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(54) **ELECTRIC VEHICLE CHARGING STATION MOBILE DEVICE PAYMENT SYSTEM**

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G06Q 20/42	(2012.01)
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(52) **U.S. Cl.**

CPC ***G06Q 20/40*** (2013.01); ***G06Q 20/145*** (2013.01); ***G06Q 20/3276*** (2013.01); ***G06Q 20/401*** (2013.01); ***G06Q 20/425*** (2013.01); ***G07F 15/005*** (2013.01); *Y02T 90/12* (2013.01); *Y02T 90/128* (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

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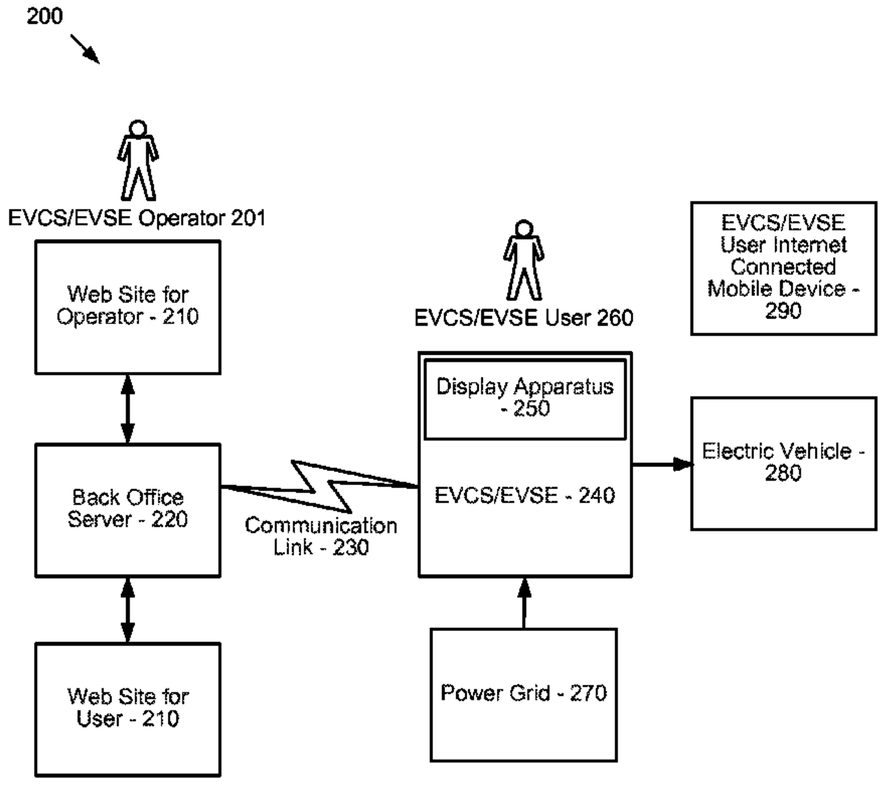
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(57) **ABSTRACT**

Disclosed herein are representative embodiments of methods, apparatus, and systems for a mobile device payment system for electric vehicle charging stations ("EVCSs") or electric vehicle supply equipment ("EVSE"). This system can be used to control the access to EVCS or EVSE and to ensure proper billing for the use of EVCS or EVSE.

14 Claims, 7 Drawing Sheets



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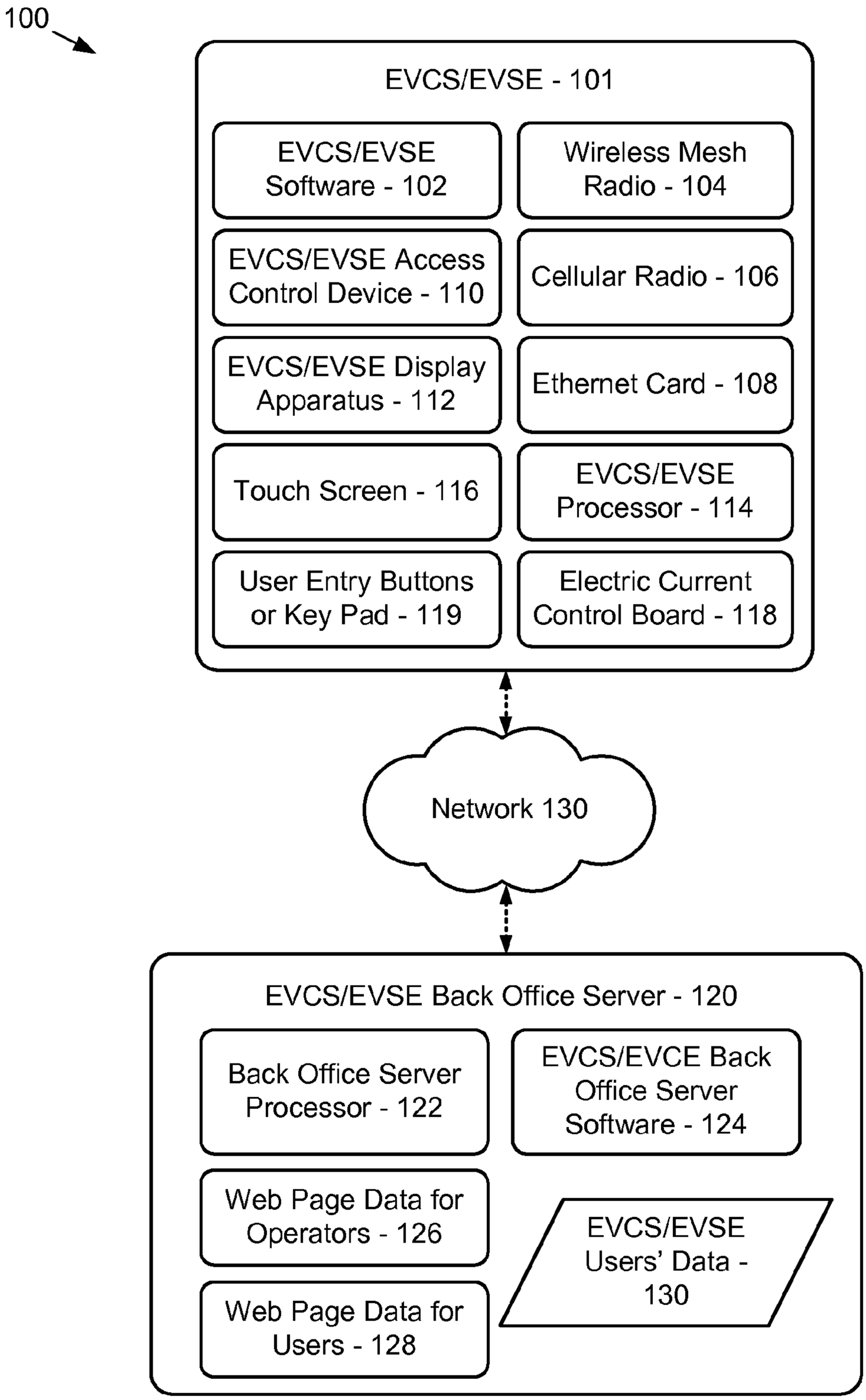

100
EVCS/EVSE - 101
EVCS/EVSE Software - 102
Wireless Mesh Radio - 104
EVCS/EVSE Access Control Device - 110
Cellular Radio - 106
EVCS/EVSE Display Apparatus - 112
Ethernet Card - 108
Touch Screen - 116
EVCS/EVSE Processor - 114
User Entry Buttons or Key Pad - 119
Electric Current Control Board - 118
Network 130
EVCS/EVSE Back Office Server - 120
Back Office Server Processor - 122
EVCS/EVCE Back Office Server Software - 124
Web Page Data for Operators - 126
EVCS/EVSE Users' Data - 130
Web Page Data for Users - 128

FIG. 1

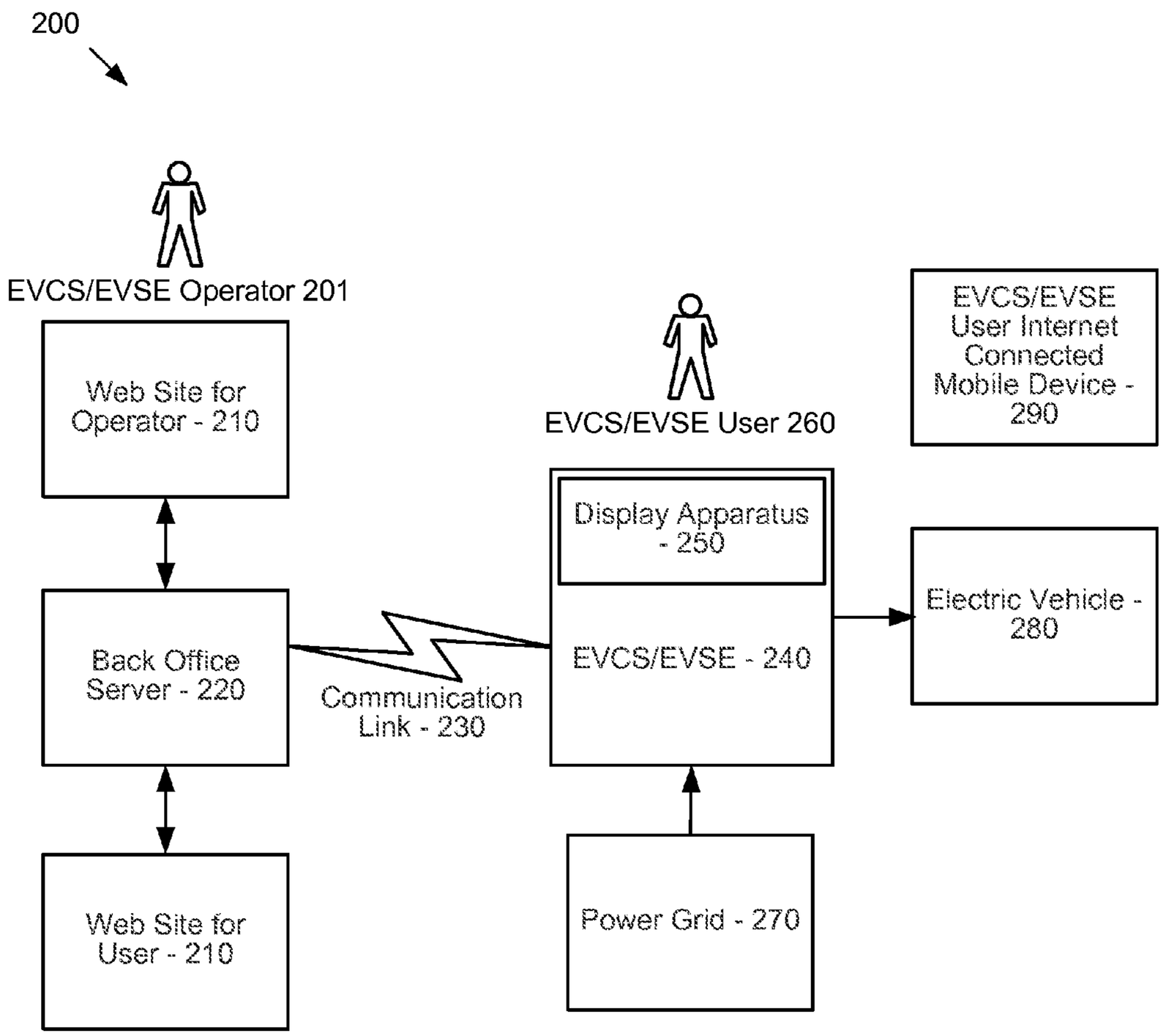

200
EVCS/EVSE Operator 201
Web Site for Operator - 210
Back Office Server - 220
Communication Link - 230
Web Site for User - 210
EVCS/EVSE User 260
Display Apparatus - 250
EVCS/EVSE - 240
Power Grid - 270
EVCS/EVSE User Internet Connected Mobile Device - 290
Electric Vehicle - 280

FIG. 2

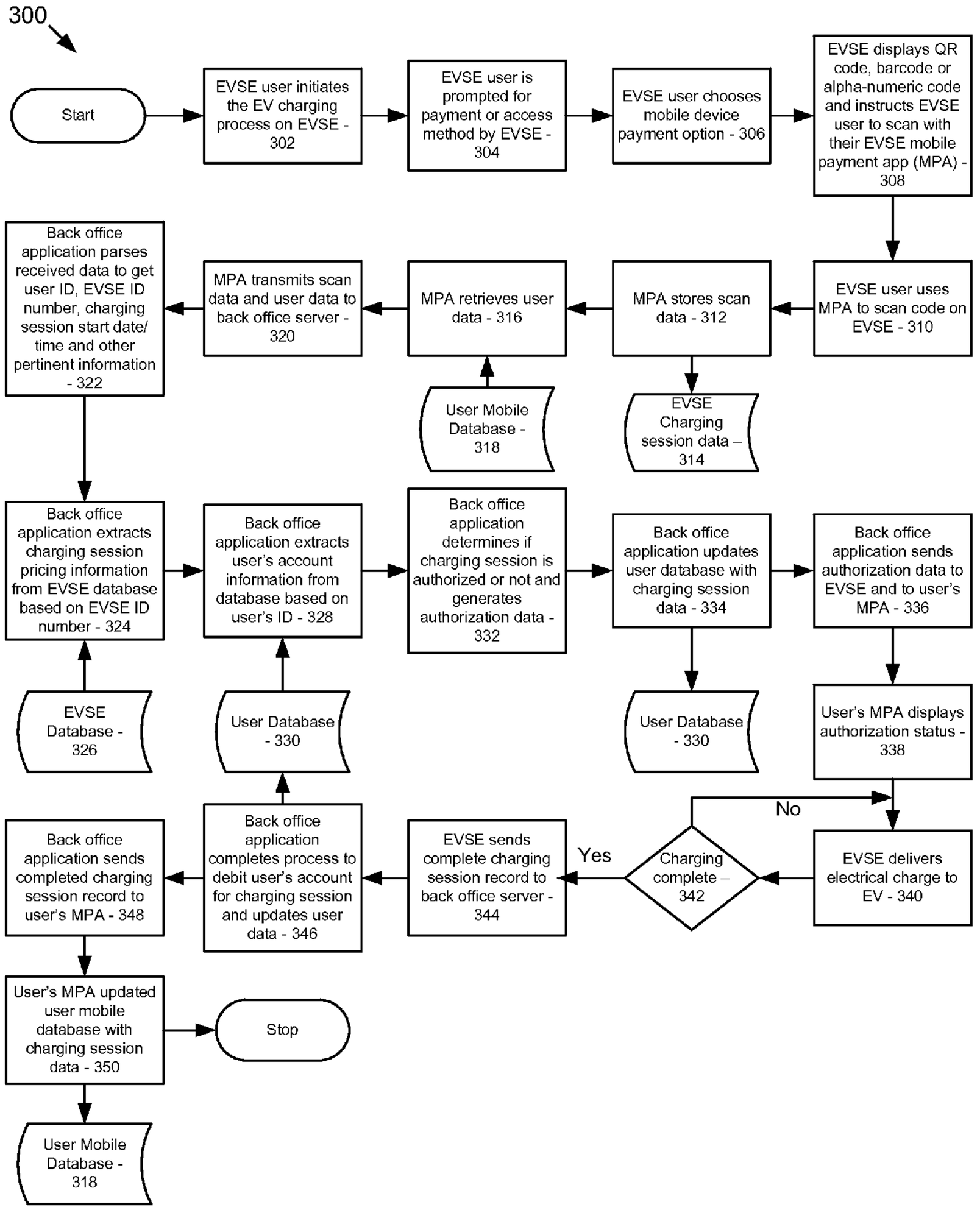

300
Start
EVSE user initiates the EV charging process on EVSE - 302
EVSE user is prompted for payment or access method by EVSE - 304
EVSE user chooses mobile device payment option - 306
EVSE displays QR code, barcode or alpha-numeric code and instructs EVSE user to scan with their EVSE mobile payment app (MPA) - 308
EVSE user uses MPA to scan code on EVSE - 310
MPA stores scan data - 312
EVSE Charging session data – 314
MPA retrieves user data - 316
User Mobile Database - 318
MPA transmits scan data and user data to back office server - 320
Back office application parses received data to get user ID, EVSE ID number, charging session start date/ time and other pertinent information - 322
Back office application extracts charging session pricing information from EVSE database based on EVSE ID number - 324
EVSE Database - 326
Back office application extracts user's account information from database based on user's ID - 328
User Database - 330
Back office application determines if charging session is authorized or not and generates authorization data - 332
Back office application updates user database with charging session data - 334
User Database - 330
Back office application sends authorization data to EVSE and to user's MPA - 336
User's MPA displays authorization status - 338
EVSE delivers electrical charge to EV - 340
Charging complete – 342
No
Yes
EVSE sends complete charging session record to back office server - 344
Back office application completes process to debit user's account for charging session and updates user data - 346
Back office application sends completed charging session record to user's MPA - 348
User's MPA updated user mobile database with charging session data - 350
Stop
User Mobile Database - 318

FIG. 3

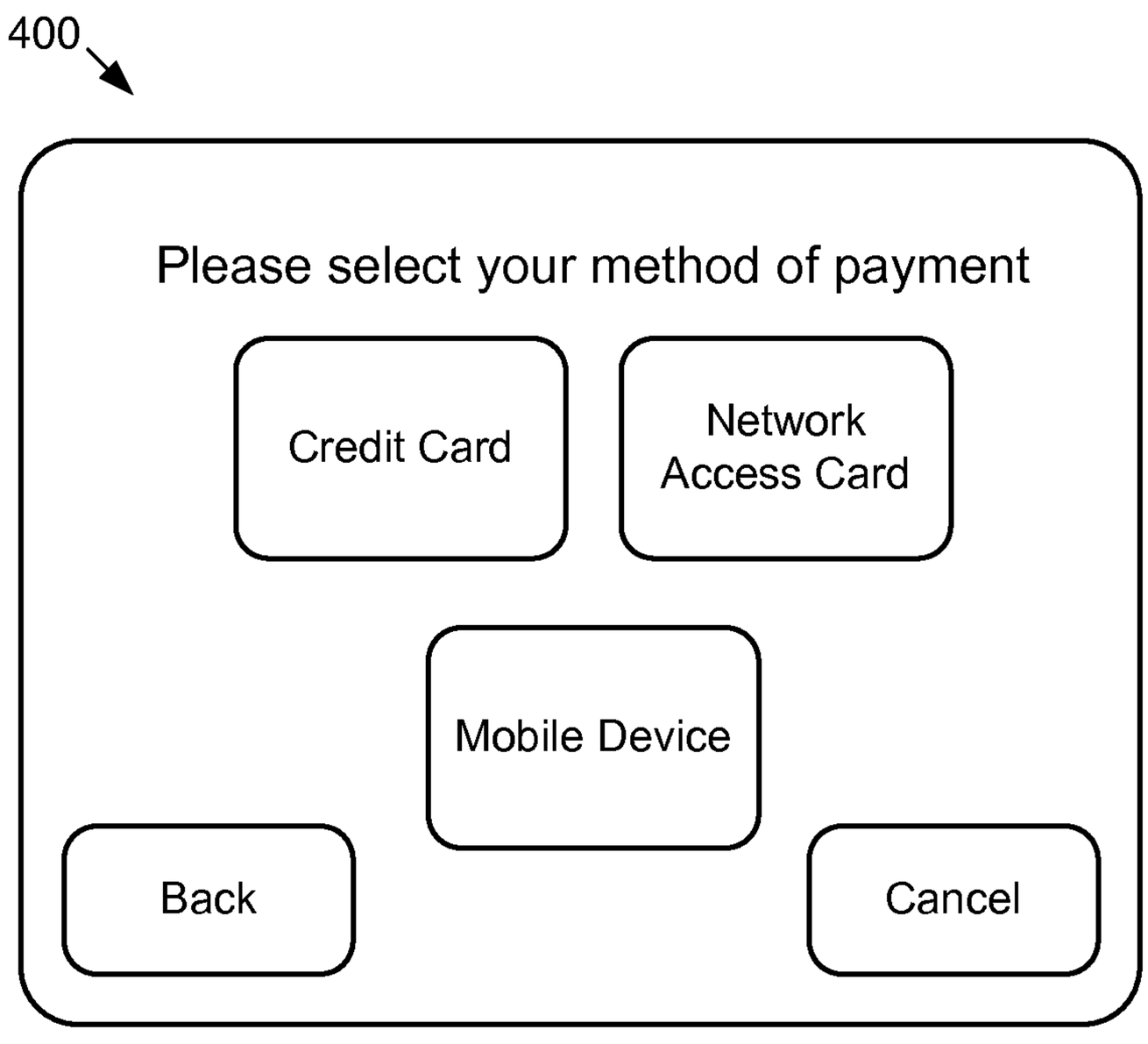

400
Please select your method of payment
Credit Card
Network Access Card
Mobile Device
Back
Cancel

FIG. 4

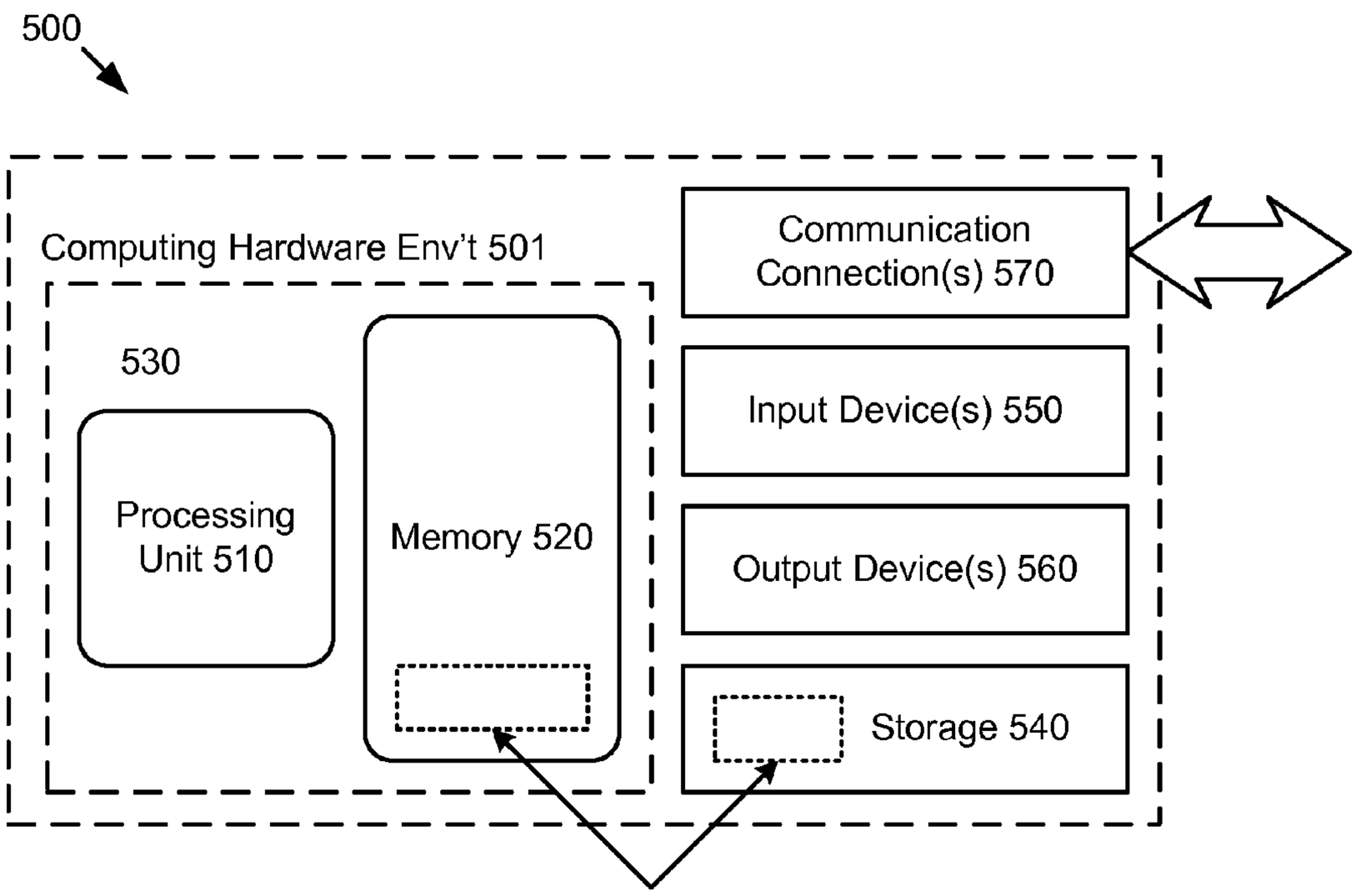
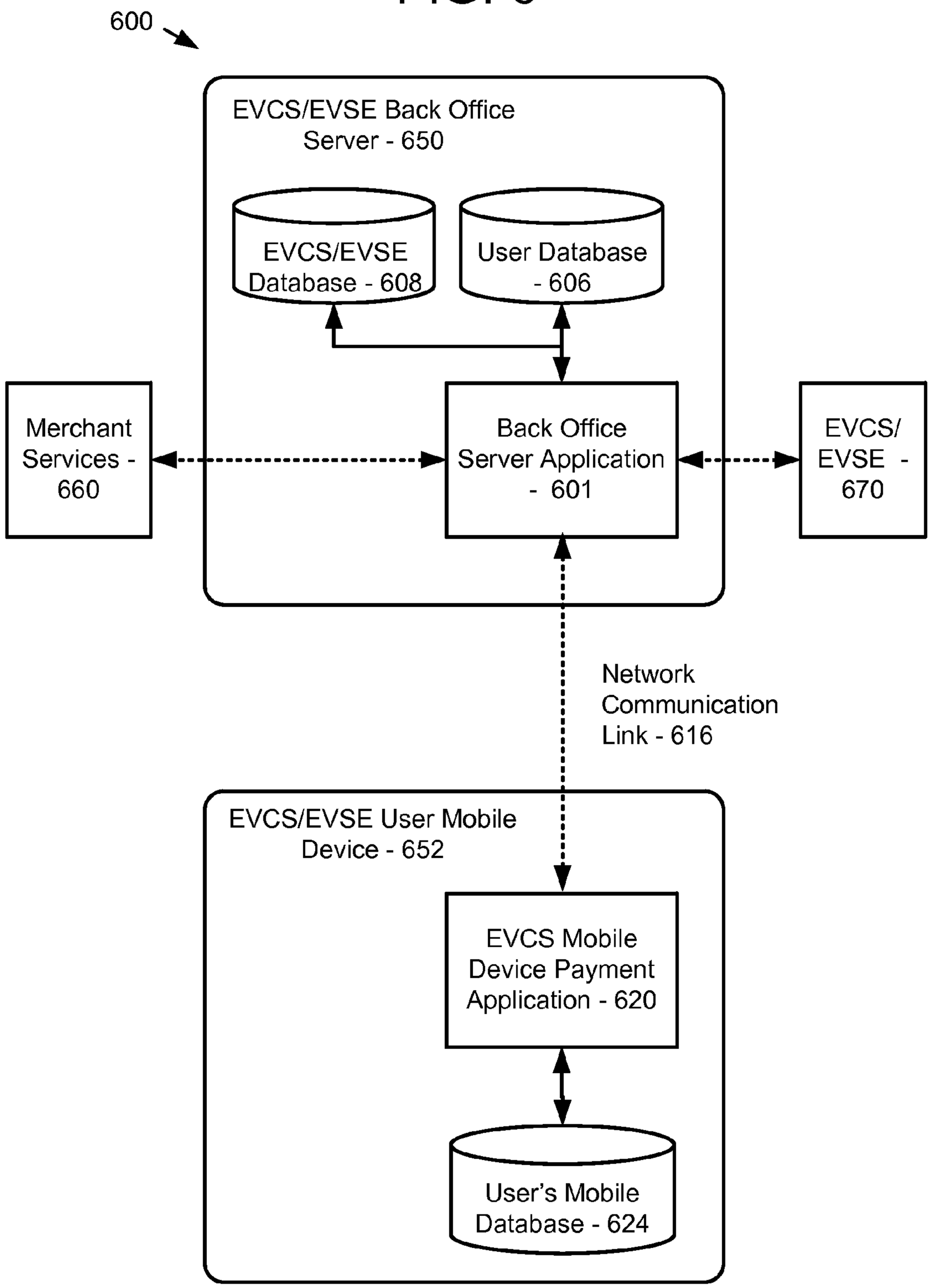

500
Computing Hardware Env't 501
530
Processing Unit 510
Memory 520
Communication Connection(s) 570
Input Device(s) 550
Output Device(s) 560
Storage 540
Software 580 for implementing disclosed electric vehicle charging methods, mobile device methods, or back room server methods

FIG. 5

FIG. 6


600
EVCS/EVSE Back Office Server - 650
EVCS/EVSE Database - 608
User Database - 606
Merchant Services - 660
Back Office Server Application - 601
EVCS/ EVSE - 670
Network Communication Link - 616
EVCS/EVSE User Mobile Device - 652
EVCS Mobile Device Payment Application - 620
User's Mobile Database - 624


700
Please scan the code below with your mobile device payment app in order to authorize charging session:
Back
Cancel

FIG. 7

ELECTRIC VEHICLE CHARGING STATION MOBILE DEVICE PAYMENT SYSTEM

CROSS REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. Provisional Application No. 61/694,647, filed on Aug. 29, 2012, and entitled "ELECTRIC VEHICLE CHARGING STATION MOBILE DEVICE PAYMENT SYSTEM", which is hereby incorporated herein by reference.

FIELD

This application relates to electric vehicle charging stations and associated systems.

SUMMARY

Disclosed below are representative embodiments of methods, apparatus, and systems relating to a mobile device payment system for electric vehicle charging stations ("EVCSs") and electric vehicle supply equipment ("EVSE"). The disclosed methods, apparatus, and systems should not be construed as limiting in any way. Instead, the present disclosure is directed toward all novel and nonobvious features and aspects of the various disclosed embodiments, alone and in various combinations and subcombinations with one another. The disclosed methods, apparatus, and systems are not limited to any specific aspect or feature or combination thereof, nor do the disclosed embodiments require that any one or more specific advantages be present or problems be solved. Furthermore, any features or aspects of the disclosed embodiments can be used in various combinations and subcombinations with one another.

Among the embodiments disclosed herein are electric vehicle charging station systems that control access to and payment for the use of the charging stations via mobile devices. Embodiments of the disclosed technology can be used to improve the basic process of connecting an electric vehicle to the power grid with an EVCS/EVSE for charging purposes by using mobile device payments to eliminate the need to carry credit/debit cards, club cards, radio frequency identification ("RFID") devices or some other access control device. Certain embodiments of the disclosed technology comprise an access control and payment system that uses a customer's existing mobile device and a display apparatus on the EVCS/EVSE. In certain situations, at the time the driver plugs their EV in to receive an electrical charge, unless it is a fixed price session, the price of the charging session will not be known. Therefore, in some embodiments of the disclosed technology, the charging system accommodates scenarios in which the cost of the service is known or unknown at the time of authorization.

Certain embodiments of the disclosed technology are built around a mobile device app running on the EV driver's Internet-connected mobile device. One or more of the following components can make up the system:

- An application running on the EV driver's mobile device that includes a login feature that the EV driver can use to authenticate their identity to the application by entering a login ID and password, or some other method to uniquely identify themselves. This application will hereinafter be referred to as the EVSE mobile device payment app ("MPA");
- An EVSE that includes Internet connectivity
- A display apparatus on the EVSE that displays either a Quick Response ("QR") Code, bar code, or alpha-numeric code that can be scanned by the MPA;
- A back-office software system that allows EV divers to create accounts that are linked to their credit card or debit card or a bank account for the purpose of paying for EV charging.

Embodiments of the disclosed systems and methods can be implemented using computing hardware, such as a computer processor embedded in the EVCS/EVSE and/or a mobile computing device. For example, embodiments of the disclosed methods can be performed using software stored on one or more non-transitory computer-readable media (e.g., one or more optical media discs, volatile memory components (such as DRAM or SRAM), or nonvolatile memory or storage components (such as hard drives)). Such software can be executed by a computer processor embedded in the EVCS/EVSE, a computer processor in a mobile device (such as a smart phone, tablet computer, or the like), or by one or more computers coupled to the EVCS/EVSE by a network (e.g., via the Internet, a wide-area network, a local-area network, a client-server network, or other such network). Embodiments of the disclosed methods can also be performed by specialized computing hardware (e.g., one or more application specific integrated circuits ("ASICs") or programmable logic devices (such as field programmable gate arrays ("FPGAs")) configured to perform any of the disclosed methods). Additionally, any intermediate or final result created or modified using any of the disclosed methods can be stored on a non-transitory storage medium (e.g., one or more optical media discs, volatile memory or storage components (such as DRAM or SRAM), or nonvolatile memory or storage components (such as hard drives)). Furthermore, any of the software embodiments (comprising, for example, computer-executable instructions which when executed by a computer cause the computer to perform any of the disclosed methods) or results (either intermediate or final) created or modified by the disclosed methods can be transmitted, received, or accessed through a suitable communication means.

One exemplary embodiment disclosed herein is a method comprising displaying a charging session code (e.g., a QR code, barcode, or alphanumeric code) on a touch screen of an electric vehicle charging station ("EVCS") or electric vehicle supply equipment ("EVSE"). Another embodiment comprises reading this code with a mobile payment application running on an internet-connected mobile device.

Another exemplary embodiment comprises one or more computer-readable media storing computer-executable instructions which when executed by a computer cause the computer to provide the display of a charging session code (e.g., a QR code, barcode or alpha-numeric code) on a touch screen of an EVCS or EVSE. A further embodiment comprises one or more computer-readable media storing computer-executable instructions which when executed by an Internet-connected mobile device cause the mobile device to read a charging session code and interact with a remote server to transmit this code and the user's data.

Another exemplary embodiment is a method comprising receiving data from an EVCS or EVSE, the data identifying a user at the EVCS or EVSE and identifying a unique charging session at the EVCS or EVSE; and using computing hardware, accessing account data associated with the user and access control policies and pricing data associated with the EVCS or EVSE and using the combination of this data to determine if the user is authorized to complete a

charging session at the EVCS or EVSE. A related embodiment comprises one or more computer-readable media storing computer-executable instructions which when executed by a computer cause the computer to perform the method.

A further embodiment is a computer configured to receive data from an EVCS or EVSE, the data identifying a user at the EVCS or EVSE and identifying a unique charging session at the EVCS or EVSE, and to access account data associated with the user and access control and payment data associated with the charging station.

Another exemplary embodiment is a method comprising, using computing hardware, sending user data associated with a user at an EVCS or EVSE and charging session data to a back office computer; and using the computing hardware, receiving authorization data from the back office computer, the authorization data indicating that the user is authorized to use the EVCS or EVSE. A related embodiment comprises one or more computer-readable media storing computer-executable instructions which when executed by a computer cause the computer to perform the method.

A further embodiment is an EVCS or EVSE comprising computing hardware configured to send user data associated with a user at an EVCS or EVSE and charging session data to a back office computer and receive authorization data from the back office computer, the authorization data indicating that the user is authorized to use the EVCS or EVSE.

The foregoing and other objects, features, and advantages of the disclosed technology will become more apparent from the following detailed description, which proceeds with reference to the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic block diagram illustrating an exemplary electric vehicle charging system with a display device coupled to a back office serve via a network.

FIG. **2** is a schematic block diagram illustrating an exemplary EVCS/EVSE system and the users of the exemplary system.

FIG. **3** is a flowchart of an exemplary method for using a mobile device to control access to and payment for the use of an EVCS/EVSE according to an embodiment of the disclosed technology.

FIG. **4** illustrates an exemplary EVCS/EVSE screen showing a possible screen for identifying which payment method the EVCS/EVSE user wishes to use.

FIG. **5** is a schematic block diagram of an exemplary computing environment for implementing embodiments of the disclosed technology.

FIG. **6** is a schematic block diagram of an exemplary network communication environment for implementing embodiments of the disclosed technology.

FIG. **7** illustrates an exemplary EVCS/EVSE screen showing a possible screen for presenting the user with a QR code to be scanned by the user in order to authorize a charging session.

DETAILED DESCRIPTION

I. General Considerations

Disclosed below are representative embodiments of methods, apparatus, and systems for using and operating electric vehicle charging stations ("EVCSs") or electric vehicle supply equipment ("EVSE") with mobile device payment technology. The disclosed methods, apparatus, and systems should not be construed as limiting in any way. Instead, the present disclosure is directed toward all novel and nonobvious features and aspects of the various disclosed embodiments, alone and in various combinations and subcombinations with one another. Furthermore, any features or aspects of the disclosed embodiments can be used in various combinations and subcombinations with one another. The disclosed methods, apparatus, and systems are not limited to any specific aspect or feature or combination thereof, nor do the disclosed embodiments require that any one or more specific advantages be present or problems be solved.

Although the operations of some of the disclosed methods are described in a particular, sequential order for convenient presentation, it should be understood that this manner of description encompasses rearrangement, unless a particular ordering is required by specific language set forth below. For example, operations described sequentially may in some cases be rearranged or performed concurrently. Moreover, for the sake of simplicity, the attached figures may not show the various ways in which the disclosed methods can be used in conjunction with other methods. Additionally, the description sometimes uses terms like "determine" and "monitor" to describe the disclosed methods. These terms are high-level abstractions of the actual operations that are performed. The actual operations that correspond to these terms may vary depending on the particular implementation and are readily discernible by one of ordinary skill in the art. Furthermore, as used herein, the term "and/or" means any one item or combination of items in the phrase.

Any of the disclosed methods can be implemented using computer-executable instructions stored on one or more computer-readable media (e.g., non-transitory computer-readable media, such as one or more optical media discs, volatile memory components (e.g., DRAM or SRAM), or nonvolatile memory or storage components (e.g., hard drives)) and executed on a computer (e.g., any commercially available computer, a computer processor embedded in the EVCS/EVSE, or a computer processor of a mobile device). Any of the intermediate or final data created and used during implementation of the disclosed methods or systems can also be stored on one or more computer-readable media (e.g., non-transitory computer-readable media).

For clarity, only certain selected aspects of the software-based embodiments are described. Other details that are well known in the art are omitted. For example, it should be understood that the software-based embodiments are not limited to any specific computer language or program. For instance, embodiments of the disclosed technology can be implemented by software written in C++, C#, Objective C, Java, Perl, JavaScript, Adobe Flash, or any other suitable programming language. Likewise, embodiments of the disclosed technology are not limited to any particular computer or type of hardware. Details of suitable computers and hardware are well known and need not be set forth in detail in this disclosure.

Furthermore, any of the software-based embodiments (comprising, for example, computer-executable instructions stored on a non-transitory computer-readable medium) can be uploaded, downloaded, or remotely accessed through a suitable communication means. Such suitable communication means include, for example, the Internet, the World Wide Web, an intranet, cable (including fiber optic cable), magnetic communications, electromagnetic communications (including RF, microwave, and infrared communications), electronic communications, or other such communication means.

The disclosed methods can also be implemented using specialized computing hardware that is configured to per-

form any of the disclosed methods. For example, the disclosed methods can be implemented by an integrated circuit (e.g., an application specific integrated circuit ("ASIC") or programmable logic device ("PLD"), such as a field programmable gate array ("FPGA")) specially designed to implement any of the disclosed methods. The integrated circuit or specialized computing hardware can be embedded in or directly coupled to an EVCS/EVSE or device that is configured to interact with the EVCS/EVSE.

FIG. **5** is a schematic block diagram **500** that illustrates a generalized example of a suitable computing hardware environment **501** in which embodiments of the disclosed technology can be implemented. The computing hardware environment **501** is not intended to suggest any limitation as to the scope of use or functionality of the disclosed technology, as the technology can be implemented in diverse general-purpose or special-purpose computing environments.

With reference to FIG. **5**, the computing hardware environment **501** includes at least one processing unit **510** and memory **520**. In FIG. **5**, this most basic configuration **530** is included within a dashed line. The processing unit **510** executes computer-executable instructions and may be a real or a virtual processor. In a multi-processing system, multiple processing units execute computer-executable instructions to increase processing power. The memory **520** may be volatile memory (e.g., registers, cache, RAM, DRAM, SRAM), non-volatile memory (e.g., ROM, EEPROM, flash memory), or some combination of the two. The memory **520** can store software **580** for implementing one or more of the described techniques for operating or using the disclosed electric vehicle charging systems. For example, the memory **520** can store software **580** for implementing any of the disclosed methods and their accompanying user interfaces.

The computing hardware environment can have additional features. For example, the computing hardware environment **501** includes storage **540**, one or more input devices **550**, one or more output devices **560**, and one or more communication connections **570**. An interconnection mechanism (not shown) such as a bus, controller, or network interconnects the components of the computing hardware environment **501**. Typically, operating system software (not shown) provides an operating environment for other software executing in the computing hardware environment **501**, and coordinates activities of the components of the computing hardware environment **501**.

Storage **540** is a type non-volatile memory and can be removable or non-removable. The storage **540** includes, for instance, magnetic disks (e.g., hard drives), magnetic tapes or cassettes, optical storage media (e.g., CD-ROMs or DVDs), or any other tangible non-transitory storage medium which can be used to store information and which can be accessed within or by the computing hardware environment **501**. The storage **540** can store the software **580** for implementing any of the described techniques, systems, or environments.

The input device(s) **550** can be a touch input device such as a keyboard, mouse, touch screen, pen, trackball, a voice input device, a scanning device, or another device that provides input to the computing environment **501**. The output device(s) **560** can be a display, touch screen, printer, speaker, or another device that provides output from the computing environment **501**.

The communication connection(s) **570** enable communication over a communication medium to another computing entity. The communication medium conveys information such as computer-executable instructions, any of the intermediate or final messages or data used in implementing embodiments of the disclosed technology, or other data in a modulated data signal. A modulated data signal is a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media include wired or wireless techniques implemented with an electrical, optical, RF, infrared, acoustic, or other carrier. For example, the communication connection(s) **570** can communicate with another computing entity over a wired or wireless network (e.g., the Internet, a wide-area network, a local-area network, a Wi-Fi network, a client-server network, a wireless mesh network, or other such network or any combination thereof).

Many of the methods, systems, and interfaces disclosed herein can be described in the general context of computer-executable instructions stored on one or more computer-readable media. Computer-readable media are any available media that can be accessed within or by a computing environment. By way of example, and not limitation, with the computing hardware environment **501**, computer-readable media include tangible non-transitory computer-readable media such as memory **520** and storage **540**. The various methods, systems, and interfaces disclosed herein can also be described in the general context of computer-executable instructions, such as those included in program modules, being executed in a computing environment on a target real or virtual processor. Generally, program modules include routines, programs, libraries, objects, classes, components, data structures, and the like that perform particular tasks or implement particular abstract data types. The functionality of the program modules may be combined or split between program modules as desired in various embodiments. Computer-executable instructions for program modules may be executed within a local or distributed computing environment.

II. Exemplary Embodiments of the Disclosed Technology

FIG. **1** is a schematic block diagram **100** illustrating an EVCS/EVSE computing hardware environment **101** for implementing embodiments of the disclosed technology. In particular, FIG. **1** illustrates an exemplary computing hardware environment **101** for an EVCS/EVSE and an exemplary computing hardware environment **120** for an EVCS/EVSE back office server. The EVCS/EVSE environment **101** is more specialized than computing hardware environment **501** but should not be construed as limiting the types of hardware that can be used to implement the disclosed technology. Furthermore, the EVCS/EVSE environment **101** and the exemplary computing hardware environment **120** for the EVCS/EVSE back office server can include any of the components described above with respect to the general computing hardware environment **501**.

The EVCS/EVSE computing hardware environment **101** includes software **102**, which comprises computer-executable instructions stored on non-transitory computer-readable media (e.g., any one or more of the non-transitory computer-readable media described above). When executed, the software can be used to implement the functionality of the EVCS/EVSE, which is described in more detail below. The EVCS/EVSE computing hardware environment **101** further comprises an EVCS/EVSE processor **114** for executing the software **102**. Suitable processors and associated parts can be obtained, for example, from Parvus Corporation. In the illustrated embodiment, the EVCS/EVSE processor **114** is interconnected to an electric current control board **118**. The

electric current control board **118**, in turn, is connected to the cables and electrical connectors of the EVCS/EVSE that provide the electrical coupling to the one or more electric vehicles (e.g., using a SAE J1772 connector, IEC 62196 electrical connector, or other such electric vehicle connector). Suitable electric current control boards and associated parts can be obtained, for example, from Texas Instruments, Riley Corp, and National Control Devices. In certain exemplary embodiments, the EVCS/EVSE software **102** is used to implement a process in which commands and data are exchanged to control the flow of electrical current between one or more electric vehicles plugged into the EVCS/EVSE (e.g., the EVCS/EVSE **240** shown in FIG. **2**) and the power grid (e.g., the power grid **270** shown in FIG. **2**). The EVCS/EVSE computing hardware environment **101** can also include one or more of a wireless mesh radio **104**, a cellular radio **106** and/or an Ethernet card **108** (or other network adapter) to provide the environment **101** with a number of wired and wireless interface capabilities for exchanging data with, for example, an EVCS/EVSE back office server **120**. Suitable wireless mesh radios and associated parts can be obtained, for example, from Digi International. Suitable cellular radios and associated parts can be obtained, for example, from Telit Communications Plc. In the illustrated embodiment, the EVCS/EVSE processor **114** includes Ethernet functionality but can include other network functionality. The EVCS/EVSE computing hardware environment **101** also includes an access control device **110**, such as a magnetic card reader or radio frequency identity ("RFID") reader, and a display device **112**, such as an LCD, LED, or plasma screen with a touch screen interface **116**. The optional touch screen interface can be a resistive touch screen, a surface acoustic wave touch screen, a capacitive touch screen, infrared touch screen, optical imaging touch screen, dispersive signal touch screen, acoustic pulse recognition touch screen, or any other touch screen that enables position detection of user interaction with the display device. Another possible option to facilitate user interaction is using a display device without a touch screen interface but with a set of user entry buttons or a keypad **119**. Although the exemplary EVCS/EVSE computing hardware environment **101** is shown as including both a touch screen **116** and a set of user entry buttons or keypad **119**, the touch screen **116** can be implemented alone or the set of user entry button or keypad **119** can be implemented alone. Suitable magnetic card readers and associated parts can be obtained, for example, from ID Tech. Suitable display devices and touch screen interfaces can be obtained, for example, from Logic Supply. As more fully described below, the touch screen interface **116** can be used to facilitate the charging of the electric vehicle and the proper billing (or crediting) for the electricity used (or supplied) by the electric vehicle coupled to the EVCS/EVSE. Although the exemplary EVCS/EVSE computing hardware environment **101** is shown as including an access control device **110** such as a magnetic card reader or RFID device, the disclosed technology is meant to provide the EVSE user with an alternative to this device as a method of access control and payment. As shown in FIG. **1**, the EVCS/EVSE computing hardware environment **101** is coupled to the EVCS/EVSE back office server environment **120** via the network **130** (e.g., the Internet, a wide-area network, a local-area network, a Wi-Fi network, a client-server network, a wireless mesh network, or other such network or any combination thereof). In particular embodiments, the back office server environment **120** is implemented as part of a cloud-based back office server.

In operation, the EVCS/EVSE computing hardware environment **100** can create a number of data packets or messages that are transmitted to the EVCS/EVSE back office server environment **102** via a network **130**. The EVCS/EVSE back office server environment **102** can receive these packets or messages and can also create data packets or messages that will be transmitted to the EVCS/EVSE computing hardware environment **100** via the network **130**. During times of high usage of the installed EVCSs/EVSE or to facilitate integration of the installed EVCSs/EVSE into a "smart" electric power grid for purposes of allowing the electric power grid operators to control the charging of connected electric vehicles (e.g., to limit the charging of connected electric vehicles during peak electricity usage times or times of high electrical prices), many messages can be sent between a number of EVCSs/EVSE and one or more EVCS/EVSE back office servers. Both the EVCS/EVSE computing hardware environment **100** and the EVCS/EVSE back office server environment **120** can therefore include data packet or message control functionality that will allow for the prioritization of data packets or messages. An exemplary method and system for communicating between the EVCS/EVSE computing hardware environment **100** and the back office server environment **120** is described below in connection with FIG. **6**.

Returning to FIG. **1**, the back office server environment **120** can be implemented using a wide variety of computers and/or servers (e.g., a suitable commercially available server). In FIG. **1**, the back office server environment **120** includes back office server software **124**, which can comprise computer-executable instructions stored on non-transitory computer-readable media (e.g., any one or more of the non-transitory computer-readable media described above). When executed, the software can be used to implement the functionality of the back office server, which is described in more detail below. The EVCS/EVSE back office server **120** further comprises a back office server processor **122** for executing software **124**. Also shown in FIG. **1** is EVSC/EVSE user data **130**. The EVSC/EVSE user data **130** can comprise data stored on non-transitory computer-readable media that is related to users of the EVCS/EVSE. For example, the data can include data about a user's identification, address, account credit balance, usage history, vehicle, and/or other such user data.

In the illustrated embodiment, the EVCS/EVSE back office server **120** also includes data **126** for implementing one or more web pages for an EVCS/EVSE operator. The web page data **126** can comprise data stored on non-transitory computer-readable media that is used to render or otherwise implement one or more web pages for display to an EVCS/EVSE operator. The web pages can be displayed, for example, using a suitable internet browser or media player implemented at a computer operated by the EVCS/EVSE operator and coupled to the back office server **120** via a network (e.g., the Internet, a wide-area network, a local-area network, a Wi-Fi network, a client-server network, a wireless mesh network, or other such network or any combination thereof). The web page data can be in any format or language suitable for implementing web pages (e.g., HTML, Flash, Java, and the like). In other embodiments, the data to be displayed to the EVCS/EVSE operator is not stored as web page data, but as data usable via a non-web-based user interface (e.g., a dedicated program that directly interfaces with the back office server **120**).

The EVCS/EVSE back office server **120** can also include data **128** for implementing one or more web pages for an EVCS/EVSE user. The web page data **128** can comprise data

stored on non-transitory computer-readable media that is used to render or otherwise implement one or more web pages for display to an EVCS/EVSE user. The web pages can be displayed, for example, using a suitable internet browser or media player implemented at a computer operated by the EVCS/EVSE user and coupled to the back office server **120** via a network (e.g., the Internet, a wide-area network, a local-area network, a Wi-Fi network, a client-server network, a wireless mesh network, or other such network or any combination thereof). The web page data can be in any format or language suitable for implementing web pages (e.g., HTML, Flash, Java, and the like). In other embodiments, the data to be displayed to the EVCS/EVSE user is not stored as web page data, but as data usable via a non-web-based user interface (e.g., a dedicated program that directly interfaces with the back office server **120**). In certain embodiments, the web page data **128** is data for implementing web pages that show the user information about the state of the user's account, including amount of credit balance and purchase history. For example, the web page data can include data for implementing a log-in screen, through which the user provide authentication information indicating that the user is a member of a group authorized to use an EVCS/EVSE in a network of EVCSs/EVSE controlled by the back EVCS/EVSE back office server **120**, and a data for implementing an account status screen, through which the user is presented a graphical or numerical indication of the state of the user's account. The EVCS/EVCE back office server software **124** can include code that receives information about the identity of the user at the log-in screen, matches the identity to an EVCS user database and causes the display of the information about the state of the user's account via one or more web pages displayed to the user. The information about the user's account can comprise, for instance, the current credit balance in the account, the method of payment (i.e. credit/debit card or bank account information) to be used for electric charging payment purposes, and a record of past charges against this account.

FIG. **2** is a schematic block diagram **200** illustrating an exemplary EVCS/EVSE system and the users of the exemplary system. In FIG. **2**, a user **260** interfaces with an EVCS/EVSE **240** using a display apparatus **250**. The display apparatus **250** allows the user to view operating instructions and/or to make entries of information. As noted above, the functionality of the display apparatus **250** can be implemented by executing appropriate EVCS/EVSE software stored at the EVCS/EVSE (e.g., EVCS/EVSE software **102**). The EVCS/EVSE **240** uses a communication device (e.g., one or more of the wireless mesh radio **104**, cellular radio **106**, or Ethernet card **108** shown in FIG. **1**) to establish a communication link **230** with a back office server **220**. The functionality of the back office server **220** can be implemented by executing appropriate back office software stored at the back office server **220** (e.g., back office server software **124**). The EVCS/EVSE **240** can also use the communication device to transmit information entered by the user **260** to the back office server **220**. This information can comprise, for example, entries made by the user via the display apparatus **250**.

In embodiments of the disclosed technology, the display apparatus **250** displays information that can be used by a mobile device operated by the user. For example, in certain embodiments, the display apparatus **250** is used to display a quick reference ("QR") code, a barcode (linear or two-dimensional), or an alpha-numeric code that can then be scanned with an Internet-connected mobile device **290** operated by the EVCS/EVSE user **260**. Furthermore, and as more fully explained below with respect to FIG. **6**, the mobile device **290** can be configured to communicate with the back office server **220** (e.g., via a cellular or other wireless network link, shown as network communication link **616**).

FIG. **6** is a schematic block diagram illustrating components of an exemplary mobile device **652** (which can correspond to the mobile device **290** in FIG. **2**) and a EVCS back office server **650** (which can correspond to the back office server **220** in FIG. **2**) with which the mobile device **652** can communicate. In the illustrated embodiment, the mobile device **652** includes an EVCS Mobile Device Payment Application ("MPA") **620** configured to communicate with a back office server application **601** (which can be part of the software **124** shown in FIG. **1**) running on the back office server **650**. The MPA **620** accesses the user's database **624** that is stored locally on the mobile device **652** (although in other embodiments, the database is stored remotely, such as in a cloud-based server). In the illustrated embodiment, the user's database **624** is a local copy of the user's account data that is stored on the back office server. The MPA **620** and the back office server application **601** can periodically synchronize these two databases. The MPA **620** can implement a "scanning" operation on the mobile device that scans the QR code, barcode, or alpha-numeric code that is shown on the display apparatus **250** (e.g., using the mobile device's camera (such as the mobile device's image sensor) and suitable software for capturing an image of the code and decoding the code) and transmits the data embedded in this code along with the user's identity information from the user's mobile database **624** to the back office server application **601** via the network communication link **616**. The data embedded in the code can include one or more of a unique identification of the EVSE **670** (such as EVSE **240** in FIG. **2**) that the user is using to charge their electric vehicle, the charging port that the user is using (if there is more than one charging port on the EVSE **670**), the start date/time of the charging session (e.g., the date and time or substantially the date and time of when the charging session data was created, potentially within some acceptable level of accuracy (for instance, ±1 minute or less)), and other information that will be used by the back office server application **601** to properly determine the costs to bill the user for this charging session.

Once this charging session data and the user identification information is received by the back office server **650**, the ability of the user to access the EVCS/EVSE can be determined (e.g., using stored users' data from user database **606** (which corresponds to data **130** shown in FIG. **1**) either directly by the back office server application or by interfacing with a remote merchant services **660** to authorize the user's payment. If the user's payment is authorized or if they are otherwise authorized to access the EVSE, the back office server **650** transmits authorization information to the EVCS/EVSE **670** via a communication link (e.g., via the communication link **230**) and the EVCS/EVSE will deliver electric charging to the electric vehicle (e.g. EV **280**). In certain embodiments, the back office server **650** will also send the authorization information to the user's mobile device **652** so that the MPA **620** can update the user's mobile database **624** and display a message to the user that the charging session is authorized.

The disclosed technology supports a variety of payment methodologies for EVCS/EVSE usage. For example, if the particular EVCS/EVSE that the user has chosen has a fixed cost per charging session, the back office server application **601** will debit the user's account for the fixed amount or

obtain authorization for the fixed amount from merchant services **660**. If the EVCS/EVSE chosen charges the user by the unit of electricity consumed (e.g., kilowatt hour), the back office server application **601** can determine how many units of electricity can be purchased by the user given their current account credit balance and send that information to the EVCS/EVSE **670**. The EVCS/EVSE **670** can then end the charging session when the user ends it, or when it has delivered the maximum units of electricity that the user was able to purchase. The maximum number of units the user can purchase can also be displayed to the user by the MPA **620** and the user can use the MPA to increase the credit balance in their account, or purchase more units of electricity, if desired. In yet another payment methodology, if the EVCS/EVSE chosen charges the user by the amount of time that the EV is connected to the EVCS/EVSE and/or is receiving an electrical charge from the EVCS/EVSE, the disclosed technology can support that methodology in a manner similar to the previous scenario with the unit of electricity replaced by the amount of time that the EV is connected to the EVCS/EVSE and/or is receiving a charge from the EVCS/EVSE.

In particular embodiments, the back office server **220** in FIG. **2** is also configured to operate a website **212** for exchanging information relative to the EVSE/EVSE with the EVCS/EVSE user **260**. The information can comprise, for example, the current status of the user's account, account records for the user, or other such information. The user **260** can use this website to increase the credit balance on their account and manage payment sources (e.g., link the charging station account to a bank account or credit/debit card).

FIG. **3** is a flow chart **300** showing an exemplary process for authorizing a user and collecting payment for use of an EVCS/EVSE using the disclosed technology. As noted above, the functionality shown in FIG. **3** can be implemented by computing hardware executing computer-executable instructions. The various procedures shown in FIG. **3** should not be construed as limiting, as any one or more of the procedures can be performed alone or in various other combinations and subcombinations in accordance with the disclosed technology.

In the illustrated embodiment, the user initiates an EV charging session on the EVCS/EVSE by plugging in their EV and/or interacting with the EVCS/EVSE user interface (process block **302**). The EVCS/EVSE will then prompt the user to select their payment method of access method (process block **304**). FIG. **4** shows an example EVCS/EVSE display screen **400** in which the user is prompted to select their method of payment. It should be noted that the term "access method" is mentioned in addition to payment method because there may be usage methodologies in which an EVCS/EVSE is free to use (no payment required to use it) but its usage is restricted to certain users, or restricted to certain types of users at certain days, times of the day or other conditions.

When the user selects the mobile device payment option (process block **306**), the EVCS/EVSE display apparatus displays a QR code, barcode, or alphanumeric code and instructs the user to use their MPA to scan this code (process block **308**). The EVCS/EVSE will generate this code based on the EVCS/EVSE's unique identification (ID) number, the charging port that the user has selected to use (if there is more than one port on the EVCS/EVSE), the date/time of the charging session start (e.g., the date and time or substantially the date and time of when the charging session data was created, potentially within some acceptable level of accuracy (for instance, ±1 minute or less)), a unique session ID number and/or other data that may be necessary to uniquely identify each charging session for proper billing. FIG. **7** shows an example EVCS/EVSE display screen **700** in which the user is prompted to scan a QR code encoding the EVCS/EVSE's unique identification (ID) number, the charging port that the user has selected to use (if there is more than one port on the EVCS/EVSE), the date/time of the charging session start (e.g., the date and time or substantially the date and time of when the charging session data was created, potentially within some acceptable level of accuracy (for instance, ±1 minute or less)), and a unique session ID number.

The user will login to the MPA on their mobile device and use the MPA to scan the code displayed by the EVCS/EVSE (process block **310**). The MPA will store the pertinent charging session data contained in the scanned code (process blocks **312** & **314**) and retrieve the user's account data from a mobile user database stored on the mobile device (by the MPA) (process blocks **316** & **318**). The MPA will then build a message that includes the user's identification data and the charging session data from the scanned code and send this message to the back office application running on the back office server (process block **320**). The messaging between the EVCS/EVSE and the back office application can take place as described in U.S. patent application Ser. No. 13/033,179, entitled "ELECTRIC VEHICLE CHARGING STATIONS WITH TOUCH SCREEN USER INTERFACE" and filed on Feb. 23, 2011, the entirety of which is hereby incorporated herein by reference.

Once the back office application receives the message from the EVCS/EVSE, it will parse this message to retrieve the user's unique ID number, the EVCS/EVSE's unique ID number, the charging session start date/time, session ID and/or other information that may be included in the message to ensure the correct payment for the charging session and/or correct control of access to the EVCS/EVSE (process block **322**). The back office server has a database of each installed EVCS/EVSE (**608** in FIG. **6**) and the back office application will use the EVCS/EVSE's unique ID number from the message to retrieve the charging station's access control policies, pricing information, and/or any other data that may be necessary to ensure correct control of access to the EVCS/EVSE and/or correct pricing of the charging session (process block **324** & **326**). The back office application will also retrieve the user's account information from the user database based on the user's unique ID number (process block **328** & **330**). Based on the EVCS/EVSE's access control profile, its pricing data and/or the user's account data, the back office application will determine if the user is authorized to use this particular EVCS/EVSE and/or if they have sufficient funds associated with their account to pay for an EV charging session on this EVCS/EVSE (process block **332**). This determination may include, but is not limited to, activities such as debiting the user's account credit balance for a fixed amount if the charging sessions are fixed price, determining the amount of time or units of electricity that the user can purchase at this particular EVCS/EVSE based on their available account credit balance and/or interfacing with a third-party merchant services or other credit/debit card processing service to enter a charge on their account in a fixed amount or place a credit hold for an amount sufficient to cover the charging session. If the user has an insufficient credit balance in their account, the back office application will also allow for them to set account preferences which instruct the back office application to debit their credit card for a fixed amount when their account's credit balance falls below a minimum level, thereby ensuring that as long as a valid credit/debit card is

associated with the account, there will always be sufficient funds in the account to cover EV charging sessions.

Once the back office application has determined whether the charging session is authorized, it will construct a message with the authorization data and update the user's database with this session's authorization data (process blocks **332** & **334**). The back office application will then transmit this authorization message to both the EVCS/EVSE and the MPA on the user's mobile device (process block **336**). When the user's MPA receives the authorization message, it will display the authorization result and other pertinent information to the user (process block **338**). The EVSE will continue to charge the EV once it receives the authorization data and the session is authorized (process block **340**). While it is not shown in FIG. **3**, if the charging session was not authorized, the EVCS/EVSE will discontinue charging the EV and it is up to the user to return to the EVCS/EVSE and initiate another charging session with an alternative payment and/or access control method.

Once the charging session is completed (for example, by the user disconnecting their EV from the EVCS/EVSE), the EVSE will construct a message with the completed charging session's data (e.g., session ID, session end date/time, energy consumption, etc.) and send this message to the back office application (process blocks **342** & **344**). Once the back office application receives this session data, it will use it to compute the final cost of the charging session (if necessary) and update the user's account data with this session data and final costs (process block **346**) (e.g., by debiting the amount from the user's account, creating a charging record for later billing, or by causing a financial transaction for paying the cost to be initiated (e.g., through a credit card vendor or bank). The back office application will then construct a message containing the final session data and send it to the MPA on the user's mobile device (process block **348**) and/or the EVCS/EVSE. Once the user's MPA receives the final session data, it will update the user's mobile data with this information, completing the process (process block **350**).

III. Further Embodiments

Having described and illustrated the principles of the disclosed technology in the detailed description and accompanying drawings, it will be recognized that the various embodiments can be modified in arrangement and detail without departing from such principles. Furthermore, any features or aspects of the disclosed embodiments can be used in various combinations and subcombinations with one another.

A further embodiment of the disclosed technology could be applied in the field of parking payment. A parking payment kiosk including a display apparatus could be used in a similar manner to display a readable QR code, barcode, or alphanumeric code. This code can be read by a mobile device application that sends the data encoded in this code along with the user credentials to a back office computer for authorization and payment purposes. The back office computer could send the authorization data to the parking payment kiosk for display to the user, printing of a receipt and/or use by parking enforcement personnel.

A further embodiment of the disclosed technology could be applied to the dispensing of other types of vehicle fuel, such as a fueling station pump (for gasoline, biofuels or compressed natural gas for example). A fueling pump including a display apparatus could be used in a similar manner to display a readable QR code, barcode, or alphanumeric code. This code can be read by a mobile device application that sends the data encoded in this code along with the user credentials to a back office computer for authorization and payment purposes. The back office computer could send the authorization data to the fueling pump for display to the user and to signal the fueling pump to begin dispensing the fuel.

Furthermore, it is to be understood that any of the features and embodiments described herein can be used in combination with any of the features and embodiments described in U.S. Provisional Application No. 61/307,318, filed on Feb. 23, 2010, and entitled "ELECTRIC VEHICLE CHARGING STATION WITH TOUCH SCREEN USER INTERFACE"; U.S. Provisional Application No. 61/409,108, filed on Nov. 1, 2010, and entitled "ELECTRIC VEHICLE CHARGING STATION WITH TOUCH SCREEN USER INTERFACE"; U.S. Provisional Application No. 61/307,377, filed on Feb. 23, 2010, and entitled "ELECTRIC VEHICLE CHARGING STATION ADVERTISING SYSTEM"; U.S. Provisional Application No. 61/353,944, filed on Jun. 11, 2010, and entitled "ELECTRIC VEHICLE CHARGING STATION ADVERTISING SYSTEM"; U.S. Provisional Application No. 61/317,181, filed on Mar. 24, 2010, and entitled "ELECTRIC VEHICLE CHARGING STATION PARKING METER SYSTEM"; U.S. Nonprovisional application Ser. No. 12/954,209, filed on Nov. 24, 2010, and entitled "ELECTRIC VEHICLE CHARGING STATION ADVERTISING SYSTEMS"; U.S. Nonprovisional application Ser. No. 13/033,179, filed on Feb. 23, 2011, and entitled "ELECTRIC VEHICLE CHARGING STATIONS WITH TOUCH SCREEN USER INTERFACE"; U.S. Nonprovisional application Ser. No. 13/070,389, filed on Mar. 23, 2011, and entitled "ELECTRIC VEHICLE CHARGING STATION PARKING METER SYSTEMS"; U.S. Provisional Application No. 61/719,483, filed on Oct. 28, 2012, and entitled "SYSTEM FOR COMBINING PAYMENT FOR ELECTRIC VEHICLE CHARGING AND PARKING"; and U.S. Provisional Application No. 61/728,134, filed on Nov. 19, 2012, and entitled "RESERVATION SYSTEMS FOR ELECTRIC VEHICLE CHARGING STATIONS", all of which are hereby incorporated herein by reference.

In view of the many possible embodiments to which the principles of the disclosed invention may be applied, it should be recognized that the illustrated embodiments are only preferred examples of the invention and should not be taken as limiting the scope of the invention.

What is claimed is:

1. A method for charging an electric vehicle at an electric vehicle charging station ("EVCS") or electric vehicle supply equipment ("EVSE") through use of a mobile device operated by a user, comprising:

executing, by computing hardware in the mobile device, a mobile device application on the mobile device configured to:

a) authenticate the user to the mobile device application;

b) read encoded charging session data that is being displayed on a display screen of an electronic display device of the EVCS or EVSE using an image sensor on the mobile device, wherein the encoded charging session data being displayed on the display screen of the electronic display device of the EVCS or EVSE includes encoded data for a unique identification of the EVCS or EVSE, a unique charging session identification number, and a charging session start date and time;

c) decode the encoded charging session data, the decoded charging session data including the unique identification of the EVCS or EVSE, the unique charging session identification number, and the charging session start date and time;

d) combine the unique identification of the EVCS or EVSE and the unique charging session identification number and the charging session start date and time with user identification data identifying the user of the mobile device application to form a dataset;

e) transmit the dataset to a remote server; and

f) receive a response from the remote server, the response indicating that a vehicle charging operation for the user is authorized at the EVCS or EVSE;

receiving, by the EVCS or EVSE, an indication from the remote server that the vehicle charging operation is authorized at the EVCS or EVSE; and

performing, by the EVCS or EVSE, the vehicle charging operation for an electric vehicle at the EVCS or EVSE in response to the indication.

2. The method of claim **1**, wherein the encoded charging session data is encoded in a QR code, barcode, or alphanumeric code.

3. The method of claim **1**, wherein the encoded charging session data is displayed as a result of the user making a selection via a touch screen interface at the EVCS or EVSE to use the mobile device application.

4. The method of claim **1**, further comprising:

by computing hardware at the remote server:

receiving the dataset transmitted from the mobile device;

determining whether to authorize a charging operation at the charging station for the user, wherein the determining is based at least in part on the received data; and

causing the EVCS or EVSE to charge the electric vehicle at the EVCS or EVSE by transmitting to the EVCS or EVSE an indication that the charging operation is authorized.

5. The method of claim **1**, further comprising:

by the computing hardware at the remote server:

receiving completed charging session data from the charging station; and

computing a cost for the charging session based at least in part on the received completed charging session data.

6. The method of claim **1**, wherein the completed charging session data comprises one or more of the unique charging session identification number, a charging session end date and time, or an indication of the energy consumed during the charging session.

7. The method of claim **1**, wherein the step to authenticate is performed by receiving a login identification and a password from the user.

8. A system for performing an electric vehicle charging operation through use of a mobile device, comprising:

an electric vehicle charging station ("EVCS") or electric vehicle supply equipment ("EVSE") comprising:

an electronic display device having an electronic display screen;

an electric current control board; and

one or more electrical connectors connected to the electric current control board and configured to provide an electrical coupling to an electric vehicle,

wherein the EVCS or EVSE is programmed and configured to display encoded charging session data on the display screen of the electronic display device, the encoded charging session data including encoded data for a unique identification of the EVCS or EVSE, a unique charging session identification number, and a charging session start date and time; and

one or more non-transitory computer-readable media storing computer-executable instructions for a mobile device application configured to cause a computer processor of the mobile device to perform a method, the method comprising:

authenticating a user to use the mobile device application on the mobile device;

reading the encoded charging session data that is being displayed on the display screen of the electronic display device of the EVCS or EVSE using an image sensor on the mobile device, wherein the encoded charging session data that is displayed on the display screen of the electronic display device of the EVCS or EVSE includes the encoded data for the unique identification of the EVCS or EVSE, the unique charging session identification number, and the charging session start date and time;

decoding the encoded charging session data, wherein the decoded charging session data includes the unique identification of the EVCS or EVSE, the unique charging session identification number, and the charging session start date and time;

combining the decoded charging session data with user identification data identifying the user of the mobile device application to form a dataset;

transmitting the dataset to a remote server; and

receiving a response from the remote server, wherein the response indicates that a vehicle charging operation for the user is authorized at the EVCS or EVSE,

wherein the EVCS or EVSE is configured to deliver an electrical charge to one or more batteries of the electric vehicle via a respective one of the electrical connectors of the EVCS or EVSE on the remote server indicating that the vehicle charging operation is authorized at the EVCS or EVSE.

9. The system of claim **8**, wherein the encoded charging session data is displayed as a result of the user making a selection via a touch screen interface at the EVCS or EVSE to use the mobile device application.

10. The system of claim **8**, wherein the authenticating is performed by receiving a login identification and a password from the user.

11. A system comprising:

an internet-connected mobile device comprising:

a computer processor;

an image sensor; and

a database storing mobile device user identification data; and

an electric vehicle charging station ("EVCS") or electric vehicle supply equipment ("EVSE") comprising:

an electronic display device having a display screen; and

one or more electrical connectors configured to provide an electrical coupling to an electric vehicle,

wherein the mobile device is configured to:

read encoded charging session data from the display screen of the EVCS or EVSE via the image sensor on the mobile device, wherein the charging session data includes a unique identification of the EVCS or EVSE and at least one of (a) a unique charging session identification number, or (b) a charging session start date and time;

access said database on the mobile device that includes said mobile device user identification data; and

wirelessly transmit the charging session data and the user identification data to a remote server, wherein the transmitted charging session data is transmitted includes the unique identification of the EVCS or EVSE and the at least one of (a) the unique charging session identification number, or (b) the charging session start date and time; and

wherein the EVCS or EVSE is configured to:

upon receiving an indication from the remote server that a vehicle charging operation is authorized at the EVCS or EVSE based on the charging session data and the user identification data, perform the vehicle charging operation for an electric vehicle by supplying an electric current to the electric vehicle via the one or more electrical connectors.

12. The system of claim **11**, wherein the encoded charging session data is encoded in a QR code or barcode.

13. The system of claim **11**, wherein the mobile device is further programmed and configured to, prior to reading the encoded charging session data, authenticate a user by receiving a login identification and a password from the user.

14. The system of claim **11**, wherein the charging session data includes each of the unique identification of the EVCS or EVSE, the unique charging session identification number, and the charging session start date and time; and

wherein the charging session data transmitted includes the unique identification of the EVCS or EVSE, the unique charging session identification number, and the charging session start date and time.

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