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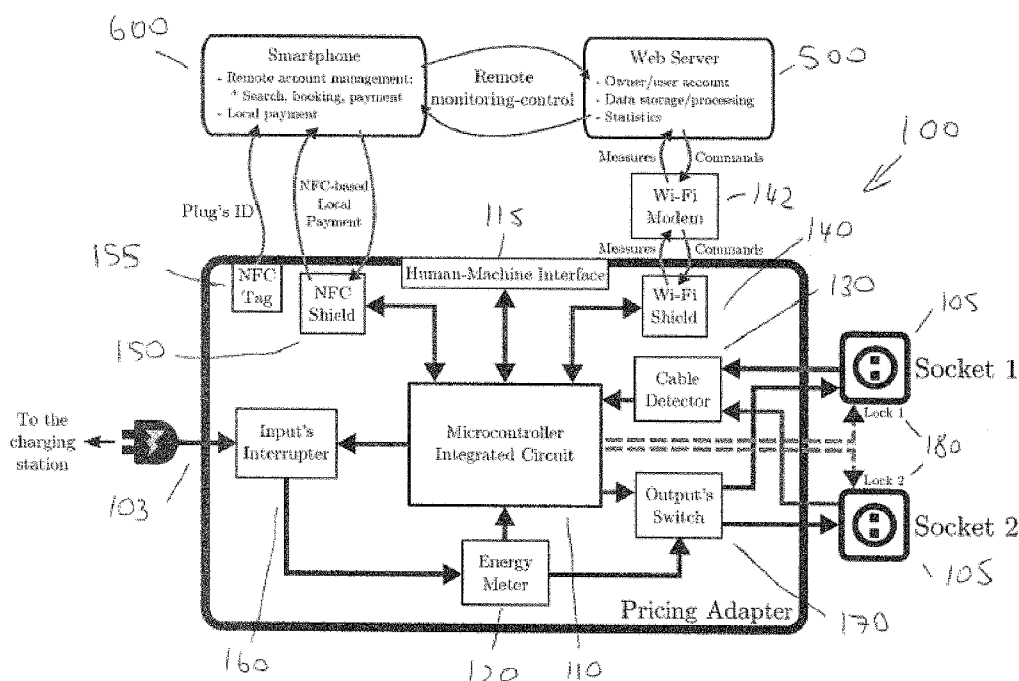
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(54) Title: PRICING ADAPTER FOR DOMESTIC ELECTRIC VEHICLE CHARGING STATIONS



(57) **Abstract:** An interface is provided to be mounted as a pricing adapter between a domestic electric vehicle charging station (EVCS) and the charging cable of an electric vehicle. It is configured to control a charging process of a vehicle to be charged, the interface comprising: an inlet for connection to the domestic EVCS; one or more outlets configured for supplying electrical power to one or more vehicles; and a computing device configured to control a charging process through the supply of power from the inlet to the one or more outlets.

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Title

Pricing Adapter for Domestic Electric Vehicle Charging Stations

Field of the Invention

5 The present disclosure relates to a pricing adapter for domestic Electric Vehicle (EV) charging stations (EVCS).

Background

10 In Ireland, the total number Electric Vehicles (EV) and Hybrid Vehicles is greater than the total number of public Electric Vehicle charging stations (EVCS), in a proportion of 1:1.09 (approximately) according to data from SIMI Motorstats revised in December 2017. In addition, the geographical density of public EVCS is relatively low in many cases (e.g., 1 charging station per town of 1500 inhabitants). This can be very critical in many situations. For example, if the distance to be travelled to reach the
15 nearest available EVCS is greater than the current electric travel autonomy, then the car will not reach the station (in the case of an EV), or it will have to switch to an internal combustion engine (in the case of an HV) and thus it will behave as a conventional polluting vehicle.

20 In addition, since charging times are much longer than the process of refuelling petrol or diesel, then long queues may build up at some EVCS, thus further reducing the practical availability of charging points. This situation is even worse in countries where the number of vehicles is already greater than the number of public EVCS.

25 In Ireland, public EVCS are currently deployed by the State (via the ESB Group), and can be accessed for free by registered EV/HV owners who qualify for the Sustainable Energy Authority of Ireland (SEAI) Grant. Registered users have a smart card which allows them to manage locally the charging process at the smart EVCS. The free-access scheme was planned to end in April 2016, and monthly bills were expected
30 to be sent to users. This did not occur by that time, but the Commission for Regulation of Utilities (CRU) is now demanding that the charging network should be maintained on a commercial basis by the ESB Group. In such a paid-access scheme, the billing process

would be potentially based on the same registration system and access process currently implemented: a smart card allows the user to start the charging process, then the charging information is stored, and finally a bill is sent to the user at the end of each month.

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Concerning traditional domestic EVCS (including those provided by the ESB group), the EV/HV starts charging once it is connected to the station (no smart cards are needed), and the house owner pays the energy consumption as part of the total electricity bill.

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Public EVCS are already configured for controlled access to the public, which easily enables a potential paid-access scheme. However, this is not possible in the context of traditional domestic EVCS. As long as house owners only use their domestic EVCS to charge their own cars, then the access to the EVCS does not have to be monitored and restricted. Also, not knowing the precise energy consumed (and in turn, the fee for that consumption) is not a problem since charging costs are simply included in household electricity bills. However, when a domestic EVCS is open to the public, then the access thereto must be controlled, and the precise energy consumption has to be known to properly calculate the fee to be charged to the users. A traditional domestic EVCS cannot perform these actions, and a more dedicated station would have to be acquired for this purpose.

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Buying a "smarter" EVCS would not only incur a higher cost, but also a new installation fee. Besides, even though a smarter EVCS allows connectivity to smart devices (phones, tables, computers), the presence of a "seller" would be necessary to orchestrate the charging process using an app (or the local payment process, at least).

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There is therefore a need to augment domestic EVCS.

30 Summary

The present disclosure provides a pricing adapter configured to control a charging process between a domestic electric vehicle charging station (EVCS) and a vehicle to be charged as detailed in claim 1, and a method of charging an electric vehicle using the pricing adapter according to claim 25. Advantageous features are provided in dependent claims.

In one embodiment, the pricing adapter may be provided between the charging station and the charging cable.

Preferably, the pricing adapter is clamped to the domestic EVCS so that external users cannot directly access the domestic EVCS without using the pricing adapter. An installation service may be required so that an adequate clamping mechanism is incorporated between the pricing adapter and the charging station. However, in an alternative embodiment, the charging station may be located indoors, so that the inlet of the pricing adapter is also indoors but the rest of its body is outdoors.

The pricing adapter (PA) is configured to allow house owners with conventional (no screens, no software) domestic EVCS to accrue revenues by sharing their EVCS for public use.

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The finalisation of the charging process may be controlled by the pricing adapter based on the availability of the payment method selected by the user, for example local payment or online payment. If no valid payment is effected, then a locking system activated from the beginning of the charging process will remain engaged to prevent the user from recovering their charging cable as a guarantee of payment.

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The pricing adapter may also be configured to record some variables of interest, such as the state of the charging process, the amount of energy consumed for the calculation of the charging fees to be paid and for statistical analysis, among others. In addition, the pricing adapter may be configured for Internet connectivity to provide online search/booking services, long-time data storage and analysis, and the aforementioned online payment methods, among others. Furthermore, the pricing

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adapter may be configured to provide a plurality of outlet sockets to enable more than one vehicle to charge off a single charging socket.

5 A significant impediment to electric vehicle rollout is the limited charging infrastructure. Since most electric vehicles are sold with the free installation of a home charging unit, by incorporating pricing adapters of the present disclosure into the public network, it is possible to significantly improve such an infrastructure limitation.

10 Specifically, allowing house owners to enable their private domestic EVCS for public access through the use of a pricing adapter (rather than through the acquisition of a "smarter" EVCS), will greatly and easily mitigate not only the lack of available public EVCS, but also the lack of a high geographical density of public EVCS, while generating an income to the house owners.

15 Controlled access to the EVCS and an automatic consumption-fee calculation would allow the house owner to keep the station open to the public without the requirement of a person orchestrating the charging/payment process. In this manner, the charging process may be performed in an accurate manner. In addition, a local payment method allows the user to access the service via debit/credit/membership cards or
20 wireless payment (Apple pay (RTM), Android pay (RTM)), while an online payment method allows other digital payment methods such as digital wallets.

25 The pricing adapter may be configured to be transported in a plug-in vehicle in much the same way as a spare wheel is carried currently, as illustrated in Figure 4a.

These and other features will be better understood with reference to the followings Figures which are provided to assist in an understanding of the present teaching.

Brief Description Of The Drawings

30 The present teaching will now be described with reference to the accompanying drawing in which:

Figure 1 illustrates a pricing adapter for domestic Electric Vehicle (EV) charging stations (EVCS) having a single-input multiple-output (SIMO) configuration, according to an embodiment of the present disclosure;

Figures 2a to 2c illustrate charging scenarios for the SIMO model of the adapter of
5 Figure 1, according to embodiments of the present disclosure;

Figure 3 is a flowchart illustrating in detail a process flow of the SIMO model of the adapter, according to an embodiment of the present disclosure;

Figures 4a to 4h illustrate charging scenarios for the single-input single-output (SISO) model of the adapter, according to embodiments of the present disclosure;

10 Figure 5 illustrates a flow chart of a SISO charging model of the adapter according to embodiments of the present disclosure; and

Figure 6 is a block diagram illustrating a configuration of a pricing adapter which includes various hardware and software components that function to perform charging processes according to the present disclosure.

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Detailed Description of the Drawings

The present disclosure will now be described with reference to an exemplary pricing adapter for domestic Electric Vehicle (EV) charging stations (EVCS) as illustrated in Figure 1. It will be understood that the exemplary pricing adapter for
20 domestic EVCS is provided to assist in an understanding of the teaching and is not to be construed as limiting in any fashion. Furthermore, elements or components that are described with reference to any one Figure may be interchanged with those of other Figures or other equivalent circuit elements without departing from the spirit of the present teaching. It will be appreciated that for simplicity and clarity of illustration,
25 where considered appropriate, reference numerals may be repeated among the figures to indicate corresponding or analogous elements.

Domestic EVCS are used by private property owners mostly at night time for two main reasons: 1) people may not stay at home (in general) during working hours, and 2)
30 the price of energy consumption is cheaper at night time. Consequently, domestic EVCS are highly prone to become expensive pieces of unused hardware mostly during

working hours, at a time when EV/HV owners may be searching for an available public EVCS with no success.

In this vein, the present disclosure enables restricted (sometimes unused) highly specialised resources such as domestic EVCS to mitigate the problem of a lack in the access to public EVCS by EV/HV owners with high quality of service, through the use of a dedicated pricing adapter as described herein.

The pricing adapter according to the present disclosure may be configured for multiplexing the output of an EVCS into several charging points, so more than one vehicle can potentially be charged at the same domestic EVCS. Also, devices other than cars can be charged in a "sharing economy" manner.

Accordingly, the present disclosure provides a pricing adapter configured to control a charging process between a domestic electric vehicle charging station (EVCS) and a vehicle to be charged, the adapter comprising: an inlet for connection to a domestic EVCS; one or more outlets configured for supplying electrical power to one or more vehicles; and a computing device configured to control a charging process through the supply of power from the inlet to the one or more outlets.

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The present disclosure also provides a method of charging an electric vehicle using the pricing adapter. The method comprises operating one or more processors of the adapter to: determine that a charging cable has been inserted into one of the outlets; lock the charging cable to the adapter; receive a signal from a user to initialise the charging process; measure the energy consumption; end the charging process prompt payment from the user based on the energy consumption; and release the charging cable once payment is effected.

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The pricing adapter may be configured as a single-input multiple-output (SIMO) device in which many outputs (sockets) are available to multiplex the single input from the charging station. A schematic for the case of two outputs is shown in Figure 1. Figure 1 is a schematic diagram of a pricing adapter 100 for domestic EVCS (not

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shown) having a single-input multiple-output (SIMO) configuration, according to an embodiment of the present disclosure. Referring to Figure 1, the pricing adapter 100 according to the present embodiment includes an inlet 103 for connection to a charging station, two outlets 105, a microcontroller 110, a user interface 115, an energy meter 120, a cable detector module 130, a near field communication (NFC) tag 155 with the ID of the pricing adapter 100 and a link to an application to access a web server 500, an input interrupter 160, an output switch 170, and two electromechanical locks 180. The locking mechanism may comprise a set of wire activated electronic locking solenoids (one per output), with manual override in case that the owner of the pricing adapter 100 requires to release it manually. This mechanism is based on the locking system available for the IEC 62196 Type 2 connector, but here is used also as a payment guarantee rather than a simple precautionary measure during the charging process. Additionally, the locking mechanism also prevents the theft of the charging cable while the vehicle owner is away.

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The pricing adapter 100 may be configured for connection to the Internet thus enabling online payment methods via a web server 500. In this regard, the adapter 100 may comprise a Wi-Fi adapter/shield 140. The pricing adapter 100 may also be configured for short range communication thus enabling a local payment method from, for example a smart device 600. In this regard, the pricing adapter 100 may comprise an NFC adapter/shield 150.

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A protocol may be established for the charging process between the charging station and the vehicle which involves active/constant communication between the charging station and the vehicle. The protocol may dictate that only one vehicle can be charged at any time; that is, no simultaneous multiplexing is allowed. Thus, a physical switching between the two outlets 105 has to be performed, so each outlet 105 of the pricing adapter 100 is configured to operate as a single-input single output (SISO) model for a constant period (duty time) defined by a (desired) fixed switching time.

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In a storyboard for the adapter according to the present disclosure, three scenarios may be envisaged, namely: I) No charging requests, II) One charging request, and III)

Two charging requests. These scenarios are illustrated in Figures 2a to 2c. Additionally, the flowchart in Figure 3 shows in more detail a process flow for the SIMO configuration of the pricing adapter 100. Referring to Figure 2a, the adapter 100 is attached to a charging station 200, waiting for a new user to insert their charging cable (CC). A power supply from the charging station 200 is disconnected until a charging request is triggered. Referring to Figure 2b, if only one outlet 105 is requesting charging, a feed from the charging station 200 is activated, and the corresponding outlet 105 is served using a SISO model. Referring to Figure 2c, if the two outlets 105 are requesting charging, a feed from the charging station 200 is activated, and both outlets 105 are intermittently served by switching the wiring from the charging station 200 according to a predefined switching time. This can be generalised for a plurality of outlets 105 as follows. If a plurality of outlets 105 request charging, a feed from the charging station 200 is activated, and the plurality of outlets 105 are intermittently served by switching the power supply from the charging station 200 according to a predefined switching time. Each outlet 105 may be monitored independently. For this, an independent set of inputs, outputs and variables is required. The wiring from the charging station 200 to be switched between the two outlets 105 may include not only power supply pins but also a post-insertion signalling pin (i.e. the control pilot). In the "Two charging requests" scenario, both outlets 105 may be configured to receive the same duty time in every period of $2 \cdot n \cdot \text{switchingTime}$, where $n = 1, 2, 3, \dots$, and such a duty time is equal to $n \cdot \text{switchingTime}$.

Figure 3 is a flowchart illustrating in detail a process flow for the single-input multiple-output (SIMO) configuration of the pricing adapter, according to an embodiment of the present disclosure. Referring to Figure 3, the microcontroller 110 checks to determine whether a charging request has been received 1010. A charging request may be determined by one or more charging cables being inserted into the one or more outlets 105. If the microcontroller 110 determines that one charging cable has been inserted in the adapter 100, a feed from the charging station 200 is enabled, and switching is disabled. If the microcontroller 110 determines that multiple charging cables have been inserted in the adapter 100, a feed from the charging station 200 is enabled, switching is enabled, and the multiple outlets are serviced according to a

switching time. The payment process and functionality are described below with reference to Figures 4 and 5.

The internal state of the pricing adapter 100 between switching times is a Single-
5 Input Single-Output (SISO) charging configuration. The SISO charging configuration of the adapter is a configuration in which the input connects with only one output at a given time (i.e., between switching times). The associated storyboard and flowchart for this configuration are illustrated in Figures 4 and 5. In this regard, Figures 4a to 4g
illustrate charging scenarios for the single-input single-output (SISO) configuration of
10 the adapter, according to embodiments of the present disclosure. For the storyboard of the SISO configuration of the adapter, seven stages may be identified, namely: I) Standby, II) New user arrival, III) Initialisation of the charging process, IV) Charging process, V) Finalisation of the charging process, VI) Payment, and VII) Departure of the served user.

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Firstly, referring to Figure 4a, in the standby stage, the adapter 100 is attached to the charging station 200, waiting for a new user to insert a charging cable 300. A message "Please insert a charging cable" may be shown on a display of the pricing adapter 100. Meanwhile, potential users can check on-line the location/status of existing
20 adapters registered on /connected to a dedicated webserver.

Referring to Figure 4b, in the new arrival stage, a new user arrives and inserts their charging cable 300 into a free outlet 105. Once the charging cable 300 is detected, the user is prompted to start the charging process (e.g. by pressing Start). The user can
25 remove the charging cable 300 before starting the charging process. In such a case, the adapter is configured to revert to the Stage I – Standby mode. Before pressing Start, the user may also select a charging policy of his/her interest, including, but not limited to: [1] Predefined charging time, so that the charging process will stop once such a time is reached and the pricing adapter 100 will automatically move to the payment stage. [2]
30 Predefined charging fee, so that the charging process will stop once such a fee is reached and then the pricing adapter 100 will automatically move to the payment stage. [3] On demand, in which the user will define the end of the charging process (e.g., by

pressing Stop). Additionally, the user may want to also select a premium service, including, but not limited to: [1] Prioritised charging, so that the user may have access to an increased duty time depending on the agreement to be charged with an increased rate. [2] Exclusive access, so that the user may prevent new users from accessing other
5 free outlets 105 of the pricing adapter 100.

Referring to Figure 4c, in the initialisation stage, if the charging process is initialised, the following happens: [1] the charging cable 300 is locked to the pricing adapter 100 through the corresponding lock 180. [2] The pricing adapter 100 then
10 activates the input's interrupter 160 and actuates the output's switch 170 so that the charging station 200 can start the charging process.

Referring to Figure 4d, in the charging stage, the charging station 200 starts charging the vehicle. The microcontroller 110 is configured to monitor energy
15 consumption and calculate the payment fee accordingly. The user can stop the charging process at any desired time by pressing a Stop button on the adapter 100.

Referring to Figure 4e, in the finalisation stage, if the charging process is ended (e.g. by pressing Stop), the following happens: [1] the pricing adapter 100 deactivates
20 the input interrupter 160 so that the charging station 200 and the charging cable 300 are disconnected inside the pricing adapter 100, and [2] a payment fee is displayed to the user on the user interface 115 of the pricing adapter 100.

Referring to Figure 4f, in the first part of the payment stage, the pricing adapter
25 100 displays the payment fee on the user interface 115, waits for a payment request (e.g., by pressing Pay), and keeps the charging cable 300 locked through the corresponding lock 180 until payment is effected.

Referring to Figure 4g, the user starts a payment request, e.g., by pressing Pay.
30 The pricing adapter 100 may first check if an online payment was made, for example through an application with access to the web server 500. If not, a local payment procedure may be activated for a while so that the user can provide the corresponding

payment method (e.g., credit/debit/membership card). Only if the payment is accepted, does the pricing adapter 100 release the corresponding lock 180 and liberates the charging cable 300. Otherwise, the charging cable 300 stays attached to the pricing adapter 100 through the corresponding lock 180 as payment guarantee.

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Referring to Figure 4h, in the departure stage, when payment has been effected, and the charging cable 300 has been released by deactivating the corresponding lock 180, the served user removes the charging cable 300, and the pricing adapter 100 reverts to the Stage I – Standby mode.

10

The pricing adapter 100 may be configured to be connected to the Internet through the internal WiFi shield/adapter 140 and a WiFi modem 142 available at the location of the charging station 200. Thus, variables of interest of the pricing adapter 100 (e.g., location, state, current consumption, etc.) can be accessed on-line depending on the user profile (e.g. admin, user). However, in the case of connection issues, the pricing adapter 100 may be configured to provide alternative means to some functionalities, for example local payment methods via the NFC modules illustrated in Figure 1.

15

Physical Start/Stop buttons on the pricing adapter 100 may not be the only ways to start/end the charging process. For example, virtual Start/Stop buttons in a dedicated application could also enable the same functionality. This also applies to a physical Pay button at the pricing adapter 100, which can have its virtual version in a dedicated application. In the case of an unsuccessful payment process, the charging cable 300 remains locked to the pricing adapter 100 through the corresponding lock 180 until any of two things happen:

25

- the user provides an (alternative) valid payment method, or
- the owner of the pricing adapter 100 unblocks it manually, for example, as a contingency option.

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Figure 5 illustrates a flow chart of a SISO charging model of the pricing adapter according to embodiments of the present disclosure. The flowchart of Figure 5 is an algorithmic description of the storyboard, as described above in relation to Figures 4a to

4h, which provides more detailed information about the use of the adapter. Referring to Figure 5, the following are inputs, outputs and variables:

- **INPUTS:** actions directly triggered by the user (pushing buttons, providing a valid payment method, etc.), or related to user actions (plugging the charging cable, etc.).

- **OUTPUTS:** actions performed by the pricing adapter (locking the charging cable, allowing the releasing of energy to the vehicle, etc.).

- **VARIABLES:** used to represent/manage quantities of interest (energy consumption, payment fee, etc.).

Referring to Figure 5, the microcontroller 110 checks to determine whether a charging request has been received. A charging request may be determined by a charging cable being inserted into one of the outlets 105. If it is determined that a charging request has been received, the microcontroller 110 determines whether a charging cable has been inserted in the adapter 2010. If the microcontroller 110 determines that one charging cable has been inserted in the pricing adapter 100, the user is prompted to start the charging process (e.g. by pressing Start) 2020. Before pressing Start, the user may also select a charging policy of his/her interest, as described above in relation to Figures 4a to 4h. If the charging process is initialised, the charging cable 300 is locked to the pricing adapter 100 and the charging station 200 starts the charging process 2030. The microcontroller 110 is configured to monitor energy consumption and calculate the payment fee accordingly 2040. The user can stop the charging process at any desired time by pressing a Stop button 2050 on the pricing adapter 100. If the charging process is ended (e.g. by pressing Stop), the following happens: [1] the pricing adapter 100 deactivates the input interrupter 160 so that the charging station 200 and the charging cable 300 are disconnected inside the pricing adapter 100, and [2] a payment fee is displayed to the user 2060 on the user interface 115 of the pricing adapter 100. The pricing adapter 100 displays 2060 the payment fee on the user interface 115, waits for a payment request (e.g., by pressing Pay), and keeps the charging cable 300 locked through the corresponding lock 180 until payment is effected. The user starts a payment request, e.g., by pressing Pay. Only if the payment is effected, does the pricing adapter 100 release the corresponding lock 180 and liberates the charging cable 300. Otherwise,

the charging cable 300 stays attached to the pricing adapter 100 through the corresponding lock 180 as payment guarantee. In the departure stage, when payment has been effected, and the charging cable 300 has been released by deactivating the corresponding lock 180, the served user removes the charging cable 300, and the pricing
5 adapter 100 reverts to the Stage I – Standby mode 2070.

Figure 6 is a block diagram illustrating a configuration of a pricing adapter 900 which includes various hardware and software components that function to perform charging processes according to the present disclosure. The pricing adapter 900
10 corresponds to the pricing adapter 100 of Figure 1, but with other components shown for extra explanation in Figure 6. Referring to Figure 6, the computing device 900 comprises a user interface 910, a processor 920 in communication with a memory 950, and a communication interface 930. The processor 920 functions to execute software instructions that can be loaded and stored in the memory 950. The processor 920 may
15 include a number of processors, a multi-processor core, or some other type of processor, depending on the particular implementation. The memory 950 may be accessible by the processor 920, thereby enabling the processor 920 to receive and execute instructions stored on the memory 950. The memory 950 may be, for example, a random access memory (RAM) or any other suitable volatile or non-volatile computer readable storage
20 medium. In addition, the memory 950 may be fixed or removable and may contain one or more components or devices such as a hard drive, a flash memory, a rewritable optical disk, a rewritable magnetic tape, or some combination of the above.

One or more software modules 960 may be encoded in the memory 950. The
25 software modules 960 may comprise one or more software programs or applications having computer program code or a set of instructions configured to be executed by the processor 920. Such computer program code or instructions for carrying out operations for aspects of the systems and methods disclosed herein may be written in any combination of one or more programming languages.

30

The software modules 960 may include at least a first application 961 and a second application 962 configured to be executed by the processor 920. During

execution of the software modules 960, the processor 920 configures the computing device 900 to perform various operations relating to the embodiments of the present disclosure, as has been described above.

5 Other information and/or data relevant to the operation of the present systems and methods, such as a database 970, may also be stored on the memory 950. The database 970 may contain and/or maintain various data items and elements that are utilized throughout the various operations of the system described above. It should be noted that although the database 970 is depicted as being configured locally to the computing
10 device 900, in certain implementations the database 970 and/or various other data elements stored therein may be located remotely. Such elements may be located on a remote device or server - not shown, and connected to the computing device 900 through a network in a manner known to those skilled in the art, in order to be loaded into a processor and executed.

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Further, the program code of the software modules 960 and one or more computer readable storage devices (such as the memory 950) form a computer program product that may be manufactured and/or distributed in accordance with the present disclosure, as is known to those of skill in the art.

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The communication interface 940 is also operatively connected to the processor 920 and may be any interface that enables communication between the computing device 900 and other devices, machines and/or elements. The communication interface 940 is configured for transmitting and/or receiving data. For example, the
25 communication interface 940 may include but is not limited to a Bluetooth, or cellular transceiver, a satellite communication transmitter/receiver, an optical port and/or any other such, interfaces for wirelessly connecting the computing device 900 to the other devices.

30 The user interface 910 is also operatively connected to the processor 920. The user interface may comprise one or more input device(s) such as switch(es), button(s), key(s), and a touchscreen.

The user interface 910 functions to facilitate the capture of commands from the user such as an on-off commands or settings related to operation of the system described above. The user interface 910 may function to issue remote instantaneous
5 instructions on images received via a non-local image capture mechanism.

A display 912 may also be operatively connected to the processor 920. The display 912 may include a screen or any other such presentation device that enables the user to view various options, parameters, and results. The display 912 may be a digital
10 display such as an LED display. The user interface 910 and the display 912 may be integrated into a touch screen display.

The operation of the computing device 900 and the various elements and components described above will be understood by those skilled in the art with
15 reference to the method and system according to the present disclosure.

The present disclosure is not limited to the embodiment(s) described herein but can be amended or modified without departing from the scope of the present disclosure. Additionally, it will be appreciated that in embodiments of the present disclosure some
20 of the above-described steps may be omitted and/or performed in an order other than that described.

Similarly the words comprises/comprising when used in the specification are used to specify the presence of stated features, integers, steps or components but do not
25 preclude the presence or addition of one or more additional features, integers, steps, components or groups thereof.

Claims

1. A pricing adapter configured to control a charging process between a domestic electric vehicle charging station (EVCS) and a vehicle to be charged, the adapter comprising:
5 an inlet for connection to a domestic EVCS;
one or more outlets configured for supplying electrical power to one or more vehicles; and
a computing device configured to control a charging process through the supply of power from the inlet to the one or more outlets.
10
2. The adapter of claim 1, being configured to interface between an EVCS and a charging cable of an electric vehicle.
3. The adapter of any preceding claim, wherein each of the one or more
15 outlets comprises a socket for receiving a charging cable of an electric vehicle.
4. The adapter of any preceding claim, wherein the computing device is configured to determine at least one of:
the state of the charging process;
20 the amount of energy consumed; and
the charging fees to be paid based on the energy consumption.
5. The adapter of any preceding claim, wherein the computing device is configured to detect one or more charging cables inserted into the one or more
25 outlets.
6. The adapter of any preceding claim, wherein the computing device is configured to prevent a power supply feed from the charging station until a charging cable has been detected.
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7. The adapter of claim 5 or 6, being configured to lock the charging cable to the adapter on detection of the charging cable.

8. The adapter of any preceding claim, being configured to adapt a charging policy of interest to the user upon receipt of a charging policy signal from a user at a user interface of the adapter .
- 5
9. The adapter of claim 8, wherein the charging policy comprises a predefined charging time policy, a predefined charging fee policy, an on demand policy, a prioritised charging policy, or an exclusive access policy.
- 10
10. The adapter of claim 8 or 9, wherein, after a charging policy is selected, the computing device is configured to initialise the charging process upon receipt of a start signal from a user at a user interface of the adapter.
11. The adapter of any preceding claim, wherein the computing device is configured to end a charging process upon receipt of a stop signal from a user at a user interface of the adapter.
- 15
12. The adapter of any preceding claim, wherein the computing device is configured to prompt the user for a payment request upon completion of a charging process.
- 20
13. The adapter of claim 12, being configured to release the charging cable when payment is effected.
- 25
14. The adapter of any preceding claim, being configured to manually release the charging cable upon intervention of an administrator of the adapter.
15. The adapter of claim 13 or 14, being configured to revert to a standby mode when the charging cable is released.
- 30

16. The adapter of any preceding claim, having a single-input multiple-output (SIMO) configuration, comprising a plurality of outlets to enable more than one vehicle to be charged from a single charging point.
- 5 17. The adapter of claim 16, comprising two outlets.
18. The adapter of claim 16 or 17, wherein, if a plurality of outlets request charging, a power supply feed from the charging station is activated, and the plurality of outlets are intermittently served by switching the power supply from
10 the charging station according to a predefined switching time.
19. The adapter of any of claims 1 to 15, having a single-input single output (SISO) configuration comprising a single outlet to enable one vehicle to be charged from a single charging point.
- 15 20. The adapter of any preceding claim, being configured for connection to the Internet thus enabling online payment methods.
21. The adapter of claim 20, comprising a Wi-Fi adapter.
- 20 22. The adapter of any preceding claim, being configured for short range communication thus enabling a local payment method.
23. The adapter of claim 22, comprising a near field communication (NFC)
25 module.
24. The adapter of any preceding claim, being configured to be fixedly attached to the EVCS so that external users are unable to directly access the EVCS without using the pricing adapter.
- 30

25. A method of charging an electric vehicle using the pricing adapter of any preceding claim, comprising operating one or more processors of the adapter to:
- 5 determine that a charging cable has been inserted into one of the outlets;
lock the charging cable to the adapter;
receive a signal from a user to initialise the charging process;
measure the energy consumption;
end the charging process;
prompt payment from the user based on the energy consumption; and
release the charging cable once payment is effected.
- 10

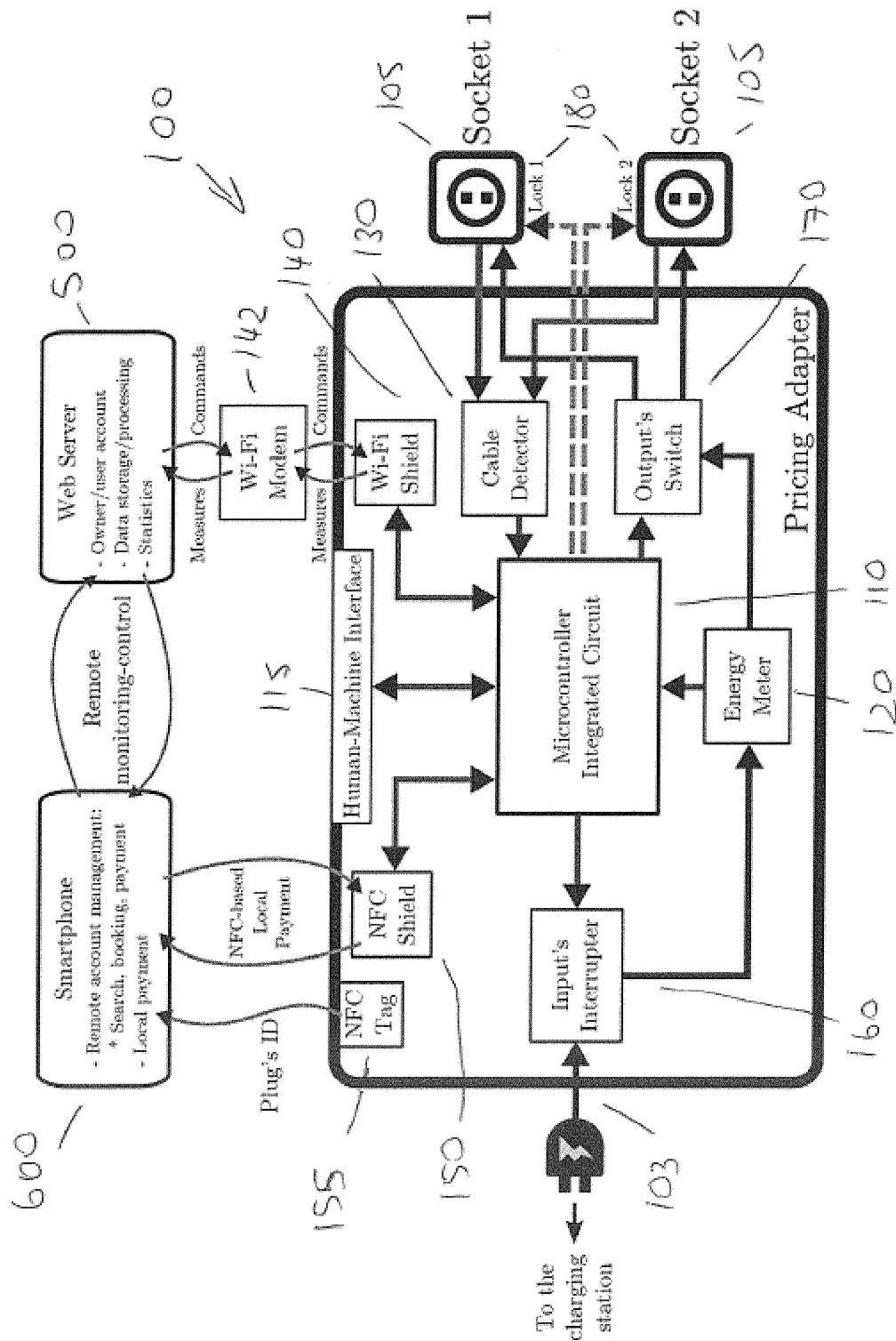


Figure 1

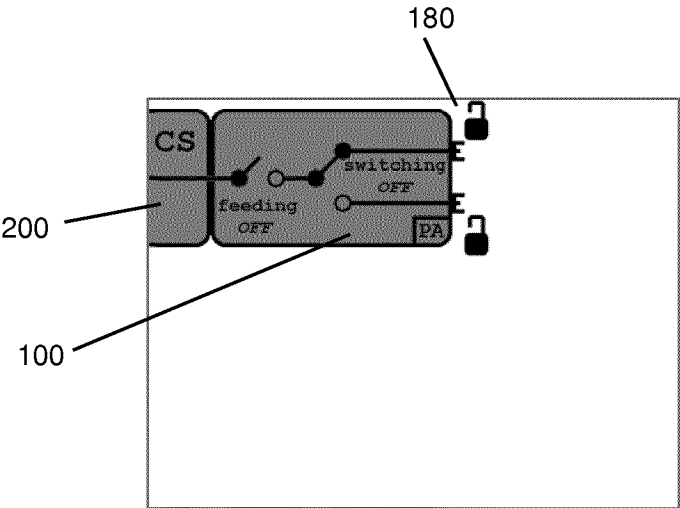


Figure 2a

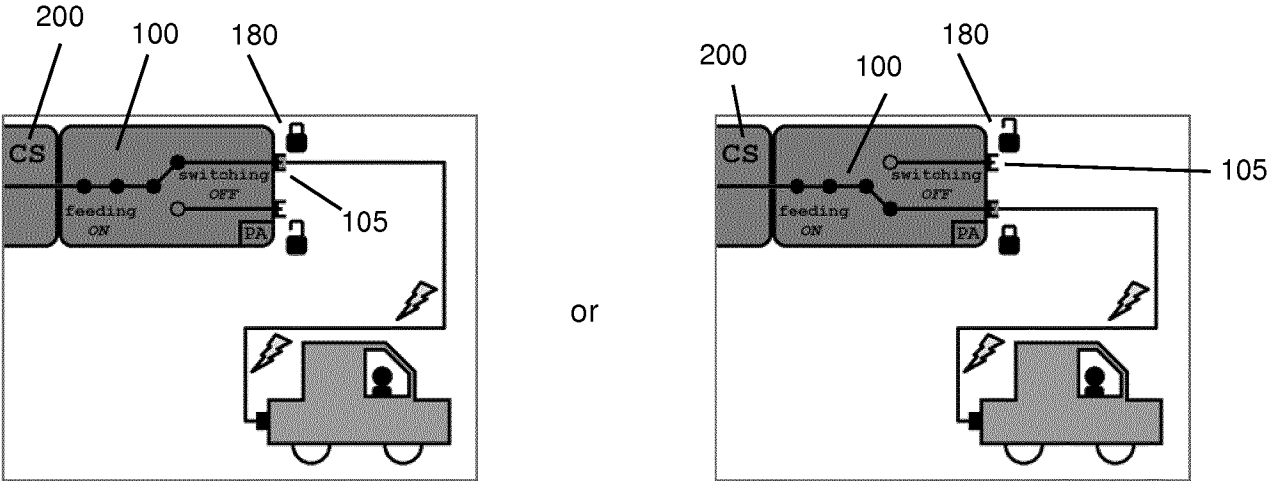


Figure 2b

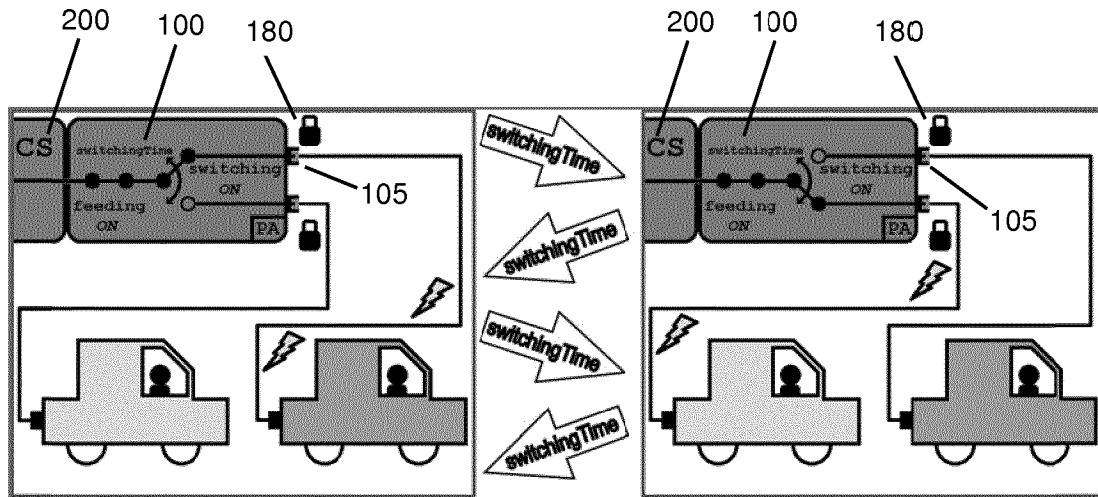


Figure 2c

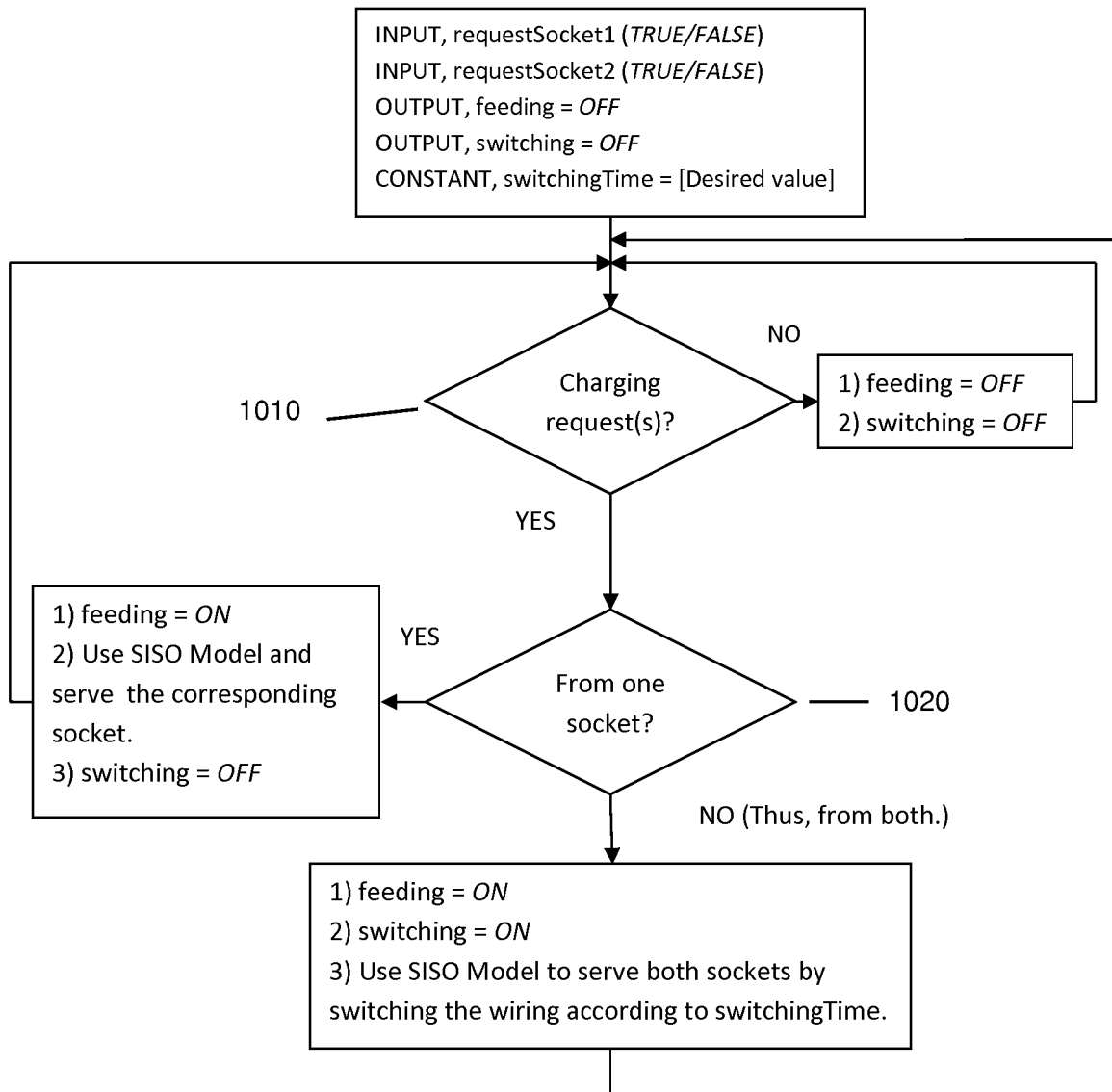


Figure 3

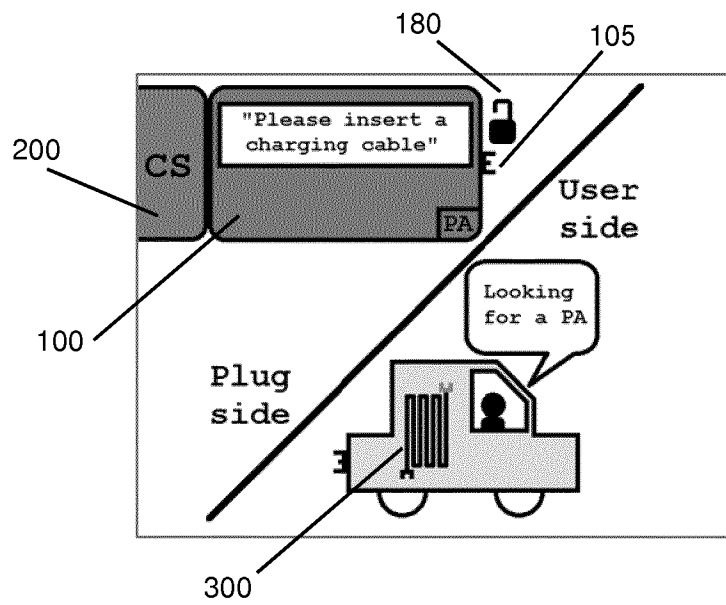


Figure 4a

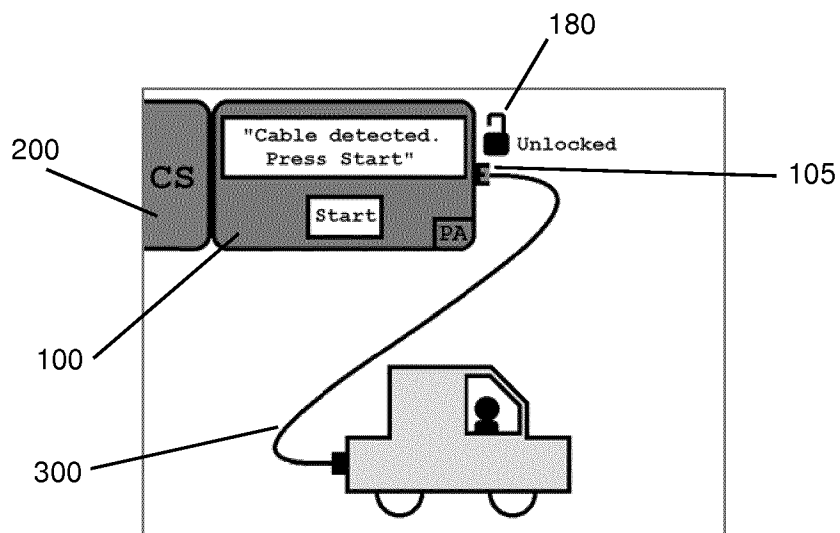


Figure 4b

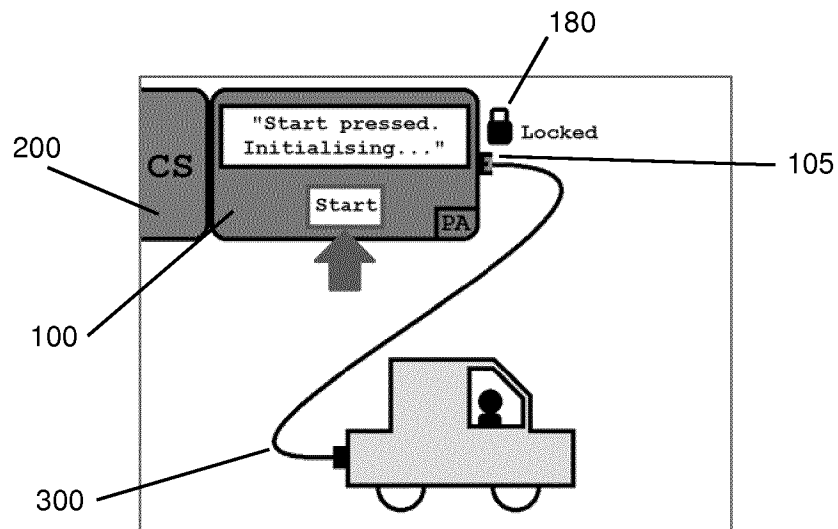


Figure 4c

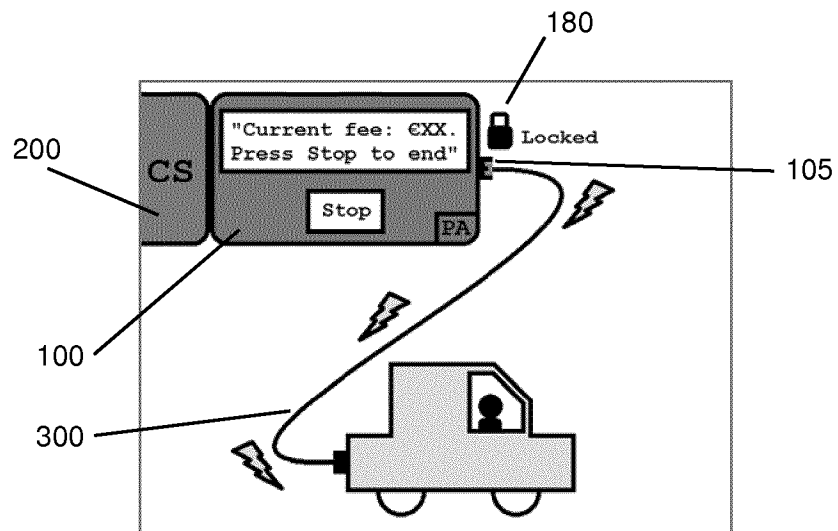


Figure 4d

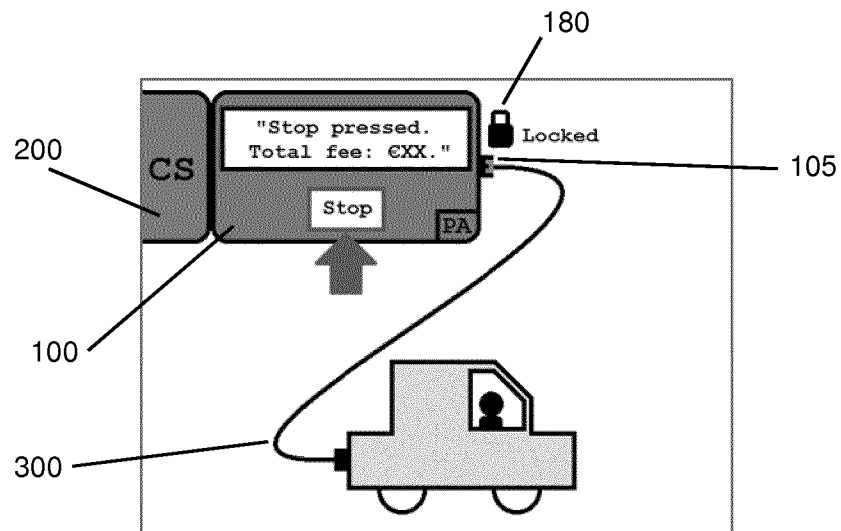


Figure 4e

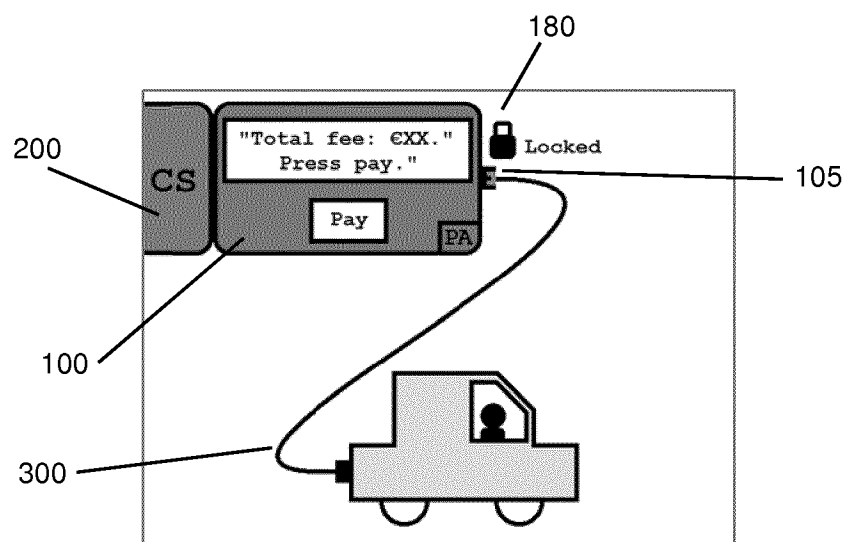


Figure 4f

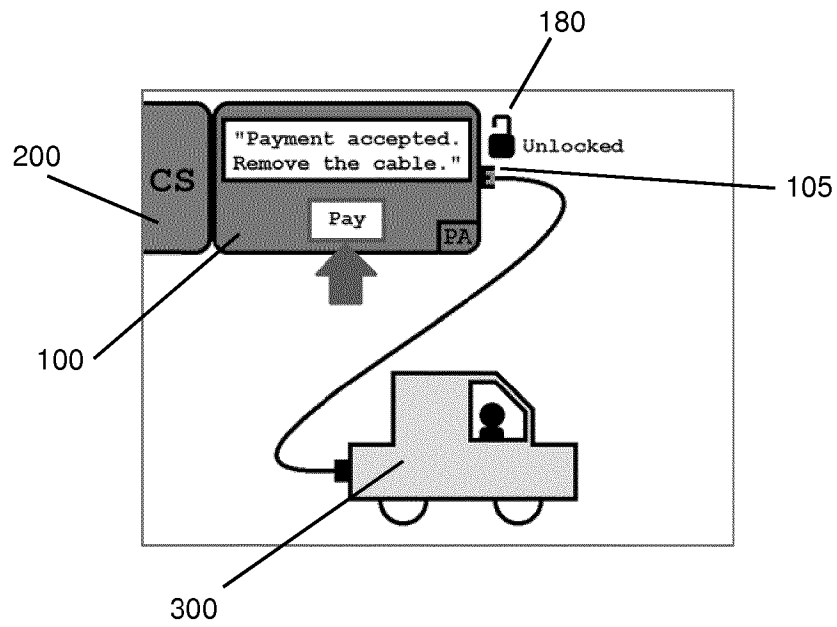


Figure 4g

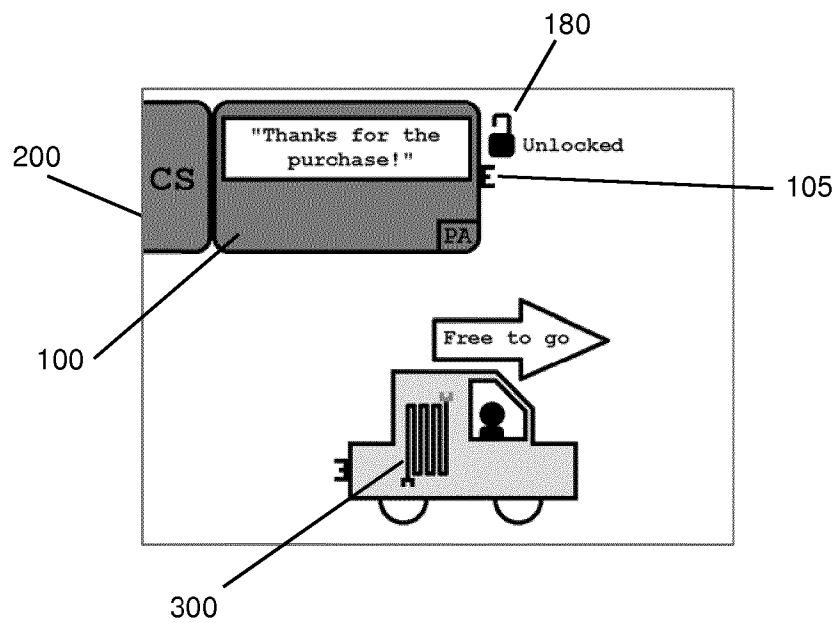


Figure 4h

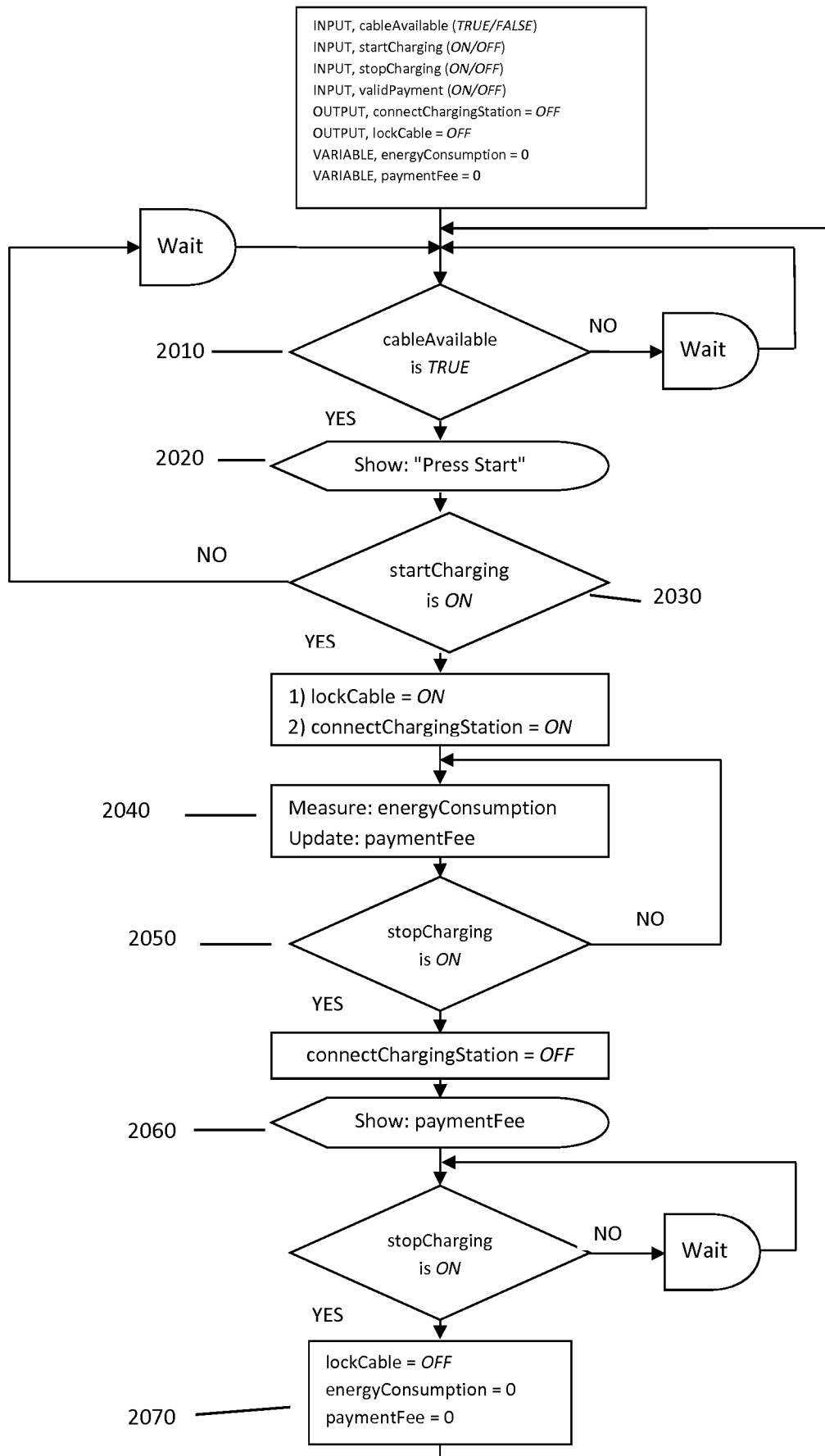


Figure 5

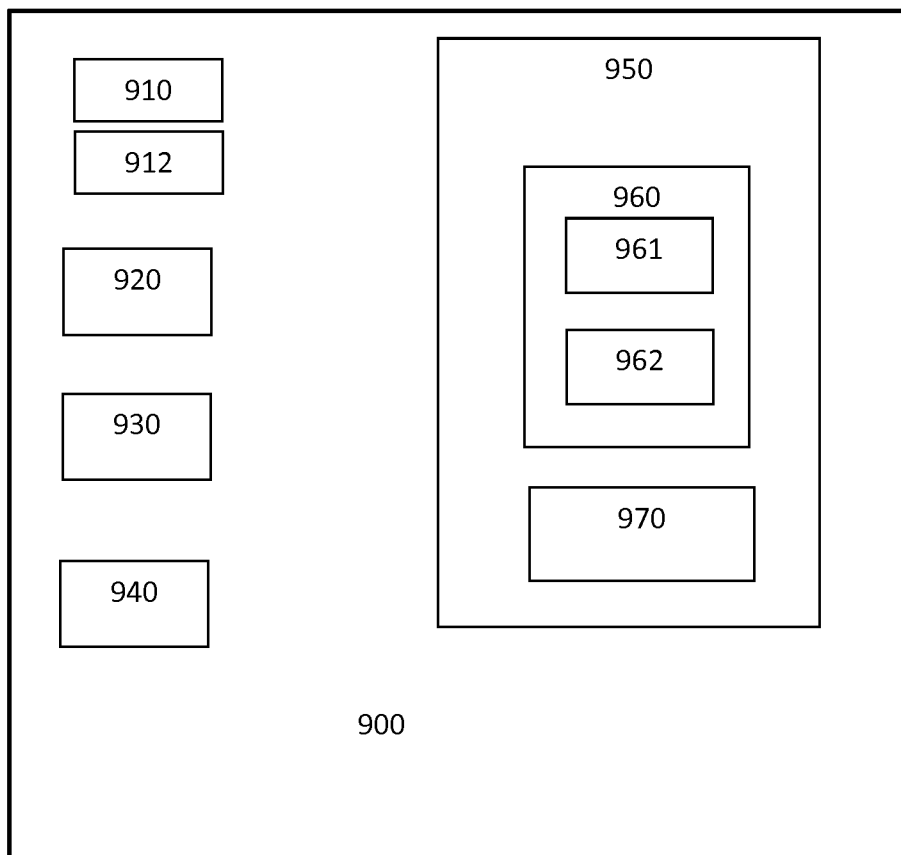


Figure 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/084238

A. CLASSIFICATION OF SUBJECT MATTER

INV. B60L11/18

ADD. G06Q50/06 G07F15/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B60L G06Q G07F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 156 978 A2 (SAN DIEGO GAS & ELECTRIC CO [US]) 24 February 2010 (2010-02-24)	1-12, 14-25
Y	paragraph [0009] paragraphs [0023] - [0034]; figure 1 paragraphs [0035] - [0040]; figure 2 paragraphs [0098] - [0100]; figure 7 -----	13
X	EP 2 711 888 A1 (SONY CORP [JP]) 26 March 2014 (2014-03-26)	1,2, 6-13,15, 19-25
Y	paragraphs [0090] - [0095]; figure 6 paragraphs [0096] - [0109]; figure 7 paragraphs [0121] - [0122]; figure 10 -----	13
X	ES 2 400 524 A2 (NOMANTICA S L [ES]) 10 April 2013 (2013-04-10) the whole document ----- -/-	1-10,14, 16-21,25



Further documents are listed in the continuation of Box C.



See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search

13 March 2018

Date of mailing of the international search report

22/03/2018

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Authorized officer

Spicq, Alexandre

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2017/084238

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	AT 507 605 A1 (SAUPER ECKHARD DIPL ING [AT]) 15 June 2010 (2010-06-15) the whole document -----	1-25
A	ES 2 382 742 A1 (MARTIN DE BUSTOS DAVID [ES]) 13 June 2012 (2012-06-13) the whole document -----	1-25

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2017/084238

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