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Method of controlling a home appliance and control system

Abstract

A method of controlling a home appliance connected to the Internet via a gateway and an appliance control server of an appliance control cloud. The appliance executes control commands for operating the appliance received from the Internet via the gateway only if the commands are received from the appliance control cloud. A control command supply server of a control command supply cloud is connected to the home appliance control cloud via the Internet, and has at least one repository storing control instruction sets to operate the appliance. The method includes authenticating a request for remote control of the appliance received from the control command supply server via the Internet, and, responsive to positive authentication, forwarding control commands from the control command supply server to the appliance. The control commands are part of a set of instructions from the repository selected based on input received by a user terminal device.

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Background/Summary

(1) This application is a U.S. National Phase application of PCT International Application No. PCT/EP2019/083728, filed Dec. 4, 2019, which is incorporated by reference herein.

FIELD OF THE INVENTION

(2) The present invention relates to a method of controlling a home appliance and to a control system for controlling the operation of a home appliance. The invention further relates to a computer program for controlling a home appliance.

BACKGROUND

(3) Conventional home appliances, such as ovens, are generally controlled by using a user interface that includes buttons, a touchscreen and the like. More recent home appliances may be capable of connecting to a local wireless network. A mobile device that is connected to the same wireless network and that includes an application for connecting to the home appliance may be allowed to control the home appliance by sending control signals over the wireless network. Although such systems provide some benefits, their functionality is quite limited. On the other hand, such remote control bears the risk of misuse, in particular when the attempt is made by an unauthorized device to access the home appliance.

(4) It is desirable to facilitate the control of such home appliance, and in particular to make it easier and more convenient for a user to control the home appliance. It is in particular desirable to enable a convenient and efficient control of the home appliance for a plurality of different operating scenarios, without requiring the user to manually control each operating step of the home appliance. It is also desirable to achieve a secure operation of the home appliance, so that misuse of the home appliance can be prevented.

SUMMARY

(5) There is a need to mitigate at least some of the drawbacks mentioned above and to improve the control of such home appliance. In particular, there is a need to provide an efficient and safe way of controlling the operation of the home appliance.

(6) This need is met by the features of the independent claims. The dependent claims describe embodiments of the invention.

(7) According to a first embodiment of the invention, a method of controlling a home appliance is provided. The home appliance is connected to the Internet via a gateway, wherein at least one home appliance control server of a home appliance control cloud is configured to communicate with the home appliance via the Internet and the gateway. The home appliance is configured to execute control commands for operating the home appliance which are received by the home appliance from the Internet via the gateway only if the control commands are received from the home appliance control cloud (in particular from one or more predetermined servers of the home appliance control cloud). At least one control command supply server of a control command supply cloud is provided and is connected to the home appliance control cloud via the Internet. The control command supply cloud comprises at least one repository storing sets of control instructions configured to operate the home appliance. The repository is provided on or is accessible by the at least one control command supply server.

(8) The home appliance control cloud is distinct from the control command supply cloud. In particular, the servers of the home appliance control cloud are physically distinct and separate from the servers of the control command supply cloud. A user account is provided on the home appliance control server, and the user account is associated with the home appliance. The method comprises authenticating, by an authentication function of the home appliance control server, a request for remote control of the home appliance that is received from the control command supply server via the Internet, wherein the request is related to the user account. The method further comprises,

responsive to a positive authentication, the forwarding of one or more control commands received from the control command supply server to the home appliance, wherein the one or more control commands are part of a set of control instructions from the repository that is selected based on input received by a user terminal device. The one or more control commands forwarded to the home appliance are such that the home appliance executes the one or more control commands upon reception.

(9) By such method, an efficient and secure control of the home appliance may be realized. A user of the home appliance does no longer need to enter individual commands for controlling the home appliance, but the user can select an instruction set from the repository and can command the execution of the control commands of such instruction set with a single input. Furthermore, the flexibility is significantly improved, since the instruction sets are provided on a separate server on the Internet, so that instruction sets may be provided by a plurality of different sources. The method thus allows the tailoring of an instruction set to the needs of the respective task to be performed by the home appliance, which leads to an improved result of the operation of the home appliance and further contributes to facilitating control. At the same time, control of the home appliance is limited to the home appliance control cloud, so that the safety and security of control can be ensured. In particular, since servers outside the home appliance control cloud are incapable of controlling the home appliance, misuse of the remote control function of the home appliance can be prevented. Although the home appliance is controlled from the publicly accessible Internet, and although the control commands are received by a separate server not forming part of the home appliance control cloud, operational safety is ensured.

(10) The home appliance may for example be pre-configured with one or more predetermined server addresses of one or more servers of the home appliance control cloud. The home appliance may then further be configured to accept control commands only from one or more of these predefined servers. The server addresses may for example be defined during manufacturing of the home appliance and may be stored in the home appliance in such a way that they cannot be changed by a user of the home appliance. Other ways of ensuring that the home appliance is controlled from the Internet only by one of the servers of the home appliance control cloud are conceivable, such as providing an authentication between the home appliance and a respective home appliance control server prior to accepting control commands.

(11) The authentication of the request for remote control may for example include the receiving of authentication credentials for the user account from the supply server or from the user terminal device.

(12) The home appliance may be on a local network that is connected to the Internet via the gateway. The home appliance control cloud and the control command supply cloud are on the other side of the gateway on the Internet. In particular, none of the servers of the home appliance control cloud and none of the servers of the control command supply cloud is in the same local network as the home appliance. In particular, the only connection from the home appliance control cloud and the control command supply cloud to the home appliance is via the public Internet.

(13) The gateway may for example be implemented in the home appliance, or the home appliance may be connected to the gateway via a local connection or a local network, for example via a local area network (LAN), via a wireless local area network (WLAN), via a personal area network (PAN) or wireless personal area network, or via a local peer-to-peer connection. The gateway may for example include a wireless access point, or the local network may include a wireless access point connected to the gateway via a LAN connection, in particular an Ethernet connection. The gateway can for example be implemented as a WLAN router. Personal area networks via which the home appliance can be connected include for example Bluetooth, ZigBee and Z-Wave. The gateway may thus for example also be a Z-Wave gateway. As indicated above, none of the servers of the home appliance control cloud or of the control command supply cloud is in the same WLAN, LAN or PAN as the home appliance.

(14) In an embodiment, the control command supply server and/or the control command supply cloud is not directly associated with any home appliance to be controlled in accordance with the sets of control instructions. Accordingly, the sets of control instructions can be provided independently from any specific home appliance. The control command supply server does accordingly furthermore not need to be concerned with any safety measures to prevent misuse of controlled home appliances. Preferably, the control command supply server and/or the control command supply cloud is not capable of directly controlling such home appliance by sending control commands to the home appliance via the Internet without any intervening server outside the control command supply cloud which provides authentication of the commands.

(15) The user terminal device may operate an application configured to establish a data connection to the control command supply server, wherein the control command supply server provides an interface allowing the application to access and search the repository for sets of control instructions for selecting said set of control instructions. A fast and efficient way of selecting the control instructions and of controlling the home appliance is thus provided.

(16) The home appliance control server is preferably located remote from the home appliance and from the gateway, wherein the control command supply server is located remote from the home appliance, from the gateway and from the home appliance control server. The home appliance control server and the control command supply server are physically separate servers located at different locations, for example at different computing centers. Preferably, at least one home appliance control server is provided for each of different jurisdictions or different countries. This allows a safe and secure control of the respective associated home appliances in accordance with the applicable standards and data regulations.

(17) The home appliances may form part of a group of home appliances, wherein the home appliance control cloud may be configured to control home appliances only of said group of home appliances. The home appliances in said group all provide a corresponding or the same interface towards the home appliance control cloud, said interface being only accessible via said home appliance control cloud. A safe control having reduced complexity may thus be achieved. The home appliances in the group may for example be manufactured by the same manufacturer. By providing the same or corresponding interfaces, the control is safer and less prone to malfunctions, since compatibility between the interfaces can be ensured.

(18) In an embodiment, the method further comprises providing a second user account for a user of the user terminal device on the control command supply server; responsive to a request to link the second user account to said user account on the home appliance control server, authenticating, by the home appliance control server, the user of said user account on the home appliance control server; and, responsive to a positive authentication, linking the user account on the control command supply server to the user account on the home appliance control server. By such method, the efficiency of the control may further be improved, in particular since no separate authentication of the user at the home appliance control server may be required as the user may be authenticated via the linked accounts, so that a faster control becomes possible. The user may for example be only required to authenticate himself at the control command supply server. For linking the accounts, the user may be authenticated by means of the user terminal device providing direct authentication at the home appliance control server, or authentication may occur by means of the user terminal device via the control command supply server.

(19) The authentication of a request for remote control may comprise providing authentication information associated with the user of the user account from the user terminal device or from the control command supply server to the home appliance control server. Alternatively, it may comprise supplying authentication information provided by a second user account on the control command supply server linked to said user account on the home appliance control server from the control command supply server to the home appliance control server. While the former may provide an improved operational safety, the latter provides a faster and more efficient control.

- (20) The home appliance control server may comprise an application programming interface (API). The control command supply server may provide the one or more control commands to the application programming interface of the home appliance control server via the Internet. The control commands may in particular be in conformity with the control commands made available by the application programming interface.
- (21) The transmission of data, in particular of the control commands, between the control command supply server and the home appliance control server may be based on the https protocol. A secure and efficient data transmission may thus be achieved. The application programming interface may in particular be a REST (representational state transfer) API or a RESTful API. Interoperability of the home appliance control server with other and different kinds of control command supply clouds may thus be ensured.
- (22) The control command supply server may encode the one or more control commands in a JavaScript object notation (JSON) format and may transmit the one or more encoded control commands to the home appliance control server. Using such language independent data format has the advantage of further improving the interoperability between different clouds. By using JSON over https for the data transmission, a fast and reliable transmission of the control commands can be achieved while ensuring interoperability with different supplier clouds.
- (23) The home appliance control server may implement a gateway function that provides a conversion between a protocol used by the control command supply server to transmit the control commands and a protocol used by the home appliance control server to communicate received control commands to the home appliance. The gateway function may for example translate control commands received in the JSON format into a format understood by the home appliance, such as a proprietary format used by the manufacturer of the home appliance. The control of the home appliance is thus made more flexible and more compatible, in particular since the control command supply cloud can provide the control commands in a generic format and does not need to be concerned with the format of control commands understood by the home appliance to be controlled. For controlling home appliances for different manufacturers, the control command supply cloud does accordingly not have to store plural corresponding instructions sets for different home appliance types, but is enabled to use one common generic instruction set. This does not only result in savings of storage space, but also in a faster processing of control command requests and in an enhanced flexibility.
- (24) The home appliance control server may use a message queuing telemetry transport (MQTT) protocol for communication with the home appliance. The home appliance control server may accordingly encode the commands into a format understood by the home appliance and may then transmit these commands using the MQTT protocol. The home appliance control server may in particular operate as a message broker, and the appliance may operate as a client. An efficient data transmission may thus be achieved, since the MQTT protocol only requires a small overhead. A safe and efficient control of the home appliance can thus be realized.
- (25) In an embodiment, the method further comprises receiving, by the home appliance control server, a message from the home appliance comprising information and/or events related to the operation of the home appliance; decoding, by the home appliance control server the received message; and forwarding, by the home appliance control server, the information and/or events comprised in the message to the control command supply server. Preferably, the control command supply server forwards the received information and/or events to the user terminal device. Additionally or alternatively, the control command supply server may use the received information and/or events to derive one or more control commands and provide the derived control command via the home appliance control server to the home appliance. By such method, the user of the home appliance can be informed about the current state of the home appliance. For example, if the home appliance is a cooking device, a current temperature and/or an elapsed time of operation of the cooking device may be provided for display to the user terminal device. It further allows an

automatic adjustment of the operating parameters.

(26) For example, if the control command supply server determines that the current operating temperature is higher than the desired operating temperature, or that a certain operating time has already been achieved, it may adjust the operating parameters of the home appliance by deriving and sending a control command. For example, an operating program may be changed, a temperature may be decreased, or an operating time may be reduced. Feedback control may thus be enabled.

(27) Additionally or alternatively, the home appliance control server may derive from the received information and/or events a control command and may transmit the derived control command to the home appliance. A safety feature may for example be implemented, according to which when the home appliance control server determines that the home appliance is operating outside predefined parameters, for example parameter bands or parameter sets, the home appliance control server may change operating parameters of the home appliance or may shut down the home appliance. As an example, if the temperature of the home appliance indicates overheating, the home appliance control server may reduce the temperature or may shut down the home appliance.

(28) The home appliance control server may for example monitor the home appliance, it may in particular request information and/or events from the home appliance, such as current operating parameters. The home appliance control server may then receive said message including the respective information and/or events.

(29) The home appliance control server may for example monitor appliance state changes, such as a temperature change, a program change, a timing change and the like. Such state changes may for example also result from a user manipulating control elements on the home appliance.

(30) When forwarding the information and/or events to the control command supply server, the home appliance control server may for example employ webhooks, in particular a http put request, in order to notify the control command supply cloud about the information and/or the event.

(31) In an embodiment, the method further comprises receiving, by the home appliance control server and from the control command supply server, a control command to capture an image indicative of the operation of the home appliance; transmitting, by the home appliance control server, a request to the home appliance to capture an image; receiving, by the home appliance control server and in response to the request, a captured image from the home appliance, transmitting the received captured image to a storage server that is connected to the Internet; and making accessible the stored captured image to the user terminal device. By means of such method, it becomes possible for the user of the user terminal device to remotely monitor the home appliance. In particular, the home appliance can be monitored even if the user is far away from the home appliance as long as the user terminal device is connected to the Internet. The storage server may form part of the home appliance control cloud, yet preferably is distinct from the home appliance control cloud. The storage server may in particular be physically distinct and separate from the home appliance control server and from the control command supply server. The storage server may for example implement a cloud object store. A publicly accessible storage cloud may for example be used as the storage server. By such configuration, the complexity of the home appliance control server and of the control command supply server can be kept low, as these servers are relieved of the burden of providing the object store.

(32) Alternatively, the home appliance control server may transmit the captured image to the control command supply server, and the control command supply server may transmit the image to the user terminal device or may make available the received image for download.

(33) The method may further comprise sending a request for such image from the user terminal device to the control command supply server. Furthermore, the method may comprise retrieving, by an application running on the user terminal, an image captured by the home appliance and stored on the storage server.

(34) The home appliance may for example be a cooking appliance, and the image may be taken

from a space in which food is cooked or prepared, for example from an oven cavity. The home appliance may accordingly be provided with a respective camera. It may have an oven cavity at which the camera is aimed.

(35) Preferably, the sets of instructions provided by the repository comprised generic control commands for controlling different models of the same type of home appliance. Interoperability can thus be ensured, and the instruction sets can be used for the same type of appliance, such as a cooker, for different makes and models.

(36) The control commands transmitted by the control command supply server in accordance with a selected set of control instructions may comprise one or a combination, preferably all of the following control commands: A control command to set an operating program of the home appliance; a control command to set one or more parameters of the selected operating program; and a control command to start operation of the home appliance in accordance with the selected operating program and the set operating parameters.

(37) For example, the home appliance is a cooking appliance, such as an oven. The operating program may be a heating program of the cooking appliance, such as 'heat from the bottom', 'heat from the top', 'grill', or the like. Operating parameters may preferably include a temperature and a time for the operating program to run (duration). The complex control program may thus be executed by the home appliance by only a single selection made by the user on the user terminal device. Control is thus facilitated and made fast and efficient.

(38) In an embodiment, the home appliance is a cooking appliance, and the sets of control instructions are associated with recipes. Each set of control instructions comprises a sequence of control commands for operating the cooking appliance. The sequence of control commands may correspond to a sequence of cooking steps to be performed by the cooking appliance in accordance with the associated recipe. Preparation of food by the cooking appliance is thus facilitated and made fast and efficient.

(39) In an embodiment, authenticating the request for remote control includes sending of a request from the home appliance control server to the user terminal device to confirm the enabling of remote control of the home appliance, and enabling remote control of the home appliance by the home appliance control server only if a user input is received that confirms the enabling of the remote control. Such request may be provided additionally or alternatively to the above described authentication methods. Accordingly, by letting the user directly confirm that remote control of the home appliance is enabled, the operational safety of the remote control may be further improved. For example, upon user confirmation, the user terminal device may send a confirmation message to the home appliance control server, in response to which the home appliance control server enables the remote control.

(40) The method may include the step of receiving, by the control command supply server, a selection of one of the sets of control instructions from a user terminal device for controlling the home appliance, and the forwarding of the control commands to the home appliance control server in accordance with the selection, i.e. the control command supply server may forward one or more control commands that form part of the selected set of control instructions.

(41) The method may furthermore comprise executing, by the home appliance, the one or more received control commands.

(42) The home appliance is preferably a cooking appliance, yet it may also be a different appliance, such as a washer, a dryer, a washer-dryer, a dishwasher, a fridge, a freezer or the like. The cooking appliance may for example be an oven, a microwave, a steamer, a stove, a barbecue or the like.

(43) The user terminal device is preferably a handheld mobile device, in particular a smartphone, a tablet, a phablet, a personal digital assistant (PDA) or a laptop.

(44) According to a further embodiment of the invention, a control system for controlling the operation of a home appliance is provided. The home appliance is connected to the Internet via a gateway, and the control system comprises a home appliance control server of a home appliance

control cloud connected to the Internet, wherein the home appliance control server is configured to communicate with the home appliance via the Internet and the gateway. It further comprises the home appliance, wherein the home appliance is configured to execute control commands for operating the home appliance which are received by the home appliance from the Internet via the gateway only if the control commands are received from the home appliance control cloud. The control system further includes a control command supply server of a control command supply cloud, wherein the control command supply server is connected to the home appliance control cloud via the Internet. The control command supply cloud comprises at least one repository storing sets of control instructions configured to operate the home appliance, wherein the repository is provided on or is accessible by the control command supply server. The home appliance control cloud is distinct from the control command supply cloud. The control command supply cloud provides an interface for access by a user terminal device, preferably by an application running on the user terminal device.

(45) The interface is configured to enable selection of one of the sets of control instructions via the user terminal device. The home appliance control server is configured to establish an association between the home appliance and a user account provided on the home appliance control server, wherein the home appliance control server further implements an authentication function configured to authenticate a request for remote control of the home appliance received from the control command supply server via the Internet, the request being related to the user account. The home appliance control server is further configured to forward, responsive to a positive authentication, one or more control commands received from the control command supply server in accordance with the selected set of control instructions to the home appliance for the execution by the home appliance. With such control system, advantages similar to the ones outlined further above may be achieved.

(46) The control system may furthermore comprise any of the above described components, such as the user terminal device, the storage server, the gateway, and the like. Furthermore, the components of the control system may have any of the above described configurations. In particular, the control system and its components may be configured to perform any of the methods described herein, and may in particular perform any of the described method steps.

(47) According to a further embodiment of the invention, a computer program for controlling a home appliance is provided. The computer program comprises control instructions which, when executed by a data processor of a home appliance control server connected to the home appliance via the Internet and a gateway, and further connected to a control command supply server, cause the data processor to perform any of the above described methods. The computer program may be provided in a volatile or non-volatile memory, and may in particular be provided on a data carrier that stores the respective control instructions. The control instructions may in particular perform any of the above described methods if they are executed by one or more data processes of the above described control system.

(48) It is to be understood that the features mentioned above and those yet to be explained below can be used not only in the respective combinations indicated, but also in other combinations or in isolation, without leaving the scope of the present invention. In particular, embodiments of the method may comprise any of the steps described herein with respect to the control system, and embodiments of the control system may be configured to perform any of the described method steps.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) The forgoing and other features and advantages of the invention will become further apparent

- from the following detailed description read in conjunction with the accompanying drawings.
- (2) In the drawings, like reference numerals refer to like elements.
 - (3) FIG. 1 is a schematic drawing showing a home appliance according to an embodiment of the invention.
 - (4) FIG. 2 is a schematic drawing showing a control system according to an embodiment of the invention.
 - (5) FIG. 3 is a schematic drawing showing a home appliance coupled to the Internet via a gateway according to an embodiment of the invention.
 - (6) FIG. 4 is a schematic drawing showing a home appliance coupled to the Internet via a gateway according to an embodiment of the invention.
 - (7) FIG. 5 is a schematic drawing showing a home appliance coupled to the Internet via a gateway according to an embodiment of the invention.
 - (8) FIG. 6 is a flow diagram schematically showing a method according to an embodiment of the invention.
 - (9) FIG. 7 is a flow diagram schematically showing a method according to an embodiment of the invention.
 - (10) FIG. 8 is a flow diagram schematically showing a method according to an embodiment of the invention.
 - (11) FIG. 9 is a schematic drawing showing a home appliance control server according to an embodiment of the invention.

DETAILED DESCRIPTION

(12) In the following, embodiments of the invention will be described in detail with reference to the accompanying drawings. It is to be understood that the following description of the embodiments is given only for the purpose of illustration and is not to be taken in a limiting sense. It should be noted that the drawings are to be regarded as being schematic representations only, and elements in the drawings are not necessarily to scale with each other. Rather, the representation of the various elements is chosen such that their function and general purpose become apparent to a person skilled in the art. As used herein, the singular forms “a,” “an,” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. The terms “comprising,” “having,” “including,” and “containing” are to be construed as open-ended terms (i.e., meaning “including, but not limited to,”) unless otherwise noted.

(13) Embodiments of the present invention provide a solution that allows a plurality of control instruction sets to be made available to a user of a home appliance via the Internet. Such control instruction sets can be stored in the cloud of a supplier, which may for example provide cooking recipes or the like. Conventional solutions do not allow the downloading of recipes and respective control instructions from the Internet, and only a very limited and predefined control instruction set may be available. Also, such control instructions are generally transmitted over a WiFi connection, so that functionality and in particular mobility of the data and the user is limited. On the other hand, the present solution restricts access by external data sources, such as a supplier cloud, to the home appliance and to the infrastructure controlling the home appliance, such as cloud and associated server.

(14) FIG. 1 schematically shows a home appliance **100** according to an embodiment. The home appliance **100** includes a controller **110** that comprises processor **112** and a memory **111**. The controller is coupled or connected to a network interface **120**, which may for example be a wireless network interface for providing a WLAN connection, or a LAN interface, in particular an Ethernet interface for connecting to a local area network. Controller **110** can communicate via the network interface **120**, for example by receiving control commands for execution by the processor **112** or transmitting information, such as information on the current operating state and operating parameters of home appliance **100**.

(15) Processor **112** may for example be a microprocessor, but may also be an application specific

integrated circuit (ASIC), a digital signal processor (DSP), or other type of processors suitable for controlling the home appliance **100**. Memory **111** may comprise volatile and/or non-volatile memory, such as RAM, ROM, flash-memory, a hard drive and the like.

(16) Controller **110** is coupled to or connected to a user interface **130**. User interface **130** may comprise hard or soft control elements, such as buttons, switches, rotary dials or the like which may be provided on a control panel of the home appliance **100**. User interface **130** may further comprise a display, such as an LCD, an LED, or another type of display for displaying information on operating parameters and the operating state of the home appliance **100** to the user. Other displays, such as simple alphanumerical displays, segmented displays, or simple light-emitting diodes may be used to indicate certain operating states may additionally or alternatively be comprised in the user interface **130**. User interface **130** may also comprise a touchscreen that allows both, the displaying of information to the user the home appliance **100**, and the entering of information and control commands, for example by means of soft buttons and the like.

(17) In the example of FIG. **1**, the home appliance **100** is a cooking appliance, and it includes components such as the heater **141** (e.g. for heating a cooking cavity), a grill **142** and a fan **143**. It should be clear that the components illustrated in FIG. **1** are only exemplary, and the home appliance **100** may comprise further or different components that can be controlled via the controller **110**. Controller **110** controls the components **141**, **142**, **143**, for example by respective control relays that provide electrical power to the respective component, such as to a heating coil of heater **141**, by turning on or adjusting the fan speed of fan **143** or the like. Controller **110** may for example be configured to control the components of home appliance **100** in accordance with an operating program, such as a program providing heat from the top and bottom of the cooking cavity, or providing heat only or in addition by the grill **142**, or by using a cooking program with circulating air by operating fan **143**. Controller **110** controls the components of home appliance **100** in accordance with operating parameters, such as a desired temperature for the cooking cavity, or a desired duration of the cooking program after the expiry of which the controller turns off the respective components, such as the heater **141**.

(18) It should be clear that in other implementations, the home appliance **100** comprises other components which are controlled by controller **110**, for example a motor rotating a drum of a washing machine, a heater for heating the water used in the washing machine, and the like. Furthermore, it should be clear that home appliance **100** can include several sensors for measuring operating parameters of the home appliance **100** and for providing feedback, such as a temperature sensor for the oven cavity, a water level sensor for measuring the water level in the tub of a washing machine, a weight sensor, a moisture sensor, and the like.

(19) The components of the home appliance **100** and the sensors (not shown) may be coupled to the controller **110** via respective input/output interfaces (not shown). These may include digital-to-analog converters, respective amplifiers, control relays and the like for providing the desired voltage and current to the components of the home appliance **100**.

(20) Memory **111** stores control instructions which when executed by the processor **112** control the functions and operation of the home appliance **100**. This can occur based on user input via user interface **130**, in accordance with predefined operating programs and parameters stored in memory **111**, and/or in accordance with control commands received via the network interface **120**.

(21) Memory **111** stores predefined addresses of servers on the Internet. Controller **110** is configured such that if control commands are received from such predefined server, the control commands are executed by the controller **110**. Such servers are in particular predetermined home appliance control servers. If control commands are received from the Internet that are not originated by such home appliance control server, the controller **110** is configured to not accept such control commands and to not execute the respective operations.

(22) FIG. **2** schematically shows a control system **10** according to an embodiment. The home appliance **100** is connected via a gateway **150** to the Internet **200**. Home appliance **100** may for

example be on a local network **160**, such as a local area network or a wireless local area network. The control system **10** includes a home appliance control server **310** (short: control server **310**) which forms part of a home appliance control cloud **300**. The home appliance control cloud **300** is provided on the Internet **200**. The servers of the home appliance control cloud **300** are in particular not located in the local network **160**, but they can communicate with the home appliance **100** only via the Internet **200** and the gateway **150**. In such configuration, the home appliance control cloud **300** can provide a safe and secure way of controlling the home appliance **100** from the Internet, and it furthermore allows the control of a plurality of different models and of home appliances **100** located at different locations across a country or across the globe.

(23) Furthermore, a control command supply cloud **400** is provided and includes one or more control command supply servers **410** (short: supply server **410**). These supply servers **410** are distinct from the home appliance control servers **310**, i.e. these are physically separate servers arranged at a different location. The servers of the control command supply cloud **400** are not directly associated with any home appliance; the servers **410** provide a cloud on the Internet that is publicly accessible. The control command supply cloud **400** includes a repository **420** that stores sets of control instructions. The repository **420** can be provided in form of a database on one of the control command supply servers, e.g. **410**, or can be provided on a separate storage server within the control command supply cloud **400**. The instruction sets comprise control commands for controlling a particular type of home appliance. The repository **410** may for example comprise a plurality of instruction sets for controlling cooking appliances, and may comprise a plurality of instruction sets for controlling a washing or drying appliance. In some embodiments, all instruction sets are provided for controlling the same type of appliance, such as a cooking device.

(24) The instruction sets comprise generic control commands for controlling the home appliance, such as setting an operating program of the home appliance, setting an operating parameter, such as temperature of the home appliance, setting a duration of the operating program, starting the home appliance, stopping the home appliance, and the like. As the instruction sets are generic, they cannot be used to directly control any home appliance.

(25) The control command supply server **410** provides an interface for access by a user terminal device **250**, such as a smartphone, a tablet, a laptop or the like. The interface may be web interface, but preferably, the terminal device **250** executes an application (or app) which communicates with the control command supply server **410** via the interface. The control command supply server **410** provides access to the repository **420** so that via the terminal device **250**, a user can access the repository **420** and search for sets of control instructions. For this purpose, a user account may be provided on the control command supply server **410** for a user of the terminal device **250**. Terminal device **250** can access this user account by sending credentials, such as username and password, associated with the user account which are either entered by the user into the terminal device **250** or which are stored on the terminal device **250**.

(26) In a similar manner, a user account for a user of the terminal device **250** may be provided on the home appliance control server **310**. By means of the terminal device **250**, the user can associate the home appliance **100** with his user account on the home appliance control server **310**. The establishing of such association is described in detail further below. Once the association is established, the home appliance control server **310** can send control commands via the gateway **150** to the home appliance **100** to control the home appliance.

(27) Home appliance **100** can in particular be configured as outlined above with respect to FIG. 1. Accordingly, home appliance **100** can only be controlled from predefined servers the addresses of which are stored in the home appliance **100**, wherein such servers form part of the home appliance control cloud **300** and in particular include the server **310**. The attempt of any server outside of the cloud **300** to control home appliance **100** will accordingly fail. Misuse of the remote control functionality of home appliance **100** can thus be avoided, and damage to home appliance **100** and dangerous operating situations can be prevented.

(28) Home appliance control server **310** and control command supply server **410** are coupled over the Internet **200**. If one of the instruction sets stored in the repository **220** is selected via the terminal device **250** for execution, the control command supply server **210** can send a request for remote control of the home appliance **100** to the home appliance control server **310**. To ensure that the commands are transmitted by the owner of the home appliance **100** or another authorized person, which is the user of the terminal device **250**, an authentication procedure is performed. This can be performed directly between the user terminal **250** and the home appliance control server **310**, or may be performed via the control command supply server **410**. Upon receiving such request, the home appliance control server **310** may for example request respective credentials, such as username and password, from the control command supply server **410**, or directly from the terminal device **250**. After receiving such credentials from the control command supply server **410**, the home appliance control server may additionally request confirmation from the terminal device **250** to enable a remote control from such external server **410**. Accordingly, a high degree of security can be ensured, and it is not possible for remote servers on the Internet to control the home appliance **100** without proper authorization.

(29) Once the authentication has been successful, the control command supply server **410** can then send control commands associated with the selected instruction set to the home appliance control server **310**. The home appliance control server **310** includes an application programming interface **320** that allows the use of a predefined set of control commands for controlling the home appliance **100**. Application programming interface **320** may for example be a REST or RESTful API. Communication between servers **310** and **410** may occur using the https protocol, wherein the control commands may be transmitted by using JSON messages. A fast, efficient and generic transmission of control commands can thus be provided by control system **10**.

(30) After authentication, the home appliance control server **310** can accordingly receive respective messages comprising control commands from the external cloud **400** via the API **320**. The control server **310** translates the received messages into a format understood by the home appliance **100**. This may for example be a data format proprietary to the manufacturer of the home appliance **100**. Control server **310** includes a respective gateway function **316** that performs such translation between the protocols. Control messages in the format predetermined by the message format of the home appliance **100** are thus transmitted via control server **310** over the Internet. The transport protocol for transmitting the messages between the home appliance **100** and the control server **310** may for example be MQTT. A fast, efficient and secure transfer of the control command messages can thus be ensured. In a similar fashion, the home appliance **100** can send information on its operating state, such as current operating parameters and events, to the control server **310**. Control server **310** may for example monitor the home appliance **100** and may repeatedly request respective information, or the home appliance **100** may be configured to periodically transmit respective information. Safety-relevant events, such as overheating, may for example be directly transmitted by the home appliance **100** to the control server **310** upon occurrence. The control server **310** decodes respective received messages comprising such information and/or events and notifies the control command supply server **410** accordingly. It may for example send https requests with the information and/or event details to the server **410**. In particular, webhooks may be used by control server **310** to notify the supply server **410**.

(31) An exemplary implementation of the home appliance control server **310** is shown in FIG. 9. The control server **310** includes a processing unit **311** that is coupled to a network interface **319**. Via network interface **319**, the control server **310** is connected to the Internet **200**. Network interface **319** may for example include an Ethernet interface. The processing unit **311** includes a processor **312** and a memory **313**. The memory **313** stores control instructions which are executed by the processor **312**, and which are configured so that any of the method steps described herein with respect to the control server **310** are performed. Memory **313** can be configured as described above with respect to FIG. 1. Processor **312** can again be a microprocessor, e.g. a multi-core

processor.

(32) When executed by the processor **312**, the control instructions stored in memory **313** can in particular implement the above-mentioned authentication function **315** and the gateway function **316**. As mentioned above, authentication function **315** provides authentication of a user, or a user account on the control command supply server **410**, trying to remote control the home appliance **100**. Gateway function **316** provides translation between the messages transmitted between control server **310** and control command supply server **410** and the messages transmitted between control server **310** and home appliance **100**.

(33) It is also conceivable that the control server **310** implements a safety function **317**. Upon being notified of an event or receiving information on the current operating state of the home appliance **100**, the control server **310** may assess such received event and/or information to determine that a safety-relevant situation has occurred at the home appliance **100**. The safety function **317** may for example check if the operating parameters of the home appliance **100** are within predefined limits. If this is not the case, in particular if a safety-relevant situation is identified by safety function **317**, it may send respective control commands to home appliance **100** that are selected to remove such safety-relevant situation, for example by sending a stop command to stop the operation of the home appliance **100**, or by adjusting an operating parameter, such as temperature, of the home appliance **100**. Operational safety of home appliance **100** can thereby be improved.

(34) It should be clear that the control server **310** may comprise further components not shown in FIG. **9**, such as a user interface comprising for example a display and an input unit such as a keyboard, and may further comprise other components that are common to a server.

(35) Turning back to FIG. **2**, upon reception of the information and/or events from home appliance **100** at the control command supply server **410**, the respective information can be forwarded to the terminal device **250** for display to a user. For example, in a cooking appliance, the current temperature in the oven cavity may be displayed to the user. The user may be enabled to make respective adjustments on operating parameters via the terminal device **250**, which are then sent in the form of control commands via the supply server **410**, the control server **310**, and the gateway **150** to the home appliance **100**. In some embodiments, the supply server **410** may derive from the received information and/or events further control commands for submission to the home appliance **100**. For example, supply server **410** may determine based on the received information that the temperature in the oven cavity is too high or too low. It may send respective control commands to adjust the temperature in the oven cavity to the desired value to the home appliance **100** along the above described path via the control server **310**.

(36) Terminal device **250** may furthermore request the capturing of an image of the operation of the home appliance **100**, such as an image of the oven cavity. A respective request is received by the supply server **410** and transmitted to the control server **310**. Control server **310** forwards such request to the home appliance **100** which executes the request and captures a respective image. The image is transmitted by home appliance **100** to the control server **310**. In an embodiment, control server **310** uploads the image to a storage server **351**, which may form part of a storage cloud **350**. Storage server **351** and/or servers of the storage cloud **350** may be distinct and physically separate from the servers of the home appliance control cloud **300**. In other implementations, storage server **351** may form part of either the cloud **300** or the cloud **400**. Storage server **351** may implement an object store in which the captured image is stored. The terminal device **250** can then be notified directly or via the supply server **410** that the captured image is available for download, or the image may be pushed to the terminal device **250**. Terminal device **250** can then access the storage server **351** and can retrieve the captured image for display to the user.

(37) In another embodiment, it is also conceivable that the image is directly transmitted by the control server **310** to the supply server **410**, which in turn transmits the image to the terminal device **250**. In the embodiment illustrated in FIG. **2**, both, the control server **310** and the supply server **410**, are relieved from having to store respective image data. The application running on the

terminal device **250** and having access to the supply server **410** may be provided with a functionality that allows direct access to the storage server **351** for retrieving the image.

(38) The terminal device **250** may accordingly be configured to execute a first application for accessing the control command supply server **410**. It may further be configured to execute a second application that is configured to communicate with the home appliance **100** via the local network **160**, for example to set up the home appliance **100**, in particular to connect the home appliance **100** to the local network, such as a WLAN, and to associate the home appliance **100** with a user account on the control server **310**. Such second application may furthermore be configured to directly communicate with the control server **310**, for example for managing the user account on the server **310**, for controlling associations with home appliances, or for receiving confirmation requests for enabling remote control.

(39) The control server **310** and the supply server **410** may be located in different or the same geographical area or country as the home appliance **100**. It is particularly advantageous if the control server **310** is located in the same country or the same region, such as the EU, as the home appliance **100**, in particular with respect to data protection regulations which defer from country to country. For example, for home appliances located in the EU, a control server **310** located in the EU may be provided, while for home appliances located in Russia, a control server **310** located in Russia may be provided.

(40) FIGS. **3** to **5** illustrate different embodiments of how the home appliance **100** can be connected to the Internet **200** via the gateway **150**. In the example of FIG. **3**, the gateway **150** is implemented as a wireless router that provides a wireless network into which the home appliance **100** is joined. Local network **160** is accordingly in this case a WLAN. Gateway **150** is connected to the Internet **200** in any known manner, such as for example via a cable network provider, DSL or the like.

(41) It should be clear that further appliances **100** may be connected to the local network **160**. In FIG. **4**, the local network **160** is implemented as a local area network, to which two home appliances **100** are connected. Gateway **150** is implemented as a respective local area network router that provides routing between the Internet **200** and the local area network. The gateway **150** is again connected to the Internet **200** in any of the above described known manners.

(42) In the example of FIG. **5**, the gateway **150** is implemented in the home appliance **100**. For example, the home appliance **100** may comprise a communication module for wirelessly communicating over a mobile telephony network. Such communication module may for example comprise a SIM card or the like to allow communication over such network. Gateway **150** thus provides a gateway between the mobile telephony network and the data communication internal to the home appliance **100**. The respective mobile communication interface provided in the home appliance **100** may for example communicate using any known mobile telecommunication standard, such as GPRS, Edge, UMTS, LTE, 5G and the like. Reference symbol **261** designates a respective radio station, such as a base station, an eNodeB or 5G base station. Reference sign **262** denotes the respective gateway of the mobile communication system to the Internet **200**.

(43) In any of the outlined configurations, it is clear that the home appliance control server **310** is not part of the respective local network **160** and can communicate with the home appliance **100** only via the Internet **200** and the gateway **150**. This is distinct from conventional systems in which for example the user terminal **250** communicates with an intelligent home device via the local smart home station located in the local network **160**.

(44) FIG. **6** is a flow diagram illustrating exemplary methods according to embodiments of the invention which may be performed for registration and authentication prior to the transmission of control commands from the supply server **410** to the control server **310**. First, the home appliance may be joined to the local network **160**, for example a WLAN, which may be performed by transmitting the respective data for joining the network from the user terminal **250** to the home appliance **100**. In step **601**, the user terminal **250** is connected to the WLAN. The user enters a command at the terminal device **250** to register the appliance **100** in the network and with the home

appliance control server **310** (step **602**). The terminal device **250** may transmit the user credentials for accessing the user account on the control server **310** and/or the network credentials for joining the WLAN to the home appliance **100**, for example by a direct link, such as WiFi direct. It may furthermore transmit a command to register the appliance with the control server **310**. Terminal device **250** may comprise a respective application running on the terminal device that submits respective messages to appliance **100** (step **603**). In step **604**, the home appliance uses the network credentials to connect to the WLAN. Furthermore, using the user credentials, such as username and password, the home appliance **100** requests registration for the user account at the control server **310** (step **605**). The respective communication occurs via the local network **160**, the gateway **150**, and the Internet **200**. The control server **310** confirms the user credentials for the user account and in response to a positive authentication associates the home appliance **100** with the respective user account (step **606**). A respective confirmation of the association of the home appliance with the user account may then be provided by the control server **310** to the terminal device **250**.

(45) It should be clear that the above described joining of the home appliance **100** into the WLAN and the association of the home appliance **100** with the user account on the control server **310** may be performed separately and independently from each other. Furthermore, other ways of associating the user account on the control server **310** with the home appliance **100** are certainly conceivable, such as logging onto the user account by the terminal device **250** and entering a respective code of the home appliance to be registered, such as by scanning a bar-code on the home appliance or the like. Furthermore, any such registration may need to be confirmed, for example by pressing a button on the home appliance **100** so as to ensure that the user is physically present at the location of the home appliance **100** and is thus likely to be the owner of the home appliance.

(46) The embodiment illustrated in FIG. **6** is particularly safe, since it is the home appliance **100** itself that requests the association of the home appliance with the user account. As the request is triggered by a direct communication between the terminal device **250** and the home appliance **100**, it can be ensured that no remote device triggers such registration.

(47) Furthermore, to facilitate control of the home appliance **100** via the supply server **410**, the user account on the supply server **410** and on the control server **310** may be linked. In step **608**, a respective command entered by the user is received at the terminal device **250**. User device **250** in response transmits the user credentials for the user account on the control server **310** and a respective command to link to this user account to the supply server **410** (step **609**). In step **610**, the supply server **410** transmits the request to link its user account to the user account on the control server **310** and the user credentials to the control server **310**. To increase the security, the control server **310** may then optionally request a confirmation of the account linking from the terminal device **250**, as indicated with the dotted line (step **611**) in FIG. **6**. If the user is authenticated by the control server **310**, and possibly the confirmation from the terminal device **250** is received, which may be checked by the authentication function **315**, the control server **310** links the user accounts (step **612**). The control server **310** then provides a confirmation of the linking of accounts to the terminal device **250**, for example via the supply server **410** (steps **613** and **614**) or directly. Such linked accounts may have the advantage of further facilitating control of the home appliance, since it can relieve the user of authenticating himself every time at the control server **310**, as it may be sufficient that the user account of the supply server **410** authenticates itself at the control server **310**.

(48) As mentioned above, the terminal device **250** may be configured to run two applications, one for performing the communication with the home appliance **100** for registration with the control server **310**, the other for communicating with the supply server **410**.

(49) FIG. **7** shows a flow diagram illustrating the control of the home appliance from the terminal device **250**. In step **701**, the terminal device transmits user credentials to the supply server **410** for logging into the user account and furthermore transmits a search query for searching the repository **420** for a set of control instructions. The user credentials may be entered by a user on the terminal

device or may be stored on the terminal device. The search query may for example be entered by the user on the terminal device using a keypad, such as a touchscreen keypad. In response to a positive authentication and the receipt of the search query, the supply server **410** performs a search in the repository in accordance with the search query and transmits the search results in step **702**. The search results are displayed to the user by the terminal device **250** and the user selects an instruction set, for example by touchscreen input (step **703**).

(50) For example, the home appliance may be a cooking appliance, and the instruction sets may be associated with recipes, in particular they may comprise control commands that correspond to steps to be performed by the cooking appliance for preparing the food when following the recipe. The user may accordingly select a respective recipe in step **703**. The user can thus browse the recipes stored in cloud **400** and select execution of the recipe on the terminal device.

(51) In response to the selection, the terminal device transmits in step **704** a command to execute the selected instruction set to the supply server **410**. In response, the supply server **410** may then request the remote control of the home appliance from the control server **310** (step **705**).

Alternatively, the request for remote control may be directly provided from the terminal device **250** to the control server **310**. In response, the control server **310** requests authentication from the supply server **410** (or from the terminal device **250**) in step **706**. The user credentials or the credentials of the linked account (see the above steps **609** to **614**) are then transmitted by the supply server **410** to the control server **310** (step **707**). Alternatively, if the terminal device **250** directly requests remote control from the control server **310**, the user credentials may be transmitted by the terminal device **250**. Optionally, the control server **310** may request confirmation of the enabling of the remote control from the terminal device **250**, for example directly as illustrated in FIG. 7 (step **708**) or indirectly via the supply server **410**. The user may then confirm the remote control by operating a respective button on the touchscreen of the terminal device **250**.

(52) After the authentication is confirmed and it is confirmed that remote control can be enabled, the control server **310** sends a respective confirmation message to the supply server **410** (step **709**). The supply server **410** can then transmit respective control commands in accordance with the selected instruction set. The control server **310** then receives the control commands (via the API **320**) and, using its gateway function **316**, translates the commands into messages understood by the home appliance **100**. In step **711**, the control server **310** forwards the control commands to the home appliance **100**. In step **712**, the control commands are executed by the home appliance.

(53) It should be clear that the instructions may comprise a relatively complex sequence of control commands, or may comprise a simple, in particular a single control command, such as start the home appliance, stop the home appliance, or adjust an operating parameter of the home appliance. For example, the instruction set may also comprise control commands such as a wait command causing the home appliance to wait for a user confirmation, or a display command causing the home appliance to display information to the user and the like. Accordingly, the user can follow the steps of the recipe and may for example be invited to place a respective good to be cooked into the oven cavity. Upon confirmation on the terminal device **250** or on the home appliance **100**, the next control command may be transmitted and executed by the home appliance **100**, or a control command queued at the home appliance **100** may be executed, such as turning on the heater of the cooking device.

(54) It should also be clear that there may be situations in which the home appliance may not execute a received control command, for example if the home appliance is in an operating state that does not allow such execution. For example, the home appliance may be unable to receive the control command, due to not being switched on or being disconnected from the power grid or the local network, or the control command may not be in accordance with the present operating state. A respective error message that the control command can at present not be executed may then be sent by the home appliance to the control server **310**, which may in turn forward the error message via the supply server **410** to the terminal device **250**, or such error message may be generated by the

control server **310**.

(55) In accordance with a chosen recipe, the set of control instructions may for example comprise the following control commands: set program to bottom heat; set target temperature to 200° C.; set duration to 20 minutes; start.

(56) During operation, the home appliance may send events and information messages to the control server **310**, or the control server **310** may request respective information from the home appliance **100**. This is illustrated in FIG. **8**, wherein an event occurs in step **801**, such as the reaching of a predetermined temperature, the expiry of a timer, the occurrence of a fault, or the like. In step **802**, the home appliance **100** transmits the event and/or respective information, such as operating parameters, to the control server **310**. Control server **310** then decodes the received message and sends the respective information to the supply server **410**, for example using the JSON format. Again, the translation between the message types may be performed by the gateway function **316**. After receiving the information in step **803**, the supply server **410** forwards the event/information to the terminal device **250** for display (step **804**). As outlined above, it is conceivable that either one of the control server **310** or the supply server **410** derives one or more control commands from the received event and/or information (steps **805** and **806**). This may for example occur at control server **310** to prevent an operation outside the predefined operating limits, to avoid damage to the home appliance **100** and to avoid dangerous situations. Likewise, the supply server **410** may derive an operating command in order to ensure that the desired operating parameters are achieved by the home appliance, for example the correct temperature and duration during the preparation of food according to the selected recipe. Respective control commands are transmitted and/or forwarded in the steps **807** and **808**. The respective control command is received by the home appliance and is executed (step **809**). It should be clear that these steps are optional.

(57) In step **810**, the terminal device **250** displays the received events and/or operating parameters. In dependence on the received event/operating parameters, the terminal device may alert the user in step **811**, for example if a temperature or a duration is exceeded, or if a fault has occurred. An efficient and safe control of the home appliance can thus be achieved.

(58) FIG. **8** furthermore illustrates method steps that may be performed for capturing an image of the operation of the home appliance in accordance with an embodiment of the invention. In step **901**, the terminal device receives from a user a command to capture an image, for example by actuation of a button on a touchscreen. The command to capture the image is transmitted to the supply server **410** in step **902**, which forwards the control command to the control server **310** in step **903**. Again employing its gateway function **316**, the control server **310** translates and forwards the control command to the home appliance (step **904**). In step **905**, the home appliance **100** executes the control command by capturing an image, for example of the oven cavity of a cooking appliance. It should be clear that other home appliances, such as a fridge, may capture an image of a different component, such as the interior of the fridge compartment. The captured image is transmitted to the control server **310** (step **906**), which uploads the captured image to the cloud object store of the storage server **351** (step **907**). In step **908**, the control server **310** notifies the terminal device **250** of the availability of the image in the object store, and in response, the terminal device **250** downloads the image from the object store and displays the image in step **909**. This may occur automatically or in response to a respective user input. As mentioned above, other implementations are conceivable, such as forwarding the image via the supply server **410** to the terminal device **250**.

(59) It should be clear that the methods illustrated in FIGS. **6**, **7** and **8** relate to different aspects of the present application and may accordingly not be performed in the respective order. Rather, the steps illustrated in FIG. **6** may for example only be performed once prior to the first remote control of the home appliance via the Internet. On the other hand, steps **801** to **811** may be performed repeatedly during operation of the home appliance **100**, prior to and after the execution of control commands in step **712**. Similarly, steps **901** to **909** may be performed at any time during operation

of the home appliance, upon request by the user.

(60) Furthermore, as outlined above, several variations can be made to the disclosed methods. Furthermore, several of the above described method steps are optional, such as steps **801-811** and **901-909**.

(61) It should be clear that the home appliance, the control server **310**, the supply server **410**, and in particular the control system **10** may be configured to perform any of the method steps described with respect to FIGS. **6** to **8**. Similarly, the respective components of the control system **10** illustrated in FIGS. **6** to **8** may have any of the configurations described above with respect to FIGS. **1** to **5** and **9**.

(62) The embodiments described above thus provide access to a plurality of sets of control instructions via the Internet, in particular via a publicly accessible cloud. At the same time, control of the home appliance via the Internet is enabled, while the access is limited and operational safety can thereby be ensured. Furthermore, e.g. for a cooking appliance, the supply cloud can use information received from the home appliance for providing information to the user and for feedback, it may in particular adjust any of the operating parameters, in particular cooking parameters, such as program, target temperature or duration, during a cooking session.

Furthermore, the user can at any time use the application operating on the terminal device to take a photo of the current state of the cooking appliance, in particular of the oven cavity. A comprehensive, efficient and secure control of the home appliance **100** is thus provided.

(63) While specific embodiments are disclosed herein, various changes and modifications can be made without departing from the scope of the invention. The present embodiments are to be considered in all respects as illustrative and non-restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

(64) TABLE-US-00001 LIST OF REFERENCE SIGNS 100 home appliance 110 controller 111 memory 112 processor 120 network interface 130 user interface 141 heater 142 grill 143 fan 150 gateway 160 local network 200 Internet 250 user terminal device 260 mobile communication network 261 radio station 262 mobile communication gateway 300 home appliance control cloud 310 home appliance control server 311 processing unit 312 processor 313 memory 315 authentication function 316 gateway function 317 safety function 319 network interface 320 application programming interface 350 storage cloud 351 storage server 400 control command supply cloud 410 control command supply server 420 repository 601-909 method steps

Claims

1. A method of controlling a home appliance, wherein the home appliance is connected to an Internet network via a gateway, wherein at least one home appliance control server of a home appliance control cloud is configured to communicate with the home appliance via the Internet network and the gateway, wherein the home appliance is configured to execute control commands for operating the home appliance which are received by the home appliance from the Internet via the gateway only if the control commands are received from said home appliance control cloud, wherein at least one control command supply server of a control command supply cloud is connected to the home appliance control cloud via the Internet network, the control command supply cloud comprising at least one repository storing sets of control instructions configured to operate the home appliance, the at least one repository being provided on or being accessible by the at least one control command supply server, wherein the home appliance control cloud is distinct from the control command supply cloud, and wherein a first user account for a user of a user terminal device is provided on said home appliance control server, the first user account being associated with the home appliance, wherein the method comprises: linking a second user account for the user of the user terminal device, provided on the control command supply server, to said first user account; authenticating, by an authentication function of the home appliance control

server, a request for remote control of the home appliance received from said control command supply server via the Internet network, the request being related to said first user account; and responsive to a positive authentication, forwarding, from the home appliance control server to the home appliance, one or more control commands received by the home appliance control server from the control command supply server, the one or more control commands being part of a set of control instructions from the repository that is selected based on input received by the user terminal device, wherein the one or more control commands forwarded to the home appliance are such that the home appliance executes the one or more control commands upon reception.

2. The method according to claim 1, wherein the control command supply server and/or the control command supply cloud is not directly associated with any home appliance to be controlled in accordance with the sets of control instructions.

3. The method according to claim 2, wherein the control command supply server and/or the control command supply cloud is not capable of directly controlling such home appliance by sending control commands to the home appliance via the Internet network without any intervening server outside said control command supply cloud which provides authentication of the commands.

4. The method according to claim 1, wherein the gateway is implemented in the home appliance or wherein the home appliance is connected to the gateway via a local connection or local network, said local connection or local network comprising: a local area network, a wireless local area network, a personal area network, a wireless personal area network, or a local peer to peer connection.

5. The method according to claim 1, wherein the user terminal device operates an application configured to establish a data connection to the control command supply server, the control command supply server providing an interface allowing the application to access and search the repository for sets of control instructions for selecting said set of control instructions.

6. The method according to claim 1, wherein the method further comprises: responsive to a request to link the second user account to said first user account on the home appliance control server, authenticating, by the home appliance control server, the user of said first user account on the home appliance control server; and responsive to a positive authentication, linking the second user account on the control command supply server to the first user account on the home appliance control server.

7. The method according to claim 1, wherein the authentication of a request for remote control comprises providing authentication information associated with the user of said first user account from the user terminal device or from the control command supply server to the home appliance control server, or supplying authentication information provided by the second user account on the control command supply server linked to said first user account on the home appliance control server from the control command supply server to the home appliance control server.

8. The method according claim 1, wherein the home appliance control server comprises an application programming interface, wherein the control command supply server provides the one or more control commands to the application programming interface of the home appliance control server via the Internet network.

9. The method according to claim 1, wherein the control command supply server encodes the one or more control commands in a JavaScript Object Notation, and formats and transmits the one or more encoded control commands to the home appliance control server.

10. The method according to claim 1, wherein the home appliance control server implements a gateway function that provides a conversion between a protocol used by the control command supply server to transmit said control commands and a protocol used by the home appliance control server to communicate control commands to the home appliance.

11. The method according to claim 1, wherein the home appliance control server uses a Message Queuing Telemetry Transport, protocol for communication with the home appliance.

12. The method according to claim 1, further comprising: receiving, by the home appliance control

server, a message from the home appliance comprising information and/or events related to the operation of the home appliance; decoding, by the home appliance control server, the received message; and forwarding, by the home appliance control server, the information and/or events comprised in the message to the control command supply server.

13. The method according to claim 12, wherein the control command supply server forwards the received information and/or events to the user terminal device and/or uses the received information and/or events to derive one or more control commands and provide the derived control command via the home appliance control server to the home appliance.

14. The method according to claim 1, further comprising: receiving, by the home appliance control server and from the control command supply server, a control command to capture an image indicative of the operation of the home appliance; transmitting, by the home appliance control server, a request to the home appliance to capture an image; receiving, by the home appliance control server and in response to the request, a captured image from the home appliance; transmitting the received captured image to a storage server that is connected to the Internet network; and making accessible the stored captured image to the user terminal device.

15. The method according to claim 1, wherein the sets of control instructions provided by the repository comprise generic control commands for controlling different models of the same type of home appliance.

16. The method according to claim 1, wherein the control commands transmitted by the control command supply server in accordance with a selected set of control instructions comprises one, a combination, or all, of the following control commands: a control command to set an operating program of the home appliance; a control command to set one or more operating parameters of the selected operating program; and a control command to start operation of the home appliance in accordance with the selected operating program and the set operating parameters.

17. The method according claim 1, wherein authenticating the request for remote control includes sending of a request from the home appliance control server to the user terminal device to confirm the enabling of remote control of the home appliance, and enabling remote control of the home appliance by the home appliance control server only if a user input is received that confirms the enabling of the remote control.

18. A computer program for controlling a home appliance, wherein the computer program comprises control instructions which, when executed by a data processor of a home appliance control server connected to the home appliance via the Internet network and a gateway, cause the data processor to perform the method of claim 1.

19. A control system for controlling the operation of a home appliance, wherein the home appliance is connected to an Internet network via a gateway, the control system comprising: a home appliance control server of a home appliance control cloud connected to said Internet network, wherein the home appliance control server is configured to communicate with the home appliance via the Internet network and the gateway; the home appliance, wherein the home appliance is configured to execute control commands for operating the home appliance which are received by the home appliance from the Internet network via the gateway only if said control commands are received from said home appliance control cloud; and a control command supply server of a control command supply cloud, wherein the control command supply server is connected to the home appliance control cloud via the Internet network, the control command supply cloud comprising at least one repository storing sets of control instructions configured to operate the home appliance, the at least one repository being provided on or being accessible by the control command supply server; wherein the home appliance control cloud is distinct from the control command supply cloud, wherein the control command supply cloud is configured to provide an interface for access by a user terminal device, the interface being configured to enable selection of one of said sets of control instructions via the user terminal device, wherein the home appliance control server is configured to establish an association between the home appliance and a first user account for a

user of the user terminal device provided on said home appliance control server, wherein the control command supply server is configured to provide a second user account for said user of the user terminal device, wherein the second user account and the first user account are linked, and wherein the home appliance control server is configured to further implement an authentication function configured to authenticate a request for remote control of the home appliance received from said control command supply server via the Internet network, the request being related to said first user account, and responsive to a positive authentication, to forward, from the home appliance control server to the home appliance, one or more control commands received by the home appliance control server from the control command supply server in accordance with the selected set of control instructions for execution by the home appliance.
