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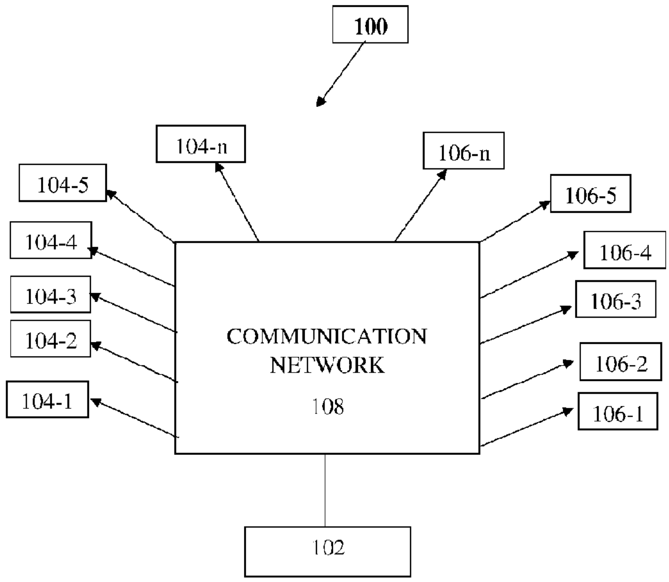

FIG. 1

(57) Abstract: Examples for extending a range of electric vehicles are disclosed. In one example, a computing system (102) includes a processor (200). The processor (200) receives a request for extending the range of a requester electric vehicle from a requester (104) associated with the requester electric vehicle, wherein the receiving comprising receiving a current battery range for the requester electric vehicle and a current location of the requester electric vehicle. The system (102) identifies one or more donor electric vehicles within a predetermined proximity range to the current location of the requester electric vehicle, wherein the current battery range of each of the one or more donor electric vehicles is greater than the current battery range of the requester electric vehicle. The system (102) transmits a list containing the one or more donor electric vehicles to the requester (104).

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EXTENDING RANGE OF ELECTRIC VEHICLES

TECHNICAL FIELD

[0001] The subject described herein in general relates to electric vehicles and, in particular, relates to systems for extending battery range of electric vehicles.

BACKGROUND

[0002] An electric vehicle (EV) is charged by providing a power supply of direct current (DC) to a battery of the EV. In an instance of an alternate current (AC) power supply, a converter is used to provide DC power to the battery of the EV. Among other ways adopted by a rider of the EV to charge the battery, battery swapping is one of them. Battery swapping allows the rider to replace depleted batteries with completely charged ones at swap stations. In an instance where the battery is discharged, the rider can change it with a fully charged one. Once a discharged battery is removed from the EV, the discharged battery is placed for charging at the swap stations such that the same battery is ready for the next EV.

BRIEF DESCRIPTION OF DRAWINGS

[0003] The detailed description is provided with reference to the accompanying figures. It should be noted that the description and the figures are merely examples of the present subject matter and are not meant to represent the subject matter itself.

[0004] Figure 1 illustrates a network environment for extending a range of an electric vehicle, in accordance with an example of the present subject matter.

[0005] Figure 2 illustrates a computing system for extending range of an electric vehicle, in accordance with an example of the present subject matter.

[0006] Figure 3 illustrates a method for extending range of an electric vehicle, in accordance with an example of the present subject matter.

[0007] Figure 4 illustrates a requester associated with an electric vehicle, in accordance with an example of the present subject matter.

[0008] Throughout the drawings, identical reference numbers designate similar, but not necessarily identical, elements. The figures are not necessarily to scale, and the size of some parts may be exaggerated to more clearly illustrate the example shown. Moreover, the drawings provide examples and/or implementations consistent with the description; however, the description is not limited to the examples and/or implementations provided in the drawings

DETAILED DESCRIPTION

[0009] The present subject matter relates to aspects of battery swapping among various electric vehicles (EVs) for extending range of electric vehicles. An electric vehicle (EV) is charged by providing a power supply of direct current (DC) to a battery of the EV. In an instance of an alternate current (AC) power supply, a converter is used to provide DC power to the battery. Conventionally, there exists a plurality of ways for charging an EV including, a Level-1 charging type, a Level-2 charging type, and a Level-3 charging type. The Level-1 charging type is a slow process of charging in which the battery is charged using a household power outlet. The Level-2 charging type is the most commonly adopted process for charging an EV, in which an AC-wall box charging equipment is installed at home or public places for charging the battery. The Level-3 charging type is the fastest and most efficient process of charging the battery from publicly installed charging stations or DC fast charging stations. Another way adopted for charging an EV is a battery swapping mechanism. Battery swapping mechanism allows a rider of the EV to replace depleted batteries with charged batteries at a battery swapping station. In some cases, once the battery is discharged from the EV, the rider can replace it with a fully charged battery. Once a discharged battery is removed from the EV, the discharged battery is placed for charging at the battery swapping station such that the same battery is fully charged and ready for the next EV that comes in at the swap station for battery swapping.

[0010] However, the problem faced by the existing art is that since EVs are still not accepted as a conventional mode of transport and the field of EVs is still on the growing phase, there are not enough charging stations and battery swapping stations available for the rider who may have to charge the EV on-route or swap the depleted battery with charged battery at the battery swapping station. There exists only a limited number of charging stations and battery swapping stations at fixed locations for battery-powered entities. It becomes very important for the rider to ensure that the battery is completely charged or is charged enough to complete an intended distance, i.e., the distance the rider intends to cover, every time the EV is taken out for a drive. The rider has to make sure to stick to the intended route and cannot make any diversions from the intended route because of the unpredictability of the charge in the battery. This might leave the rider in a difficult situation where the battery is not sufficiently charged, or the battery dies before reaching the charging stations, or the destination. In an instance, where the battery charging is completely depleted before-hand, this could affect a driving range of the EV as well as the life of the battery.

[0011] In some scenarios, there might exist multiple other users having sufficiently charged battery who might not need the charged battery at that point in time available within the vicinity of the rider in need. In other words, there might exist other EVs with enough charging to fulfill the requirement of the rider, where such charged battery at that point in time is of no use to the other user. However, the state of the art technology does not provide any mechanism for the riders in need, of extending the EVs range and in need of more charging to complete the intended distance, to request and connect with other EV riders with sufficiently charged batteries who are interested to swap their charged batteries with the riders in need.

[0012] To overcome the above-mentioned problem, conventionally, there exists a system which suggests an on-the-go entity-to-entity charging in transportation systems. According to the art, the charging is achieved when the rider in need of the battery, i.e., a requester rider and, other user willing to provide the battery charging to the requester rider i.e., a donor rider, both are in a mobile state. As per the art, the requester's EV, based on geospatial location and the transport speed of the donor's EV, speed locks with the EV of the donor rider. Once the speed locking is achieved and the two EVs are in range for charge sharing, both the EVs extend their charging arms. The arms heads contain the charging ports, and they latch together using, e.g., either through magnetic pads or other means. The arms and the overall charging operation can be coordinated by respective arm controllers of each EV. This is just one possible realization of the charge transfer mechanism. The entire charging operation can be safely orchestrated if the EVs involved follow a certain predefined protocol. However, the problem faced by this disclosure is that it requires a lot of predefined protocols to be followed. Further, the problem faced by the art is that the charging is transferred when both the donor EV and the requester EV mirror each other's speed and are within range while moving on road. This could be quite dangerous on a road not only for the donor rider and requester rider but also for other vehicles on the road as well.

[0013] The present subject matter discloses aspects related to extending a range of an electric vehicle (EV). According to an aspect, a computing system, hereinafter also referred to as "system", is disclosed for extending the range, such as a driving range, of the EV. The system according to the present invention is so designed that it connects through a communication network to a plurality of electric vehicles (EVs). According to an example, the system may be a central server and may have a cloud based implementation. According to an aspect, a plurality of riders of the plurality of EVs register their EVs on the system through the communication network. According to another example, while registering on the system, rider of each of the plurality of EVs provide battery information. The battery information may include information related to an EV battery, plurality of compatible vehicles with which the batteries may be swapped and number of reward points that is expected for swapping their charged batteries. According to another example, the system registers EVs and stores the battery information of each of the plurality of EVs in a memory.

[0014] According to an aspect, once the registration is successful on the system, before travelling, a rider in need of extending battery range may trigger a request for battery swapping and may provide data to the system through the communication network for extending range of the requester's EV. The request sent to the system may include current battery range of the requester EV, compatible EVs with plurality of swappable batteries, details of the battery to be swapped, and incentive details associated with battery swapping activity. The requester's EV may be the EV in need of extending range. According to an example, the requester may be associated with a requester's EV, where the requester may be a mobile device of the rider riding the requester's EV, or a console, an instrument cluster, a dashboard or a system linked or embedded into the EV with wireless transceiver capabilities able to connect to the system or a plurality of donors via the communication network.

[0015] According to an example, the system, upon receiving the request from the requester, calculates an amount of charging required by the requester to fulfil the rider of requester EV's traveling requirements. Based on the request, the data received by the system and the charging requirements of the requester, the system identifies one or more donors associated with donor EVs within a predetermined proximity range to a current location of the requester EV. The system may based on driving range requirement of the requester, suggest a donor with a partially charged battery that may be sufficient enough to help increase the battery range of the requester's EV.

According to an example, instead of the donor EV, the requester may receive required battery range from a charging service station or a battery vendor. According to this example, the charging service stations, swap stations, battery vendors may also register on the system, such that the system may connect the requesters to such stations that may be in the predetermined proximity range to the current location of the requester EV. This in turn provides a scalable battery sharing platform, allowing battery swapping between consumers, i.e., C2C, between businesses i.e., B2B also, between consumers and businesses.

[0016] The donor's EV may be the EV with sufficient range. According to an example, the donor may be associated with the donor's EV, where the donor may be interested in providing their charged battery to the requester. The donor may be a mobile device of a rider riding the donor's EV, or a console, an instrument cluster, a dashboard or a system linked or embedded into the EV with wireless transceiver capabilities able to connect to the system or the requester.

[0017] According to an aspect of the invention, the system receives the request and the data from the requester. The data sent by the requester to the system is the current battery range of the requester's EV and the current location of the requester's EV. The system calculates the amount of charging required by the requester to fulfil the requester's traveling requirements. According to an example, the system includes a shared battery identification engine. The shared battery identification engine in response to receiving the request, the data, and charging requirements identifies one or more donors from the memory that are available within the predetermined proximity range to the current location of the requester's EV. The system, on locating such donors, checks through its memory whether the donors are interested to swap their sufficiently charged batteries with the requester according to the battery information received by the system from the donor while registering. In other words, the shared battery identification engine of the system finds donor EVs having battery that is sufficiently charged to fulfill the range requirement of the requester's EV and connects the requester to the donor on a condition that such charged battery is not required by the donor at that point in time and that donor is interested to swap the sufficiently charged battery with the requester. According to this example, the donor can provide the charged battery to the requester within the predetermined proximity range to the current location of the requester whose charge state of battery is less and who is in need of the charged battery. According to this aspect of the disclosure, the requester may not have to worry about locating charging stations or battery swapping stations and will be able to easily connect to the donor who is interested in providing their charged battery to the requester. According to this disclosure, requestors may put up a request and connect easily with donors with sufficiently charged batteries who are interested to swap their charged batteries without affecting the range of their batteries.

[0018] According to this aspect of the disclosure, the problem of the state of the art where charging stations are limited and there are not enough charging stations available for a rider to charge the EV on-route is solved by way of connecting the plurality of donors within the predetermined proximity range to the current location of the requester. According to this example, the plurality of EVs register on the system such that it is possible to connect with other EVs within each other's predetermined proximity. The system helps connecting the plurality of EVs, such that it is possible to swap the charged batteries between riders or between rider and a station or between stations. The system helps the riders of requester's EV to increase their EVs battery range by helping them connect and swap their depleted battery with the riders of donor EVs who are in the proximate range of the riders of requester's EV, have sufficiently charged battery to fulfill requester EVs charging requirements and are interested to swap. According to this example, a common platform is provided for the plurality of EVs to connect and share the sufficiently charged/partially charged batteries with one another.

[0019] According to another example of this aspect of the disclosure, the system provides the list of available donor EVs to the requester only after the shared battery identification engine of the system identifies the required range for the requester, battery compatibility between the requester EV's battery and the donor EV's battery, time that may be available with the donor to charge the battery after swapping, and the range which the donor at a later point in time wishes to travel.. The system considers the next time instant at which the rider of the donor EV would need to drive the EV, the range the rider of the donor EV would require to travel and the time required for charging drained battery that will be received by the rider of the donor EV in case of swapping. In this regard, the circuitry of the system considers the charging and travel requirements of all the registered EVs such that the driving range and the battery condition is not hampered.

[0020] According to another aspect of the present subject matter, the system includes a security authentication engine. In an instance where the requester selects the donor to swap the battery with, the security authentication engine provides a requester machine-readable code to the donor and the donor machine-readable security code to the requester. The donor machine-readable code sent to the requester includes personal information of the rider of the requester's EV, a vehicle registration number of the requester's EV, an associated battery number, and bank account details of rider of the requester's EV, and the like. On the other hand, the requester machine-readable security code is transmitted for a selected donor electric vehicle from amongst the one or more donor electric vehicles. The requester machine-readable security code may include personal information of the rider of the selected donor EV, the vehicle registration number of the selected donor's EV, the associated charged battery number which is available for sharing by the rider of the selected donor's EV, the bank account details of the rider of the selected donor's EV, a number of reward points that the rider of the selected donor's EV expects in return of swapping its charged battery with the requester, and the like. The security authentication engine transmits requester machine-readable security code to the donor. According to this example, the machine-readable security codes sent to the requester and to the donor allows the respective riders to track movement of the battery and corresponding EVs. Along with the machine-readable security codes a navigation route is displayed on each respective instrument cluster allowing the riders to navigate route to each other.

[0021] According to an example, in an instance when the requester reaches the selected donor EV's location, the requester and the donor verify the machine-readable security codes sent by the system. According to an example, once the codes are successfully read/scanned the requester sends a battery swapping confirmation to the system. The battery swapping confirmation includes personal information of the rider of the donor EV, the vehicle registration number of the selected donor's EV, the associated charged battery number which is available for sharing by the selected donor's EV, the plurality of bank account details of the rider of the selected donor's EV, the number of reward points that the donor expects for sharing the charged battery with the requester. The system verifies the details received through the battery swapping confirmation from its memory. According to an example, the system confirms the donor details shared by the requester, since the donor details shared by the requester could only be shared after a successful reading/scanning of the machine-readable security codes sent to the donor and requester. According to another example, the system verifies the battery swapping activity and securely transfer expected reward points to the donor for swapping the battery with the requester. This in turn, provides incentives to riders of the donor EVs that are willing to swap the sufficiently charged batteries with the riders of the requester EVs that are in need to extend battery range.

[0022] According to an example, the notification indicator engine sends a notification after successfully crediting rewards to the donor. According to this example, once the notification is sent to the donor, then only the donor provides the sufficiently charged battery of the donor's EV to the requester and in return, takes the less charged battery of the requester. According to this example, the battery swapping is made easy, since the system provides a connected platform for sharing of charged electrical batteries amongst a plurality of EVs. Incentives are also provided to the donors willing to share their charged battery. According to another aspect, the donor machine-readable security code and the requester machine-readable security code provided by the security engine of the system ensures a secure way of receiving the charged batteries from the donors. According to this disclosure, the battery swapping arrangement takes place in a secure manner between consumers. According to the disclosure as above, the problem of accidents and unruly incidents on the road for battery swapping is solved, as the donor and requester may meet up to swap batteries under safe conditions.

[0023] The above aspects are further illustrated in the figures and described in the corresponding description below. It should be noted that the description and figures merely illustrate principles of the present subject matter. Therefore, various arrangements that encompass the principles of the present subject matter, although not explicitly described or shown herein, may be devised from the description and are included within its scope.

[0024] Figure 1 illustrates a network environment 100 for extending a range of an electric vehicle (EV), in accordance with an implementation of the present subject matter. The network environment 100 provides for EVs (not shown in Figure 1) in need to swap batteries to connect with the EVs with sufficiently charged batteries, and riders of EVs that are interested to swap their sufficiently charged batteries with the EVs in need. The sufficiently charged batteries may include batteries which are charged enough to fulfill the traveling requirements of an EV that is need of the battery. The network environment 100 may include a computing system 102 which may regulate and facilitate in extending the range of the EVs. The plurality of EVs register on the computing system 102 through a communication network 108. The network environment 100 may include the system 102 that may be connected to the plurality of EVs through the communication network 108. In one example, the communication network 108 may be a wireless network, a wired network, or a combination thereof. The network can also be an individual network or a collection of many such individual networks, interconnected with each other and functioning as a single large network, e.g., the Internet or an intranet. The network can be one of the different types of networks, such as intranet, local area network (LAN), wide area network (WAN), and the internet. The network may either be a dedicated network, a virtual network, or a shared network, which represents an association of the different types of networks that use a variety of protocols, for example, Hypertext Transfer Protocol (HTTP), and Transmission Control Protocol/Internet Protocol (TCP/IP), to communicate with each other. An example of a network may include Fiber Channel Protocol (FCP) on Fiber Channel media. In an example, the network may include a Global System for Mobile Communication (GSM) network, a Universal Mobile Telecommunications System (UMTS) network, or any other communication network that use any of the commonly used protocols, for example, Hypertext Transfer Protocol (HTTP) and Transmission Control Protocol/Internet Protocol (TCP/IP).

[0025] The network environment 100 enables registration of a plurality of EVs with the system 102 and to connect to each other for swapping batteries to extend their range. According to an example, the system 102 may be a central server, a laptop computer, a personal computer (PC), a supercomputer, and the like. According to an example, the system 102 may be a central server having cloud-based implementations and workings. The system 102 regulates and facilitates in extending the range of the EVs. The riders of the plurality of EVs register their EVs on the system 102 through the communication network 108. According to another example, while registering on the system 102, riders of each of the plurality of EVs provide battery information. The battery information may include information related to an EV battery, i.e., the battery of an EV, a plurality of compatible vehicles with which the batteries may be swapped and number of reward points that is expected for swapping their charged batteries. The computing system 102 registers the plurality of EVs and stores the battery information of each of the plurality of EVs in a memory (not shown in Figure 1) of the system 102.

[0026] According to an aspect, the plurality of EVs in the need of swapping batteries to extend the range and to fulfill travel requirements, after registering on the system 102, may send a request to the system 102 for assistance in extending range for the batteries of respective EVs. According to an example, the EVs that are in need for swapping batteries or extending range are referred to as requester EVs. The system 102 can, in response to the request, connect the plurality of EVs which may have the required battery range and the intent to swap the battery with the requester

EV. According to an example, the EVs that have sufficiently charged batteries and are interested to swap the charged battery with the requester EVs are referred to as donor EVs.

[0027] According to an aspect, the system 102 may receive the request along with a data through the communication network 108 from a plurality of requesters 104-1, 104-2, 104-3, 104-4, 104-5…104-n. The plurality of requesters 104-1, 104-2, 104-3, 104-4, 104-5…104-n are hereinafter collectively referred to as the requester 104. The requester is a system linked with the requester EV such that the requester EV connects through the requester 104 to the system 102 or a donor 106. The requester 104 linked with the requester EV can be a mobile system, a mobile phone, a tablet, a laptop of the rider of the EV. According to another example, the requester 104 can be built into, for example, an instrument cluster of the EV and is capable of wireless communication. According to other example, the requester 104 may be a mobile system of the rider riding the requester EV, or a console, an instrument cluster, a dashboard or a system linked or embedded into the EV with wireless transceiver capabilities able to connect to the system or a plurality of donors, and the like. The system 102 receives the request from the requester 104 to extend the range of a requester EV. The requester EV may be associated with the requester, i.e., in need of extending the range. The request sent by the requester 104 to the system 102 may include the current battery range of the requester EV, compatible EV with swappable batteries, details of the battery to be swapped, and incentive details associated with battery swapping activity. The requester 104 may be associated with the requester EV that sends the request to the system 102 for extending the range of the requester EV. In other words, the requester 104 triggers the request to the system 102 when it is in need of extending the range of the requester EV to fulfill the travel requirements. According to another example, the requester 104 may through the request and the data transfer the travel requirements of requester EV such that the system 102 can compute the required battery range by the requester to fulfil the travel requirements. The travel requirements can be the distance the requester EV intends to cover. According to an example, the data includes the current battery range of the requester EV and the current location of the requester's EV. According to an example, the data sent by the requester 104 to the system 102 is sent along with the request for extending range of the EV. According to another example, the requester while registering on the system 102 may agree to continually share the data with the system 102. The system 102 may determine the amount of charging required by the requester to fulfil the requester's traveling requirements.

[0028] According to an example, based on the request, the data received by the requester and the charging requirements of the requester calculated by the engines (not shown in Figure 1) of the system. The system 102 identifies one or more donors 106-1, 106-2, 106-3, 106-4, 106-5, ... 106-n from the memory which are available within a predetermined proximity range to the current location of the requester 104. Multiple donors 106-1, 106-2, 106-3, 106-4, 106-5...106-n are hereinafter collectively referred to as the donor 106. The donor is a system linked with the donor EV such that, the donor EV connects through the donor 106 to the system 102 or the requester 104. The donor EV may be the EV with sufficient range. The donor 106 linked with the donor EV can be a mobile system, a mobile phone, a tablet, a laptop of the rider of the EV. According to another example, the donor 106 can be built into, for example, an instrument cluster of the EV and is capable of wireless communication. According to other example, the donor 106 may be a console, an instrument cluster, a dashboard or a system linked or embedded into the EV with wireless transceiver capabilities able to connect to the system 102 or a plurality of donors 106, and the like. According to an example, the donor EV may also be a charging service station and a battery vendor. According to an example, the donor EV may not necessarily be fully charged. The donor EV may be sufficiently charged to fulfill the requester EV's travel requirements. According to an example, the donor 106 may be associated with the donor's EV, where the donor may be interested in providing their charged battery to the requester 104.

[0029] The system 102, on locating and identifying one or more donors 106, checks if the one or more donors 106 are interested to swap their sufficiently charged batteries with the requester 104. The system 102 may find one or more donors 106 having a battery that is sufficiently charged to fulfill the range requirement of the requester's EV. According to an example, the system 102 connects the requester 104 to the donor 106 based on a condition that donor EV's charged battery is not required by the one or more donors 106 at that point in time and the one or more donors 106 are interested to swap their sufficiently charged battery with the requester 104. According to this example, the one or more donors 106 can provide the charged battery to the requester 104 that is within a predetermined proximity range to the current location of the requester 104, who has less charging state of battery and is in dire need to extend the range of the EV.

[0030] According to other aspect of the present subject matter, after the system 102 has identified one or more donor EVs within the predetermined proximity range to the current location of the requester EV having current battery range greater than the current battery range of the requester's EVs, the system 102 transmits a list containing of such one or more donor EVs to the requester. The list transmitted by the computing system 102 to the requester 104 may include the current battery level available with one or more of the donors 106, associated battery range, the current location of the of donors, and the like.

[0031] Figure 2 illustrates the computing system 102 for extending range of the EV, in accordance with an example of the present subject matter. The computing system 102 includes a processor 200. The processor 200 includes an interface(s) 202. The processor 200 as disclosed above includes a plurality of engines 204 which can include a shared battery identification engine 214, a notification indicator engine 216, a security authentication engine 218, other engines 222.The processor 200, in addition to the components discussed above, may include a memory 206 having parameter data 210 and other data 212. The memory stores processor instructions, which are executed by the processor. The other data 212 may include data generated and saved by the engines 204 to provide various functionalities to the computing system 102.

[0032] The processor 200 may include microprocessors, microcomputers, microcontrollers, digital signal processors, central processing units, state machines, logic circuitries, and/or any other systems that manipulate signals and data based on computer-readable instructions. Further, functions of the various elements shown in the figures, including any functional blocks labeled as "processor(s)", may be provided through the use of dedicated hardware as well as hardware capable of executing computer-readable instructions. Further, the plurality of engines 204, among other capabilities, may fetch and execute computer-readable instructions stored in the memory 206. The memory 206 communicatively coupled to the engines 204, may include a non-transitory computer-readable medium including, for example, volatile memory, such as Static Random-Access Memory (SRAM) and Dynamic Random-Access Memory (DRAM), and/or non-volatile memory, such as Read-Only-Memory (ROM), erasable programmable ROM, flash memories, hard disks, optical disks, and magnetic tapes.

[0033] The engines 204 may be a combination of hardware and programming (for example, programmable instructions) to use functionalities of the engines 204. Engines 204 are not intended to encompass software per se. For example, the programming for the engines 204 may be processor executable instructions stored on a non-transitory machine-readable storage medium and the hardware for the engines 204 may include a processing resource (for example, processors), to execute such instructions. In the present examples, the machine-readable storage medium stores instructions that, when executed by the processing resource, deploy engines 204. In such examples, the computing system 102 may include the machine-readable storage medium storing the instructions and the processing resource to execute the instructions, or the machine-readable storage medium may be separate but accessible to the computing system 102 and the processing resource. In other examples, engines 204 may be deployed using electronic circuitry (e.g., field-programmable gate array (FPGA), application-specific integrated circuits (ASICs), etc.).

[0034] In an example, the computing system 102 can connect to the plurality of EVs through the interface(s) 202. The interface(s) 202 may include a variety of commercially available interfaces, for example, interfaces for peripheral system(s), such as data input output systems, referred to as I/O systems, storage systems, network systems, and intermediate power systems. The interfaces 202 may facilitate multiple communications within a wide variety of networks and protocol types, including wired networks and wireless networks.

[0035] According to an example, the riders of plurality of EVs register their EVs on the computing system 102 through the communication network 108. According to another example, the computing system 102 may save the battery information of the plurality of EVs provided by riders of each of the plurality of EVs in the memory 206 of the system 102. The battery information provided by the riders of plurality of EVs while registering includes information related to the EVs batteries, compatible EVs with which the batteries may be swapped and number of reward points that is expected for swapping their charged batteries. According to another example, the computing system 102 registers EVs and stores the battery information of each of the plurality of EVs in the memory 206.

[0036] According to another example, the riders of the plurality of EVs while registering on the system 102 agree to continually share a current data of the EVs. The current data may include current battery range, an information associated with the current charge condition, percentage of the battery and the current location of the plurality of the EVs. As a result, the system 102 continually receives the current data and saves the current data in the other data 212 of the memory 206.

[0037] According to an aspect, the system 102 receives the request from the requester 104 to extend the range of a requester EV. The requester EV may be associated with the requester, i.e., in need of extending the range. The request may include the current battery range of a requester EV, compatible EV with swappable batteries, details of the battery to be swapped, and incentive details associated with battery swapping activity. According to an example, the data includes the current battery range of the requester EV and the current location of the requester's EV. According to an example, the data sent by the requester 104 to the system 102 is sent along with the request for extending range of the EV. According to another example, the requester while registering on the system 102 may agree to continuously send the data to the system 102. The system 102 through the engines 204 calculates the amount of range extension required by the requester to fulfil the requester's traveling requirements.

[0038] The system 102 receives the request of the requester EV through, for example, processor 200 and the interface(s) 202. In this regard, the processor 200 receives the current battery range for the requester EV and the current location of the requester EV.

[0039] According to an example, based on the request, the data received by the requester and the charging requirements of the requester calculated by the other engines 222, the system 102 from the parameter data 210 identifies one or more of the donors 106 within the predetermined proximity range to the current location of the requester EV. The processor 200 takes into consideration the parameter data 210 and other data 212 of the registered EVs in the memory 206 to identify the one or more donors 106. The parameter data 210 may be the battery information shared by the EV while registering on the computing system 102 and the other data 212 may be battery range requirements of the requester.

[0040] The processor 200 of the computing system 102 identifies through a shared battery identification engine 214 of the engines 204 if the current battery range of each of the one or more donor EVs is greater than the current battery range of the requester EV. According to an example, the donor 106 or any EVs, while registering on the computing system 102, may agree to continually share the current battery range and the current location with the computing system 102. The computing system 102 may, through a notification indicator engine 216 of the engines 204, send an alert to the donor 106 to confirm if the donor 106 is interested to swap battery after receiving the request by the requester 104. According to other example, the donor 106 might connect directly to the computing system 102 showing an interest to swap their charged batteries.

[0041] The shared battery identification engine 214, in response to receiving the request and the data from the requester 104, identifies one or more donors with the help of the processor 200 that are available within the predetermined proximity range to the current location of the requester 104. The processor 200, on identifying one or more donors 106, may check through its memory 206 whether the donors 106 are interested to swap their sufficiently charged batteries with the requester based on the data provided to them while registering on the computing system 102. In other words, the shared battery identification engine 214 may find the donor EVs having battery that is sufficiently charged to fulfill the range requirement of the requester's EV and connects the requester 104 to the donor 106 on a condition that such charged battery is not required by the donor at that point in time and that donor is interested to swap the sufficiently charged battery with the requester. According to other example, the interested donor may alert the computing system 102 if they voluntarily want to switch their battery and the shared battery identification engine 214 may check the interested donor's EVs configuration if it matches the requirements of the requester 104.

[0042] According to an example, the donor 106, while registering on the computing system 102, may accept the condition of continually sharing donors EV's charging conditions and current location of the donor EV or the donor 106. Once the shared battery identification engine 214 identifies a donor 106 with sufficient charging to fulfill the requirement of the requester to extend requester EV's range, the other engines 222 send an alert through the notification indicator engine 216 to the donor to know about the charging requirements and travel requirements of the donor 106. The processor 200, upon receiving the data as requested by the donor 106, considers the charging requirements of the donor's EV as well before adding the said donor identified by the shared battery identification engine 214 in the list of available EVs. In other words, the processor 200 and the shared battery identification engine 214 includes the donor 106 in the list of available EVs sent to the requester 104 only after establishing that the battery swap would not hamper donor's 106 future travel requirements, charging requirements, and driving range. According to this example, in the event the donor 106 swaps their sufficiently charged battery with the requester 104, the computing system 102 makes sure if the less charged battery received by the donor 106 would be able to sufficiently charge till the time the donor 106 wishes to travel to fulfill donor's travel requirements. According to an example, the processor 200 estimates an expected reduction in battery range from the current battery range for the donor EV after swapping and transmits the expected reduction in the battery range to the donors. In other words, while selecting the donor or preparing the donor list, the system considers a next time instant at which the rider of the donor EV would need to drive the EV, the range required by the donor EV and the time required for charging of drained battery received by the donor EV in case the battery swapping takes place. According to another aspect, in case the swapped battery received by the donor 106 would not be able to charge up sufficiently enough after the expected reduction till the time the donor 106 wishes to travel to fulfill their travel requirements, the computing system 102 provides the said donor 106 with an option to connect and swap their battery with another donor 106 while traveling. The another donor 106 would have sufficient charged battery to fulfill the donor's travel requirements. In this regard, the circuitry of the computing system 102 considers the charging and travel requirements of all the registered EVs such that the driving range and the battery condition and the battery's range is not hampered. According to an example, the notification indicator engine 216, through the interface(s) 202, transfers a notification to the donor 106 mentioning expected reduction in battery range after swap with the requester 104 and providing the donor with an option to connect with the other donor to fulfill their travel requirements, and if the donor accepts such condition then only the donor 106 is added on to the list to be sent to the requester 104.

[0043] For example, donor EV's battery is charged 70% and the rider of the donor EV wishes to travel after 4 hours for 40kms, and the donor receives a request from requester for sharing of the battery. In such a scenario, the system 102 determines level of charging of the battery provided by the requester to the donor during swapping. In case, the battery from requester can be charged within 4 hours and can provide a range of 40kms then only the donor is selected by the system for sharing of the battery with requester. In another embodiment, the donor may be notified of a requirement from requester and, may also be notified that within 4 hours only 30 kms range is possible in such a scenario, the donor may have an option of swapping the battery received from requester with another donor while travelling. If the donor accepts such a condition then the system may select donor for sharing the battery with requester.

[0044] The computing system 102 provides the list of available donor EVs to the requester 104 only after the establishing that the battery swap would not hamper donor's future travel requirements, charging requirements and driving range. In this regard, the circuitry of the system considers the charging and travel requirements of all the registered EVs such that the driving range and the battery condition is not hampered.

[0045] The processor 200, upon finalizing the list of one or more donors 106 from the shared battery identification engine 214, transfers the list through its interface 202 to the requester 104. The list sent to the requester 104 may include location of the one or more donors 106, current battery level available with each of the donors, the associated battery range, the reward points that need to be provided to the donors in case the battery swapping activity takes place.

[0046] The interface 202 receives a notification from the requester 104 indicating the donor 106 selected by the requester 104. According to an example, a security authentication engine 218 of the computing system 102 provides a requester machine-readable code to the donor 106 and the donor machine-readable security code to the requester 104. The donor machine-readable code shared with the selected requester 104 includes personal information of the rider of the requester's EV, a vehicle registration number of the requester's EV, an associated battery number, and bank account details of rider of the requester's EV and, the like. On the other hand, the requester machine-readable security code shared with the donor 106 selected by the requester 104 includes personal information of the rider of the selected donor's EV, the vehicle registration number of the selected donor's EV, the associated charged battery number which is available for sharing by the rider of the selected donor's EV, the bank account details of the rider of the selected donor's EV, a number of reward points that the rider of the selected donor's EV expects in return of swapping its charged battery with the requester, and the like.

[0047] According to other example, instead of sending a list, the system 102 may after receiving the request from the requester 104, may independently identify a donor 106 having battery sufficiently charged to fulfil the requester EV's range requirements that may be available within the predetermined proximity range to the current location of the requester's EV. In this regard, the system 102 may independently select a donor 106 for swapping the sufficiently charged battery with the requester 104. According to an example, the battery identification engine and the processor of the system 102 may independently identify and select the donor 106 that may be the most suitable available within the predetermined proximity range to the current location of the requester's EV. The system connects the requester 104 to the donor 106 on a condition that such charged battery is not required by the donor at that point in time and that donor 106 is interested to swap the sufficiently charged battery with the requester 104.

[0048] According to an example, the processor 200 and the interface 202 receives a battery swapping confirmation from the requester 104. According to an example, the battery swapping confirmation can only be sent by the requester 104 once the uniquely generated separate machine-readable codes shared with the donor 106 and the requester 104 are successfully read/scanned. The battery swapping confirmation shared by the requester 104 includes the confirmation of completion of the code scanning/reading process, plurality of personal information of the rider of the donor EV, the vehicle registration number of the selected donor's EV, the associated charged battery number which is available for sharing by the selected donor's EV, the plurality of bank account details of the rider of the selected donor's EV, the number of reward points that the donor expects for sharing the charged battery with the requester. According to an example, the computing system 102 through the processor 200 and other engines 222 verifies the details received through the requester from the memory 206. In other words, the computing system 102 verifies the details regarding received by the requester through battery swapping confirmation from the memory. According to an example, the system confirms the donor details shared by the requester since, the donor details shared by the requester could only be shared after a successful reading/scanning of the uniquely generated machine-readable security codes sent to the donor and requester separately.

[0049] According to an example, the computing system 102, through processor 200 and engines 204, verifies the details received from the requester in form of battery swapping confirmation and securely transfers the reward points that the donor expected in exchange of sharing their charged battery. The notification indicator engine 216 sends an authentication notification to the donor 106 indicating receipt of the reward points and therefore, allowing the battery swapping arrangement to take place.

[0050] Figure 3 illustrates a method 300 for facilitating extending range of an EV, for instance, by battery swapping. The order in which the method 300 is described is not intended to be construed as a limitation, and any number of the described method blocks can be combined in any appropriate order to execute the method 300 or another method. Additionally, individual blocks may be deleted from the method 300 without departing from the spirit and scope of the subject matter described herein.

[0051] The method 300 can be performed by computing systems, for example, based on instructions retrieved from non-transitory computer readable media. The computer readable media can include machine-executable or computer-executable instructions to perform all or portions of the described method. The computer readable media may be, for example, digital memories, magnetic storage media, such as a magnetic disks and magnetic tapes, hard drives, or optically readable data storage media.

[0052] The method 300 may be performed by a computing system, such as by the computing system 102. In either case, the method 300 may be performed by the processor 200. For the sake of understanding the description of Figure 3, the components of the system 102 performing the various elements of the method 300 are described in with reference to Figure 2 and are not repeated here for the sake of brevity.

[0053] At block 302, the system 102 receives the request from the requester 104 to extend the range of requester EV. The system 102 also receives the data comprising current battery range for the requester electric vehicle and a current location of the requester electric vehicle. The system 102 through its processor 200 and plurality of engines 204 calculates the amount of charging that would be required by the requester EV to fulfill the charging and traveling requirements of the requester.

[0054] At block 304, the system 102 based on the request and data received by the requester 104 and, the charging and traveling requirements computed by the plurality of engines 204 and the processors 200 identifies one or more donors EVs from the memory which are available within the predetermined proximity range to the current location of the requester 104. The processor 200 of the system identifies one or more donor EVs having the current battery range greater than the current battery range of the requester EV. The system does not locate one or more donors with full charging but locates donors having battery that is sufficiently charged to fulfill the range requirement of the requester's EV. The computing system 102 adds the one or more donors 106 on the list to be sent to the requester only on such a condition that, such charged battery is not required by the donor 106 at that point in time and that donor 106 is interested to swap their sufficiently charged battery with the requester 104.

[0055] At block 306, as soon as the computing system 102 has identified one or more donor EVs within the predetermined proximity range to the current location of the requester EV having current battery range greater than the current battery range of the requester's EVs, the processor 200 and the interface 202 transmits a list containing of such one or more donor EVs to the requester. The list transmitted by the computing system 102 to the requester 104, includes the current battery level available with one or more of the donors, the associated battery range, the current location of the of donors, expected reward points by the donor, and the like. The requester 104 may select the donor 106 based on the list and the information provided in the list to swap batteries with.

[0056] At block 308, the security authentication engine 218 provides a requester machine-readable code to the donor 106 selected by the requester 104 and provides the donor machine-readable security code to the requester 104. The security authentication engine 218 transmits machine-readable codes as above only when the interface 202 receives a notification from the requester 104 indicating the selection of the donor 106. According to an example, the requester machine-readable code shared with the donor 106 includes personal information of the rider of the requester's EV, a vehicle registration number of the requester's EV, an associated battery number, and bank account details of rider of the requester's EV and, the like. On the other hand, the donor machine-readable security code shared with the requester includes personal information of the rider of the selected donor's EV, the vehicle registration number of the selected donor's EV, the associated charged battery number which is available for sharing by the rider of the selected donor's EV, the bank account details of the rider of the selected donor's EV, a number of reward points that the rider of the selected donor's EV expects in return of swapping its charged battery with the requester, and the like.

[0057] At block 310, notification indicator engine 216 authenticates the transaction after the requester successfully scans the requester machine-readable code shared with the selected donor 106. In other words, the notification indicator engine 216 authenticates the battery swapping activity after the interface 202 and the processor 200 receives the battery swapping confirmation from the requester 104. The battery swapping confirmation indicates that the requester has successfully scanned and read the uniquely generated requester machine-readable code shared with the donor 106 selected by the requester 104. The computing system 102 authenticates the completion of the swapping by verifying the battery swapping confirmation notification received by the computing system 102. The computing system 102 verifies the battery swapping activity and the battery swapping confirmation received, which includes the personal information of the donor and the requester, and further vehicle registration number of the donor and the requester, and associated charged battery number which is available for sharing by the donor to the requester, bank account details of donor, a number of reward points that the donor expects for sharing the charged battery with the requester. In this regard, the notification indicator engine 216 sends an authentication notification to the donor 106 indicating acknowledgement of the transfer of expected reward points and therefore, allowing and authenticating the battery swapping arrangement.

[0058] Figure 4 illustrates the requester 104 associated with an electric vehicle, in accordance with an example of the present subject matter. According to an example, the requester 104 may be associated with the requester's EV. The requester 104 is so designed that it includes a processor 400. The requester 104 also includes a controller 402, a memory 404 and an interface.

[0059] The processor 400 may include microprocessors, microcomputers, microcontrollers, digital signal processors, central processing units, state machines, logic circuitries, and/or any other systems that manipulate signals and data based on computer-readable instructions. Further, functions of the various elements shown in the figures, including any functional blocks labeled as "processor(s)", may be provided through the use of dedicated hardware as well as hardware capable of executing computer-readable instructions.

[0060] Further, the controller 402 can be implemented as a microcontroller, a microcomputer, and/or any system that manipulates signals based on operational instructions. According to said embodiment, controller 402 can include a processor and a system memory. The processor can be a single processing unit or a number of units, all of which could include multiple computing units. The processor may be implemented as one or more microprocessors, microcomputers, microcontrollers, digital signal processors, central processing units, state machines, logic circuitries, and/or any systems that manipulate signals, based on operational instructions. Among other capabilities, the processor(s) is provided to fetch and execute computer-readable instructions stored in the system memory. The system memory may be coupled to the processor and can include any computer-readable medium known in the art including, for example, volatile memory, such as Static-Random Access Memory (SRAM) and Dynamic-Random Access Further, the processor 400, among other capabilities, may fetch and execute computer-readable instructions stored in the memory 404. The memory 404 communicatively coupled to the processor 400, may include a non-transitory computer-readable medium including, for example, volatile memory, such as Static Random-Access Memory (SRAM) and Dynamic Random-Access Memory (DRAM), and/or non-volatile memory, such as Read-Only-Memory (ROM), erasable programmable ROM, flash memories, hard disks, optical disks, and magnetic tapes.

[0061] In an example, the requester 104 can connect to the computing system 102 (not shown in Figure 4) and the donor 106 (not shown in Figure 4) through the interface(s) 406. The interfaces 406 may include a variety of commercially available interfaces, for example, interfaces for peripheral system(s), such as data input output systems, referred to as I/O systems, storage systems, network systems, and intermediate power systems. The interfaces 406 may facilitate multiple communications within a wide variety of networks and protocol types, including wired networks and wireless networks.

[0062] The requester is a system linked with the requester EV such that, the requester EV connects through the requester 104 to the system 102 or a donor 106. The requester 104 linked with the requester EV can be a mobile system, a mobile phone, a tablet, a laptop of the rider of the EV. According to another example, the requester 104 can be built into for example the instrument cluster of the EV and is capable of wireless communication. According to other example, the requester 104 may be a mobile system of the rider riding the requester EV, or a console, an instrument cluster, a dashboard or a system linked or embedded into the EV with wireless transceiver capabilities able to connect to the system or a plurality of donors 106 through the communication network 108. The requester EV can be the EV which is in need of extending range in order to fulfill the rider of the requester EV's travelling requirements. The requester, through processor 400, interface 406 may trigger a request to the computing system 102 for extending the range of the requester EV. The requester 104, may through processor 400 and the memory 404, transmit data along with the request. The data transmitted by the memory 404, the controller 402 and the processor 400 may include sending the current battery range for the requester EV and the current location of the requester EV. According to an example, the data sent by the requester 104 to the computing system 102 can be while sending the request for extending range of the vehicle. According to another example, the data can be continually sent to the computing system 102 by the requester 104.

[0063] After sending the request and the data, the requester 104, may receive the list containing one or more donor EVs from the computing system 102. According to an example, the list transmitted by the computing system 102 to the requester 104, includes the current battery level available with one or more of the donors, the associated battery range, the current location of the of donors, and the like. The requester 104 may select the donor 106 based on the list and the information provided in the list to swap batteries with.

[0064] The list includes the details of the one or more donor EV that are identified to be within a predetermined proximity range to the current location of the requester EV. The list only includes the details of one or more donors 106 with the current battery range of each of the one or more donor EVs greater than the current battery range of a requester EV. The rider of the requester EV selects from the plurality of donors with which the requester wishes to swap the battery. The requester 104 sends a notification to the computing system 102 of the selected donor 106.

[0065] According to an example, the requester 104 receives the donor machine-readable code for a selected donor from amongst the one or more donor EVs. The donor machine-readable security code includes personal information of the rider of the selected donor's EV, the vehicle registration number of the selected donor's EV, the associated charged battery number which is available for sharing by the rider of the selected donor's EV, the bank account details of the rider of the selected donor's EV, a number of reward points that the rider of the selected donor's EV expects in return of swapping its charged battery with the requester, and the like. According to an example, the requester 104 also receives a navigation route that is computed from the requester's location to the donor's location i.e., displayed on the instrument cluster.

[0066] According to another example, when the rider of requester EV reaches the location of the donor, the requester 104 may verify the receiver machine-readable security code available with the donor 106 and may transfer the expected reward points. In this regard, the requester transmits the battery swapping confirmation to the computing system 102 in response to reading the requester machine-readable security code on the donor.

[0067] Although the functionalities of the requester 104, i.e., the system associated with the EV, have been provided above with reference to the components shown in Figure 4, the present subject matter also contemplates a method performed by the requester 104. Therefore, it should be understood that the functionalities as described above with respect to the requester 104 are also envisaged in the form of a method and these functionalities are not repeated (as a method) for the sake of brevity.

[0068] The claimed steps as discussed above are not routine, conventional, or well understood in the art, as the claimed steps enable the following solutions to the existing problems in conventional technologies.

[0069] Although implementations of extending a range of electric vehicles are described, it is to be understood that the present subject matter is not necessarily limited to the specific features of the systems or methods or other aspects described herein. Rather, the specific features are disclosed as implementations for extending the range of electric vehicles.

I/We Claim:

1. A computing system (102) for extending a range of an electric vehicle, the computing system (102) comprising:

   a processor (200); and

   a memory communicatively coupled to the processor, wherein the memory stores processor instructions, which, on execution, causes the processor to:

   receive a request for extending the range of a requester electric vehicle from a requester (104) associated with the requester electric vehicle, wherein the receiving comprising receiving a current battery range for the requester electric vehicle and a current location of the requester electric vehicle;

   identify one or more donor electric vehicles within a predetermined proximity range to the current location of the requester electric vehicle, wherein the current battery range of each of the one or more donor electric vehicles is greater than the current battery range of the requester electric vehicle;

   transmit a list containing the one or more donor electric vehicles to the requester (104);

   transmit, for a selected donor electric vehicle from amongst the one or more donor electric vehicles, a donor machine-readable security code to the requester (104); and

   transmit, to a donor (106) associated with the selected donor electric vehicle, a requester machine-readable security code,

   wherein the donor machine-readable security code and the requester machine-readable security code are usable at least for authentication.

2. The computing system (102) as claimed in claim 1, wherein the donor machine-readable security code sent to the requester (104) includes personal information of a rider of the requester electric vehicle, a vehicle registration number of the requester electric vehicle, an associated battery number, and bank account details of the rider of the requester electric vehicle.

3. The computing system (102) as claimed in claim 1, wherein the requester machine-readable security code sent to the donor (106) selected by the requester (104) includes personal information of a rider of the selected donor electric vehicle, a vehicle registration number of the selected donor electric vehicle, an associated charged battery number which is available for sharing by the rider of the selected donor electric vehicle, bank account details of the rider of the selected donor electric vehicle, a number of reward points that the rider of the selected donor electric vehicle expects in return of swapping a charged battery with the requester (104).

4. The computing system (102) as claimed in claim 1, wherein the list includes the one or more donor electric vehicles that are identified to be within the predetermined proximity range to the current location of the requester electric vehicle.

5. The computing system (102) as claimed in claim 1, wherein the processor (200) is to send an authentication notification to the donor (106) after receiving a battery swapping confirmation from the requester (104).

6. The computing system (102) as claimed in claim 1, wherein the processor (200) is to verify battery swapping activity and securely transfer expected reward points to the donor for swapping a battery.

7. The computing system (102) as claimed in claim 1, wherein the processor (200) is to send a notification to the donor (106) acknowledging transfer of expected reward points to the donor (106).

8. The computing system (102) as claimed in claim 1, wherein the processor (200) is to estimate an expected reduction in battery range from the current battery range for the one or more donor electric vehicles and transmit the expected reduction to the one or more donor electric vehicles.

9. The computing system (102) as claimed in claim 1, wherein the one or more donor electric vehicles includes a charging service station and a battery vendor.

10. The computing system (102) as claimed in claim 1, wherein the request comprises the current battery range of the requester electric vehicle, compatible electric vehicles with a plurality of swappable batteries, details of battery to be swapped, and incentive details associated with battery swapping activity.

11. The computing system (102) as claimed in claim 1, wherein the processor (200) receives, during registration of one of the requester electric vehicle and a donor electric vehicle, battery information including information related to an electric vehicle battery, a plurality of compatible vehicles with which the plurality of swappable batteries may be swapped, and number of reward points that is expected for swapping charged battery.

12. The computing system (102) as claimed in claim 1, wherein the processor (200) sends an alert via a notification indicator engine (216) to one or more donors (106) to know charging requirements and travel requirements of the one or more donors (106).

13. The computing system (102) as claimed in claim 1, wherein the processor (200) estimates an expected reduction in battery range from the current battery range for the one or more donor electric vehicles after swapping and transmits the expected reduction in the battery range to the one or more donors.

14. A requester (104) associated with a requester electric vehicle, the requester comprising:
a processor (400) to:

transmit a request for extending a range of the requester electric vehicle, wherein the transmitting comprising sending a current battery range for the requester electric vehicle and a current location of the requester electric vehicle;

receive a list containing one or more donor electric vehicles, wherein the one or more donor electric vehicles are identified to be within a predetermined proximity range to the current location of the requester electric vehicle, wherein the current battery range of each of the one or more donor electric vehicles is greater than the current battery range of the requester electric vehicle;

receive, for a selected donor electric vehicle from amongst the one or more donor electric vehicles, a donor machine-readable security code; and

transmit, in response to reading a requester machine-readable security code on a donor, a battery swapping confirmation.

15. The requester (104) as claimed in claim 14, wherein the request comprises the current battery range of the requester electric vehicle, compatible electric vehicles with swappable batteries, details of battery to be swapped, and incentive details associated with battery swapping activity.

16. The requester (104) as claimed in claim 14, wherein the battery swapping confirmation includes personal information of a rider of the selected donor electric vehicle, a vehicle registration number of the selected donor electric vehicle, an associated charged battery number which is available for sharing by the selected donor electric vehicle, bank account details of the rider of the selected donor electric vehicle, a number of reward points that the donor expects for sharing a charged battery with the requester.

17. The requester (104) as claimed in claim 14, wherein the processor (400) selects the donor from the list containing one or more donor electric vehicles and, receives a navigation route computed from a location of the requester electric vehicle to the location of the selected donor electric vehicle.

18. A method (300) for extending a range of an electric vehicle, the method comprising:

receiving (302), from a requester (104), a request for extending the range of a requester electric vehicle associated with the requester electric vehicle, wherein the receiving comprising receiving a current battery range for the requester electric vehicle and a current location of the requester electric vehicle;

identifying (304), by a processor (200), one or more donor electric vehicles within a predetermined proximity range to the current location of the requester electric vehicle, wherein the current battery range of each of the one or more donor electric vehicles is greater than the current battery range of the requester electric vehicle;

transmitting (306), by the processor (200), a list containing the one or more donor electric vehicles to the requester (104);

transmitting (308), by the processor (200), a donor machine-readable security code to the requester (104) for a selected donor electric vehicle from amongst the one or more donor electric vehicles; and

transmitting, by the processor (200), a requester machine-readable security code to a selected donor (106),

wherein the donor machine-readable security code and the requester machine-readable security code are usable at least for authentication.

19. The method (300) as claimed in claim 18, wherein the method comprises authenticating, by the processor (200), a transaction after the requester (104) successfully scans the requester machine-readable security code shared with the selected donor (106).

20. The method (300) as claimed in claim 18, wherein the donor machine-readable security code includes personal information of a rider of the requester electric vehicle, a vehicle registration number of the requester electric vehicle, an associated battery number, and bank account details of the rider of the requester electric vehicle.

21. The method (300) as claimed in claim 18, wherein the requester machine-readable security code includes personal information of a rider of the selected donor electric vehicle, a vehicle registration number of the selected donor electric vehicle, an associated charged battery number which is available for sharing by the rider of the selected donor electric vehicle, bank account details of the rider of the selected donor electric vehicle, a number of reward points that the rider of the selected donor electric vehicle expects in return of swapping a charged battery with the requester (104).

22. The method (300) as claimed in claim 18, wherein the list includes the one or more donor electric vehicles that are identified to be within the predetermined proximity range to the current location of the requester electric vehicle.

23. The method (300) as claimed in claim 18, comprising sending a notification to the selected donor (106) acknowledging transfer of expected reward points to the selected donor (106).

24. The method (300) as claimed in claim 18, wherein the transmitting the list comprises estimating an expected reduction in battery range from the current battery range for the one or more donor electric vehicles and transmitting the expected reduction to the one or more donor electric vehicles.

25. The method (300) as claimed in claim 18, wherein the one or more donor electric vehicles includes a charging service station and a battery vendor.

26. The method (300) as claimed in claim 18, wherein the request comprises the current battery range of the requester electric vehicle, compatible electric vehicles with a plurality of swappable batteries, details of battery to be swapped, and incentive details associated with battery swapping activity.

27. The method (300) as claimed in claim 18, comprising registering, during registration of one of the requester electric vehicle and a donor electric vehicle, battery information including information related to an electric vehicle battery, a plurality of compatible vehicles with which the plurality of swappable batteries may be swapped, and number of reward points that is expected for swapping charged battery.

28. The method (300) as claimed in claim 18, comprising sending an alert via a notification indicator engine (216) to one or more donors (106) to know charging requirements and travel requirements of the one or more donors (106).

29. The method (300) as claimed in claim 18, comprising estimating an expected reduction in battery range from the current battery range for the one or more donor electric vehicles

after swapping and transmitting the expected reduction in the battery range to the one or more donors (106).

30. A method for extending a range of an electric vehicle, the method comprising:

transmitting, by a processor (400), a request for extending the range of a requester electric vehicle, wherein the transmitting comprises sending a current battery range for the requester electric vehicle and a current location of the requester electric vehicle;

receiving, by processor (400), a list containing one or more donor electric vehicles, wherein the one or more donor electric vehicles are identified to be within a predetermined proximity range to the current location of the requester electric vehicle, wherein the current battery range of each of the one or more donor electric vehicles is greater than the current battery range of the requester electric vehicle;

receiving, by the processor (400), for a selected donor electric vehicle from amongst the one or more donor electric vehicles, a donor machine-readable security code; and

transmitting, by the processor (400), in response to reading a requester machine-readable security code on a donor, a battery swapping confirmation.

31. The method as claimed in claim 30, wherein the request comprises the current battery range of the requester electric vehicle, compatible electric vehicles with swappable batteries, details of the battery to be swapped, and incentive details associated with battery swapping activity.

32. The method as claimed in claim 30, wherein the battery swapping confirmation includes personal information of a rider of the selected donor electric vehicle, a vehicle registration number of the selected donor electric vehicle, an associated charged battery number which is available for sharing by the selected donor electric vehicle, bank account details of the rider of the selected donor electric vehicle, a number of reward points that the donor expects for sharing a charged battery with a requester.

33. The method as claimed in claim 30, comprising selecting the donor from the list containing one or more donor electric vehicles and receiving a navigation route computed from a location of the requester electric vehicle to the location of the selected donor electric vehicle.

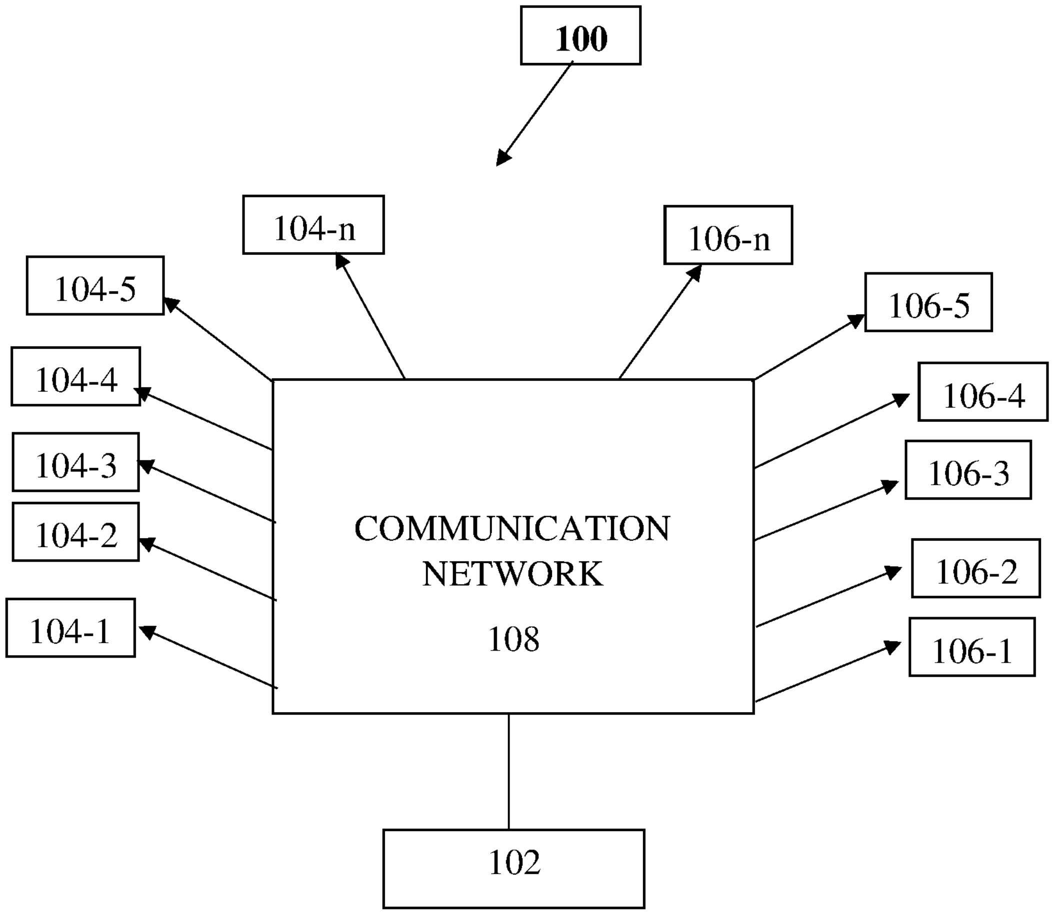
100
104-n
106-n
104-5
106-5
104-4
106-4
104-3
106-3
104-2
106-2
104-1
106-1
COMMUNICATION
NETWORK
108
102

FIG. 1

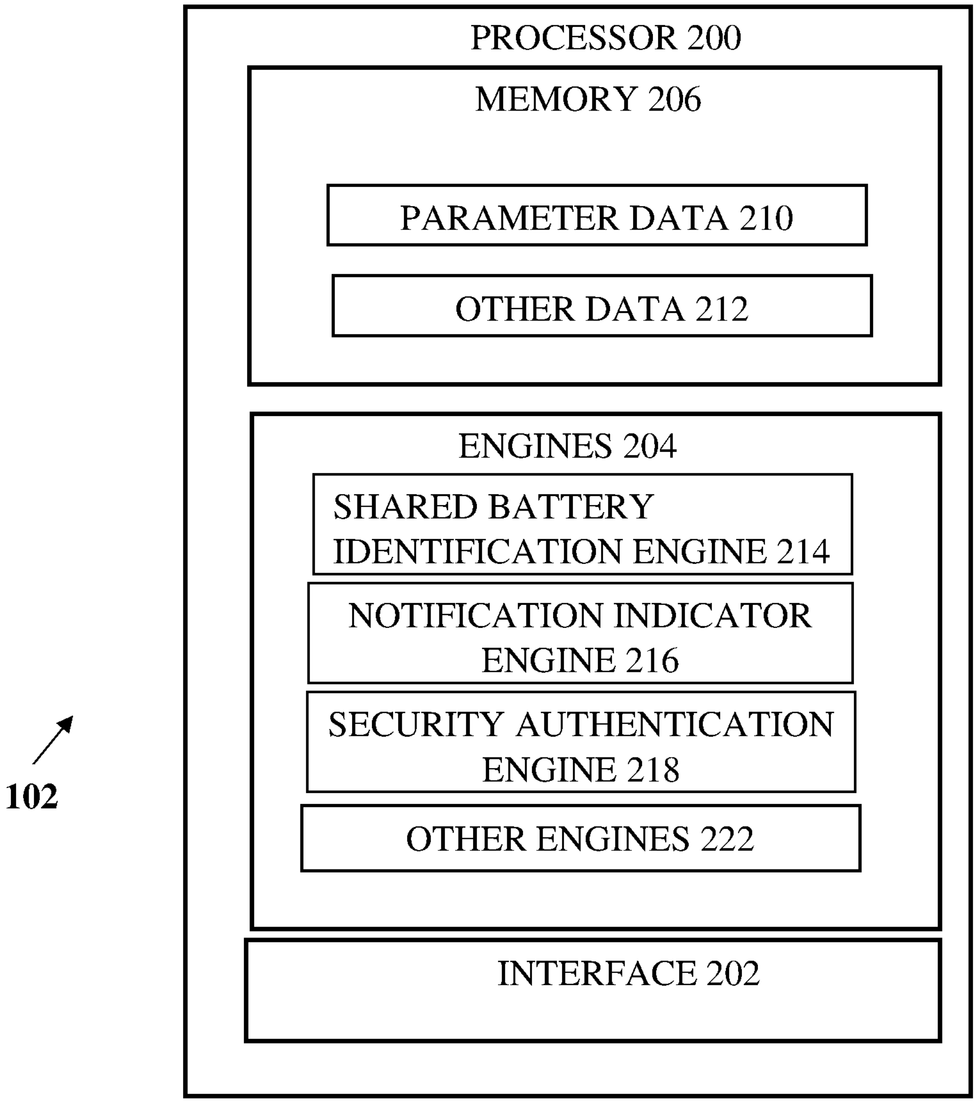
PROCESSOR 200
MEMORY 206
PARAMETER DATA 210
OTHER DATA 212
ENGINES 204
SHARED BATTERY IDENTIFICATION ENGINE 214
NOTIFICATION INDICATOR ENGINE 216
SECURITY AUTHENTICATION ENGINE 218
OTHER ENGINES 222
INTERFACE 202
102

FIG. 2

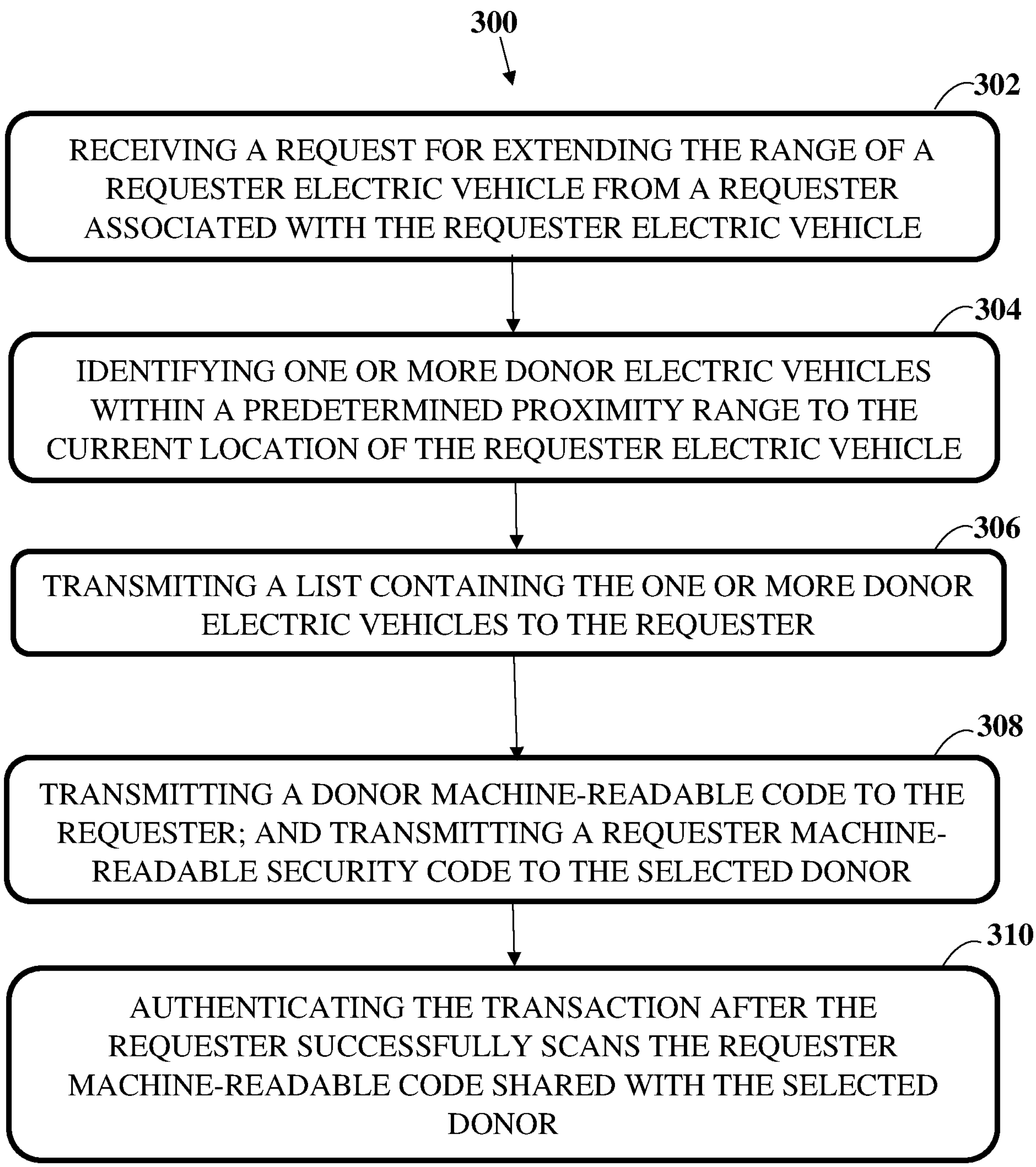
300
302
RECEIVING A REQUEST FOR EXTENDING THE RANGE OF A REQUESTER ELECTRIC VEHICLE FROM A REQUESTER ASSOCIATED WITH THE REQUESTER ELECTRIC VEHICLE
304
IDENTIFYING ONE OR MORE DONOR ELECTRIC VEHICLES WITHIN A PREDETERMINED PROXIMITY RANGE TO THE CURRENT LOCATION OF THE REQUESTER ELECTRIC VEHICLE
306
TRANSMITING A LIST CONTAINING THE ONE OR MORE DONOR ELECTRIC VEHICLES TO THE REQUESTER
308
TRANSMITTING A DONOR MACHINE-READABLE CODE TO THE REQUESTER; AND TRANSMITTING A REQUESTER MACHINE-READABLE SECURITY CODE TO THE SELECTED DONOR
310
AUTHENTICATING THE TRANSACTION AFTER THE REQUESTER SUCCESSFULLY SCANS THE REQUESTER MACHINE-READABLE CODE SHARED WITH THE SELECTED DONOR

FIG. 3

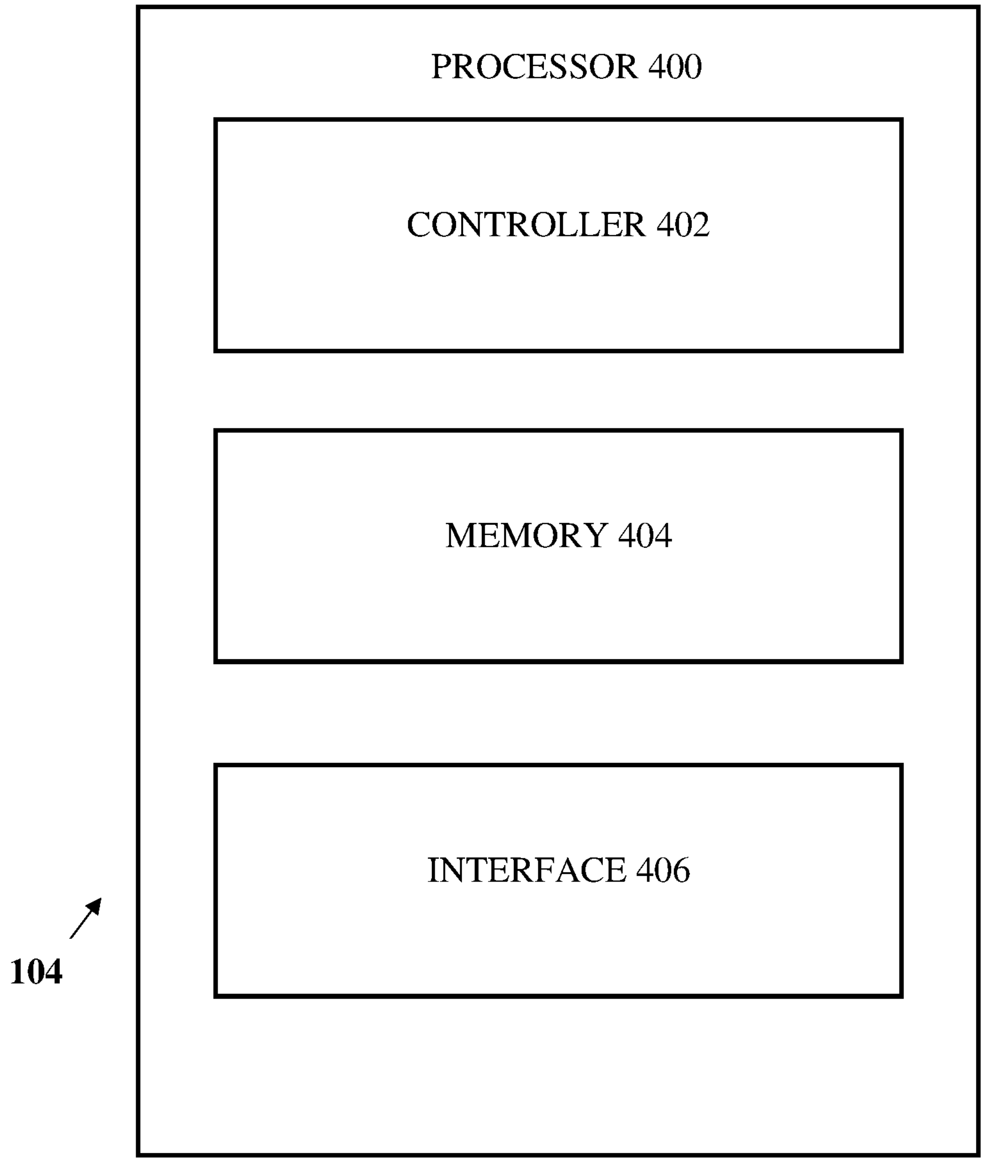

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IN2022/051050

A. CLASSIFICATION OF SUBJECT MATTER
G06Q50/30,B60L53/80 Version=2023.01

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, B60L, G01C

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

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

Databases: PatSeer, IPO Internal Database, Google Patents
Keywords : battery,swap,vendor,donor,vehicle,alert,reward,authentication

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US20220036330A1 (LYVES HATCHER PTE LTD), 03.02.2022 (3 February 2022) [refer to abstract, para. 20-21, 47-49, 52, 59-63, 71-73, 76-81, 83, 86-89, 95-98; figures 6B, 9A-9B, 12A-12B; claims 3-4, 7, 10, 13, 18, 21]	1-33
Y	IN202141038639A (OBEN ELECTRIC VEHICLES PVT LTD), 01.04.2022 (1 April 2022) [refer to para. 11, 62; figures 2-4; Claims 1, 4, 6, 11]	1-33

☐ 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
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"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
09-02-2023	09-02-2023
Name and mailing address of the ISA/ Indian Patent Office Plot No.32, Sector 14,Dwarka,New Delhi-110075 Facsimile No.	Authorized officer Rakesh Kumar Telephone No. +91-1125300200

Citation	Pub.Date	Family	Pub.Date
US 20220036330 A1	03-02-2022	WO 2022023818 A1	03-02-2022
		TW 202210325 A	16-03-2022