONESI, Mauro; Via Eligio Mari 59/H, I-44123 Ferrara (IT).
- (74) **Agents:** PERSI, Patrizia et al.; Luppi Crugnola & Partners S.r.l., Viale Corassori 54, I-41124 Modena (IT).
- (81) **Designated States** (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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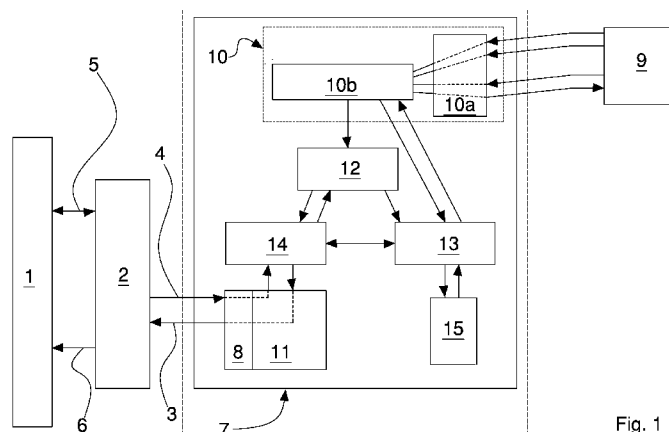
(54) **Title:** CONTROL SYSTEM AND METHOD OF AN AUTOMATIC MACHINE

Fig. 1

(57) **Abstract:** An automatic machine comprises a production line along which a number of materials is fed and treated to manufacture a product and comprises a plurality of operative members interacting with said materials and/or said final product and which comprise electric and/or electronic components distributed along the production line. A control system of an automatic machine comprises control means (1) of the operation of the automatic machine, which can store and/or process a set of management data and of functionalities of the electric/electronic components and/or of the automatic machine and which comprise data exchange means (2). The control system further comprises communication means, by means of which the control means (1), exclusively through the data exchange means (2), allow access to the management data and/or to the functionalities and/or allow notification of events deriving from the operation of the automatic machine and relating to the management data and/or the functionalities. A user visualization graphic interface which is connectable to the control means through the communication means is provided for providing access to and/or receiving notifications from, the management data and/or the functionalities. The control system comprises a web server (7) comprising web data exchange means (8) that is connectable to the data exchange means (2) of the control means (1) through the communication means, and the graphic interface is of the web type, visualizable as a set of pages in a web browser for an interaction with a user or through a dedicated application,

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Published:

- *without international search report and to be republished
upon receipt of that report (Rule 48.2(g))*

Control system and method of an automatic machine

The invention relates to a control system and a method of an automatic machine, in particular an automatic machine for packaging products, for example products of the food industry or pharmaceutical products.

The automatic machines normally used in the food industry or pharmaceutical industry comprise a production line along which a determined number of materials is fed and treated to make a product. A plurality of operative members interacting with these materials and/or with the product and comprising electric and/or electronic components are distributed along the production line and a control system is provided for supervising the operation of the operating members.

This control system normally comprises control means of the operation of the automatic machine and a user visualization graphic interface (also commonly known as HMI - Human Machine Interface) arranged on the machine, which on the one hand communicates with the control means through a communication network and on the other hand with a user, to supervise and control the machine during the operation thereof.

The control means can comprise a single control unit, for example a PLC, and coincide therewith or be distributed on multiple control units, or on the electrical and electronic components if such components are of the "smart" type, i.e. they are provided with intelligence. For the sake of simplicity, it will be assumed below that the control means and the control unit coincide.

The graphic interface is based on management data that the control means store and process during operation of the machine.

The management data comprise, for example, anomaly warning messages and signals, production and/or reject counters, machine parameters or analogue and/or digital internal work variables, associated with the operation or configuration of

the electric or electronic components, position and/or speed signals of the motors installed in the machine.

Control systems of the SCADA type, acronym deriving from the English indicating "Supervisory Control And Data

5 Acquisition", are known, i.e. specialized integrated systems

that are able to provide in an industrial environment a complete development environment comprising control means

for monitoring an industrial process, electric and/or electronic components that have already been configured to

10 be connected to the control means, a graphic interface through which it is possible to display the management data

illustrated above and extrapolate statistics from these data. Such control systems, which offer simplified and

intuitive languages both for programming the logic of the control unit and for programming the user interface, and the

15 hardware of which can be scaled in relation to the complexity of the industrial process, have spread

successfully in the industry because they are extremely versatile and are easy to configure. In fact, by simply

20 installing the electronic components in a machine and correctly configuring the control program and graphic

interface of the SCADA system it is possible to make an automatic machine or an industrial process operative in a

short time.

25 A database inside the control unit stores the management data of the automatic machine that were listed above that

are updated by cyclical polling performed by the control unit towards the electric/electronic components that are

connected to the control unit. The polling cycle time is

30 usually fixed on the basis of compromised between efficiency performance requested of the control system and the cost of

the control system to meet this performance.

Such data can be accessed through the user visualization interface, in which the updates are displayed as soon as

35 they become available after the cyclical update.

Recently, SCADA systems have also been proposed with a web-type client user interface that is able to offer the same display of the interface on the machine, but remotely and on a web browser. Typically, such systems with a web interface envisage the database inside the control unit providing an access through the web, so that the database manages the requests of the web interface. The database data, which are accessible via web through the user interface, are thus displayed with a delay that reflects the time taken by the cyclical update.

A drawback of the known control systems of the SCADA type, if they are used in the more complex machines of the food industry or of the pharmaceuticals industry, is that they are not suitable, both due to the architecture and due to the personalization of the control logic, for the more complex functionalities that the machine requires. In addition to this, if high performance is required, they require a hardware and software configuration that is such as to make them more costly than control systems with proprietary architectures, in proportion to the cost of the machine.

It is noted that current automatic machines for treating food or pharmaceutical products are very complex both from the mechanical point of view and from the electric/electronic point of view. In the last few years, traditional mechanical drives, in which the movement derives from a single electric motor, have been replaced by a plurality of independent electric drives, each of which is synchronized electronically with the others. Further, in order to improve product quality continuously, every more sophisticated controls have been added that have made it necessary to increase significantly both the sensors and the actuators found in the machine. The arrival of "smart" field devices, i.e. of devices installed in the machine that are provided with a microcontroller, has made a great amount of

information available on the state of such devices or on the configuration thereof.

In such automatic high-performance machines control systems have thus been designed that have efficient and highly specialized proprietary architectures that are able to provide response times that are appropriate to the requests arising from the electric and/or electronic components of the operating members. In order to do this, event systems have been provided, i.e. systems that are based on notifications that the control unit can send to the user visualization interface without any need for the control unit to run a polling cycle to update the value of the electric or electronic components.

The management data of the control unit thus reside in a database inside the control unit and the visualization interface is updated by notifications relating to such management data, as soon as the latter change.

The complexity of the automatic machine is reflected in the complexity of the logic required to run the automatic machine and in the extremely high number of data in the database of the management data, which nevertheless have to be submitted to a user or to any other application using the data in a homogeneous manner.

In order to facilitate the task for machine technicians responsible for carrying out the machine, and in order to prevent direct and uncontrolled access to these data, over the years the complex functionalities residing in the control unit have increased that are offered by the visualization interface and are obtained as a cooperation service between the interface and the control unit, relative to specific elements found in the machine or to functionalities of the automatic machine. For example, elementary functions adjusting parameters have been grouped according to a logic of belonging to a specific group of operating members of the machine or to a type of production, to make it easier for a user to start production or change a

product brand. The complex functionalities comprise any one of production start, pause, stop requests, requests for statistical data, alarm list requests. Such complex functionalities, which are additional to the management data, involve cross checks performed by the control unit and/or by the interface, which can make operational, for example, some requests only if carried out at a suitable moment and/or in a suitable position of the operating members of the machine and/or by a user with the suitable authorizations.

Simplifying the functionalities offered a user on a machine has thus entailed a greater number of complex functionalities managed by the control unit of the automatic machine that are additional to the management data.

Over time, also in the control systems with the proprietary architectures illustrated above the need emerged to develop a visualization interface of the web type to make the interface independent of the type of operating system in which the interface is developed and further provide a user with an instrument that is easy to use because, over time, this type of interface is become increasingly widespread and known.

In order to respond to this need, it is not possible to make available via web only the data of the database of the management data of the control unit, for example to use a web interface that has been specifically built thereupon. The complex functionalities disclosed above that are necessary to make running easier for the machine operators are an added value compared with the simple access to only the management data.

For example, the complex "production start" functionality provides a preliminary control of the user profile to determine the authorizations that are sufficient for running the functionality, which is followed by an insertion in the control unit of suitable parameters for production during the startup step, such as checks of the status of the

control unit in order to be able to actually start production. In other words, the "production start" has been designed as a coordinated service between the software of the visualization interface and the software of the control unit, to run this initial step in a controlled and complete manner. Even if the management data of the database of the control unit became accessible via web, and thus displayable in a specific interface of web type, the complex functionality of "production start" would not be available because it is a coordinated service of modification of the management data and of the control logic.

It is noted that in the case of machines of the pharmaceutical sector, such automatic machines are very long, also extending for some metres, and can be enclosed in a cleanroom. Along the automatic machine multiple user interface devices are thus arranged, for example display of important dimensions, in which each display is configured for displaying only parts of the interface of the zone of the machine in which the interface device is positioned.

Another drawback of the control systems, especially of machines of the pharmaceutical sector, is that it is necessary to design different types of user interface, each associated with a different device. Further, multiple interface devices are required on the machine and thus multiple displays are required. This results in high costs that are due both to the design of the graphic interface and to the number of displays necessary on the machine.

The object of the present invention is to implement a system and a control method of an automatic machine, which is free of the problems disclosed above and which is at the same time easy and cheap to make.

A further object is to provide a control system and method that allow a user interface of web type to be implemented or an application with access to web data (definable as "app" or "web app"), through which access is possible both to the management data and to the complex additional

functionalities particularly designed for machine operators, provided by the control means of the automatic machine.

A still further object is to provide a control system and method in which design of the operator interface is simplified and the cost of the interface devices on the machine is limited, without thereby decreasing accessibility for the operators to the user graphic interface.

Such objects and still others are all achieved by a control system and method of an automatic machine as established by the independent claim and by the further claims set out below.

The invention can be better understood and implemented with reference to the attached drawings that illustrate some embodiments thereof by way of non-limiting example, in which:

Figure 1 shows a detailed schematic view of a web server according to the invention in communication with the control means of an automatic machine.

Figure 2 shows a schematic view of the control system of the automatic machine comprising the web server according to the invention.

With reference to Figures 2, an automatic machine 100 for packaging products, for example for packaging a food product like tea or coffee respectively in bags and in capsules or capsules or pills for the pharmaceuticals industry, comprises a production line 101 provided with operating units (not illustrated in detail) along which a number of materials making up the product are fed and treated (i.e. the non-woven fabric sheet material for making tea bags or multilayered plastics sheet material for the coffee capsules and the loose tea or powdered coffee) and a number of initial products to be packaged such as loose tea, powdered coffee or powder containing a medicament.

If we take as an example an automatic machine for packaging tea bags, the automatic machine comprises a group for feed non-woven fabric sheet material, that is formed and/or

folded in a forming and/or packing group to make an intermediate product that is able to receive the loose tea. The intermediate product, which is subsequently fed to a filling group, receives the loose tea to be packaged and is subsequently fed to closing group of the tea bag and to a group for giving the tea bag an outer packaging to make a product like an individually packaged tea bag.

The operating groups disclosed above comprise a plurality of operative members that interact with the packaging materials and/or with the product and which comprise electric and/or electronic components distributed along the production line, such as, for example, electric motors, solenoid valves and sensors.

The automatic machine 100 further comprises a control system 102 comprising control means of the operation of the automatic machine, indicated schematically by number 1 in Figure 1 and Figure 2. The aforesaid operating members can perform a respective function only if and when they are activated by the control means 1.

The control means 1 are suitable for storing and/or processing a set of management data and functionalities of the electric/electronic operative members and/or of the automatic machine 100, during interaction with the electric/electronic operative members. These management data and these functionalities have already been disclosed previously and the description thereof is not repeated here.

It is noted that the control means 1 are shown in Figure 2 as comprising a single control unit 103 and coinciding therewith. The control unit 103 is suitable for running a control program of the automatic machine 100. Alternatively, according to what has already been illustrated previously and is not repeated here, the control means can be distributed over multiple control units.

The control system further comprises communication means 104 and one or more graphic visualization interfaces indicated

schematically by number 105 in Figure 2, through which a user is able to control the automatic machine 100.

As illustrated in Figure 1, the control means 1 further comprise data exchange means, indicated with 2.

5 The control means 1 allow through the data exchange means 2 access to the management data and/or to the functionalities and/or allow notification of events deriving from the operation of the operating members of the automatic machine and which relate to these management data and/or these
10 functionalities. The data exchange means 2 of the control means 1 are accessible through the communication means 104.

It is pointed out that access to, and/or notifications of events from, the management data and/or functionalities is exclusively allowed through the data exchange means 2. In
15 other words, although the control means 1 comprise a database of management data, these data are accessible non directly but only through the data exchange means 2. Direct access to these data via web has been prevented to allow interaction through the data exchange means 2 not only with
20 the data but also with all the complex functionalities developed over time for the automatic machine 100.

The management data can have a value of a different type in relation to the contents to which they are intended. For example, each datum can have a numeric or Boolean,
25 enumerative, date/time or string value in order to be able to store one or more text strings.

A production and/or reject counter is a whole number datum, on the other hand an alarm message or anomaly warning is a text string datum, where one or more warning strings have to
30 be stored to be submitted to the user, possibly the same message in different languages.

With each datum, on the other hand, additional properties are associated regarding the type of datum, owing to which the control means 1 is able to ensure that the datum always
35 and only takes on valid data to ensure correct behaviour over time of the electric and/or electronic component with

which the datum is associated. As an example of additional properties, with each datum there can be associated a status, its measuring unit, a permissible work interval, the level of authorization required to permit a modification by a user and lastly possible translations if the datum is, or is also associated, with a string datum.

Usually, the database of the management data is divided into views, organized by categories, and each of these views can be accessed through the data exchange means 2.

An example of possible views are the production data, which are usually stored for more than one production shift and the journal file of which is accessible as a view via a request for statistical data integrated into a function.

Similarly, views can be organized for navigating between the production parameters.

The start/pause/stop production functionality not only comprises writing certain parameters but also supplements control to prevent the simultaneous start-up of multiple types of productions and above all for preventing the operating members of the automatic machine not being ready to start production.

The visualization graphic interface 105 is connectable to the control means 1 through the communication means 104 and allows access to and/or receiving notifications from the management data and/or such functionalities, allowing the display thereof.

The display can be updated cyclically and thus in this case the graphic interface 105 will cyclically request access to the management data and to the functionalities of the control means 1, or updating can also be requested by the control means 1, by requests received from the control means 1 and relating to events that arise from the operation of the automatic machine. The events are communicated to the graphic interface 105 as soon as there is a change to the "status" of the automatic machine, "status" of the automatic machine being defined as any operating condition, a

variation of which is viewed as an event to be notified to the graphic interface.

The graphic interface 105 can be visualized in a physical device on the machine or on movable devices as disclosed better below. The communication means 104 is in fact implementable both as an industrial Ethernet or also as a WI-FI network according to the IEEE 802.11 standard shown schematically in Figure 2. Alternatively, the communication means can be implemented as logical communication channels between applications resident in the same physical device.

In detail, the data exchange means 2 comprise a library of procedures that provides a set of data request RPCs 3 (acronym for Remote Procedure Calls) through which it is possible to access the management data and/or the functionalities of the control means 1 and a set of events notification RPCs 4 therefrom.

This two-way RPC channel is thus able to ensure synchronous communication between the control means and external devices in which it is completely irrelevant for the definition of RPC that the "procedure" physically resides in the same device in which the control means reside. If the "calling" procedure is in a different computer from the "called" computer, the communication network nevertheless makes the "remote" call accessible as if it were a "local" call.

The data request RPCs 3 can be "called" when access to the data of the control means is necessary and they are adapted by the data exchange means 2, and i.e. by the data exchange means, to the control means 1 and thus the automatic machine as a data exchange request 5 or as a command setting 6.

The events notification RPCs 4 are on the other hand able to "call" an external procedure if the automatic machine informs the data exchange means 2 of an update of the management data and/or of the functionalities of the control means 1 of the automatic machine.

The control system further comprises a web server 7 (Figures 1 and 2), which comprises web data exchange means 8

connectable to the data exchange means 2 of the control means 1 through the communication means 104. The web data exchange means 8 comprise a library of web procedures, which provides both the data request RPCs 3 and the events notification RPCs 4, which are similar to those of the control means 1 but are complementary to them from the point of view of the type of call.

The web server 7 is able to "call" the data request RPCs 3 when the web data exchange means 8 require it.

The events notification RPCs 4 of the web server 7 are on the other hand "called" in the event of data supplied by the control means 1 to the web server 7. In this manner the data exchange means 2 of the control means 1 are connectable to the web data exchange means 8 and the access to the management data and/or to the functionalities of the machine is guaranteed, with a flow of exchanged data both from and to the control means 1.

In detail, the communication means 104 guarantee the connection between the procedures libraries, in a completely transparent manner with respect to where the web server 7 or the control means 1 can be resident. It should be noted that in Figure 1 the web server is illustrated separated from the control unit 103 wherein the control means 1 are concentrated but could also be part of the same control unit 103, or distributed on multiple physical devices.

The graphic interface 105 is of the web type, which is displayable as a set of pages in a web browser for an interaction with a user, and is connectable to the web server 7, or is a suitably developed application that accesses the web data that is definable as an "app" or "web app". In this manner, the visualization graphic interface allows access to and/or receiving notifications relating to the management data and/or the functionalities through the data exchange means 8 of the web server 7. The web server 7 is thus able to make available the management data and/or the specific functionalities of an automatic machine to a

web graphic interface of "standard" type or to an "app". Above all, it is thus possible to have complete access to the complex functionalities offered by the automatic machine 100.

5 The control system 101 can further comprise a mobile device 9, like for example a tablet, in particular of the I-PAD™ type or a smartphone, and/or a computer, for which it is particularly advantageous that the communication means 104 are a communication network of the wi-fi type. If the mobile
10 device is in fact a tablet that can be substantially held by a user without the need for further supports the graphic interface can be displayable in the mobile device 9 and follow the movements of the user in front of the operating members of the automatic machine, as detailed better below.

15 The web pages of the interface 105 can display views found in the database of the automatic machine by executing data request RPCs 3, as a data exchange request 3.

On the other hand, if the web pages not only require a visualization but also a modification of a management datum
20 to change a machine parameter setting or reset an alarm, through the data request RPCs 3 the new data value and the identity of the user requesting the modification can be sent to the machine. The data request RPC 3 call will execute a command setting request 6.

25 It is noted that some complex command setting operations may even require second confirmation of the identity of the user or of a further user as further authorization.

The graphic interface 105 is able to receive notifications from the automatic machine through the events notification
30 RPCs 4 that can transmit updated data to the displayed page through the web server 7. The web pages of the graphic interface are thus able to display in real time data/functions relating to components of the machine, "real time" being defined as the fact that the data exchange
35 between the graphic interface and the automatic machine is immediate save for delays imposed by the communication

network and the processing time due to both the control means 1 of the machine and to the web server 7 or web browser on which the graphic interface 105 is based. It is also emphasized that there are no further delays due for example to complex polling cycles for a cyclical update of the management data of the automatic machine, because an update of the automatic machine is notified also to the graphic interface and is not read cyclically.

Certain types of data are moreover presented only on special pages. For efficient alarm management, the alarm code, the description and status of each alarm or active warning message of the control system are displayed and the user can be allowed to select the alarms or warnings from those displayed that have already been analyzed, which can be stored as alarms or recorded warnings on alarm statistics pages of the control means. It is pointed out that "alarm" is defined as an event the activation of which is able to arrest the automatic machine and for which an intervention, often operational, on which machine is required, for example to deal with a material build-up in the machine. A "warning" is on the other hand defined as an event that indicates a fault the activation of which is of interest to the user, who does not, however, intervene to stop the automatic machine, for example a warning about material consumption.

Other pages of the graphic interface 105 are on the other hand dedicated to a synoptic table of a machine showing schematically and in a customizable manner the structure of the automatic machine or parts thereof, and on the display of which images, labels, buttons and values of variable data can be shown. From a main page of the synoptic table other pages can also be called up. The display of a synoptic table can also be used as a main menu of contextual navigation. If the mobile device 9 is moreover of third generation, the interface 105 is able to exploit the characteristics of these devices relating to the visualization of an image, which allow display in an easy-to-use manner with

interaction of touch type images of dimensions that are much greater than the available screen, which images are easily explorable through scrolling and zoom.

It is also pointed out that it is possible to show in the same mobile device both the web graphic interface 105 for controlling the automatic machine and a further graphic interface of the web type (which is not illustrated), for example a user manual, comprising a set of pages displaying multimedia documentary data that are associable with the automatic machine. The mobile device 9 is suitable for showing both. In other words, it is possible to concentrate both the display and management of the data and of the control functionalities of the automatic machine, and the display of possible other multimedia documents that are not usually resident in the control means 1 but elsewhere.

The multimedia documentary data can be any one of libraries of constructive schemes, mechanical schemes, electric schemes, exploded drawings, and/or libraries of operation manuals for example maintenance manuals, use manuals, safety manuals, videos and commercial material.

The communication means 104 of the control system 101 of an automatic machine are in fact usually implemented as an plant network inside the production site in which the automatic machine is installed. Nevertheless, generally, in any plant, there is also a further external communication network, which is connectable to the plant communication network, for example to access web Internet data. It is pointed out that precisely because of the properties of each mobile device relating to connection to any communication network the documentary data illustrated above can reside and be stored on the mobile device 9, in servers inside the plant network or in servers outside the plant network, which are reachable simply through an URL logical address.

The mobile device 9 further comprises localization means (not illustrated) for localizing the position of the mobile device with respect to the automatic machine. Such

localization means can directly exploit position detecting elements that are already present in the latest generation of mobile devices such as GPS detecting means, an accelerometer or position detecting wi-fi means.

Alternatively, it is possible to exploit an image acquisition optical apparatus that is normally found in the mobile devices and is usable in combination with an optical code, for example a QR code, which is placed on a portion of automatic machine and indicates the position in the machine.

Reading and decoding the optical code enables the mobile device 9 to be localized in relation to the automatic machine 100. A radio frequency apparatus can also be used for this purpose in combination with an RF-ID tag arranged inside, a mechanical component of the automatic machine.

The context that is associable with a user is defined by an authorization profile and/or by a configuration of the pages as customized for each user and/or by the position of the mobile device 9 relative to the automatic machine. The management data and/or the functionalities displayable on the pages of the control graphic interface or the documentary data displayable in the manuals graphic interface, are a function of this context that is associable with each user. In other words, different interface pages are displayable according to the authorizations profile and/or of the pages configuration and/or of the position of each user.

We shall set out better below what is meant by authorizations profile and by configuration of the pages for each user.

With regard to the position of the mobile device 9 with respect to the automatic machine, in particular with respect to the operating members along the production line 101, it is important to underline that it allows the graphic interface to be "localized".

In fact, owing to the position of the mobile device 9, the control graphic interface or the manuals graphic interface

is able to display only pages that are associable with the position of the mobile device 9 in relation to the automatic machine 1. Such pages are thus updated dynamically as the position detected by the mobile device varies with respect to the machine and thus a sole mobile device can be configured automatically, showing in different positions different interface pages and thus "localizing" the graphic interface 105.

The web server 7, for the properties of the web server 7, is suitable for simultaneously connecting multiple interface pages coming from both the same mobile device 9 and from multiple mobile devices 9, and is thus suitable for receiving respective requests from each displayed page. The graphic interface can be accessible through a browser of the mobile device, and in this case it will be independent of the operating system of the mobile device 9. If the graphic interface is made specifically for the operating system of the hosting mobile device 9 (for example, IOS of Apple or Android of Google) it is a "web app" that will connect to the same web server 7 but will fully exploit the hardware of the mobile device 9.

The web server 7, illustrated in Figure 1, comprises a requests manager 10, for managing each request coming from each page, and an interaction manager 11 with the web data exchange means 8. The requests manager 10 is in communication with the interaction manager 11, so as to forward and adapt requests coming from each page to the web data exchange means 8, as will be seen below. In detail, the requests manager 10 comprises an interface web 10a that is directly connectable to the client web of the graphic interface and a requests analyzer 10b, for preparing the requests according to standard requirements set by the interaction manager 11 and passing on the requests.

The web server 7 further comprises a context manager 12 of the users, which is connectable to the requests manager 10, in particular to the requests analyzer 10b, for associating

and storing a context to each user which is connectable to the web server. A pages manager 13 is also connectable to the requests manager 10 and to the context manager 12.

Specifically, it is connectable to the requests analyzer 10b and can generate the pages requested by the user and thus propose displaying the management data and/or the functionalities of the automatic machine requested on each page, through the data obtained from the interaction manager 11, with which it is in communication, which is in connection with the web data exchange means 8. It should be noted that the web server 7 also stores a plurality of pages models 15, through which the web pages can be configured with simplicity, owing to a large number of optional parameters. The pages manager 13 can thus generate the pages that are displayable in the graphic interface by taking into consideration a specific pages model 15 selected by the user, the customization of each page and the context stored by the context manager 12.

The pages manager 13 is thus able to generate the display thereof, in response to requests coming from the requests analyzer 10b and from the context stored by context manager 12 and is thus responsible for transmitting the updated data to each page. The pages manager 13 is activatable by the requests of each page but also by the notifications from the management data and/or from the functionalities that the automatic machine can transmit.

As said previously, the context associated with a user is defined by the authorizations profile, by the configuration of the pages as customized for each user and/or by the position of the mobile device in relation to the automatic machine.

We have already illustrated how the position of the mobile device 9 contributes to defining the context and how it is usable for display purposes. On the other hand, with regard to the authorizations profile, an account is associated with each user the management of which is delegated to a user

validation body. The control unit can comprise this user validation body or this body can be reachable through the communication means 104, for example the plant network if the user validation is performed by a user domain to which the automatic machine has access. The interface web on the mobile device 9 restricts itself to forwarding a user identity detected by the user validation body, for the recognition of the user. The graphic interface can show the account of each user with possible groups defined in the user management device, wherever it resides.

Each authorizations profile is stored in the control means 1 and is manageable through web server 7 owing to the context manager 12. In this manner, at every possible access to the management data and/or to the functionalities of the machine a set of rights is assigned, each attributed to a respective user or to a user belonging to a specific group distinguished by a specific prefix.

The context manager 12 manages the authorizations profile associated with each user at the moment of access to the web server 7 and this profile is usable for requests coming from the user. Users who present sufficient rights (for example, the administrators) can interact with a special page that shows the values of the rights of each group.

We have said that access to the web server 7 is possible simultaneously also from different pages of the same mobile device 9 or of different mobile devices 9. Accesses by the same user from different devices, or from different clients, can be managed as different contexts.

The context manager 12 also stores the customization of the pages, as configured by the person who designed the visualization pages, for example the colour of the pages and/or of specific buttons, font sizes, etc.

According to an alternative embodiment, the colour of the background of the pages is stored in the same implementation template of each page and the context manager stores only the set of the rights of each user, the group to which the

user belongs and the position of the user with respect to the machine. The colour of some buttons is in fact derivable from the set of rights and varies with the variation in the rights of the user and/or of the logic status of the interface during its operation. On the other hand, the font size is freely modifiable by the user through the configuration of the browser. Accordingly, according to this alternative embodiment the context that is associable with a user is defined by the authorizations profile, by the group to which the profile belongs and by the position in relation to the machine.

In consideration of the plurality of the possible pages models 15 and of the stored context, it could be possible that for a user profile the pages manager 13 automatically refreshes the image of the synoptic table as the position of the mobile device 9 varies on an interface, for example during a movement of the user. For a different user profile on the other hand, also on a page that is visualizable in the same mobile device 9, the pages manager 13 could maintain the display of the synoptic table fixed as the position of the mobile device 9 varies in relation to the automatic machine 1.

The web server 7 further comprises a command manager 14, suitable for receiving commands from the pages through the pages manager 13 and for notifying the pages manager 13, evaluating the commands and/or the notifications on the basis of the context stored by the context manager 12. It is pointed out that if the user validation body is part of the control means 1 the user validation is managed by the context manager 12 through the command manager 14 and a user is thus validated through the access to the interaction manager 11.

We note that the interaction manager 11 is exclusively connectable to the command manager 14 and it is thus by means of the command manager 14 that the context manager 12 and the pages manager 13 can provide access to, and/or

receive notifications from the management data and/or the functionalities of the control means 1. The pages manager 13 is thus in communication with the interaction manager 11 through the command manager 14.

5 In this manner only the command manager 14 is responsible for managing and synchronizing the set of all the requests that are active in the web server 7, in combination with the interaction manager 11. Communication between the requests manager 10 and/or the pages manager 13 and/or the context
10 manager 12 and the interaction manager 11 occurs through the command manager 14, in connection with all the managers.

In use, a first user X1, who is with his or her mobile device 9 in a first position Y1, runs the graphic interface and a request for connection to the web server 7 is made to
15 which the account authentication request is forwarded (by the user validation body wherever it resides). The control method of the present invention provides for the requests manager 10 receiving and analyzing the request received. In particular, it is the interface web 10a of the requests
20 manager 10, which receives the connection request and passes the connection request to the requests analyzer 10b, which subsequently forwards the connection request to the context manager 12, in connection with the requests manager 10. At the end of the evaluation of the context manager 12, the web
25 server responds with the appropriate context according to the user X1 and to the position Y1.

For the context of the first user X1 the customization data and the authorizations profile associated with the user and thus the pages generator 13 are retrieved, in connection
30 with the context generator 12, sends the initial visualization page or pages to the mobile device 9. These pages are generated by the pages generator 13 by retrieving a pages model 15 and evaluating the context of the user according to what has been stored by the context manager 12.

35 When the first user X1 wants to display a page with the current values of the management data, a request to access

the management data and/or the machine functionalities is generated by the graphic interface. This request is received by the requests manager 10 of the web server 7 and forwarded to the interaction manager 11, with which the requests manager 10 is in communication, to access these data and/or these functionalities through the web data exchange means 8. The web data exchange means connect to the data exchange means 2 of the control means 1 through the communication means and the graphic interface can receive and then display the data and/or the functionalities concerned owing to the web data exchange means 8 of the web server 7. To do this, the interaction manager 11 adapts each request coming from each of the pages of the graphic interface to the web data exchange means 8.

In detail, the command manager 14 receives the requests from the requests manager 10 and/or from the pages manager 13 and notifies the pages manager 13 when the requested data are received or notifications are received from the automatic machine.

The data and/or the notifications are anyway evaluated through the context managed by the context manager 12, that controls possible authorizations and/or customization of the user X1 and the position of the mobile device in Y1. In order to send the requests, the command manager 14 connects to the interaction manager 11 and is connected therewith exclusively. In other words, any data request that is sent to the data exchange means 2 of the control means 1 is set up by the interaction manager 11 and sent through the web data exchange means 8.

The pages manager 13 is placed in communication with the interaction manager 11 through the command manager 14.

The command manager 14, if necessary, transforms a request, for example concerning a complex functionality, into one or more basic requests, subsequently sent to the interaction manager 11 of the web data exchange means 8. Further, the command manager 14, if necessary, transforms multiple basic

requests, into a complex request, subsequently sent to the interaction manager 11 of the web data exchange means 8.

The web data exchange means 8 connects to the data exchange means 2 of the control means 1 and then the data request
5 RPCs of the library 8 of the web server 5 "call" the control means 1 that offers access to the management data and/or to the functionalities of the control means 1. The call ends with a datum/multiple data recovered at the end of the call procedure or a possible outcome of the remote procedure
10 call.

On the other hand, if during production an event occurs about which the graphic interface has to be informed the events notification RPCs 4 "call" the web data exchange means 8. The interaction manager 11 receives the data that
15 are the subject of the notification and transfers the data to the command manager 14 to assign them to a specific page amongst those active in the device and/or amongst all the mobile devices. The command manager 14 notifies the pages manager 13 of the change, which then regenerates the pages
20 of the interface.

If a second user X2 runs the graphic interface in the same mobile device 9 positioned in the first position Y1, the connection to the web server 7 occurs in a manner that is identical to what has been said above. Nevertheless, the
25 context manager 12 will manage a different context for the different user, due to the fact that the customization data, the authorizations profile and the pages model 15 for the second user X2 are possibly different from those for the first user X1.

30 The different context between the users can result in that the main page of the graphic interface of the first user X1 showing a synoptic table of pages and the main page of the second user X2 showing the production statistics.

Lastly, if the position of the mobile device 9 changes in
35 relation to the automatic machine, the device will be in position Y2 and the context will thus be different in the

new position. The main page, if for example the context associated with the user X1 permits it, will show an enlarged or different view of the machine synoptic table in relation to the position Y2.

5 A program is provided in association with the control system, which comprises a code for implementing the control method according to the invention when this program is run in the control system.

It has already been said that the control means 1, even if
10 it is distributed, comprises at least one control unit 103 for running the machine control program. If the control means 1 coincides with the control unit 103, the control unit 103 also comprises the data exchange means 2 for
15 accessing to and/or notifying of data and of the functionalities of the control means 1, implemented as a program comprising a code for accessing the data and/or functionalities of the control program of the automatic machine, when stored in the control unit.

The web server is also a program, comprising a code for
20 providing the web data exchange means 8 that is the subject of the present invention, when this program is run in a respective server device (not illustrated), in communication with the control means 1 or in the specific case in the control unit 103. This server device can also be resident in
25 the control unit (and in this case the communication means 104 is inside the operating system of the control unit) or in an external device.

The web data exchange means 8 of the web server 7 just as the requests manager 10, the context manager 12, the pages
30 manager 13, the command manager 14 and the interaction manager 11 are implemented as interoperative applications of the web server 7, comprising a code for implementing the control method according to the invention when this program is run in the web server 7.

35 According to one embodiment, the data exchange means 2 comprises directional communication channels, i.e.

alternative methods to the communication RPCs between processes. Similarly, also the web data exchange means comprises similar communication channels that enables the data exchange means 2 of the control means 1 to be connected
5 to the web data exchange means 8 of the web server 7.

Owing to the web data exchange means 8 present in the web server 7 in connection with the data exchange means 2 of the control means 1, data and/or functionalities that are not otherwise accessible are made available to an interface on a
10 web browser or on a "web app".

The presence of the web server 7 and of the managers inside thereto ensures that the context controls of each user are conducted before accessing the data and the functionalities of the control means 1 and an environment of integrated
15 services is thus supply that is specifically developed for a highly complex automatic machine in which the controls of context and of congruency between data and commands is adhered to.

Further, the web server 7 allows the potential offered by
20 the today's mobile devices such as tablets and smartphones to be exploited and the user graphic interface to be optimized by contextualizing the user graphic interface.

Owing to the fact that the mobile device can be gripped whilst an operator is moving in front of the machine, the
25 machine can be devoid of a plurality of fixed visualization devices distributed along the machine, because it is the mobile device that varies the display as soon as the user moves along the machine. The advantage of this solution is clear if one of the usual means of intervention by a
30 maintenance technician on a machine is used, the maintenance technician often being forced to intervene in zones that are difficult to access to solve problems with machine components, mechanical and/or electric and/or electronic problems.

35 Owing to the invention, the technician no longer has to move continuously between the intervention zone and the display

of data and functions on which he works in a fixed device that is far from the invention zone. In fact, merely by positioning the mobile device near this zone, pages can be shown with detailed data and functions relating precisely to the machine part that is the object of the intervention. The position of the mobile device 9 in relation to the automatic machine is in fact part of the visualization context of the graphic interface. This leads to a significant saving as it is possible to both reduce the number of fixed devices required and reduce the intervention time by a machine technician, concentrating in a sole zone. Further, as the graphic interface is configured dynamically and automatically, there is no longer any need to design different types of graphic interface for different types of machine operating user.

What has been said for the instruction manuals clearly also applies to any other type of data or functionality, contextualization of the pages of the graphic interface being applicable to each part of the interface.

In the same mobile device it is possible to have machine control and/or supervision pages and simultaneously pages accessing services offered by the machine manufacturer via web or by the same web. Such services may not necessarily be linked to running the automatic machine but only relate thereto. For example, a connection may be provided to a CRM (customer relationship management) service of the manufacturer of the automatic machine for requests for example relating to spare parts from the catalogue, remote technical intervention, etc.

For example, the machine maintenance technician could be connected to a technical assistance centre of the machine manufacturer, and simultaneously display alarms and/or warnings relating to the machine in production to be reported to the assistance centre.

Further, the presence of the web server 7 makes it possible to connect multiple different automatic machines to a single

line supervisor, arranging multiple web servers or a single web server connected to multiple machines. If a single web server is connected to multiple machines, each machine will be accessible separately through web data exchange means 8
5 dedicated to the connection with the data exchange means 2 of each machine. In this case, the web server 7 can comprise a plurality of interaction managers 11 for managing multiple automatic machines with a sole mobile device 9, each interaction manager 11 being arranged for managing a
10 respective automatic machine. On the other hand, if each machine is connected to a dedicated web server 7, a supervision interface page can be constructed for showing aggregate data and allowing the different machines to be controlled simultaneously, for example by exploiting a line
15 production start functionality that synchronizes the production of multiple machines.

CLAIMS

1. A control system (102) of an automatic machine (100), wherein the automatic machine (100) comprises a production line (101) along which a number of materials is fed and treated to manufacture a product and a plurality of operative members interacting with said materials and/or said product and comprising electric and/or electronic components distributed along the production line; said control system (102) comprising:
- 10 - control means (1) of the operation of said automatic machine (100) suitable for storing and/or processing a set of management data and functionalities of said electric/electronic components and/or of said automatic machine (100), comprising data exchange means (2);
 - 15 - communication means (104), by means of which said control means (1), exclusively through said data exchange means (2), allow access to said management data and/or to said functionalities and/or allow notification of events deriving from the operation of said automatic machine (100) and relating to said management data and/or said functionalities;
 - a visualization graphic interface (105) intended to a user for the control of said automatic machine (100), which is connectable to said control means (1) through said communication means (104) and suitable for providing access to and/or receiving notifications from, said management data and/or said functionalities,
 - 25 - a web server (7) comprising web data exchange means (8), for example a library of web procedures that are suitable for providing a set of RPCs;
 - 30 - said web data exchange means (8) being connectable to said data exchange means (2) of said control means (1) through said communication means (104), for example are connectable to a corresponding library of procedures that are suitable for providing a corresponding set of RPCs of said data exchange means (2);
 - 35

- wherein said graphic interface (105) is of the web type, visualizable as a set of pages in a web browser or in a "web app" for an interaction with a user, it is connectable to said web server (7) and it is suitable for accessing and/or receiving notifications from, said management data and/or said functionalities of said control means (1) through said web data exchange means (8) of said web server (7);

- a mobile device (9), in particular a tablet, for example of the I-PAD™ type, or a smartphone, and/or a computer, which is connectable to said communication means (104), in particular through a communication network in wi-fi mode, for example IEEE 802.11, said graphic interface (105) being visualizable in said mobile device (9) through said web browser or said "web app",

said control system (102) being characterized in that said web server (7) or said "web app" is suitable for simultaneously connecting multiple interface pages of a same mobile device (9) or of multiple mobile devices (9) and for receiving different requests from each displayed page, said web server (7) comprising:

- an interaction manager (11) with said web data exchange means (8);

- a requests manager (10), in communication with said interaction manager (11), to receive and manage each enquiry coming from each page;

- said interaction manager (11) being suitable for adapting said requests from each of said pages to said web data exchange means (8);

- a context manager (12) of said users, for associating and storing a context to each user which is connectable to said web server (7);

- a pages manager (13) for displaying said management data and/or said functionalities on each page,

- wherein said pages manager (13) is connectable to said context manager (12), for varying said visualization based on said context stored by said context manager (12), it is

further connectable to said requests manager (10) and it is in communication with said interaction manager (11);

- said pages manager (13) being activatable by said requests received by said requests manager (10) or as well by notifications receivable by said interaction manager (11);

- a command manager (14), which is connectable to said pages manager (13) and to said context manager (12), suitable for receiving commands from said pages through said pages manager (13), to notify said pages manager (13) and to assess said commands and/or said notifications based on said context stored by said context manager (12); wherein said interaction manager (11) is exclusively connectable to said command manager (14) to provide access to, and/or to receive notifications from, said management data and/or said functionalities of said control means (1);

- wherein said pages manager (13) is in communication with said interaction manager (11) through said command manager (14).

2. System according to claim 1, wherein said mobile device (9) comprises localization means to detect a position of said mobile device (9) relative to said automatic machine (100), in particular wherein said localization means comprises any one of: GPS detecting means, an accelerometer, position detecting wi-fi means, an image acquisition optical apparatus that can be used in combination with an optical code positionable on a portion of said automatic machine (100) and indicating said position, a radio-frequency reading equipment that can be used in combination with a RF-ID tag positionable on a mechanical component of said automatic machine (100) and indicating said position.

3. System according to claim 1 or claim 2, wherein said mobile device (9) is suitable to display both said visualization graphic interface and a further manuals graphic interface of the web type, comprising a set pages of a library displaying documentary data that are associable to said automatic machine (100), for example any one of

libraries of constructive schemes, mechanical schemes, electric schemes, exploded drawings, and/or libraries of operation manuals for example maintenance manuals, use manuals, safety manuals; said documentary data being stored
5 in said mobile device (9) and/or being receivable from said mobile device (9) through said communication means (104).

4. System according to claim 2 or 3, as appended to claim 2, wherein said management data and/or said functionalities visualizable in said pages of said control graphic interface
10 or said documentary data visualizable in said manuals graphic interface, are as a function of a context associable to each user, defined by at least said position of said mobile device (9) relative to said automatic machine.

5. System according to any preceding claim, wherein said
15 context is defined by an authorizations profile and/or a personalization profile of said pages and/or by said position of said mobile device (9) relative to said automatic machine (100).

6. System according to any preceding claim, wherein said
20 data comprise any one of alarm messages determining the automatic stop of said automatic machine, anomaly warning messages, production counters, value of analogue and/or digital internal control variables, position/speed signals, control parameters of said automatic machine; and wherein
25 said functionalities comprise any one of production start requests, brand change requests, statistical data requests, alarm list requests.

7. A control method of an automatic machine (100) wherein said automatic machine (100) comprises: a production line
30 (101) along which a number of materials is fed and treated to manufacture a product; a plurality of operative members interacting with said materials and/or said product and comprising electric and/or electronic components distributed along the production line; wherein said method comprises:

35 - storing and/or processing in control means (1) of the operation of said automatic machine (100) a set of

management data and functionalities of said electric/electronic operative members and providing data exchange means (2);

- providing communication means (104) to allow said control means (1), exclusively through said data exchange means (2), providing access to said management data and/or to said functionalities and/or notifying events deriving from the operation of said automatic machine and relating to said management data and/or said functionalities;

- providing a visualization graphic interface (105) intended to a user to control said automatic machine (100) and to connect said graphic interface (105) to said control means (1) through said communication means (104) for providing access to, and/or receiving notifications from, said management data and/or said functionalities;

- providing a web server (7) comprising web data exchange means (8), for example a library of web procedures that are suitable for providing a set of RPCs;

- connecting said web data exchange means (8) to said data exchange means (2) of said control means (1) through said communication means (104), for example through a corresponding library of procedures that are suitable for providing a corresponding set of RPCs;

- implementing said graphic interface (105) of the web type connected to said web server (7) as a set of pages visualizable in a web browser or in a "web app" for an interaction with a user, so that said graphic interface provides access to, and/or receives notifications from, said management data and/or said functionalities of said control means (1) through said web data exchange means (8) of said web server (7);

- providing a mobile device (9), in particular a tablet, for example a tablet of the I-PAD™ type or a smartphone, and/or a computer, connecting said mobile device (9) to said communication means (104), in particular through a

communication network in wi-fi mode, and displaying said graphic interface (105) in said mobile device (9);
said method being characterized in that it further comprises:

- 5 - simultaneously connecting multiple pages of a same mobile device (9) or of multiple mobile devices (9) to said web server (7), associating a request to each page and providing in said web server (7) an interaction manager (11) with said web data exchange means (8) and providing a requests manager
10 (10) for receiving and managing each request coming from each page; establishing a communication between said requests manager (10) and said interaction manager (11); wherein said interaction manager (11) adapts said requests from each of said pages to said web data exchange means (8);
- 15 - providing a context manager (12) of said users, for associating and storing a context to each user which is connectable to said web server (7);
 - providing a pages manager (13) for displaying said management data and/or said functionalities in each page;
- 20 - connecting said pages manager (13) to said context manager (12), for varying said displaying based on said context stored by said context manager (12);
 - further connecting said pages manager (13) to said requests manager (10) and establishing a communication
25 between said pages manager (13) and said interaction manager (11);
 - activating said pages manager (13) with requests received from said requests manager (10) or with notifications received from said interaction manager (11);
- 30 - providing a command manager (14), connecting said command manager (14) to said pages manager (13) and to said context manager (12);
 - wherein said command manager (14) receives commands from said pages through said pages manager (13), notifies said
35 pages manager (13) and assesses said commands and/or said

notifications based on said context stored by said context manager (12);

- connecting said interaction manager (11) exclusively to said command manager (14) for providing access to, and/or receiving notifications from, said management data and/or said functionalities of said control means (1);

- wherein said establishing a communication between said pages manager (13) and said interaction manager (11) is implemented through said command manager (14).

8. Method according to claim 7, and comprising detecting a position of said mobile device (9) relative to said automatic machine (100) through localization means of said mobile device (9), wherein in particular said localization means comprises any one of: GPS detecting means, an accelerometer, position detecting wi-fi means, an image acquisition optical apparatus that can be used in combination with an optical code positionable on a portion of said automatic machine and indicating said position, a radio-frequency reading equipment that can be used in combination with a RF-ID tag positionable on a mechanical component of said automatic machine and indicating said position.

9. Method according to claim 7 or 8, and comprising displaying in the same mobile device (9) both said control graphic interface of said automatic machine and a further manuals graphic interface of the web type, comprising a set of pages of a library displaying documentary data that are associable to said automatic machine (100), and receiving said set of documentary data pages as stored in said mobile device and/or as received through said communication means (104).

10. Method according to claim 8 or 9, as appended to claim 8, and comprising associating a context to each user, defining said context through at least said position of said mobile device (9) relative to said automatic machine (100); displaying said management data and/or said functionalities

in said pages of said control graphic interface or said documentary data in said manual's graphic interface, as a function of said context associated to each user.

11. Method according to claim 10, as appended to claim 8,
5 and comprising defining said context through an authorizations profile and/or a personalization profile of said pages and/or through said position of said mobile device relative to said automatic machine (100).

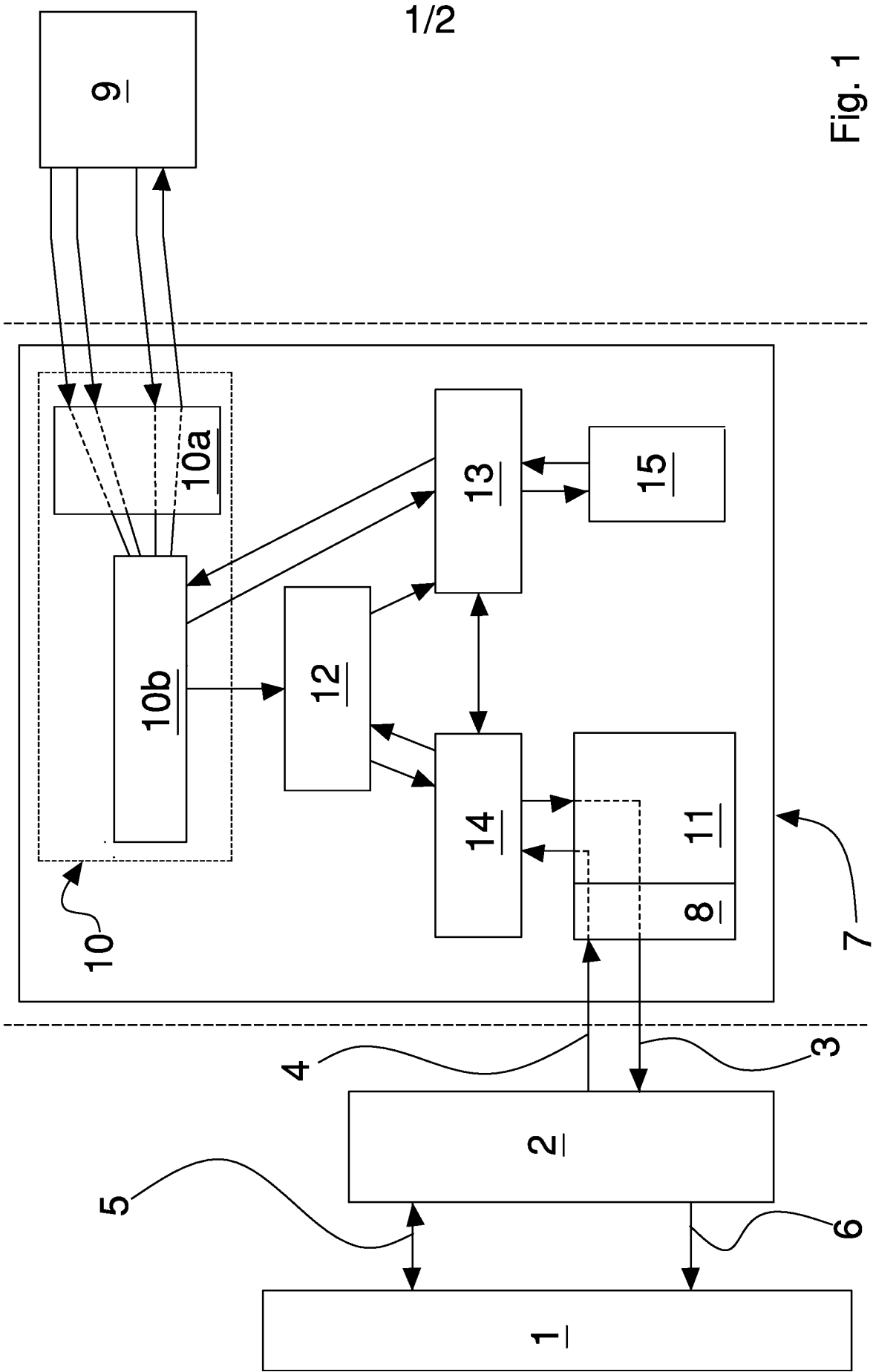


Fig. 1

Fig. 2

