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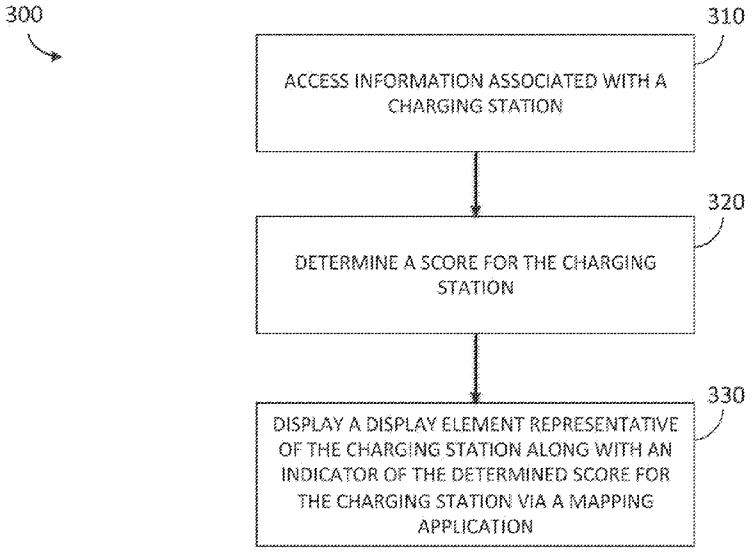

FIG. 3

(57) Abstract: A system and method for ranking or scoring charging stations and/or charging events or sessions, and/or performing actions based on the ranking or scoring is described. In some embodiments, a charging station ranking engine is configured to rank charging stations, or potential charging events, based on feedback received from users of the charging stations, such as drivers of electric vehicles, or other dynamically determined factors.

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SCORING CHARGING STATIONS USED BY ELECTRIC VEHICLES

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Patent Application No. 61/858,934, filed on July 26, 2013, entitled RANKING ELECTRIC VEHICLE CHARGING STATIONS, and U.S. Provisional Patent Application No. 61/937,397, filed on February 7, 2014, entitled SCORING CHARGING EVENTS FOR ELECTRIC VEHICLES, which are hereby incorporated by reference in their entirety.

BACKGROUND

[0002] Although the adoption of electric vehicles is increasing, there are still many people that find them confusing or inaccessible, or are otherwise not interested in using electric vehicles for their transportation needs. Therefore, technology is being developed to remove such barriers associated with the adoption of electric vehicles.

BRIEF DESCRIPTION OF THE DRAWINGS

[0003] FIG. 1 is a block diagram illustrating components of a suitable computing environment.

[0004] FIG. 2 is a block diagram illustrating the components of a charging station ranking engine.

[0005] FIG. 3 is a flow diagram illustrating a method for ranking electric vehicle charging stations.

[0006] FIGs. 4A-4E are display diagrams illustrating example displays presenting ranked electric vehicle stations via a mobile application.

[0007] FIG. 5 is a flow diagram illustrating a method for performing an action associated with a potential charging event.

[0008] FIG. 6 is a block diagram illustrating the components of a charging event ranking engine.

[0009] FIG. 7 is a flow diagram illustrating a method for performing an action associated with a scored charging event.

[0010] FIG. 8 is a display diagram illustrating an example display presenting a scored charging event.

DETAILED DESCRIPTION

Overview

[0011] A system and method for ranking or scoring charging stations and/or charging events or sessions, and/or performing actions based on the ranking or scoring is described. In some embodiments, a charging station ranking engine is configured to rank charging stations, or potential charging events, based on feedback received from users of the charging stations, such as drivers of electric vehicles, or other dynamically determined factors. For example, the charging event ranking engine may rank a potential or prospective charging event at a charging station based on a current or dynamically determined suitability of the charging station for a specific electric vehicle.

[0012] The charging station ranking engine may perform various actions based on the rankings, such as display the rankings, highlight highly ranked charging stations in a mapping application, provide rewards to owners of highly ranked charging stations, and so on.

[0013] In some embodiments, a charging event ranking engine is configured to rank and/or score charging events and/or charging sessions between a charging station and an electric vehicle. For example, the charging event ranking engine may rank or score commenced or completed charging events and/or charging sessions based on determining how efficient, cost-effective, and/or green the events or sessions were.

[0014] The ranking engines and various performed methods will now be described with respect to various embodiments. The following description provides specific details for a

thorough understanding of, and enabling description for, these embodiments of the system. However, one skilled in the art will understand that the system may be practiced without these details. In other instances, well-known structures and functions have not been shown or described in detail to avoid unnecessarily obscuring the description of the embodiments of the system.

[0015] It is intended that the terminology used in the description presented below be interpreted in its broadest reasonable manner, even though it is being used in conjunction with a detailed description of certain specific embodiments of the system. Certain terms may even be emphasized below; however, any terminology intended to be interpreted in any restricted manner will be overtly and specifically defined as such in this Detailed Description section.

Suitable System

[0016] As described herein, various systems and methods for ranking charging stations and/or charging events are described.

[0017] Figure 1 illustrates components of a suitable computing environment 100 in which the systems and methods for ranking charging stations and/or charging events may be supported and/or implemented. The computing environment 100 includes a mobile device 110, such as a mobile phone or tablet computer that supports and provides applications (e.g., "apps") to a user of the mobile device 110. For example, the mobile device 110 may include a mobile application 127 provided by the charging interface system 125. The mobile application 127 may communicate with the charging interface system 125, one or more charging networks 140, a charging station 145, and/or a computing device 135 supported by an electric vehicle 130, over a network 105, such as the internet or other wireless or telecommunication networks. The electric vehicle (EV) 130 (e.g., a vehicle, plugin hybrid, range extended hybrid, electric traction or battery or plugin vehicle) is connected to the charging station 145 via a charging cable 147, which provides charge to a battery pack of the EV 130.

[0018] The mobile device 110 may be a tablet computer, mobile device, smart-phone, net-book, mobile GPS navigation device, or any other device that supports, presents, and/or displays

apps via a user interface, such as a touch-screen, of the device. The mobile device 110 includes various hardware and/or software components in order to provide such functionality. For example, the mobile device 110 includes various human interface components, device components, and memory, and so on.

[0019] The mobile device 110 may include a touch-screen or other input component that provides input to a processor. The touch-screen may include or communicate with a hardware controller, such as a touch-screen driver, that interprets raw signals received from the touch-screen and transmits information associated with a contact event (e.g., a pressing of an app via the touch-screen), to the processor. The touch-screen may be part of a display, such as a touch-screen display, a flat panel display, an electronic ink display, a head-mounted display, a liquid crystal display, a light-emitting diode display, a plasma panel display, an electro-luminescent display, a vacuum fluorescent display, a digital projector, a laser projector, a heads-up display, and so on. The mobile device 110 may include other interface components, such as a speaker that provides appropriate auditory signals to assist a user in navigating a touch-screen, and so on.

[0020] The mobile device 110 may include various device components, such as sensors (e.g., GPS or other location determination sensors, motion sensors, gyroscopes, light sensors, and so on), removable storage devices (e.g., SIM cards), cameras and other video capture devices, microphones and other audio capture devices, communication devices (e.g., Bluetooth devices, radios, antennas), and so on.

[0021] The mobile device 110 may include a processor that communicates with data or applications stored in memory of the device 110, which may include a combination of temporary and/or permanent storage, and both read-only and writable memory (random access memory or RAM), read-only memory (ROM), writable non-volatile memory such as FLASH memory, hard drives, floppy disks, SIM-based components, and so on. The memory may include various program components or modules, such as an operating system, and various applications, such as applications downloaded to the device 110. For example, the memory may store applications native to the device that perpetually operate on the device (e.g., a keyboard application that provides a virtual keyboard, a text messaging application, and so on) as well as applications that

are downloaded by a user and launched by the device (e.g., applications associated with social networking sites, games, and so on).

[0022] The memory may store one or more applications associated with an electric vehicle, such as the mobile application 127, which facilitates communications between the mobile device 110 and an electric vehicle 130, the computing device 135 of the electric vehicle 130, the charging network 140, the charging station 145, and/or a server supporting the charging interface system 125.

[0023] For example, the mobile application 127 may communicate over the network 105 with the computing device 135 of the electric vehicle 130, the charging network 140, the charging station 145, and/or the charging interface system 125. The network 105 may be a Local Area Network (LAN), a Wide Area Network (WAN), the Internet, or other networks capable of facilitating various communications between computing devices.

[0024] In some example embodiments, the mobile application 127 may communicate directly with various components of the computing environment 100. The mobile device 110 may include various communication components (e.g., Bluetooth) that facilitate short range, near field, and/or other direct or personal area network communications between devices. For example, the mobile application 127 may utilize Bluetooth communication to exchange data with the charging network 140 and/or the charging station 145 when other networks are unavailable or inaccessible (e.g., when the EV 130 is at the charging station 145 in an underground parking lot that does not receive sufficient wireless or telecommunication signals).

[0025] The computing device 135 of the electric vehicle 130 may include various computing components and/or modules configured and/or programmed to control, manage, diagnose, or otherwise interact with components of the electric vehicle 130. For example, the EV computing device 135 may include an on-board computing system that includes on-board diagnostics, such as components configured and/or programmed to detect and/or receive information from the electric vehicle's engine, battery pack, various sensors, dashboard controls, and so on. The components may detect, sense, and/or capture various types of information, such as outside temperature information, inside temperature information, internal engine or component temperatures, motor rpm information, motor temperature information, power

consumption information, charger temperature information, information associated with peak power consumption, location or geographical information, tire pressure information, tire temperature information, information captured by seat pressure sensors, error codes or other operational information, and so on. For example, the components may detect, receive, and/or access motor controller information, such as information associated with the power, voltage, current, frequency, waveform, modulation, and/or regenerative power of the motor of the EV, as well as information from modules which control ancillary functions of the EV, such as information associated with operations of the lights, wipers, anti-lock brakes, seat warmers, music, climate controls, light sensors, smoke sensors, acceleration sensors, and other ancillary operations of an EV.

[0026] In some example embodiments, the computing environment 100 includes a charging station ranking engine 150 that is configured to access information associated with electric vehicle charging stations, determine rankings and/or scores for the electric vehicle charging stations, and display, or cause to be displayed, information within a map displayed by the mobile application 125 that presents the rankings or scores along with icons representing the electric vehicle charging stations, among other things. As described herein, the charging station ranking engine 150 may also perform other actions that are based on or otherwise associated with the rankings or scores of the charging stations.

[0027] In some example embodiments, the charging station ranking engine 150 may access information associated with potential or prospective charging events or sessions, determine rankings and/or scores for the charging events, and perform actions associated with the ranked charging events.

[0028] In some example embodiments, the computing environment 100 includes a charging event ranking engine 160 that is configured to access information associated with completed charging events or sessions, determine rankings and/or scores for the charging events, and perform actions associated with the ranked charging events.

[0029] FIG. 1 and the discussion herein provide a brief, general description of a suitable computing environment in which the charging interface system 125 can be supported and implemented. Although not required, aspects of the system are described in the general context

of computer-executable instructions, such as routines executed by a general-purpose computer, e.g., mobile device, a server computer, or personal computer. Those skilled in the relevant art will appreciate that the system can be practiced with other communications, data processing, or computer system configurations, including: Internet appliances, hand-held devices (including tablet computers and/or personal digital assistants (PDAs)), all manner of cellular or mobile phones, multi-processor systems, microprocessor-based or programmable consumer electronics, set-top boxes, network PCs, mini-computers, mainframe computers, and the like. Indeed, the terms "computer," "host," and "host computer," and "mobile device" and "handset" are generally used interchangeably herein, and refer to any of the above devices and systems, as well as any data processor.

[0030] Aspects of the system can be embodied in a special purpose computing device or data processor that is specifically programmed, configured, or constructed to perform one or more of the computer-executable instructions explained in detail herein. Aspects of the system may also be practiced in distributed computing environments where tasks or modules are performed by remote processing devices, which are linked through a communications network, such as a Local Area Network (LAN), Wide Area Network (WAN), or the Internet. In a distributed computing environment, program modules may be located in both local and remote memory storage devices.

[0031] Aspects of the system may be stored or distributed on computer-readable media (e.g., physical and/or tangible computer-readable storage media, such as non-transitory media), including magnetically or optically readable computer discs, hard-wired or preprogrammed chips (e.g., EEPROM semiconductor chips), nanotechnology memory, biological memory, or other data storage media. Indeed, computer implemented instructions, data structures, screen displays, and other data under aspects of the system may be distributed over the Internet or over other networks (including wireless networks) or they may be provided on any analog or digital network (packet switched, circuit switched, or other scheme). Those skilled in the relevant art will recognize that portions of the system reside on a server computer, while corresponding portions reside on a client computer such as a mobile or portable device, and thus, while certain hardware platforms are described herein, aspects of the system are equally applicable to nodes

on a network. In an alternative embodiment, the mobile device or portable device may represent the server portion, while the server may represent the client portion.

[0032] Any of the machines, databases, or devices shown in FIG. 1 may be implemented in a general-purpose computer modified (e.g., configured or programmed) by software to be a special-purpose computer to perform the functions described herein for that machine, database, or device. For example, a computer system able to implement any one or more of the methodologies described herein. Moreover, any two or more of the machines, databases, or devices illustrated in FIG. 1 may be combined into a single machine, and the functions described herein for any single machine, database, or device may be subdivided among multiple machines, databases, or devices.

Examples of Ranking Electric Vehicle Charging Stations

[0033] As described herein, the charging station ranking engine 150 includes components, modules, and/or engines that perform various algorithms, processes, and/or methods to score or rank electric vehicle charging stations and/or cause a mapping application, such as mobile application 125, to display a map of charging stations along with indicators that represent scores or rankings assigned to the displayed charging stations, among other things.

[0034] FIG. 2 is a block diagram illustrating the components of the charging station ranking engine 150. In some example embodiments, the charging station ranking engine 150 may include one or more modules and/or components to perform one or more operations of the charging station ranking engine 150. The modules may be hardware, software, or a combination of hardware and software, and may be executed by one or more processors. For example, the charging station ranking engine 150 may include an information module 210, a ranking module 220, a display module 230, and a context module 240.

[0035] In some example embodiments, the information module 210 is configured and/or programmed to access or receive information associated with multiple charging stations and/or potential charging events at the charging stations. For example, the information module 210

may access information received or captured by the mobile application 125 and associated with charging stations displayed by a map provided by the mobile application.

[0036] Example types of information may include check-in information (which may include reviews, feedback, user interactions, and/or other binary information or other information input by users of electric vehicles to the mobile application 125.

[0037] In some example embodiments, the ranking module 220 is configured and/or programmed to rank each of the charging stations and/or potential charging events based on the accessed information. For example, the ranking module 220 may generate, calculate, or otherwise determine a score or ranking for some or all of the charging stations displayed by the mobile application 125.

[0038] The ranking module 220 may assign rankings or scores to the charging stations in a variety of ways and using a variety of scoring or ranking formats. For example, the ranking module 220 may rank or score charging stations by determining a score between 1 and 10 (or greater) for each of the charging stations that is based on a date-weighted average of binary station reviews received during check-in actions at the charging stations. As another example, the ranking module 220 may rank or score charging stations by determining a score between 1 and 10 for each of the charging stations that is based on information received during a most recent check-in action.

[0039] Furthermore, the ranking module 220 may assign various types of ranking or scoring formats to the charging stations, such as numerical formats (e.g., a number between a range, such as 1-10), binary formats (e.g., a score or rank that identifies the station as satisfactory or not), and so on.

[0040] In some example embodiments, the display module 230 is configured and/or programmed to display icons representative of the charging stations along with indicators for rankings assigned to each of the charging stations within a mapping application supported by a mobile device. For example, the display module 230 may display indicators such as text or other informational indicators, color-coded indicators, stars or other ranking indicators, and so on.

[0041] In some example embodiments, the context module 240 is configured and/or programmed to access context information associated with a potential charging event at a charging station. For example, the context module 240 may access information identifying a state of charge for an electric vehicle to be charged during the potential charging event, a route to be traveled from a current location of the electric vehicle and a location of the charging station, and/or information associated with reviews of previous charging events at the charging station. As another example, the context module 240 may access information identifying a state of charge for an electric vehicle to be charged during the potential charging event and a route to be traveled from a current location of the electric vehicle and a location of the charging station. As another example, the context module 240 may access information identifying a cost to charge the electric vehicle during the potential charging event and information associated with reviews of previous charging events at the charging station. Of course, the context module 240 may access other types of information associated with a potential charging event at a charging station.

[0042] In some example embodiments, the ranking module 220, when determining a score for a potential charging event at a charging station, may update a score previously assigned to the charging station (e.g., a score based on reviews) based on the accessed context information. For example, the ranking module 220 may update a score previously assigned to the charging station based on information identifying a state of charge for an electric vehicle to be charged during the potential charging event, may update a score previously assigned to the charging station based on information identifying a predicted route currently traveled by an electric vehicle to be charged during the potential charging event, and so on.

[0043] FIG. 3 is a flow diagram illustrating a method for ranking electric vehicle charging stations. The method 300 may be performed by the charging station ranking engine 150 and, accordingly, is described herein merely by way of reference thereto. It will be appreciated that the method 300 may be performed on any suitable hardware.

[0044] In operation 310, the charging station ranking engine 150 accesses information associated with a charging station, For example, the information module 210 accesses information associated with check-in actions for the charging station and provided by users of electric vehicles.

[0045] In operation 320, the charging station ranking engine 150 determines a score for the charging station based on the accessed information. For example, the ranking module 220 determines a score between 1 and 10 for the charging station that is based on a date-weighted average of binary station reviews received during the check-in actions, and/or determines a score between 1 and 10 for the charging station that is based on information received during a most recent check-in action, among other things.

[0046] The ranking module 220 may determine scores or rankings for charging stations that are based on other types of information, such as dynamically determined information (e.g., a current charge state of an electric vehicle driven by a user of the mobile application 125), vehicle destination information (e.g., information identifying a route or predicted route for an electric vehicle driven by a user of the mobile application 125), vehicle location information (e.g., a current or predicted location of an electric vehicle driven by a user of the mobile application 125), and so on.

[0047] The following code snippet provides an example of how the ranking module 220 may calculate scores for charging stations:

```
def calculate_score(loc_id):
    redis.delete("locations:%d:score" % loc_id)
    location = Location.query.get(loc_id)
    if not location:
        return False
    score = None
    #use last 10 reviews, and weight them using how far they are since now
    num_data_points = 0

    MAX_POINTS = 10

    if len(location.reviews) <= 3:
        return None
```

```
elif len(location.reviews) <= 8:
    score = 9
else:
    score = 10

for review in location.reviews:
    if review.rating > 0:
        num_data_points += 1
    elif review.rating < 0:
        review_adjustment = math.sqrt(MAX_POINTS - num_data_points) - 1
        #review_score = review.rating #if review.rating > 0 else review.rating * 2
        #days_ago = math.ceil((datetime.now() - review.created_at).days)
        #review_adjustment = review_score * math.exp(-0.0231*days_ago) #halflife 120 days
        score += -1 * review_adjustment
        num_data_points += 1

    if num_data_points == MAX_POINTS:
        break

if score < 0:
    score = 0
redis.set("locations:%d:score" % location.id, score)
return score
```

[0048] In operation 330, the charging station ranking engine 150 displays a display element representative of the charging station along with an indicator of the determined score for the charging station via a mapping application. For example, the display module 230 may display various indicators along with or proximate to icons representing charging stations for scores or rankings assigned to the charging stations, among other things.

[0049] FIGs. 4A-4E are display diagrams illustrating screen shots displayed when presenting rankings associated with electric vehicle charging stations via the mobile application 125. For example, FIG. 4A depicts a screen shot of an introductory page of the mobile application 125, FIG. 4B depicts a screen shot of a check-in page that facilitates a user or driver check-in at a charging station (along with receipt of a review or feedback), and FIGs. 4C to 4E depicts screen shots that display icons representing charging stations along with scores or rankings determined by the charging station ranking engine 150 described herein, among other things.

Examples of Ranking Potential Charging Events for an Electric Vehicle

[0050] As described herein, the charging station ranking engine 150 includes components, modules, and/or engines that perform various algorithms, processes, and/or methods to score or rank potential or future charging events and/or perform actions based on the scored or ranked potential or future charging events.

[0051] FIG. 5 is a flow diagram illustrating a method 500 for performing an action associated with a potential charging event. The method 500 may be performed by the charging station ranking engine 150 and, accordingly, is described herein merely by way of reference thereto. It will be appreciated that the method 500 may be performed on any suitable hardware.

[0052] In operation 510, the charging station ranking engine 150 accesses context information associated with a potential charging event at a charging station. For example, the context module 240 may access information identifying a state of charge for an electric vehicle to be charged during the potential charging event, a route to be traveled from a current location of the electric vehicle and a location of the charging station, and/or information associated with reviews of previous charging events at the charging station.

[0053] As another example, the context module 240 may access information identifying a state of charge for an electric vehicle to be charged during the potential charging event and a route to be traveled from a current location of the electric vehicle and a location of the charging station. As another example, the context module 240 may access information identifying a cost

to charge the electric vehicle during the potential charging event and information associated with reviews of previous charging events at the charging station. Of course, the context module 240 may access other types of information associated with a potential charging event at a charging station.

[0054] In operation 520, the charging station ranking engine 150 determines a score for the potential charging event at the charging station based on the accessed information. The ranking module 220 may determine scores or rankings for charging stations that are based on other types of information, such as dynamically determined information (e.g., a current charge state of an electric vehicle driven by a user of the mobile application 125), vehicle destination information (e.g., information identifying a route or predicted route for an electric vehicle driven by a user of the mobile application 125), vehicle location information (e.g., a current or predicted location of an electric vehicle driven by a user of the mobile application 125), and so on.

[0055] For example, the ranking module 220 may generate, calculate, or otherwise determine a score or ranking for some or all of the charging stations displayed by the mobile application 125. The ranking module 220 may assign rankings or scores to the charging stations in a variety of ways and using a variety of scoring or ranking formats. For example, the ranking module 220 may rank or score charging stations by determining a score between 1 and 10 (or greater) for each of the charging stations that is based on a date-weighted average of binary station reviews received during check-in actions at the charging stations. As another example, the ranking module 220 may rank or score charging stations by determining a score between 1 and 10 for each of the charging stations that is based on information received during a most recent check-in action. Furthermore, the ranking module 220 may assign various types of ranking or scoring formats to the charging stations, such as numerical formats (e.g., a number between a range, such as 1-10), binary formats (e.g., a score or rank that identifies the station as satisfactory or not), and so on.

[0056] In some example embodiments, the ranking module 220, when determining a score for a potential charging event at a charging station, may update a score previously assigned to the charging station (e.g., a score based on reviews) based on the accessed context information. For example, the ranking module 220 may update a score previously assigned to the charging

station based on information identifying a state of charge for an electric vehicle to be charged during the potential charging event, may update a score previously assigned to the charging station based on information identifying a predicted route currently traveled by an electric vehicle to be charged during the potential charging event, and so on.

[0057] In operation 530, the charging station ranking engine 150 displays a display element representative of the charging station along with an indicator of the determined score for the charging station via a mapping application. For example, the display module 230 may display indicators such as text or other informational indicators, color-coded indicators, stars or other ranking indicators, and so on.

[0058] In some example embodiments, the charging station ranking engine 150 may perform various actions that are based on a ranked or scored charging event. For example, the charging station ranking engine 150 may perform an action on behalf of a driver of the electric vehicle that is based on the score determined for the potential charging event, may automatically reserve the charging station when the score determined for the potential charging event is above a threshold score, and so on.

[0059] As another example, the charging station ranking engine 150 may receive an indication that an actual charging event has occurred between the electric vehicle and the charging station, assign a score to the actual charging event that is based on the score determined for the potential charging event at the charging station, and provide a reward to a driver of the electric vehicle that is based on the score assigned to the actual charging event. In some example embodiments, the charging station ranking engine 150 may incentivize drivers of electric vehicles to utilize positively reviewed charging stations or may incentivize the drivers to charge their vehicles at charging stations that facilitate highly scored charging events or sessions.

[0060] Thus, in some example embodiments, the charging station ranking engine 150 accesses context information associated with a potential charging event at a charging station, and determines a score for the potential charging event at the charging station by updating a score previously assigned to the charging station using the context information. The charging station ranking engine 150, therefore, may provide drivers with dynamically determined scores or

rankings of charging stations when they are deciding what charging stations to utilize in charging their vehicles.

Examples of Ranking Completed Charging Events for an Electric Vehicle

[0061] As described herein, the charging event ranking engine 160 includes components, modules, and/or engines that perform various algorithms, processes, and/or methods to score or rank completed charging events and/or perform actions based on the scored or ranked completed charging events.

[0062] FIG. 6 is a block diagram illustrating the components of the charging event ranking engine 160. In some example embodiments, the charging event ranking engine 160 may include one or more modules and/or components to perform one or more operations of the charging event ranking engine 160. The modules may be hardware, software, or a combination of hardware and software, and may be executed by one or more processors. For example, the charging event ranking engine 160 may include an energy identification module 610, a scoring module 620, and an action module 630.

[0063] In some example embodiments, the energy identification module 610 is configured and/or programmed to access information associated with a charging event at an electric vehicle. For example, the energy identification module 610 may access information associated with an energy source (e.g., a wind energy source, a solar energy source, a biofuel source, and/or other renewable energy sources) used to provide energy to the electric vehicle during the charging event, information associated with a cost of energy provided to the electric vehicle during the charging event, information associated with a ranking assigned to a charging station used during the charging event, and so on.

[0064] In some example embodiments, the scoring module 620 is configured and/or programmed to score the charging event based on the accessed information. For example, the scoring module 620 may assign a relatively high score to the charging event when a renewable energy source is used to provide energy to the electric vehicle during the charging event, may assign a relatively low score to the charging event when the charging event occurs during a peak

energy time period for an electric grid that provided the energy to the electric vehicle during the charging event, and so on. The scoring module 620 may perform some or all of the techniques described herein when scoring or ranking a charging event.

[0065] In some example embodiments, the action module 630 is configured and/or programmed to perform an action associated with the scored charging event. For example, the action module 630 may display an indication of a score assigned to the charging event via a mapping application associated with a driver of the electric vehicle, may present a reward to a driver of the electric vehicle that is based on a score assigned to the charging event, and so on.

[0066] As described herein, the charging event ranking engine 160 may perform a variety of method or processes when scoring a completed charging event. FIG. 7 is a flow diagram illustrating a method 700 for performing an action associated with a scored charging event. The method 700 may be performed by the charging event ranking engine 160 and, accordingly, is described herein merely by way of reference thereto. It will be appreciated that the method 700 may be performed on any suitable hardware.

[0067] In operation 710, the charging event ranking engine 160 accesses information associated with a charging event at an electric vehicle. For example, the energy identification module 610 may access information associated with an energy source (e.g., a wind energy source, a solar energy source, a biofuel source, and/or other renewable energy sources) used to provide energy to the electric vehicle during the charging event, information associated with a cost of energy provided to the electric vehicle during the charging event, information associated with a ranking assigned to a charging station used during the charging event, and so on.

[0068] In operation 720, the charging event ranking engine 160 scores the charging event based on the accessed information. For example, the scoring module 620 may assign a relatively high score to the charging event when a renewable energy source is used to provide energy to the electric vehicle during the charging event, may assign a relatively low score to the charging event when the charging event occurs during a peak energy time period for an electric grid that provided the energy to the electric vehicle during the charging event, and so on. The scoring module 620 may perform some or all of the techniques described herein when scoring or ranking a charging event.

[0069] In operation 730, the charging event ranking engine 160 performs an action associated with the scored charging event. For example, the action module 630 may display an indication of a score assigned to the charging event via a mapping application associated with a driver of the electric vehicle, may present a reward to a driver of the electric vehicle that is based on a score assigned to the charging event, and so on.

[0070] As an example, FIG. 8 depicts an example display 800 presenting a scored charging event. The display 800 includes a map showing a charging station along with a display element that provides information associated with a score assigned to a recent charging event at the charging station. For example, the displayed information includes the date of the charging event (e.g., CHARGE ON 12/01/13), the score assigned to the charging event (e.g., GREENSCORE OF 94/100), and the source of the energy (e.g., WIND ENERGY). Of course, other information may be displayed.

[0071] Thus, in some example embodiments, the charging event ranking engine 160 may identify a source of energy used to charge an electric vehicle during a charging event, assign a score to the charging event based on the identified source of energy, and perform an action for a driver of the electric vehicle based on the score assigned to the charging event.

Conclusion

[0072] Unless the context clearly requires otherwise, throughout the description and the claims, the words “comprise,” “comprising,” and the like are to be construed in an inclusive sense, as opposed to an exclusive or exhaustive sense; that is to say, in the sense of “including, but not limited to.” As used herein, the terms "connected," "coupled," or any variant thereof, means any connection or coupling, either direct or indirect, between two or more elements; the coupling of connection between the elements can be physical, logical, or a combination thereof. Additionally, the words “herein,” “above,” "below," and words of similar import, when used in this application, shall refer to this application as a whole and not to any particular portions of this application. Where the context permits, words in the above Detailed Description using the singular or plural number may also include the plural or singular number respectively. The word

"or," in reference to a list of two or more items, covers all of the following interpretations of the word: any of the items in the list, all of the items in the list, and any combination of the items in the list.

[0073] The above detailed description of embodiments of the system is not intended to be exhaustive or to limit the system to the precise form disclosed above. While specific embodiments of, and examples for, the system are described above for illustrative purposes, various equivalent modifications are possible within the scope of the system, as those skilled in the relevant art will recognize. For example, while processes or blocks are presented in a given order, alternative embodiments may perform routines having steps, or employ systems having blocks, in a different order, and some processes or blocks may be deleted, moved, added, subdivided, combined, and/or modified. Each of these processes or blocks may be implemented in a variety of different ways. Also, while processes or blocks are at times shown as being performed in series, these processes or blocks may instead be performed in parallel, or may be performed at different times.

[0074] While many embodiments described above employ software stored on the mobile device, the scripts and other software noted above may be hard coded into the mobile device (e.g. stored in EEPROM, PROM, etc.). Further, the above functionality may be implemented without scripts or other special modules.

[0075] The teachings of the system provided herein can be applied to other systems, not necessarily the system described above. The elements and acts of the various embodiments described above can be combined to provide further embodiments.

[0076] All of the above patents and applications and other references, including any that may be listed in accompanying filing papers, are incorporated by reference. Aspects of the system can be modified, if necessary, to employ the systems, functions, and concepts of the various references described above to provide yet further embodiments of the system.

[0077] These and other changes can be made to the system in light of the above Detailed Description. While the above description details certain embodiments of the system and describes the best mode contemplated, no matter how detailed the above appears in text, the

system can be practiced in many ways. Details of the local-based support system may vary considerably in its implementation details, while still being encompassed by the system disclosed herein. As noted above, particular terminology used when describing certain features or aspects of the system should not be taken to imply that the terminology is being redefined herein to be restricted to any specific characteristics, features, or aspects of the system with which that terminology is associated. In general, the terms used in the following claims should not be construed to limit the system to the specific embodiments disclosed in the specification, unless the above Detailed Description section explicitly defines such terms. Accordingly, the actual scope of the system encompasses not only the disclosed embodiments, but also all equivalent ways of practicing or implementing the system under the claims.

[0078] While certain aspects of the system are presented below in certain claim forms, the inventors contemplate the various aspects of the system in any number of claim forms. Accordingly, the inventors reserve the right to add additional claims after filing the application to pursue such additional claim forms for other aspects of the system.

CLAIMS

We claim:

1. A computerized method, comprising:
accessing information associated with a charging station; and
determining a score for the charging station based on the accessed information.

2. The method of claim 1, further comprising:
presenting a display element representative of the charging station along with an indicator of the determined score for the charging station via a mapping application.

3. The method of claim 1, wherein accessing information associated with a charging station includes accessing information associated with check-in actions at the charging stations and provided by users of electric vehicles; and wherein determining a score for the charging station based on the accessed information includes determining a score between 1 and 10 for the charging station that is based on a date-weighted average of binary station reviews received during the check-in actions.

4. The method of claim 1, wherein accessing information associated with a charging station includes accessing information associated with check-in actions at the charging stations and provided by users of electric vehicles; and wherein determining a score for the charging station based on the accessed information includes determining a score between 1 and 10 for the charging station that is based on information received during a most recent check-in action.

5. A system, comprising:
an information module that accesses information associated with multiple charging stations;

a ranking module that ranks each of the charging stations based on the accessed information; and

a display module that is configured to display icons representative of the charging stations along with indicators for rankings assigned to each of the charging stations within a mapping application supported by a mobile device.

6. The system of claim 5, wherein the information module is configured to access binary charging station reviews associated with check-in actions received via the mapping application and provided by users of electric vehicles that have previously utilized the charging stations.

7. The system of claim 5, wherein the information module is configured to access charging station reviews associated with most recent check-in actions received via the mapping application and provided by users of electric vehicles that have most recently utilized the charging stations.

8. The system of claim 5, wherein the information module accesses information associated with check-in actions at the charging stations and provided by users of electric vehicles; and wherein the ranking module determines a score between 1 and 10 for the charging station that is based on a date-weighted average of binary station reviews received during the check-in actions.

9. The system of claim 5, wherein the ranking module determines a score that is based on a date-weighted average of binary station reviews received during the check-in actions.

10. A computer-readable storage medium whose contents, when executed by a computing system, cause the computing system to perform operations for presenting charging station information to a driver of an electric vehicle, the operations comprising:

accessing information associated with a charging station, the information obtained from reviews provided by drivers of electric vehicles that have utilized the charging station;

determining a score for the charging station based on the accessed information; and

causing a mapping application to display an icon representative of the charging station and an indicator representative of the determined score for the charging station.

11. The computer-readable storage medium of claim 10, wherein causing a mapping application to display an icon representative of the charging station and an indicator representative of the determined score for the charging station includes causing the mapping application to display the icon and the indicator proximate to a route displayed by the mapping application and currently traveled by the electric vehicle.

12. The computer-readable storage medium of claim 10, wherein causing a mapping application to display an icon representative of the charging station and an indicator representative of the determined score for the charging station includes causing the mapping application to display the icon and the indicator via a mapping application presented by a mobile device associated with the driver of the electric vehicle.

13. The computer-readable storage medium of claim 10, wherein causing a mapping application to display an icon representative of the charging station and an indicator representative of the determined score for the charging station includes causing the mapping application to display the icon and the indicator via a mapping application presented by a vehicle display within the electric vehicle.

14. The computer-readable storage medium of claim 10, wherein accessing information associated with a charging station includes accessing information associated with check-in actions at the charging stations and provided by users of electric vehicles; and wherein determining a score for the charging station based on the accessed information includes determining a score between 1 and 10 for the charging station that is based on a date-weighted average of binary station reviews received during the check-in actions.

15. The computer-readable storage medium of claim 10, wherein accessing information associated with a charging station includes accessing information associated with check-in actions at the charging stations and provided by users of electric vehicles; and wherein determining a score for the charging station based on the accessed information includes determining a score between 1 and 10 for the charging station that is based on information received during a most recent check-in action.

16. A computerized method, comprising:

accessing context information associated with a potential charging event at a charging station; and

determining a score for the potential charging event at the charging station based on the accessed information.

17. The method of claim 16, further comprising:

displaying a display element representative of the charging station along with an indicator of the determined score for the charging station via a mapping application.

18. The method of claim 16, wherein the accessed context information includes information identifying a state of charge for an electric vehicle to be charged during the potential charging event, a route to be traveled from a current location of the electric vehicle and a location of the charging station, and information associated with reviews of previous charging events at the charging station.

19. The method of claim 16, wherein the accessed context information includes information identifying a state of charge for an electric vehicle to be charged during the potential charging event and a route to be traveled from a current location of the electric vehicle and a location of the charging station.

20. The method of claim 16, wherein the accessed context information includes information identifying a cost to charge the electric vehicle during the potential charging event and information associated with reviews of previous charging events at the charging station.

21. The method of claim 16, further comprising:

performing an action on behalf of a driver of the electric vehicle that is based on the score determined for the potential charging event.

22. The method of claim 16, further comprising:

automatically reserving the charging station when the score determined for the potential charging event is above a threshold score.

23. The method of claim 16, further comprising:

receiving an indication that an actual charging event has occurred between the electric vehicle and the charging station;

assigning a score to the actual charging event that is based on the score determined for the potential charging event at the charging station; and

providing a reward to a driver of the electric vehicle that is based on the score assigned to the actual charging event.

24. The method of claim 16, wherein determining a score for the potential charging event at the charging station based on the accessed information includes updating a score previously assigned to the charging station based on the accessed context information.

25. The method of claim 16, wherein determining a score for the potential charging event at the charging station based on the accessed information includes updating a score previously assigned to the charging station based on information identifying a state of charge for an electric vehicle to be charged during the potential charging event.

26. The method of claim 16, wherein determining a score for the potential charging event at the charging station based on the accessed information includes updating a score previously

assigned to the charging station based on information identifying a predicted route currently traveled by an electric vehicle to be charged during the potential charging event.

27. A system, comprising:

a context module that is configured to access context information associated with a potential charging event at a charging station; and

a ranking module that is configured to determine a score for the potential charging event at the charging station based on the accessed information.

28. The system of claim 27, further comprising:

a display module that is configured to display a display element representative of the charging station along with an indicator of the determined score for the charging station via a mapping application.

29. The system of claim 27, wherein the context module is configured to access information identifying a state of charge for an electric vehicle to be charged during the potential charging event, a route to be traveled from a current location of the electric vehicle and a location of the charging station, and information associated with reviews of previous charging events at the charging station.

30. The system of claim 27, wherein the context module is configured to access information identifying a state of charge for an electric vehicle to be charged during the potential charging event and a route to be traveled from a current location of the electric vehicle and a location of the charging station.

31. The system of claim 27, wherein the context module is configured to access information identifying a cost to charge the electric vehicle during the potential charging event and information associated with reviews of previous charging events at the charging station.

32. The system of claim 27, wherein the ranking module is configured to update a score previously assigned to the charging station based on the accessed context information.

33. The system of claim 27, wherein the ranking module is configured to update a score previously assigned to the charging station based on information identifying a state of charge for an electric vehicle to be charged during the potential charging event.

34. The system of claim 27, wherein the ranking module is configured to update a score previously assigned to the charging station based on information identifying a predicted route currently traveled by an electric vehicle to be charged during the potential charging event.

35. A computer-readable storage medium whose contents, when executed by a computing system, cause the computing system to perform operations, comprising:

accessing context information associated with a potential charging event at a charging station; and

determining a score for the potential charging event at the charging station by updating a score previously assigned to the charging station, the updated score based on the context information.

36. A computerized method, comprising:

accessing information associated with a charging event at an electric vehicle;

scoring the charging event based on the accessed information; and

performing an action associated with the scored charging event.

37. The method of claim 36, wherein performing an action associated with the scored charging event includes displaying an indication of a score assigned to the charging event via a mapping application associated with a driver of the electric vehicle.

38. The method of claim 36, wherein performing an action associated with the scored charging event includes presenting a reward to a driver of the electric vehicle that is based on a score assigned to the charging event.

39. The method of claim 36, wherein accessing information associated with a charging event at an electric vehicle includes accessing information associated with an energy source used to provide energy to the electric vehicle during the charging event.

40. The method of claim 36, wherein accessing information associated with a charging event at an electric vehicle includes accessing information associated with a cost of energy provided to the electric vehicle during the charging event.

41. The method of claim 36, wherein accessing information associated with a charging event at an electric vehicle includes accessing information associated with a cost of energy provided to the electric vehicle during the charging event and associated with an energy source used to provide energy to the electric vehicle during the charging event.

42. The method of claim 36, wherein accessing information associated with a charging event at an electric vehicle includes accessing information associated with a ranking assigned to a charging station used during the charging event.

43. The method of claim 36, wherein scoring the charging event based on the accessed information includes assigning a relatively high score to the charging event when a renewable energy source is used to provide energy to the electric vehicle during the charging event.

44. The method of claim 36, wherein scoring the charging event based on the accessed information includes assigning a relatively low score to the charging event when the charging event occurs during a peak energy time period for an electric grid that provided the energy to the electric vehicle during the charging event.

45. A system, comprising:

an energy identification module that is configured to access information associated with a charging event at an electric vehicle;

a scoring module that is configured to score the charging event based on the accessed information; and

an action module that is configured to perform an action associated with the scored charging event.

46. The system of claim 45, wherein the action module is configured to display an indication of a score assigned to the charging event via a mapping application associated with a driver of the electric vehicle.

47. The system of claim 45, wherein the action module is configured to present a reward to a driver of the electric vehicle that is based on a score assigned to the charging event.

48. The system of claim 45, wherein the energy identification module is configured to access information associated with an energy source used to provide energy to the electric vehicle during the charging event.

49. The system of claim 45, wherein the energy identification module is configured to identify an energy source used to provide energy to the electric vehicle during the charging event.

50. The system of claim 45, wherein the energy identification module is configured to access information associated with a cost of energy provided to the electric vehicle during the charging event.

51. The system of claim 45, wherein the energy identification module is configured to access information associated with a cost of energy provided to the electric vehicle during the charging event and associated with an energy source used to provide energy to the electric vehicle during the charging event.

52. The system of claim 45, wherein the energy identification module is configured to access information associated with a ranking assigned to a charging station used during the charging event.

53. The system of claim 45, wherein the scoring module is configured to assign a relatively high score to the charging event when a renewable energy source is used to provide energy to the electric vehicle during the charging event.

54. The system of claim 45, wherein the scoring module is configured to assign a relatively low score to the charging event when the charging event occurs during a peak energy time period for an electric grid that provided the energy to the electric vehicle during the charging event.

55. A computer-readable storage medium whose contents, when executed by a computing system, cause the computing system to perform operations, comprising:

identifying a source of energy used to charge an electric vehicle during a charging event;

assign a score to the charging event based on the identified source of energy; and

perform an action for a driver of the electric vehicle based on the score assigned to the charging event.

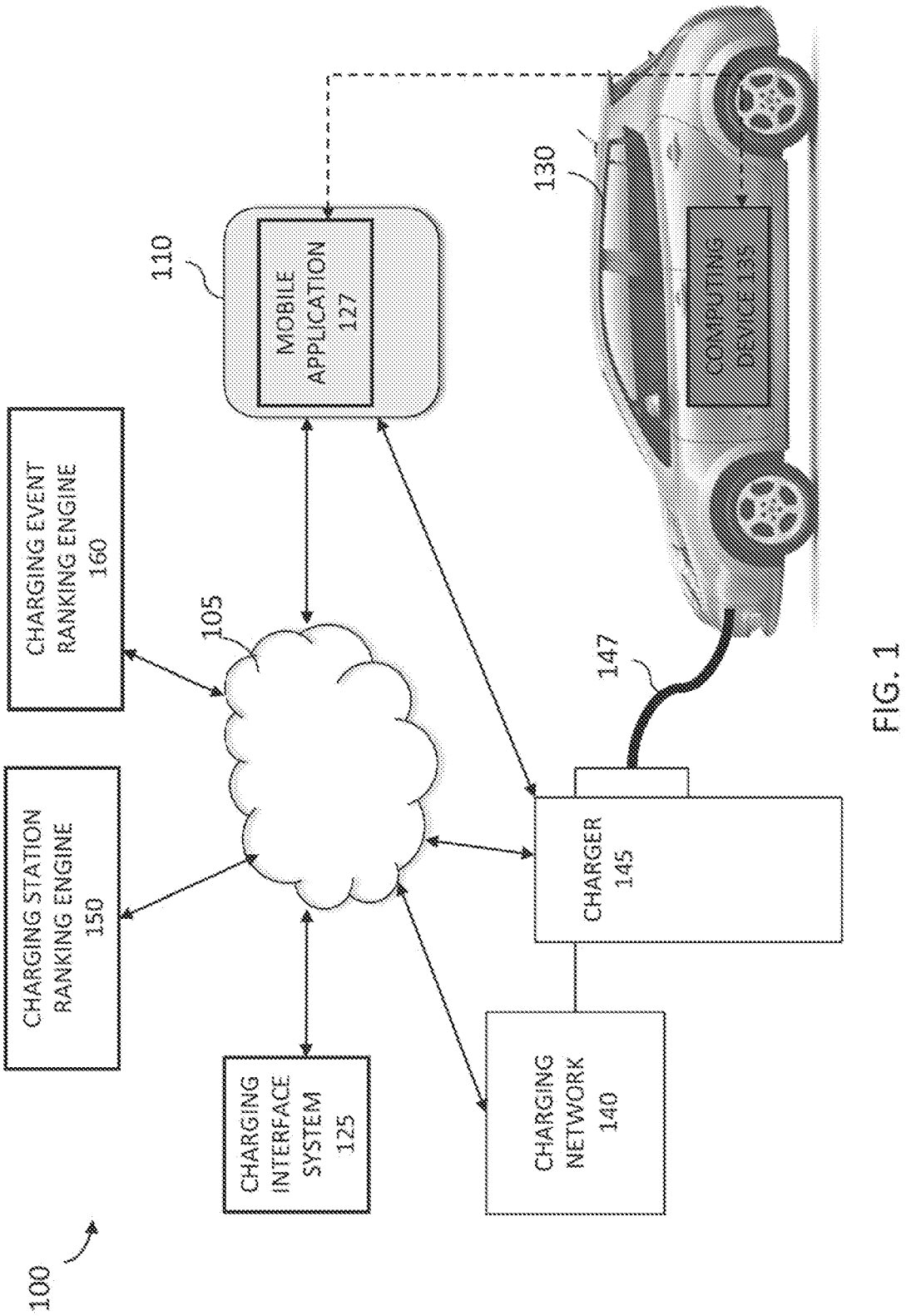
100
110
MOBILE APPLICATION 127
130
CONTROL DEVICE
105
CHARGING EVENT RANKING ENGINE 160
CHARGING STATION RANKING ENGINE 150
CHARGING INTERFACE SYSTEM 125
CHARGING NETWORK 140
CHARGER 145
147

FIG. 1

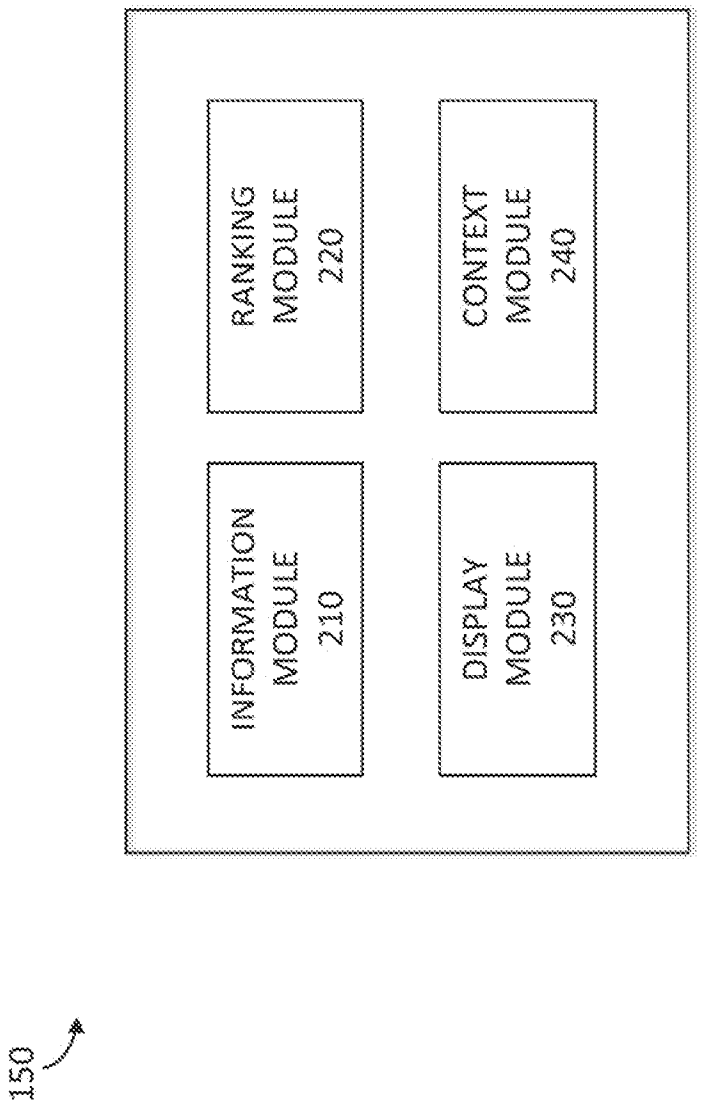
150
INFORMATION MODULE 210
RANKING MODULE 220
DISPLAY MODULE 230
CONTEXT MODULE 240

FIG. 2

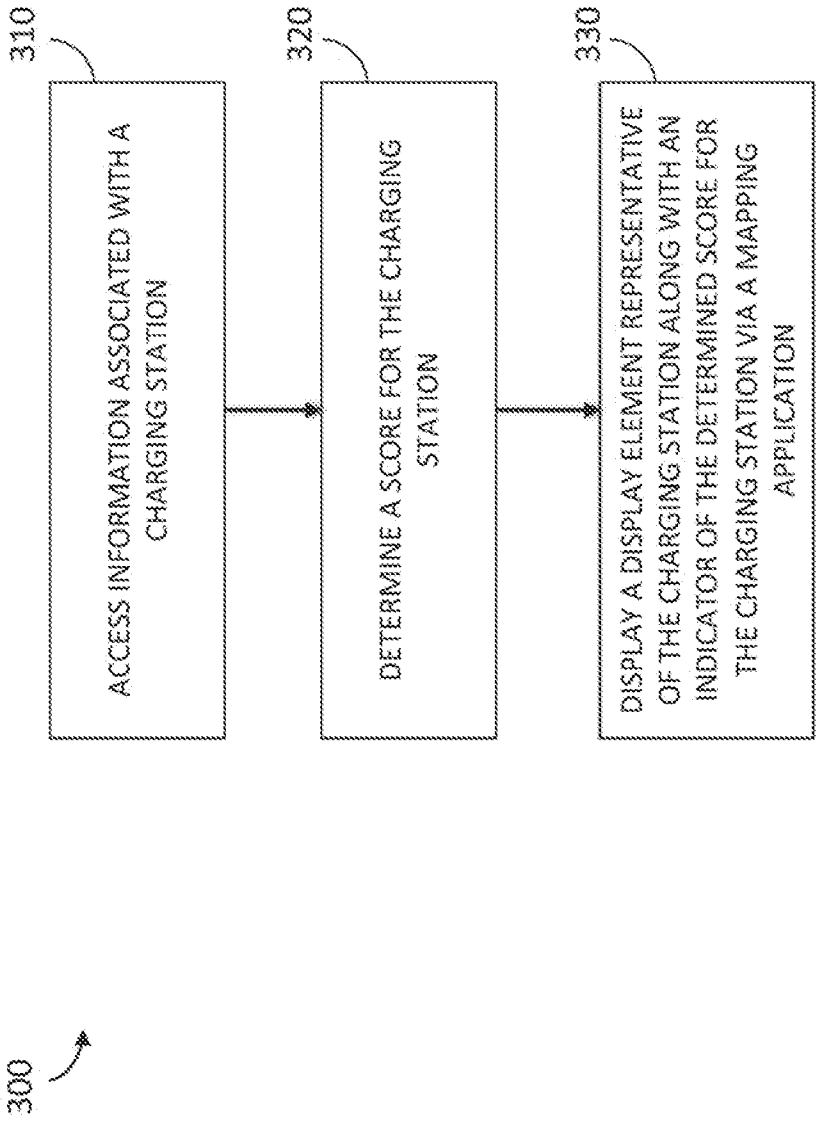
300
310
ACCESS INFORMATION ASSOCIATED WITH A CHARGING STATION
320
DETERMINE A SCORE FOR THE CHARGING STATION
330
DISPLAY A DISPLAY ELEMENT REPRESENTATIVE OF THE CHARGING STATION ALONG WITH AN INDICATOR OF THE DETERMINED SCORE FOR THE CHARGING STATION VIA A MAPPING APPLICATION

FIG. 3

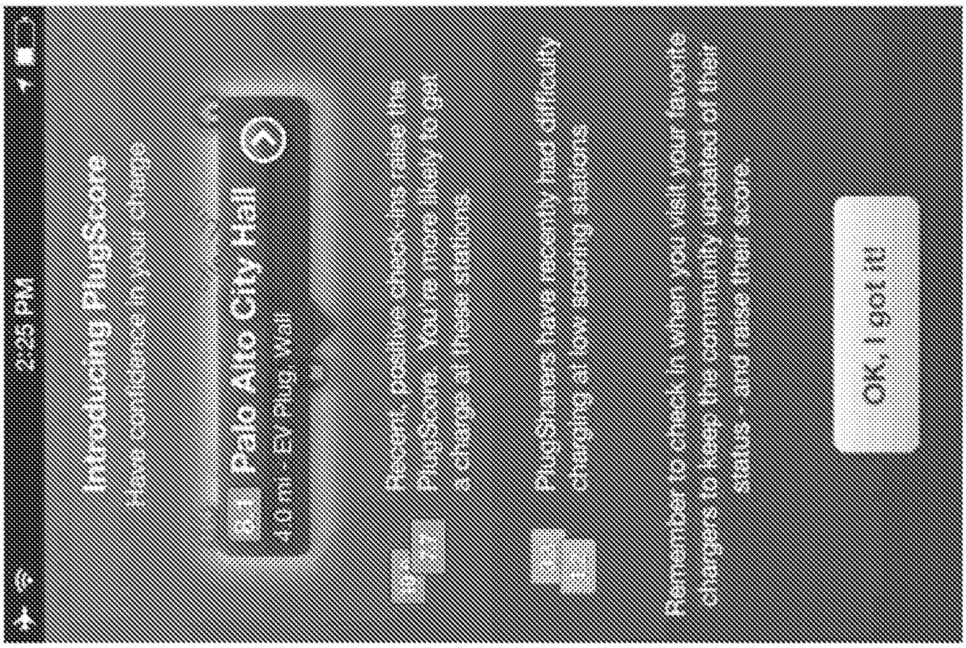
2:25 PM
Introducing PlugScore
Have confidence in your charge
8.1 Palo Alto City Hall
4.0 mi - EV Plug Wall
Recent, positive check-ins raise the PlugScore, you're more likely to get a charge at these stations.
PlugShare's have recently had difficulty charging at low scoring stations.
Remember to check in when you visit your favorite chargers to keep the community updated of their status - and raise their score.
OK, I got it!

FIG. 4A

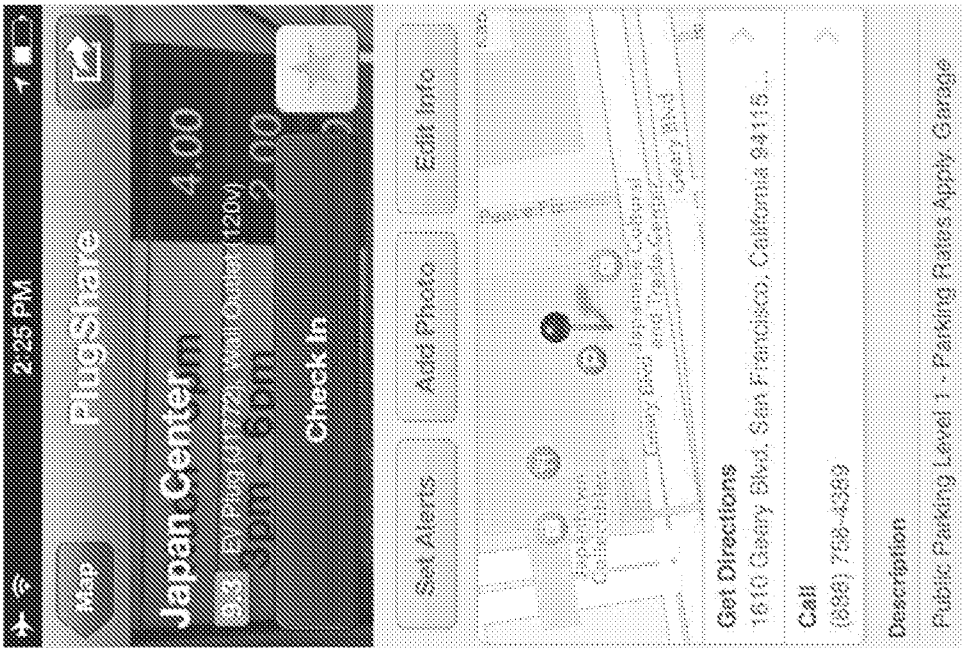
2:25 PM
Map
PlugShare
Japan Center
EV Plug (J1772), Wall Outlet (120V)
Check In
Set Alerts
Add Photo
Edit Info
Get Directions
1610 Geary Blvd, San Francisco, California 94115...
Call
Description
Public Parking Level 1 - Parking Rates Apply Garage

FIG. 4B

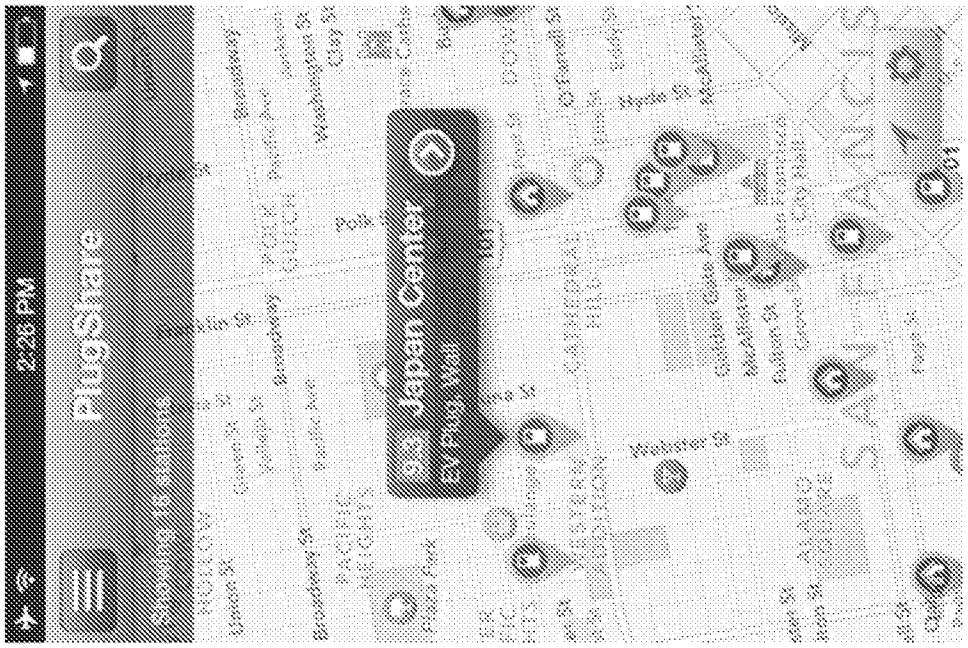

FIG. 4C

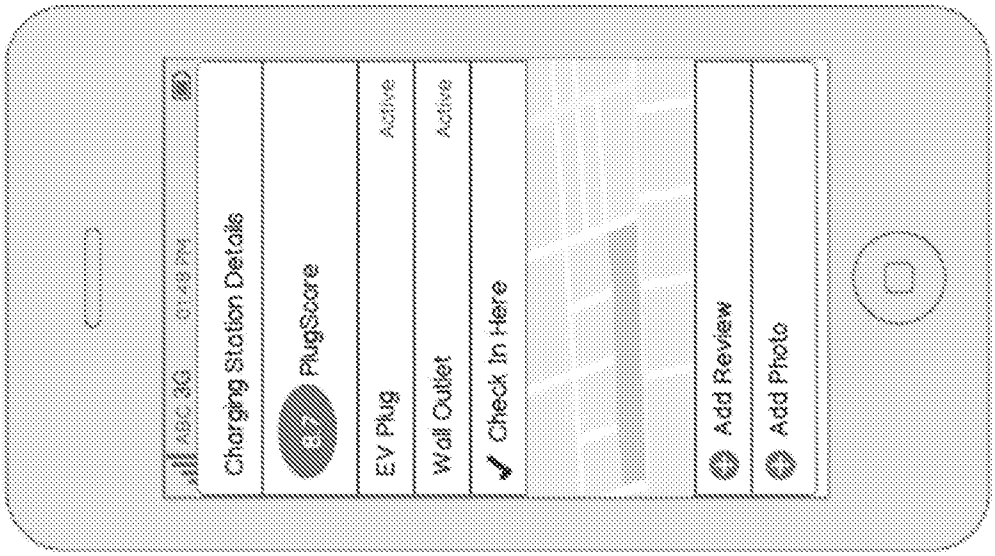
Charging Station Details
PlugScore
EV Plug
Active
Wall Outlet
Active
Check In Here
Add Review
Add Photo

FIG. 4E

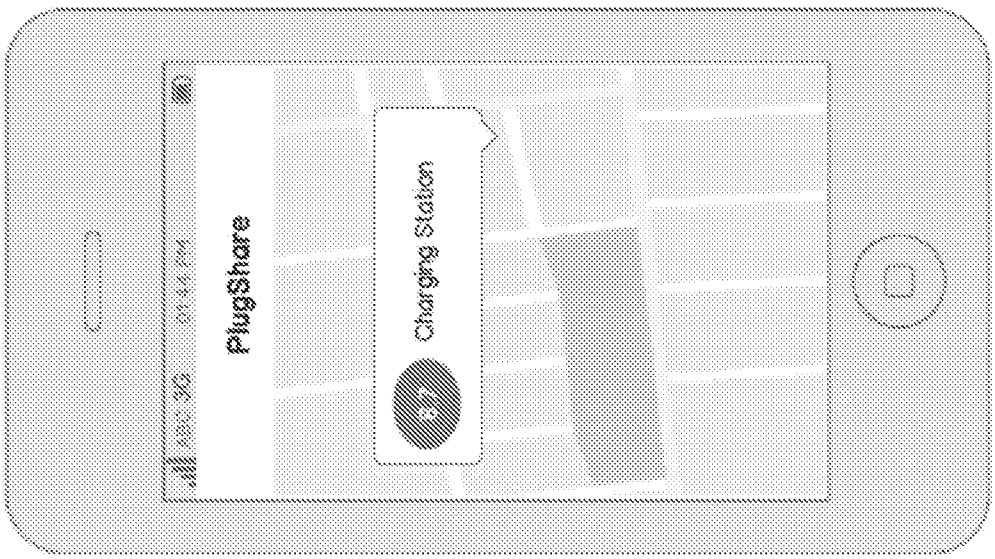
PlugShare
Charging Station

FIG. 4D

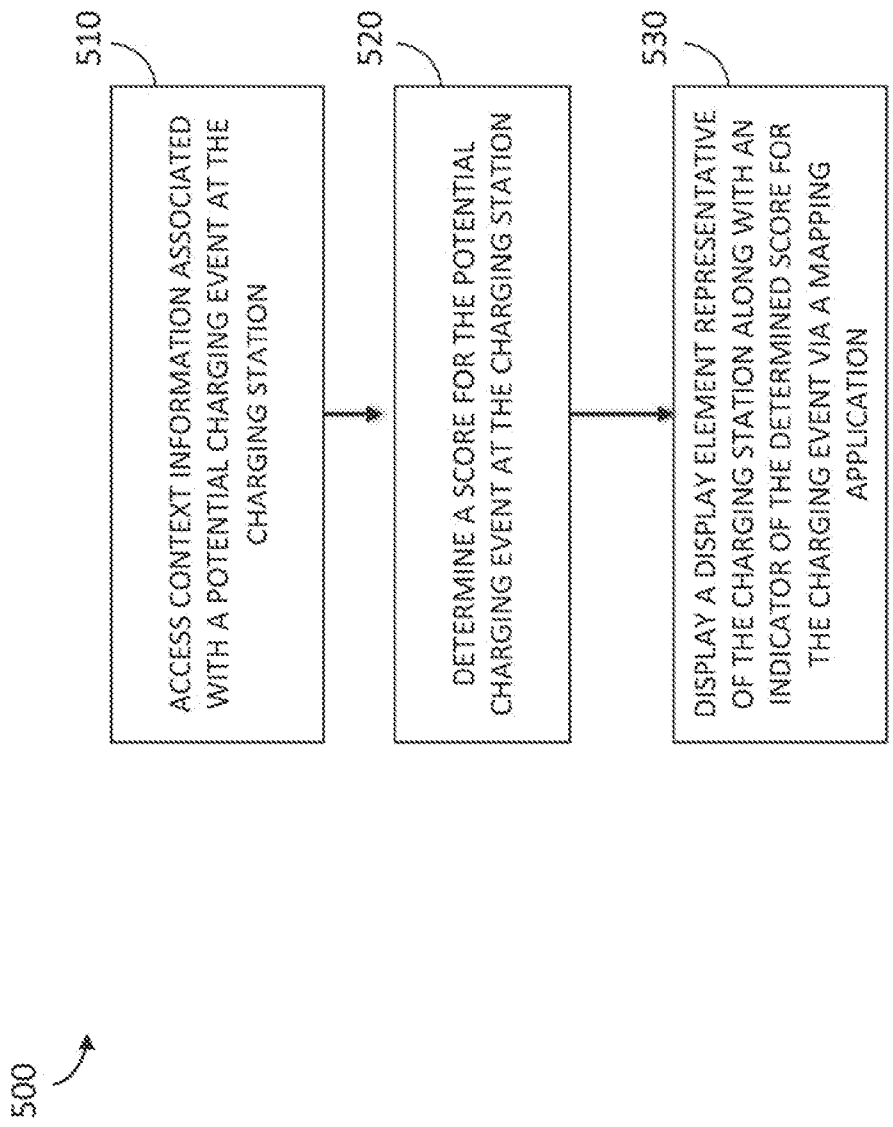
500
510
ACCESS CONTEXT INFORMATION ASSOCIATED WITH A POTENTIAL CHARGING EVENT AT THE CHARGING STATION
520
DETERMINE A SCORE FOR THE POTENTIAL CHARGING EVENT AT THE CHARGING STATION
530
DISPLAY A DISPLAY ELEMENT REPRESENTATIVE OF THE CHARGING STATION ALONG WITH AN INDICATOR OF THE DETERMINED SCORE FOR THE CHARGING EVENT VIA A MAPPING APPLICATION

FIG. 5

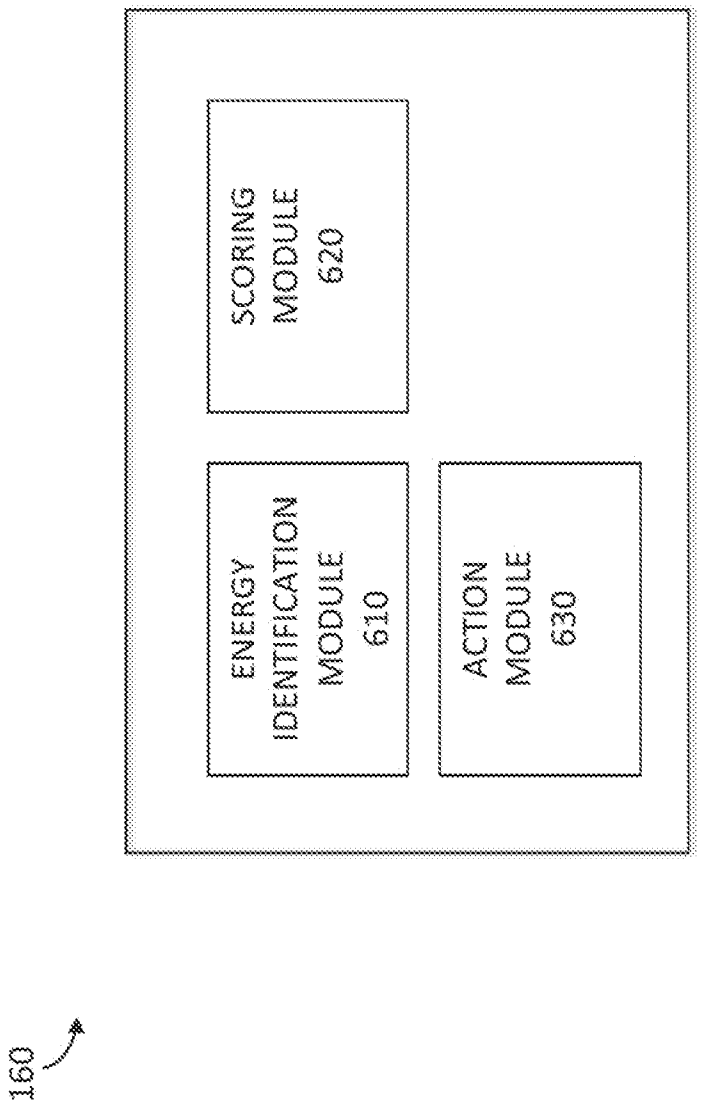
160
ENERGY IDENTIFICATION MODULE 610
SCORING MODULE 620
ACTION MODULE 630

FIG. 6

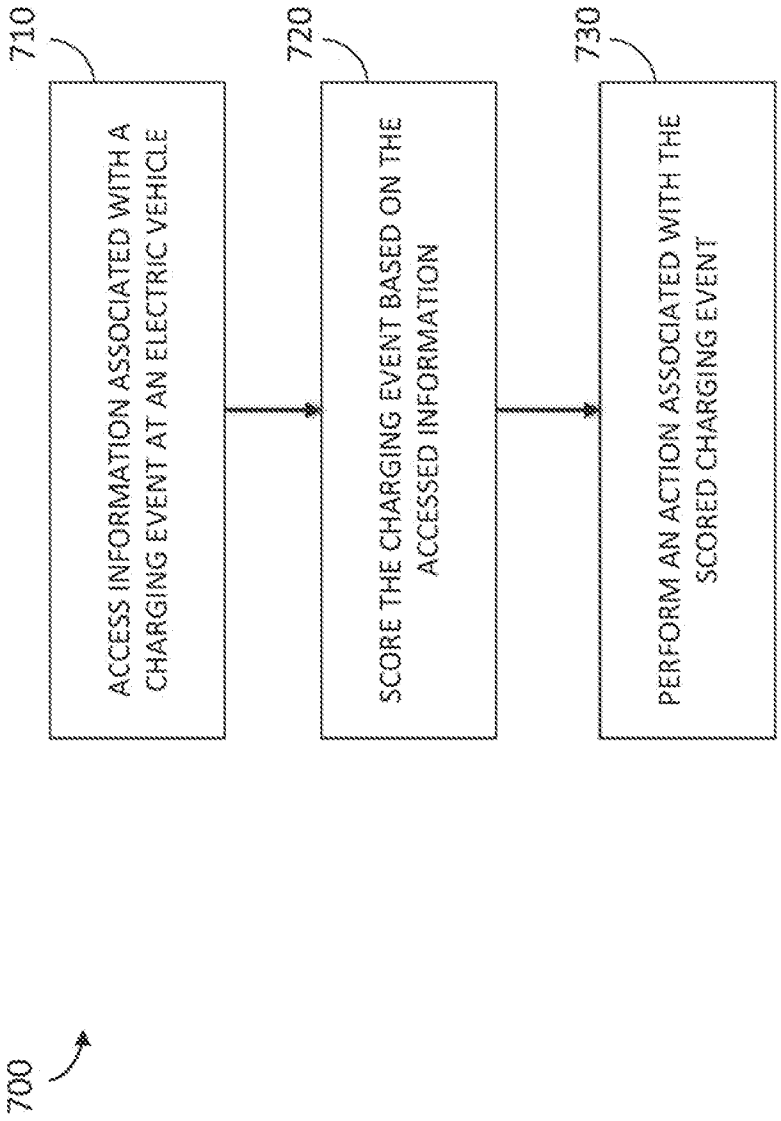
700
710
ACCESS INFORMATION ASSOCIATED WITH A CHARGING EVENT AT AN ELECTRIC VEHICLE
720
SCORE THE CHARGING EVENT BASED ON THE ACCESSED INFORMATION
730
PERFORM AN ACTION ASSOCIATED WITH THE SCORED CHARGING EVENT

FIG. 7

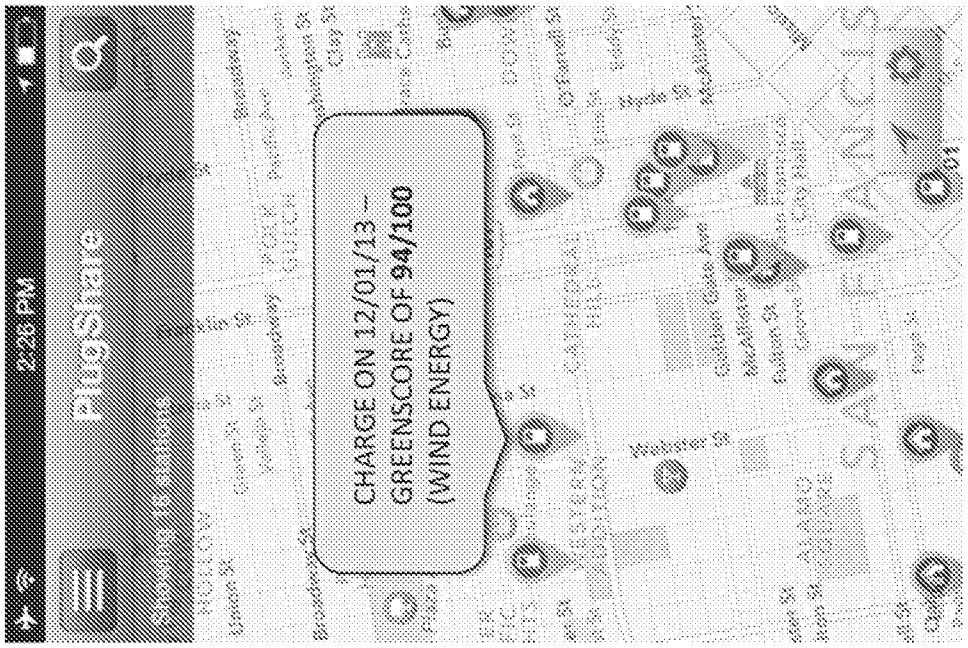
2:23 PM
PlugShare
CHARGE ON 12/01/13 –
GREENSCORE OF 94/100
(WIND ENERGY)

FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/048311

A. CLASSIFICATION OF SUBJECT MATTER

G06Q 50/30(2012.01)i

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)
G06Q 50/30; G07G 1/14; G01C 21/26; G06Q 30/00; G06Q 50/00; G01C 21/34; G06Q 10/00; G06Q 50/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: electric vehicle, charging station, score, rank, review, reward

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2578997 A1 (HITACHI, LTD.) 10 April 2013 See abstract, paragraphs [0010], [0016], [0021], [0041], [0051], [0062]-[0064], [0073], [0089], [0127]-[0128], [0132], [0142], claims 1-3, 6, 10 and figures 12-15.	1-22,24-35
Y		23,36-54
A		55
X	US 2009-0281885 A1 (VITTORIO CASTELLI et al.) 12 November 2009 See abstract, paragraphs [0012], [0019], [0022], claims 10, 15-20 and figures 1, 3.	55
Y		23,36-54
A		1-22,24-35
A	US 2012-0109519 A1 (ROBERT M. UYEKI) 03 May 2012 See abstract, claims 15-20 and figures 2-6.	1-55
A	US 2009-0313103 A1 (RONALD AMBROSIO et al.) 17 December 2009 See abstract, paragraphs [0056]-[0057], [0061]-[0062], claims 1, 8-9 and figure 3.	1-55
A	US 2013-0090936 A1 (JAMES SOLOMON et al.) 11 April 2013. See abstract, claims 1-5, 7, 9 and figures 1-2B.	1-55

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"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
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07 November 2014 (07.11.2014)	**07 November 2014 (07.11.2014)**

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701, Republic of Korea
Facsimile No. +82-42-472-7140

Authorized officer
OH, Eung Gie
Telephone No. +82-42-481-8744

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2014/048311

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2578997 A1	10/04/2013	JP 2013-085449 A	09/05/2013
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