

**METHOD AND SYSTEM FOR DETERMINING AN OPTIMAL LOCATION AND
SIZE OF AN ELECTRIC-VEHICLE CHARGING STATION**

FIELD OF THE DISCLOSURE

5 The present disclosure relates generally to the field of charging station planning systems in a geographical region. More particularly, the present disclosure relates to methods and systems for determining, an optimal location for placement of an electric-vehicle charging station (EVCS) and an optimal size of the EVCS, based on one or more EVCS parameters.

BACKGROUND

10 The following description of related art is intended to provide background information pertaining to the field of the disclosure. This section may include certain aspects of the art that may be related to various features of the present disclosure. However, it should be appreciated that this section be used only to enhance the understanding of the reader with respect to the present disclosure, and not as admissions of prior art.

15 The global push towards a sustainable and greener future has led to a significant increase in the adoption of electric vehicles (EVs) as an eco-friendly alternative to conventional fossil fuel-powered vehicles. EVs offer numerous environmental benefits, such as reduced greenhouse gas emissions and air pollution. However, for EVs to truly become a viable alternative to traditional vehicles, the challenge of providing an adequate number of electric vehicle charging Stations (EVCSs) in strategic locations must be addressed. The placement and sizing of these charging stations play a vital role in promoting widespread EV adoption and ensuring a seamless and positive user experience.

25 One of the major obstacles to the rapid adoption of EVs is range anxiety, which is the fear of running out of charge and being stranded. This concern can be alleviated through the implementation of adequate charging infrastructure, assuring users that they can find convenient charging points wherever they go. A robust network of charging stations encourages more people to embrace EVs, as they gain confidence in the availability of charging facilities during their daily commutes and long journeys. Moreover, transitioning from fossil fuel vehicles to EVs relies heavily on the availability of a reliable charging network to make electric mobility attractive and accessible to the masses.

To achieve the goal of promoting EVs over fossil fuel vehicles, several objectives need to be addressed:

- 5 • Centralized Strategic Planning: A centralized strategic planning approach is crucial to maximize the effectiveness of charging station placement. This involves meticulous analysis and optimization of locations to ensure comprehensive coverage of high-demand areas.
- 10 • Demand Prediction and Spatiotemporal Analysis: Advanced data analytics and demand prediction models help identify regions with high EV usage and charging demands. These insights aid in determining the optimal distribution of charging stations.
- 15 • Balancing Highways and Urban Areas: Charging stations must be strategically placed along highways for long-distance travel convenience, while urban areas require dense coverage due to higher population density and daily commuting.
- Accessibility and Convenience: Charging stations should be situated in easily accessible locations, such as shopping malls, office complexes, residential areas, and public parking lots, to promote convenience and encourage regular usage.
- 20 • Scalable Capacity: The charging station's capacity should be scalable to accommodate the increasing number of EVs in the future, ensuring that the infrastructure remains efficient and cost-effective in the long run.
- Integration with Grid and Energy Management: Careful consideration should be given to the integration of charging stations with the existing power grid and energy management systems to optimize electricity distribution and load balancing.

In conclusion, the growth and widespread adoption of electric vehicles are closely linked to the availability of an adequate number of electric vehicle charging stations. Strategic
25 planning, data-driven optimization, and consideration of renewable energy integration are essential elements in successfully implementing a robust charging infrastructure. As policymakers, governments, and private stakeholders invest in building a reliable and convenient charging network, the transition from fossil fuel vehicles to EVs will be facilitated, leading to a cleaner and more sustainable transportation future for all.

30 Further, several solutions have been developed in the past to determine the optimal location and the optimal size of Electric Vehicle Charging Stations (EVCSs) in a region. However, these prior approaches suffer from significant drawbacks that hinder their effectiveness. One

key issue is that the existing solution relies on charging data from existing EVCSs in other regions to estimate charging demand in the target area. This reliance on data from unrelated sources may result in inaccurate predictions. Furthermore, these prior solutions utilized probabilistic prediction methods for estimating EV charging demand, which are not precise and reliable. Another limitation of the existing solutions is their dependency on customer data and charging history from existing EVCSs, making them less versatile and applicable to a wider range of scenarios. Additionally, the prior solutions often estimate EV charging demand by fitting a Gaussian function to the charging history data from existing EVCSs, which leads to discrepancies in the results, especially in regions with different charging patterns. Moreover, the optimization formulations utilized in the existing solutions make the prior known solutions less compatible and less efficient; for instance, some prior solutions sense traffic information through traffic sensors to estimate demand, or certain prior known solutions model vehicular flow through different areas to estimate demand; such solutions introduce inaccuracies and limitations in their estimations. These limitations highlight the need for an innovative and improved approach to address the challenges in determining the optimal location and the optimal size of EVCSs.

Thus, there exists an imperative need in the art to determine an optimal location and optimal size of an electric-vehicle charging station (EVCS) for placement of the electric-vehicle charging station (EVCS) in a geographical region based on one or more EVCS parameter, which the present disclosure aims to address.

OBJECTS OF THE INVENTION

Some of the objects of the present disclosure, which at least one embodiment disclosed herein satisfies are listed herein below.

It is an object of the present disclosure to provide a system and a method that facilitates determining at least one optimal location of one or more electric vehicle charging stations (EVCSs) and an optimal size of the one or more EVCSs for placement of the one or more EVCSs in a geographical region.

It is another object of the present disclosure to provide a solution that determines updated geographical data associated with the geographical region based on the set of geographical data and at least one of a list of potential charging station locations and a list of point of interest locations, wherein the updated geographical data comprises at least an updated road

network data, an updated list of electronic vehicle charging station data, an updated population data and an updated infrastructure data.

It is another object of the present disclosure to provide a solution to determine a list of demand centres comprising of EV charging centre locations and estimated EV charging
5 centre demand values associated with the geographical region based on at least one of the set of geographical data and the set of updated geographical data.

It is also an object of the present disclosure to provide a system and a method that identifies a set of candidate locations associated with at least one demand centre from the list of demand centres based on an existing infrastructure data associated with the set of geographical data.

10 It is another object of the present disclosure to provide a solution that determines by using one or more optimization techniques, at least one optimal location and an optimal size of one or more electric vehicle charging stations (EVCSs) for placement of the one or more electric vehicle charging stations (EVCSs) in a geographical region based on the set of candidate locations and at least one parameter from the set of EVCS parameters.

15 SUMMARY

This section is intended to introduce certain aspects of the disclosed method and system in a simplified form and is not intended to identify the key advantages or features of the present disclosure.

An aspect of the present disclosure relates to a system for determining at least one optimal
20 location and an optimal size of one or more electric vehicle charging stations (EVCSs). The system comprises an input unit, configured to receive, at least a name of a geographical region. Further, system comprises a processing unit, the said processing unit is configured to receive from a storage unit, a set of geographical data associated with the geographical region. Further, the processing unit is configured to identify, at least a list of potential
25 charging station locations and a list of point of interest locations based on the set of geographical data. The processing unit is further configured to determine via a data fusion module, a set of updated geographical data associated with the geographical region based on the set of geographical data, and at least one of the list of potential charging station locations and the list of point of interest locations. The processing unit is further configured to
30 determine, a list of demand centres associated with the geographical region based on at least one of the set of geographical data and the set of updated geographical data, wherein each

demand centre from the list of demand centre comprises at least one of an EV charging centre location and an estimated EV charging centre demand value. Further, the processing unit is configured to identify, a set of candidate locations associated with at least one demand centre from the list of demand centres based on an existing infrastructure data associated with the set of geographical data, wherein each candidate location from the set of candidate locations is associated with a set of electric vehicle charging station (EVCS) parameters. Thereafter, the processing unit is configured to determine using one or more optimization techniques, the at least one optimal location of the one or more electric vehicle charging stations (EVCSs) and the optimal size of the one or more EVCSs based on the set of candidate locations and at least one parameter from the set of EVCS parameters.

Another aspect of the present disclosure relates to a method for determining at least one optimal location and an optimal size of one or more electric vehicle charging stations (EVCSs). The method further comprises receiving, by an input unit, at least a name of a geographical region. Further, the method comprises receiving, by a processing unit from a storage unit, a set of geographical data associated with the geographical region. The method further comprises identifying, by the processing unit, at least a list of potential charging station locations and a list of point of interest locations based on the set of geographical data. The method further comprises determining, by the processing unit via a data fusion module, a set of updated geographical data associated with the geographical region based on the set of geographical data, and at least one of the list of potential charging station locations and the list of point of interest locations. Further, the method encompasses determining, by the processing unit, a list of demand centres associated with the geographical region based on at least one of the set of geographical data and the set of updated geographical data, wherein each demand centre from the list of demand centre comprises at least one of an EV charging centre location and an estimated EV charging centre demand value. The method further encompasses identifying, by the processing unit, a set of candidate locations associated with at least one demand centre from the list of demand centres based on an existing infrastructure data associated with the set of geographical data, wherein each candidate location from the set of candidate locations is associated with a set of electric vehicle charging station (EVCS) parameters. Thereafter, the method encompasses determining, by the processing unit using one or more optimization techniques, the at least one optimal location of the one or more electric vehicle charging stations (EVCSs) and the optimal size of the one or more EVCSs

based on the set of candidate locations and at least one parameter from the set of EVCS parameters.

BRIEF DESCRIPTION OF DRAWINGS

The accompanying drawings, which are incorporated herein, and constitute a part of this disclosure, illustrate exemplary embodiments of the disclosed methods and systems in which like reference numerals refer to the same parts throughout the different drawings. Components in the drawings are not necessarily to scale, emphasis instead being placed upon clearly illustrating the principles of the present disclosure. Some drawings may indicate the components using block diagrams and may not represent the internal circuitry of each component. It will be appreciated by those skilled in the art that disclosure of such drawings includes disclosure of electrical components, electronic components or circuitry commonly used to implement such components.

FIG.1 illustrates an exemplary block diagram depicting an exemplary network architecture diagram [100], in accordance with exemplary embodiments of the present disclosure.

FIG.2 illustrates an exemplary block diagram of a system [200] for determining at least one optimal location and an optimal size of one or more electric vehicle charging stations (EVCSs), in accordance with exemplary embodiments of the present disclosure.

FIG.3 illustrates an exemplary method flow diagram [300], for determining at least one optimal location and an optimal size of one or more electric vehicle charging stations (EVCSs), in accordance with exemplary embodiments of the present disclosure.

FIG.4 illustrates an exemplary process flow diagram [400], for determining a list of demand centres associated with a geographical region, in accordance with exemplary embodiments of the present disclosure.

The foregoing shall be more apparent from the following more detailed description of the disclosure.

DETAILED DESCRIPTION

In the following description, for the purposes of explanation, various specific details are set forth in order to provide a thorough understanding of embodiments of the present disclosure. It will be apparent, however, that embodiments of the present disclosure may be practiced
5 without these specific details. Several features described hereafter can each be used independently of one another or with any combination of other features. An individual feature may not address any of the problems discussed above or might address only some of the problems discussed above. Some of the problems discussed above might not be fully addressed by any of the features described herein. Example embodiments of the present
10 disclosure are described below, as illustrated in various drawings in which like reference numerals refer to the same parts throughout the different drawings.

The ensuing description provides exemplary embodiments only, and is not intended to limit the scope, applicability, or configuration of the disclosure. Rather, the ensuing description of the exemplary embodiments will provide those skilled in the art with an enabling description
15 for implementing an exemplary embodiment. It should be understood that various changes may be made in the function and arrangement of elements without departing from the spirit and scope of the disclosure as set forth.

As used herein the terms "electric vehicle charging station(s)", "EVCS", "charging station(s)", and "vehicle charging station(s)" are used interchangeably to refer to electric
20 vehicle charging station(s). It is important to note that the use of these terms interchangeably is intended solely for ease of reading and understanding and should not be construed as a limitation on the scope of the disclosure. These terms are meant to convey the same concept, and no differentiation is intended between them. The disclosure as disclosed herein encompasses all aspects and variations related to electric vehicle charging stations, regardless
25 of the specific terminology used.

It should be noted that the terms "mobile device", "user equipment", "user device", "communication device", "device" and similar terms are used interchangeably for the purpose of describing the invention. These terms are not intended to limit the scope of the invention or imply any specific functionality or limitations on the described embodiments.
30 The use of these terms is solely for convenience and clarity of description. The invention is not limited to any particular type of device or equipment, and it should be understood that

other equivalent terms or variations thereof may be used interchangeably without departing from the scope of the invention as defined herein.

Specific details are given in the following description to provide a thorough understanding of the embodiments. However, it will be understood by one of ordinary skill in the art that the
5 embodiments may be practiced without these specific details. For example, circuits, systems, networks, processes, and other components may be shown as components in block diagram form in order not to obscure the embodiments in unnecessary detail. In other instances, well-known circuits, processes, algorithms, structures, and techniques may be shown without unnecessary detail in order to avoid obscuring the embodiments.

10 Also, it is noted that individual embodiments may be described as a process which is depicted as a flowchart, a flow diagram, a data flow diagram, a structure diagram, or a block diagram. Although a flowchart may describe the operations as a sequential process, many of the operations can be performed in parallel or concurrently. In addition, the order of the operations may be re-arranged. A process is terminated when its operations are completed but
15 could have additional steps not included in a figure.

The word “exemplary” and/or “demonstrative” is used herein to mean serving as an example, instance, or illustration. For the avoidance of doubt, the subject matter disclosed herein is not limited by such examples. In addition, any aspect or design described herein as “exemplary” and/or “demonstrative” is not necessarily to be construed as preferred or advantageous over
20 other aspects or designs, nor is it meant to preclude equivalent exemplary structures and techniques known to those of ordinary skill in the art. Furthermore, to the extent that the terms “includes,” “has,” “contains,” and other similar words are used in either the detailed description or the claims, such terms are intended to be inclusive—in a manner similar to the term “comprising” as an open transition word—without precluding any additional or other
25 elements.

Further, the user device may also comprise a “processor” or “processing unit” includes processing unit, wherein processor refers to any logic circuitry for processing instructions. The processor may be a general-purpose processor, a special purpose processor, a conventional processor, a digital signal processor, a plurality of microprocessors, one or more
30 microprocessors in association with a DSP core, a controller, a microcontroller, Application

Specific Integrated Circuits, Field Programmable Gate Array circuits, any other type of integrated circuits, etc. The processor may perform signal coding data processing, input/output processing, and/or any other functionality that enables the working of the system according to the present disclosure. More specifically, the processor is a hardware processor. The proposed invention offers a novel and non-obvious solution to determine an optimal location and optimal size of Electric Vehicle Charging Stations (EVCSs) in any target city, overcoming the limitations of prior art in this field. Unlike most existing approaches that focus on different optimization problem formulations and city-specific details, the novel solution as disclosed herein aims to build a robust city-agnostic system for EVCS location and sizing optimization. It achieves this through three innovative components. Firstly, a unique mechanism extracts city-specific data from multiple sources and converts it into a unified format to be used in downstream tasks. Secondly, a novel method utilizes this city-specific information to project potential EV charging demands in terms of locations and intensity. Finally, a Mixed-Integer Linear Programming (MILP) based optimizer takes the city-specific data and the projected EV charging demands as inputs to generate optimal locations and sizing for new EVCS, minimizing overall costs and complying with various business and regulatory constraints. By significantly reducing the building and operating costs of EVCS infrastructure, the solution as disclosed in the present disclosure offers mobility solution providers an effective means to minimize expenses related to new EV charging stations. Furthermore, the present solution as disclosed holds the potential to enhance and supplement the existing EV ecosystem management solutions i.e., the interconnected network of various components, technologies, and services that support the adoption, operation, and maintenance of Electric Vehicles (EVs)..

Hereinafter, exemplary embodiments of the present disclosure will be described in detail with reference to the accompanying drawings so that those skilled in the art can easily carry out the solution provided by the present disclosure.

Referring to Figure 1, the Figure 1 illustrates an exemplary block diagram depicting an exemplary network architecture diagram [100], in accordance with exemplary embodiments of the present disclosure. As shown in Figure 1, the exemplary network architecture diagram [100] comprises at least one user equipment (UE) [102] connected to at least one network server [104] via at least one network [106], wherein in an implementation the network server [104] further comprises a system [200] configured to implement the feature of the present

invention. Also, in an implementation the system [200] may reside partially in either the network server [104] or the user device [102] or may be in connection with the network server [104] and the user device [102], in a manner as obvious to a person skilled in the art to implement the features of the present disclosure.

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Also, in Figure 1 only the single user equipment (or may be referred to as user device) [102] and the single network server [104] are shown, however, there may be multiple such user equipment [102] and/or network servers [104] or there may be any such numbers of said user equipment [102] and/or network server [104] as obvious to a person skilled in the art or as
10 required to implement the features of the present disclosure. Further, in the implementation where the system [200] is present in the network server [104], based on the implementation of the features of the present disclosure, an optimal location and an optimal size for placement of an Electric-Vehicle charging station (EVCS) in a geographical region is determined by the system [200], by receiving at the network server [104] from the user
15 equipment [102], a name of the geographical region. Then, determining a set of geographical data for the geographical region. Then, identifying a potential charging station locations and a point of interest. Next, using a data fusion module, generating an updated geographical data for the geographical region by incorporating information from the potential charging station locations and the point of interest. Subsequently, based on at least one of the set of
20 geographical data and the updated geographical data, determining a list of demand centres for the geographical region, which includes EV charging centre locations and estimated EV charging centre demand values. After that, identifying a set of candidate locations associated with the demand centres, utilizing an existing infrastructure data, wherein each candidate location is linked to a set of electric vehicle charging station (EVCS) parameters. Finally, via
25 one or more optimization techniques, determining the optimal location(s) of one or more electric vehicle charging stations and optimal size of the one or more electric vehicle charging stations for placing the one or more electric vehicle charging stations (EVCSs) in the geographical area, based on the set of candidate locations and at least one parameter from the set of EVCS parameters.

30 Referring to Figure 2, an exemplary block diagram of a system [200], for determining at least one optimal location and an optimal size of one or more electric vehicle charging stations (EVCSs) is shown, in accordance with the exemplary embodiments of the present invention. The system [200] comprises at least one input unit [202], at least one processing unit [204]

and at least one storage unit [206]. Also, all of the components/ units of the system [200] are assumed to be connected to each other unless otherwise indicated below. Also, in Fig. 2 only a few units are shown, however, the system [200] may comprise multiple such units or the system [200] may comprise any such numbers of said units, as required to implement the features of the present disclosure. Further, in an implementation, the system [200] may be present in a network server [104] as depicted in figure 1 to implement the features of the present invention. The system [200] may be a part of the network server [104] / or may be independent of but in communication with the network server [104].

10 The system [200] is configured to determine at least one optimal location of one or more electric vehicle charging stations (EVCSs) and an optimal size of the one or more EVCSs for placement of the one or more electric vehicle charging stations (EVCSs) in a geographical region, with the help of the interconnection between the components/units of the system [200].

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In order to determine at least one optimal location of one or more electric vehicle charging stations (EVCSs) and an optimal size of the one or more EVCSs for placement of the one or more EVCS in a geographical region, the input unit [202] of the system [200] is configured to receive, at least a name of a geographical region. In an implementation of the present solution, the name of the geographical region may be received by the input unit [202] based on a user input provided by a user. In another implementation of the present solution, receiving the name of the geographical region by the input unit [202] may also comprise automatically detecting the name of the geographical region based on one or more predefined actions, such as receiving from the user a latitude and longitude of the geographical region or receiving from the user a pin code of a region associated with the geographical region etc.

Further, the processing unit [204] is at least connected to the input unit [202], and the processing unit [204] is configured to receive from the storage unit [206], a set of geographical data associated with the geographical region, wherein the set of geographical data comprises at least a road network data, a list of existing electronic vehicle charging station data, a population data, and an existing infrastructure data.

In an exemplary implementation of present solution as disclosed herein, the road network data may be received by the processing unit [204] using one or more data sources such as via

a public street map data source and/or via a private street map data source using a data library defined for such data source(s). In another exemplary implementation of the present solution, the road network data may be received by the processing unit [204] in a predefined road network data format such as a Graph format or the like.

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In an exemplary implementation of present solution as disclosed herein, the list of existing electronic vehicle charging station data may be received by the processing unit [204] using one or more data sources such as a public charge map data source and/or via a private charge map data source via a data library such as a public charge map API data library. In another exemplary implementation of the present disclosure, the list of existing electronic vehicle charging station data may be received by the processing unit [204] based on a query mechanism, wherein the processing unit [204] may use a centroid of the geographical region and/or a centroid of a part of geographical region from the geographical region to query the geographical location of an existing electronic vehicle charging station located within a specified radius of the geographical region and/or within the part of geographical region from the geographical region e.g., 30 km radius of the geographical region. In another exemplary implementation of the present solution, the list of existing electronic vehicle charging station data may be received by the processing unit [204] in a predefined format such as a standard file format.

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In an exemplary implementation of present solution as disclosed herein, the population data may be received by the processing unit [204] using one or more data sources such as a public API data source and/or via a private API data source using a data library defined for such data source(s). In another exemplary implementation of the present solution, the population data may be received by the processing unit [204] in a predefined road network data format such as an integer format.

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In an exemplary implementation of present solution as disclosed herein, the existing infrastructure data may be received by the processing unit [204] using one or more data sources such as via a public street map data source and/or via a private street map data source using a data library defined for such data source(s). In another exemplary implementation of the present solution, the existing infrastructure data may be received by the processing unit [204] in a predefined road network data format such as a standard file format. The term "existing infrastructure data" as used in the present disclosure may include, but is not limited

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to, data related to existing building structures such as schools, malls, parking lots, vacant land parcels, and other similar elements within the specified geographical region.

It should be noted that the use of the terms "a public charge map data source," "a private charge map data source", "a public API data source", "a public charge map API data library," "°" and "integer format" are used herein is solely for illustrative purposes. These examples are provided to enhance understanding and should not be construed as imposing any limitations on the scope of the present disclosure. Further, the solution as disclosed herein is not restricted to the mentioned exemplary data sources, data libraries, or predefined formats. Instead, it encompasses the utilization of any other data source, data library, or predefined format that achieves similar functionality or serves the same purpose. Furthermore, the person skilled in the art would readily appreciate that various alternative data sources, data libraries, and formats exist that can be employed to implement the present disclosure and these alternatives are fully embraced within the scope of the present disclosure, even though they may not have been explicitly described in this specification. Thus, any reference to specific data sources, data libraries, or formats in the present disclosure is made purely for explanatory purposes and should not be interpreted as a limitation on the scope of the present disclosure. The present disclosure is intended to encompass all modifications, substitutions, or equivalents that fall within the scope of the claims, regardless of whether such alternatives were explicitly mentioned or not.

Further, the processing unit [204] is configured to identify, at least a list of potential charging station locations and a list of point of interest locations based on the set of geographical data.

25 In an exemplary implementation of present solution as disclosed herein, the list of potential charging station locations may be identified by the processing unit [204] using one or more data sources such as via a public street map data source and/or via a private street map data source using a data library defined for such data source(s). In another exemplary implementation of the present disclosure, the list of potential charging station locations may
30 be identified by the processing unit [204] based on the existing infrastructure data received by the processing unit [204]. Further, in order to identify the list of potential charging station locations based on the existing infrastructure data, at least one infrastructure data may be used as an initial potential charging station location based on one or more potential charging location parameters for e.g., an infrastructure data such as a data indicating details of public

parking lots may be utilized as an initial potential charging station location based on the one or more potential charging location parameters. For instance, as the public parking lots are places where electric cars usually spend a lot of idle time, and the public parking lots are hotspots for human activity in the geographical region, therefore the public parking lots may serve as good candidate locations for potential EV charging stations. In another exemplary implementation of the present solution, the list of potential charging station locations may be received by the processing unit [204] in a predefined format such as a standard file format.

Further, in another exemplary implementation of present solution as disclosed herein, the list of point of interest locations may be identified by the processing unit [204] using one or more data sources such as via a public street map data source and/or via a private street map data source using a data library defined for such data source(s). In another exemplary implementation of the present disclosure, the list of point of interest locations may be identified by the processing unit [204] based on the existing infrastructure data received by the processing unit [204]. In another exemplary implementation of the present disclosure, the list of point of interest locations may be identified by the processing unit [204] by utilizing at least one infrastructure data from the existing infrastructure data as an initial potential point of interest location based on one or more potential point of interest parameters for e.g., an infrastructure data such as a data indicating an amenity location for e.g., a mall, office, a club house may be utilized as an initial potential point of interest location based on one or more potential point of interest parameters i.e., a human footfall value parameter, a vehicle idle parking time parameter, a population density parameter or any other parameter that may be obvious to the person skilled in the art. In an exemplary scenario, a mall associated with the geographical region may comprise a human footfall value more than a predefined threshold value for e.g. a ABC mall is utilized as initial potential point of interest location based on at least the potential point of interest parameter that the ABC mall comprises a human footfall value of 2000 wherein the predefined threshold value is 1000. In another exemplary implementation of the present solution, the list of point of interest locations may be received by the processing unit [204] in a predefined format such as a standard file format.

Further, the processing unit [204] is configured to determine via a data fusion module, a set of updated geographical data associated with the geographical region based on the set of geographical data, and at least one of the list of potential charging station locations and the list of point of interest locations, wherein the set of updated geographical data comprises at

least an updated road network data, an updated list of electronic vehicle charging station data, an updated population data and an updated infrastructure data. It would be appreciated by the person skilled in the art that the term the set of updated geographical data associated with the geographical region as used herein refers to an updated geographical data may be determined
5 via a use of a data fusion module to combine at least various sources of information, including the geographical data and one or more additional data related to the list of potential charging station locations and the list of point of interest locations. Further, the term "updated road network data" as used herein refers to the information regarding the road infrastructure within a geographical region. This data is derived or updated through the process described in
10 the present disclosure and may include details such as road layouts, traffic patterns, road types, and other relevant road-related information.

Further, it would also be appreciated by the person skilled in the art that the term "updated list of electronic vehicle charging station data" as used herein refers to a collection of
15 information about electronic vehicle charging stations present within the geographical region. This data is updated or enhanced as part of the data fusion process, and it includes details such as the location, a geographical region, charging protocols, and other pertinent attributes of the charging stations. Further, the term "updated population data" as used herein refers to the population residing or frequenting the geographical region. This data is updated based on
20 the data fusion process and may include details such as population size, demographics, density, and other relevant population-related characteristics. Furthermore, the term "updated infrastructure data" as used herein includes information about various types of infrastructure within the geographical region, such as buildings, schools, malls, parking lots, vacant land parcels, and other relevant structures. This data is updated or improved through the process
25 outlined in the specification.

Further, it is to be noted that the use of terms such as "updated geographical data," "updated road network data," "updated list of electronic vehicle charging station data," "updated population data," and "updated infrastructure data" in the present disclosure should not be
30 interpreted or construed to restrict the scope of the present disclosure. Additionally, it is to be noted that the intention behind employing these terms is solely for descriptive and illustrative purposes to explain the technical aspects and embodiments of the present disclosure. It is not intended to limit the present disclosure's broader scope, applications, or potential variations in any manner.

Further, the processing unit [204] is configured to determine, a list of demand centres associated with the geographical region based on at least one of the set of geographical data and the set of updated geographical data, wherein each demand centre from the list of
5 demand centre comprises at least one of an EV charging centre location and an estimated EV charging centre demand value.

In an implementation of the present solution, in order to determine the list of demand centres associated with the geographical region, the processing unit [204] is configured to retrieve
10 from the storage unit [206], at least the road network data associated with the geographical region and the population data associated with the geographical region.

Further, the processing unit [204] is configured to determine, a set of an electric vehicle (EV) charging centre locations based on at least the road network data and the population data.
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Further, the processing unit [204] is configured to retrieve from the storage unit [206], a population data associated with each EV charging centre location from the set of EV charging centre location.

Further, the processing unit [204] is configured to determine, an estimated EV charging centre demand value associated with said each EV charging centre location based on at least the set of EV charging centre locations and the population data associated with said each EV charging centre location. In an implementation of the present solution, the estimated EV charging centre demand value associated with said each EV charging centre location is
20 determined by the processing unit [204] based on one or more demand value projection techniques such as a Centrality-based EV demand projection technique and/or a Cluster-based EV demand projection technique.
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In an exemplary implementation of the present solution, in order to determine the estimated
30 EV charging centre demand value associated with the geographical region via the Centrality-based EV demand projection technique, the present solution identifies one or more central nodes in the updated road network data of the geographical region via a predefined analysis method such as a graph centrality analysis method, wherein each central node from the one or more central nodes refers to a location of which may used to determine the list of demand

centres in the geographical region. Further, in an exemplary graph centrality analysis method may utilize the updated road network data to find one or more areas of potential that may be the areas that are hotspots of activity in the geographical region. Furthermore, the graph centrality analysis method may identify the nodes that are important and/or central with respect to one or more nodes in a road network graph. For example, the one or more of the following two exemplary graph centrality measuring method may be used to implement the present solution:

1. A degree centrality measuring method, wherein the term “degree centrality” defines the importance of a node based on the degree of that node. The higher the degree, the more crucial it becomes in the graph.
2. A betweenness centrality measuring method, wherein the term “betweenness centrality” defines the importance of any node based on the number of times it occurs in the shortest paths between other nodes. Further, the said method measures the percentage of the shortest paths in a road network and determines where a particular node lies in it.

Furthermore, in another implementation of the present solution, the Centrality-based EV demand projection technique may also determine an electric-vehicle (EV) projection i.e., the projected number of EV in coming times. To determine the EV projection via the said technique, the Centrality-based EV demand projection technique may compute a top K1 nodes from the one or more nodes, wherein a top K1 road network nodes i.e., a top K1 central nodes, may be based on at least one of a user input and a centrality score associated with each node from the one or more nodes. Then a location of said top K1 nodes may be used to determine the list of demand centres. In an exemplary implementation of the present solution, the one or more central nodes may be very close to each other and might over-represent the geographical region in terms of EV charging centre location, in order to negate such over representation, the solution may implement a distance heuristic to ensure that each demand centre from the list of demand centres is at least a predefined distance apart from each other.

In an exemplary implementation of the present solution, in order to determine the list of demand centres associated with the geographical region via the Cluster-based EV demand projection technique, the Cluster-based EV demand projection technique may use one or more predefined set of techniques such as k-means techniques, k-means++ techniques to determine one or more clusters of the updated road network data associated with the geographical region based on the Geodesic distance. In an implementation, said one or more

clusters may be used to estimate a location of the EV charging centre location and the EV charging centre demand value in the geographical region. In an exemplary implementation, an unsupervised machine learning technique like k-means clustering, hierarchical agglomerative clustering may be used to determine one or more clusters of the updated road network data and /or a clusters of the updated infrastructure data nodes tagged, for example, as “buildings” or “amenities” in the OSM. In an implementation, said one or more clusters may be based on a Geodesic (Latitude, Longitude) distance approximations also referred as geospatial clustering, for each demand centre from the list of demand centres associated with the geographical region.

Furthermore, in another implementation of the present solution, the Cluster-based EV demand projection technique may also determine an electric-vehicle (EV) projection i.e., the projected number of EV in coming times. To determine the EV projection via the said technique, the Cluster-based EV demand projection technique may after performing geospatial clustering, the technique determines K2 clusters from the one or more clusters. In an implementation, K2 clusters may be determined from the one or more clusters based on an user input. In another implementation, the K2 clusters may be used to project the EV charging centre demand value via fusion module which may be further utilised to determine the EV charging centre location.

In an exemplary implementation of the present solution, the combination of the Centrality-based EV demand projection technique and the Cluster-based EV demand projection technique may be utilized to determine a consolidated list of demand centres associated with the geographical region. In such an implementation, the combination of the K2 clusters determined from the one or more clusters via the Cluster-based EV demand projection technique and the top K1 central nodes computed from the one or more nodes via the Centrality-based EV demand projection technique may be used by the processing unit [204] to determine the list of demand centres associated with the geographical region.

In one implementation, the present solution as disclosed may assume the EV charging centre location to be the centroid of the one or more clusters of the updated road network data and /or a clusters of the updated infrastructure data nodes tagged, for example, as “buildings” or “amenities” in a public/private street map. Furthermore, the updated population data associated with the geographical region is apportioned to each individual cluster from the one or more clusters based on a number of central nodes in each said cluster. Thereafter, the

cluster-specific population may be processed via a Machine learning (ML) model to determine the EV charging centre demand value in each said cluster. For instance in light of the present disclosure:

- For each cluster $c = 1, \dots, K2$ compute g_c = no. of ‘central’ road network nodes lying within cluster, c .

- For each cluster c , compute the population, P_c , of each cluster as follows:

$$P_c = \frac{g_c}{K1} * \text{population of city}$$

where $K1$ = Total no. of ‘central’ road network nodes in the geographical region.

- This population, P_c , is used as a feature in the ML model to predict demand value corresponding to cluster c .
- The location of the demand centre for each cluster is assumed to be the centroid of all road network nodes in that cluster.

In an exemplary ML-based prediction model as shown below, the EV charging centre demand value (d_c) for cluster c is the yearly EV charging centre demand value (kWh/year) in that cluster. Further, the population of each cluster is estimated as a portion of the total population of the geographical region based on one or more population projection techniques that may be obvious to a person skilled in the art in light of the present disclosure. The EV charging centre demand value depends on various factors like the EV penetration rate, EV penetration rate and other socio-economic factors specific to the region under consideration. The present solution via the ML-based prediction model proposes a data-driven approach to estimate and refine the value of the EV charging centre demand value using ground truth data from the field. Further in an exemplary scenario, to achieve the above the ML-based prediction model estimates demand in each cluster $c = 1, \dots, K2$, with the following socio-economic features, x_c :

x_c = [population of the cluster (P_c), no. of ‘central’ nodes in the cluster (g_c), no. of Point of Interest (POI) nodes in the cluster, average age of the population in the cluster, average income of the population in the cluster, no. of registered vehicles in the cluster etc.].

The population (P_c) of the cluster and the number of ‘central’ nodes which lie in the cluster (g_c) are hand-crafted features used to predict the EV charging centre demand value.

The other cluster-specific socio-economic features like average income, no. of registered vehicles etc. may be extracted through the data retrieval module of the ML-based prediction model or from openly available government data repositories or open sources. The target variable i.e., the yearly EV charging centre demand value, d_c , for a given cluster c is obtained
 5 from the field by aggregating the yearly EV charging centre demand value from all the existing electric vehicle charging stations that lie within that cluster. The feature matrix X_i for a target geographical region i is obtained by appending feature vectors of all the clusters in that target geographical region, as follows:

$$X_i = [x_1; x_2; \dots x_{K2}]$$

Thus, the feature matrix X_i would have $K2$ rows. Similarly, the target vector y_i for a
 10 geographical region i is obtained by appending the target variable (d_c) of all the clusters in that target geographical region, as follows. The target vector y_i would also have $K2$ rows.

$$y_i = [d_1; d_2; \dots d_{K2}]$$

The entire training data is created by aggregating X_i and y_i respectively across $i = 1, 2, \dots n$ cities within the same geographical region to create a sufficiently large matrix X (with $n * K2$ rows) and its corresponding target vector y (also with $n * K2$ rows), as
 15 follows:

$$X = [X_1; X_2; \dots X_n]$$

$$y = [y_1, y_2, \dots, y_n]$$

Standard ML-based prediction model such as linear / nonlinear regression model, decision trees model, neural networks model may be trained on this aggregated X vs. y data, to predict the EV charging centre demand value, d_c , for clusters in the geographical region of interest.

20 Further, the processing unit [204] is configured to determine, the list of demand centre based on the set of EV charging centre locations and the estimated EV charging centre demand value associated with said each EV charging centre location. In a preferred exemplary implementation of the present disclosure, a combination of the Centrality-based EV demand projection technique and the Cluster-based EV demand projection technique may be utilized
 25 to determine the list of demand centres associated with the geographical region.

Further, the processing unit [204] is configured to identify, a set of candidate locations associated with at least one demand centre from the list of demand centres based on an existing infrastructure data associated with the set of geographical data, wherein each candidate location from the set of candidate locations is associated with a set of electric vehicle charging station (EVCS) parameters, wherein the set of EVCS parameters comprises at least an EVCS deployment cost parameter, an EVCS access parameter, an EVCS infrastructure size parameter, and an EVCS charging demand type parameter.

It is to be noted that the term “EVCS deployment cost parameter” refers to a numerical value or set of values associated with each candidate location within the set of candidate locations. Further, it represents the estimated or actual cost required for establishing an electric vehicle charging station at a specific candidate location. This parameter takes into account various expenses such as equipment procurement, installation, permits, labor, grid connection, and any other relevant costs related to deploying the EVCS infrastructure. Similarly, it is to be noted that the term “EVCS access parameter” refers to a characteristic or set of characteristics associated with each candidate location within the set of candidate locations. Further, it indicates the ease of access or availability of the location to potential electric vehicle users. This parameter may consider factors such as proximity to main roads, highways, urban centres, public transportation hubs, or other relevant access points that can attract electric vehicle owners to use the charging station. Similarly, it is to be noted that the term “EVCS infrastructure size parameter” refers to a numerical value or set of values associated with each candidate location within the set of candidate locations. Further, it represents the physical size or capacity of the electric vehicle charging station that can be accommodated at the specified location. This parameter considers the number of charging points or stalls that can be installed, the available space for expansion, and other relevant factors related to the size and scalability of the EVCS infrastructure. Similarly, it is to be noted that the term “EVCS charging demand type parameter” refers to a classification or categorization associated with each candidate location within the set of candidate locations. It describes the specific type or level of charging demand expected at the location. This parameter may include designations such as slow charging, fast charging, rapid charging, or ultra-fast charging, based on the expected charging requirements of electric vehicles at the given location.

In the implementation of the described solution, each candidate location is associated with a unique combination of these EVCS parameters, including the EVCS deployment cost parameter, EVCS access parameter, EVCS infrastructure size parameter, and EVCS charging

demand type parameter. These parameters play a crucial role in determining the viability and suitability of establishing an electric vehicle charging station at a specific location, considering the existing infrastructure data and geographical information associated with the set of candidate locations and demand centres. It is important to note that the definitions of terms provided above in the present disclosure are included solely for explanatory and clarificatory purposes. They are intended to facilitate a better understanding of the present disclosure and its components. However, it should be explicitly understood that these definitions are not intended to impose any limitations or restrictions on the scope of the disclosure. The person skilled in the art would readily recognize that the terms used herein may have broader interpretations within the context of the present disclosure. The definitions provided should not be construed as confining the present disclosure to specific implementations or configurations. Rather, they serve as illustrative examples to aid in comprehension. Further, the scope of the present disclosure should be determined by the claims appended to the present disclosure. Any variations, alterations, or modifications of the terms used herein, which would be evident to one skilled in the art, are expressly considered to fall within the ambit of the present disclosure as defined by the claims. Therefore, the disclosed present disclosure is not limited to the precise meanings ascribed to the terms in the present disclosure. It is understood that different interpretations or embodiments may be apparent to those familiar with the relevant art, and such variations are encompassed by the spirit and scope of the present disclosure as claimed.

Thereafter, the processing unit [204] is configured to determine using one or more optimization techniques, the at least one optimal location of the one or more electric vehicle charging stations (EVCSs) and the optimal size of the one or more EVCSs, based on the set of candidate locations and at least one parameter from the set of EVCS parameters.

In an implementation the present solution, aims to maximize the utilization of the one or more EVCSs, minimize a EVCS deployment cost parameter associated with each EVCS from the one or more EVCSs, and ensure equitable access to the one or more EVCSs for one or more EV users. In an implementation, to achieve the above the present solution may leverage mixed integer linear programming (MILP) model, to determine the most efficient sizing and effective placement of the one or more EVCSs, considering the spatial distribution of demand associated with the one or more EVCS, points of interest and existing electronic vehicle charging station data. In an implementation, the solution receives – as inputs – a set of candidate locations to with the one or more EVCSs. In an example in other words, the present

solution considers all nodes tagged 'parking' in geographical region as a set of candidate locations, the problem is formulated as follows:

- **Objective:**
 - To minimize:
 - 5 ▪ An EVCS deployment cost associated with each EVCS from the one or more EVCSs, an operational cost associated with each EVCS from the one or more EVCSs, and a Charger cost associated with each EVCS from the one or more EVCSs.
 - 10 ▪ 'Accessibility' costs required to pull EV charging centre demand value from the list of demand centres cost associated with each EVCS from the one or more EVCSs.
- **Constraints:**
 - **Demand constraints:**
 - 15 ▪ Installed each EVCS must satisfy an existing EV charging centre demand value.
 - **Distance constraints:**
 - 20 ▪ The one or more EVCS should be installed:
 - At least α km (user input) away from any existing EVCS
 - At least within β km (user input) of each point of interest location from the list of point of interest locations
 - At least γ km (user input) away from each other
 - **Supply constraints:**
 - 25 ▪ Supply from each EVCS must not exceed the known charging capacity.
 - Chosen no. of 'fast' chargers and 'slow' chargers should not exceed known limits.

The MILP model to achieve the objective may perform one or more steps as mentioned below:

30

- Determine objective function as-

$$\text{Objective function} = \underset{\substack{y_j \in \{0,1\} \\ x_{ij} \geq 0}}{\text{Min}} C \sum_{j=1}^n y_j + \lambda \sum_{i=1}^m \sum_{j=1}^n A_{ij} x_{ij} + G \sum_{j=1}^n g_j + Q \sum_{j=1}^n q_j$$

wherein on or more decision Variables are-

- 5 $y_j \in \{0,1\}$ – potential charging station (binary; corresponds to the potential charging station locations extracted)

x_{ij} – yearly demand served to i^{th} demand centre by j^{th} station

g_j – number of slow chargers in j^{th} potential charge station

q_j – number of fast chargers in j^{th} potential charge station

- 10 wherein on or more inputs are-

C = yearly equivalent of EVCS deployment cost + yearly operation cost

* EVCS deployment cost includes electric and civil expenses

* An operational cost associated with each EVCS from the one or more EVCS includes maintenance, land lease, promotion expenses

- 15 λ – cost per km for driving an EV

A_{ij} – distance from i^{th} demand centre to j^{th} charging station (locations of the demand centres used to calculate this distance is obtained through the process described)

G – yearly equivalent cost of a single slow charger

Q – yearly equivalent cost of a single fast charger

20

- Determine one or more constraints-

wherein on or more demand constraints are:

- The demand d_i at demand centre i should be completely distributed to activated ($y_j = 1$) charge stations:

25

- $\sum_j x_{ij} \geq d_i \quad \forall i$

- x_{ij} must be zero for all j for which $y_j = 0$, to ensure this the following inequality can added:

- $x_{ij} \leq d_i y_j \quad \forall i, j$

wherein on or more supply constraints are-

- Each station j , when activated, should contain sufficient chargers to supply the demand.

$$\sum_i x_{ij} \leq 365 * \rho \left(\frac{g_j}{t_s} + \frac{q_j}{t_f} \right) \quad \forall j$$

5 ρ , station active hours = 12 hr. (assumption)

t_s , charging time (hr.) for slow charger [e.g., 8 hr. for “ABC AC-001” charger]

t_f , charging time (hr.) for fast charger [e.g., 0.8 hr. for “AAA” charger]

- Bound constraints: g_j & q_j must be zero for all j for which $y_j = 0$. To ensure this and to ensure that the parameters between lie within the known upper and lower limits, following can be included:

$$g_j \leq M_s y_j$$

$$g_j \geq L_s y_j$$

$$q_j \leq M_f y_j$$

15 $q_j \geq L_f y_j$

M_s, L_s – Upper and lower limits for number of slow chargers

M_f, L_f – Upper and lower limits for number of fast chargers

wherein on or more distance constraints are-

- Each station j , when activated should have sufficient distance from nearest existing charge station, wherein the nearest existing charge station is defined as-

$$dist_{je} \geq \alpha y_j \quad \forall j, k \text{ (} \alpha \text{ user input) where } e \text{ is nearest existing charging station.}$$

- Each station j , when activated should be in sufficient proximity to nearest point of interest, wherein the nearest point of interest is defined as-

$$dist_{jl} y_j \leq \beta \quad \forall j, l \text{ (} \beta \text{ user input) where } l \text{ is the nearest point of interest.}$$

- 25 Sufficient distance between any pair of activated charge stations, j, j' :

$$dist_{jj'} \geq \gamma y_{jj'} \quad \forall j, j' \text{ (} \gamma \text{ user input)}$$

$$y_{jj'} \leq y_j$$

$$y_{jj'} \leq y_{j'}$$

$$y_{jj'} \geq y_j + y_{j'} - 1$$

Now, referring to Figure 3, an exemplary method flow diagram [300], for determining at least one optimal location and an optimal size of one or more electric vehicle charging stations (EVCSs), in accordance with exemplary embodiments of the present invention is shown. In an implementation the method [300] is performed by the system [200]. Further, in an implementation, the system [200] may be present in a user equipment [102] to implement the features of the present invention. Also, as shown in Figure 3, the method [300] starts at step [302].

At step [304], the method [300] as disclosed by the present disclosure comprises receiving, by an input unit [202], at least a name of a geographical region. In an implementation of the present solution, the name of the geographical region may be received by the input unit [202] based on a user input provided by a user. In another implementation of the present solution, receiving the name of the geographical region by the input unit [202] may also comprise automatically detecting the name of the geographical region based on one or more predefined actions, such as receiving from the user a latitude and longitude of the geographical region or receiving from the user a pin code of a region associated with the geographical region etc.

Next, at step [306], the method [300] as disclosed by the present disclosure comprises receiving, by a processing unit [204] from a storage unit [206], a set of geographical data associated with the geographical region, wherein the set of geographical data comprises at least a road network data, a list of existing electronic vehicle charging station data, a population data, and an existing infrastructure data.

In an exemplary implementation of present solution as disclosed herein, the road network data may be received by the processing unit [204] using one or more data sources such as via a public street map data source and/or via a private street map data source using a data library defined for such data source(s). In another exemplary implementation of the present solution, the road network data may be received by the processing unit [204] in a predefined road network data format such as a Graph format or the like.

In an exemplary implementation of present solution as disclosed herein, the list of existing electronic vehicle charging station data may be received by the processing unit [204] using one or more data sources such as a public charge map data source and/or via a private charge map data source via a data library such as a public charge map API data library. In another exemplary implementation of the present disclosure, the list of existing electronic vehicle

charging station data may be received by the processing unit [204] based on a query mechanism, wherein the processing unit [204] may use a centroid of the geographical region and/or a centroid of a part of geographical region from the geographical region to query the geographical location of an existing electronic vehicle charging station located within a
5 specified radius of the geographical region and/or within the part of geographical region from the geographical region e.g., 30 km radius of the geographical region. In another exemplary implementation of the present solution, the list of existing electronic vehicle charging station data may be received by the processing unit [204] in a predefined format such as a standard file format.

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In an exemplary implementation of present solution as disclosed herein, the population data may be received by the processing unit [204] using one or more data sources such as a public API data source and/or via a private API data source using a data library defined for such data source(s). In another exemplary implementation of the present solution, the population
15 data may be received by the processing unit [204] in a predefined road network data format such as an integer format.

In an exemplary implementation of present solution as disclosed herein, the existing infrastructure data may be received by the processing unit [204] using one or more data
20 sources such as via a public street map data source and/or via a private street map data source using a data library defined for such data source(s). In another exemplary implementation of the present solution, the existing infrastructure data may be received by the processing unit [204] in a predefined road network data format such as a standard file format. The term "existing infrastructure data" as used in the present disclosure may include, but is not limited
25 to, data related to existing building structures such as schools, malls, parking lots, vacant land parcels, and other similar elements within the specified geographical region.

It should be noted that the use of the terms "a public charge map data source," "a private charge map data source", "a public API data source", "a public charge map API data library,"
30 "and "integer format" are used herein is solely for illustrative purposes. These examples are provided to enhance understanding and should not be construed as imposing any limitations on the scope of the present disclosure. Further, the solution as disclosed herein is not restricted to the mentioned exemplary data sources, data libraries, or predefined formats. Instead, it encompasses the utilization of any other data source, data library, or predefined

format that achieves similar functionality or serves the same purpose. Furthermore, the person skilled in the art would readily appreciate that various alternative data sources, data libraries, and formats exist that can be employed to implement the present disclosure and these alternatives are fully embraced within the scope of the present disclosure, even though
5 they may not have been explicitly described in this specification. Thus, any reference to specific data sources, data libraries, or formats in the present disclosure is made purely for explanatory purposes and should not be interpreted as a limitation on the scope of the present disclosure. The present disclosure is intended to encompass all modifications, substitutions, or equivalents that fall within the scope of the claims, regardless of whether such alternatives
10 were explicitly mentioned or not.

Next, at step [308], the method [300] as disclosed by the present disclosure comprises identifying, by the processing unit [204], at least a list of potential charging station locations and a list of point of interest locations based on the set of geographical data.

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In an exemplary implementation of present solution as disclosed herein, the list of potential charging station locations may be identified by the processing unit [204] using one or more data sources such as via a public street map data source and/or via a private street map data source using a data library defined for such data source(s). In another exemplary
20 implementation of the present disclosure, the list of potential charging station locations may be identified by the processing unit [204] based on the existing infrastructure data received by the processing unit [204]. Further, in order to identify the list of potential charging station locations based on the existing infrastructure data, at least one infrastructure data may be used as an initial potential charging station location based on one or more potential charging
25 location parameters for e.g., an infrastructure data such as a data indicating details of public parking lots may be utilized as an initial potential charging station location based on the one or more potential charging location parameters. For instance, as the public parking lots are places where electric cars usually spend a lot of idle time, and the public parking lots are hotspots for human activity in the geographical region, therefore the public parking lots may
30 serve as good candidate locations for potential EV charging stations. In another exemplary implementation of the present solution, the list of potential charging station locations may be received by the processing unit [204] in a predefined format such as a standard file format.

Further, in another exemplary implementation of present solution as disclosed herein, the list of point of interest locations may be identified by the processing unit [204] using one or more data sources such as via a public street map data source and/or via a private street map data source using a data library defined for such data source(s). In another exemplary implementation of the present disclosure, the list of point of interest locations may be identified by the processing unit [204] based on the existing infrastructure data received by the processing unit [204]. In another exemplary implementation of the present disclosure, the list of point of interest locations may be identified by the processing unit [204] by utilizing at least one infrastructure data from the existing infrastructure data as an initial potential point of interest location based on one or more potential point of interest parameters for e.g., an infrastructure data such as a data indicating an amenity location for e.g., a mall, office, a club house may be utilized as an initial potential point of interest location based on one or more potential point of interest parameters i.e., a human footfall value parameter, a vehicle idle parking time parameter, a population density parameter or any other parameter that may be obvious to the person skilled in the art. In an exemplary scenario, a mall associated with the geographical region may comprise a human footfall value more than a predefined threshold value for e.g. a ABC mall is utilized as initial potential point of interest location based on at least the potential point of interest parameter that the ABC mall comprises a human footfall value of 2000 wherein the predefined threshold value is 1000. In another exemplary implementation of the present solution, the list of point of interest locations may be received by the processing unit [204] in a predefined format such as a standard file format.

Next, at step [310], the method [300] as disclosed by the present disclosure comprises determining, by the processing unit [204] via a data fusion module, a set of updated geographical data associated with the geographical region based on the set of geographical data, and at least one of the list of potential charging station locations and the list of point of interest locations, wherein the set of updated geographical data comprises at least an updated road network data, an updated list of electronic vehicle charging station data, an updated population data and an updated infrastructure data. It would be appreciated by the person skilled in the art that the term the set of updated geographical data associated with the geographical region as used herein refers to a method or process for determining updated geographical data may be via a use of a data fusion module to combine at least various sources of information, including the geographical data and one or more additional data related to the list of potential charging station locations and the list of point of interest

locations. Further, the term "updated road network data" as used herein refers to the information regarding the road infrastructure within a geographical region. This data is derived or updated through the process described in the present disclosure and may include details such as road layouts, traffic patterns, road types, and other relevant road-related information.

Further, it would also be appreciated by the person skilled in the art that the term "updated list of electronic vehicle charging station data" as used herein refers to a collection of information about electronic vehicle charging stations present within the geographical region. This data is updated or enhanced as part of the data fusion process, and it includes details such as the location, a geographical region, charging protocols, and other pertinent attributes of the charging stations. Further, the term "updated population data" as used herein refers to the population residing or frequenting the geographical region. This data is updated based on the data fusion process and may include details such as population size, demographics, density, and other relevant population-related characteristics. Furthermore, the term "updated infrastructure data" as used herein includes information about various types of infrastructure within the geographical region, such as buildings, schools, malls, parking lots, vacant land parcels, and other relevant structures. This data is updated or improved through the process outlined in the specification.

Further, it is to be noted that the use of terms such as "updated geographical data," "updated road network data," "updated list of electronic vehicle charging station data," "updated population data," and "updated infrastructure data" in the present disclosure should not be interpreted or construed to restrict the scope of the present disclosure. Additionally, it is to be noted that the intention behind employing these terms is solely for descriptive and illustrative purposes to explain the technical aspects and embodiments of the present disclosure. It is not intended to limit the present disclosure's broader scope, applications, or potential variations in any manner.

Next, at step [312], the method [300] as disclosed by the present disclosure comprises determining, by the processing unit [204], a list of demand centres associated with the geographical region based on at least one of the set of geographical data and the set of updated geographical data, wherein each demand centre from the list of demand centre

comprises at least one of an EV charging centre location and an estimated EV charging centre demand value.

Referring now to figure 4, illustrating a method flow diagram [400], for determining the list
5 of demand centres associated with the geographical region, in accordance with exemplary
embodiments of the present disclosure. In an implementation of the present disclosure, the
method [400] may be implemented in conjunction with the system [200] as disclosed by the
present disclosure to determine the list of demand centres associated with the geographical
region. Also, as shown in Figure 4, the method [400] starts at step [402].

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At step [404], the method [400] as disclosed by the present disclosure comprises retrieving,
by the processing unit [204] from the storage unit [206], at least the road network data
associated with the geographical region and the population data associated with the
geographical region.

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Next, at step [406], the method [400] as disclosed by the present disclosure comprises
determining, by the processing unit [204], a set of an electric vehicle (EV) charging centre
locations based on at least the road network data and the population data.

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Next, at step [408], the method [400] as disclosed by the present disclosure comprises
retrieving, by a processing unit [204] from a storage unit [206], a population data associated
with each EV charging centre location from the set of EV charging centre location.

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Next, at step [410], the method [400] as disclosed by the present disclosure comprises
determining, by the processing unit [204], an estimated EV charging centre demand value
associated with said each EV charging centre location based on at least the set of EV
charging centre locations and the population data associated with said each EV charging
centre location. . In an implementation of the present solution, the estimated EV charging
centre demand value associated with said each EV charging centre location is determined by
30 the processing unit [204] based on one or more demand value projection techniques such as a
Centrality-based EV demand projection technique and/or a Cluster-based EV demand
projection technique.

In an exemplary implementation of the present solution, in order to determine the estimated EV charging centre demand value associated with the geographical region via the Centrality-based EV demand projection technique, the present solution identifies one or more central nodes in the updated road network data of the geographical region via a predefined analysis method such as a graph centrality analysis method, wherein each central node from the one or more central nodes refers to a location of which may used to determine the list of demand centres in the geographical region. Further, in an exemplary graph centrality analysis method may utilize the updated road network data to find one or more areas of potential that may be the areas that are hotspots of activity in the geographical region. Furthermore, the graph centrality analysis method may identify the nodes that are important and/or central with respect to one or more nodes in a road network graph. For example, the one or more of the following two exemplary graph centrality measuring method may be used to implement the present solution:

- 3. A degree centrality measuring method, wherein the term “degree centrality” defines the importance of a node based on the degree of that node. The higher the degree, the more crucial it becomes in the graph.
- 4. A betweenness centrality measuring method, wherein the term “betweenness centrality” defines the importance of any node based on the number of times it occurs in the shortest paths between other nodes. Further, the said method measures the percentage of the shortest paths in a road network and determines where a particular node lies in it.

Furthermore, in another implementation of the present solution, the Centrality-based EV demand projection technique may also determine an electric-vehicle (EV) projection i.e., the projected number of EV in coming times. To determine the EV projection via the said technique, the Centrality-based EV demand projection technique may compute a top K1 nodes from the one or more nodes, wherein a top K1 road network nodes i.e., a top K1 central nodes, may be based on at least one of a user input and a centrality score associated with each node from the one or more nodes. Then a location of said top K1 nodes may be used to determine the list of demand centres. In an exemplary implementation of the present solution, the one or more central nodes may be very close to each other and might over-represent the geographical region in terms of EV charging centre location, in order to negate such over representation, the solution may implement a distance heuristic to ensure that each demand centre from the list of demand centres is at least a predefined distance apart from each other.

In an exemplary implementation of the present solution, in order to determine the list of demand centres associated with the geographical region via the Cluster-based EV demand projection technique, the Cluster-based EV demand projection technique may use one or more predefined set of techniques such as k-means techniques, k-means++ techniques to
5 determine one or more clusters of the updated road network data associated with the geographical region based on the Geodesic distance. In an implementation, said one or more clusters may be used to estimate a location of the EV charging centre location and the EV charging centre demand value in the geographical region. In an exemplary implementation, an unsupervised machine learning technique like k-means clustering, hierarchical
10 agglomerative clustering may be used to determine one or more clusters of the updated road network data and /or a clusters of the updated infrastructure data nodes tagged, for example, as “buildings” or “amenities” in the OSM. In an implementation, said one or more clusters may be based on a Geodesic (Latitude, Longitude) distance approximations also referred as geospatial clustering, for each demand centre from the list of demand centres associated with
15 the geographical region.

Furthermore, in another implementation of the present solution, the Cluster-based EV demand projection technique may also determine an electric-vehicle (EV) projection i.e., the projected number of EV in coming times. To determine the EV projection via the said technique, the Cluster-based EV demand projection technique may after performing
20 geospatial clustering, the technique determines K2 clusters from the one or more clusters. In an implementation, K2 clusters may be determined from the one or more clusters based on an user input. In another implementation, the K2 clusters may be used to project the EV charging centre demand value via fusion module which may be further utilised to determine the EV charging centre location.

25 In an exemplary implementation of the present solution, the combination of the Centrality-based EV demand projection technique and the Cluster-based EV demand projection technique may be utilized to determine a consolidated list of demand centres associated with the geographical region. In such an implementation, the combination of the K2 clusters determined from the one or more clusters via the Cluster-based EV demand projection
30 technique and the top K1 central nodes computed from the one or more nodes via the Centrality-based EV demand projection technique may be used by the processing unit [204] to determine the list of demand centres associated with the geographical region.

In one implementation, the present solution as disclosed may assume the EV charging centre location to be the centroid of the one or more clusters of the updated road network data and /or a clusters of the updated infrastructure data nodes tagged, for example, as “buildings” or “amenities” in a public/private street map. Furthermore, the updated population data associated with the geographical region is apportioned to each individual cluster from the one or more clusters based on a number of central nodes in each said cluster. Thereafter, the cluster-specific population may be processed via a Machine learning (ML) model to determine the EV charging centre demand value in each said cluster. For instance in light of the present disclosure:

- For each cluster $c = 1, \dots, K2$ compute g_c = no. of ‘central’ road network nodes lying within cluster, c .

- For each cluster c , compute the population, P_c , of each cluster as follows:

$$P_c = \frac{g_c}{K1} * \text{population of city}$$

where $K1$ = Total no. of ‘central’ road network nodes in the geographical region.

- This population, P_c , is used as a feature in the ML model to predict demand value corresponding to cluster c .
- The location of the demand centre for each cluster is assumed to be the centroid of all road network nodes in that cluster.

In an exemplary ML-based prediction model as shown below, the EV charging centre demand value (d_c) for cluster c is the yearly EV charging centre demand value (kWh/year) in that cluster. Further, the population of each cluster is estimated as a portion of the total population of the geographical region based on one or more population projection techniques that may be obvious to a person skilled in the art in light of the present disclosure. The EV charging centre demand value depends on various factors like the EV penetration rate, EV penetration rate and other socio-economic factors specific to the region under consideration. The present solution via the ML-based prediction model proposes a data-driven approach to estimate and refine the value of the EV charging centre demand value using ground truth data from the field. Further in an exemplary scenario, to achieve the above the ML-based prediction model estimates demand in each cluster $c = 1, \dots, K2$, with the following socio-economic features, x_c :

x_c = [population of the cluster (P_c), no. of ‘central’ nodes in the cluster (g_c), no. of Point of Interest (POI) nodes in the cluster, average age of the population in the cluster, average income of the population in the cluster, no. of registered vehicles in the cluster etc.].

The population (P_c) of the cluster and the number of ‘central’ nodes which lie in the cluster (g_c) are hand-crafted features used to predict the EV charging centre demand value. The other cluster-specific socio-economic features like average income, no. of registered vehicles etc. may be extracted through the data retrieval module of the ML-based prediction model or from openly available government data repositories or open sources. The target variable i.e., the yearly EV charging centre demand value, d_c , for a given cluster c is obtained from the field by aggregating the yearly EV charging centre demand value from all the existing electric vehicle charging stations that lie within that cluster. The feature matrix X_i for a target geographical region i is obtained by appending feature vectors of all the clusters in that target geographical region, as follows:

$$X_i = [x_1; x_2; \dots x_{K2}]$$

Thus, the feature matrix X_i would have $K2$ rows. Similarly, the target vector y_i for a geographical region i is obtained by appending the target variable (d_c) of all the clusters in that target geographical region, as follows. The target vector y_i would also have $K2$ rows.

$$y_i = [d_1; d_2; \dots d_{K2}]$$

The entire training data is created by aggregating X_i and y_i respectively across $i = 1, 2, \dots n$ cities within the same geographical region to create a sufficiently large matrix X (with $n * K2$ rows) and its corresponding target vector y (also with $n * K2$ rows), as follows:

$$X = [X_1; X_2; \dots X_n]$$

$$y = [y_1, y_2, \dots, y_n]$$

Standard ML-based prediction model such as linear / nonlinear regression model, decision trees model, neural networks model may be trained on this aggregated X vs. y data, to predict the EV charging centre demand value, d_c , for clusters in the geographical region of interest.

Next, at step [412], the method [400] as disclosed by the present disclosure comprises determining, by the processing unit [204], the list of demand centre based on the set of EV charging centre locations and the estimated EV charging centre demand value associated with

said each EV charging centre location. In a preferred exemplary implementation of the present disclosure, a combination of the Centrality-based EV demand projection technique and the Cluster-based EV demand projection technique may be utilized to determine the list of demand centres associated with the geographical region.

5

Thereafter, the method [400] terminates at step [414].

Again referring to figure 3, Next, at step [314], the method [300] as disclosed by the present disclosure comprises identifying, by the processing unit [204], a set of candidate locations associated with at least one demand centre from the list of demand centres based on an
10 existing infrastructure data associated with the set of geographical data, wherein each candidate location from the set of candidate locations is associated with a set of electric vehicle charging station (EVCS) parameters. Further, in an implementation of the present solution, the set of EVCS parameters comprises at least an EVCS deployment cost parameter, an EVCS access parameter, an EVCS infrastructure size parameter, and an EVCS charging
15 demand type parameter.

It is to be noted that the term “EVCS deployment cost parameter” refers to a numerical value or set of values associated with each candidate location within the set of candidate locations. Further, it represents the estimated or actual cost required for establishing an electric vehicle charging station at a specific candidate location. This parameter takes into account various
20 expenses such as equipment procurement, installation, permits, labor, grid connection, and any other relevant costs related to deploying the EVCS infrastructure. Similarly, it is to be noted that the term “EVCS access parameter” refers to a characteristic or set of characteristics associated with each candidate location within the set of candidate locations. Further, it indicates the ease of access or availability of the location to potential electric vehicle users.
25 This parameter may consider factors such as proximity to main roads, highways, urban centres, public transportation hubs, or other relevant access points that can attract electric vehicle owners to use the charging station. Similarly, it is to be noted that the term “EVCS infrastructure size parameter” refers to a numerical value or set of values associated with each candidate location within the set of candidate locations. Further, it represents the physical
30 size or capacity of the electric vehicle charging station that can be accommodated at the specified location. This parameter considers the number of charging points or stalls that can be installed, the available space for expansion, and other relevant factors related to the size and scalability of the EVCS infrastructure. Similarly, it is to be noted that the term “EVCS

charging demand type parameter” refers to a classification or categorization associated with each candidate location within the set of candidate locations. It describes the specific type or level of charging demand expected at the location. This parameter may include designations such as slow charging, fast charging, rapid charging, or ultra-fast charging, based on the expected charging requirements of electric vehicles at the given location.

In the implementation of the described solution, each candidate location is associated with a unique combination of these EVCS parameters, including the EVCS deployment cost parameter, EVCS access parameter, EVCS infrastructure size parameter, and EVCS charging demand type parameter. These parameters play a crucial role in determining the viability and suitability of establishing an electric vehicle charging station at a specific location, considering the existing infrastructure data and geographical information associated with the set of candidate locations and demand centres. It is important to note that the definitions of terms provided above in the present disclosure are included solely for explanatory and clarificatory purposes. They are intended to facilitate a better understanding of the present disclosure and its components. However, it should be explicitly understood that these definitions are not intended to impose any limitations or restrictions on the scope of the disclosure. The person skilled in the art would readily recognize that the terms used herein may have broader interpretations within the context of the present disclosure. The definitions provided should not be construed as confining the present disclosure to specific implementations or configurations. Rather, they serve as illustrative examples to aid in comprehension. Further, the scope of the present disclosure should be determined by the claims appended to the present disclosure. Any variations, alterations, or modifications of the terms used herein, which would be evident to one skilled in the art, are expressly considered to fall within the ambit of the present disclosure as defined by the claims. Therefore, the disclosed present disclosure is not limited to the precise meanings ascribed to the terms in the present disclosure. It is understood that different interpretations or embodiments may be apparent to those familiar with the relevant art, and such variations are encompassed by the spirit and scope of the present disclosure as claimed.

Next, at step [316], the method [300] as disclosed by the present disclosure comprises determining, by the processing unit [204] using one or more optimization techniques, the at least one optimal location of the one or more electric vehicle charging stations (EVCSs) and the optimal size of the one or more EVCSs based on the set of candidate locations and at least one parameter from the set of EVCS parameters.

In an implementation the present solution, aims to maximize the utilization of the one or more EVCSs, minimize a EVCS deployment cost parameter associated with each EVCS from the one or more EVCSs, and ensure equitable access to the one or more EVCSs for one or more EV users. In an implementation, to achieve the above the present solution may leverage
 5 mixed integer linear programming (MILP) model, to determine the most efficient sizing and effective placement of the one or more EVCSs, considering the spatial distribution of demand associated with the one or more EVCS, points of interest and existing electronic vehicle charging station data. In an implementation, the solution receives – as inputs – a set of candidate locations to with the one or more EVCSs. In an example in other words, the present
 10 solution considers all nodes tagged ‘parking’ in geographical region as a set of candidate locations, the problem is formulated as follows:

- **Objective:**

- To **minimize:**

- An EVCS deployment cost associated with each EVCS from the one or more EVCSs, an operational cost associated with each EVCS from the one or more EVCSs, and a Charger cost associated with each EVCS from the one or more EVCSs.
 - ‘Accessibility’ costs required to pull EV charging centre demand value from the list of demand centres cost associated with each EVCS from the one or more EVCSs.

- **Constraints:**

- **Demand constraints:**

- Installed each EVCS must satisfy an existing EV charging centre demand value.

- **Distance constraints:**

- The one or more EVCS should be installed:
 - At least α km (user input) away from any existing EVCS
 - At least within β km (user input) of each point of interest location from the list of point of interest locations
 - At least γ km (user input) away from each other

- **Supply constraints:**

- Supply from each EVCS must not exceed the known charging capacity.

- Chosen no. of ‘fast’ chargers and ‘slow’ chargers should not exceed known limits.

5 The MILP model to achieve the objective may perform one or more steps as mentioned below:

- Determine objective function as-

$$\text{Objective function} = \underset{\substack{y_j \in \{0,1\} \\ x_{ij} \geq 0}}{\text{Min}} C \sum_{j=1}^n y_j + \lambda \sum_{i=1}^m \sum_{j=1}^n A_{ij} x_{ij} + G \sum_{j=1}^n g_j + Q \sum_{j=1}^n q_j$$

wherein on or more decision Variables are-

10 $y_j \in \{0,1\}$ – potential charging station (binary; corresponds to the potential charging station locations extracted)

x_{ij} – yearly demand served to i^{th} demand centre by j^{th} station

g_j – number of slow chargers in j^{th} potential charge station

q_j – number of fast chargers in j^{th} potential charge station

15 wherein on or more inputs are-

C = yearly equivalent of EVCS deployment cost + yearly operation cost

* EVCS deployment cost includes electric and civil expenses

* An operational cost associated with each EVCS from the one or more EVCS includes maintenance, land lease, promotion expenses

20 λ – cost per km for driving an EV

A_{ij} – distance from i^{th} demand centre to j^{th} charging station (locations of the demand centres used to calculate this distance is obtained through the process described)

G – yearly equivalent cost of a single slow charger

Q – yearly equivalent cost of a single fast charger

25

- Determine one or more constraints-

wherein on or more demand constraints are:

- The demand d_i at demand centre i should be completely distributed to activated ($y_j = 1$) charge stations:

- $\sum_j x_{ij} \geq d_i \quad \forall i$
- x_{ij} must be zero for all j for which $y_j = 0$, to ensure this the following inequality can added:
 - $x_{ij} \leq d_i y_j \quad \forall i, j$

5

wherein on or more supply constraints are-

- Each station j , when activated, should contain sufficient chargers to supply the demand.

$$\sum_i x_{ij} \leq 365 * \rho \left(\frac{g_j}{t_s} + \frac{q_j}{t_f} \right) \quad \forall j$$

10

ρ , station active hours = 12 hr. (assumption)

t_s , charging time (hr.) for slow charger [e.g., 8 hr. for “ABC AC-001” charger]

t_f , charging time (hr.) for fast charger [e.g., 0.8 hr. for “AAA” charger]

15

- *Bound constraints:* g_j & q_j must be zero for all j for which $y_j = 0$. To ensure this and to ensure that the parameters between lie within the known upper and lower limits, following can be included:

$$g_j \leq M_s y_j$$

$$g_j \geq L_s y_j$$

$$q_j \leq M_f y_j$$

20

$$q_j \geq L_f y_j$$

M_s, L_s – Upper and lower limits for number of slow chargers

M_f, L_f – Upper and lower limits for number of fast chargers

wherein on or more distance constraints are-

- Each station j , when activated should have sufficient distance from nearest existing charge station, wherein the nearest existing charge station is defined as-

25

$$dist_{je} \geq \alpha y_j \quad \forall j, k \quad (\alpha \text{ user input}) \text{ where } e \text{ is nearest existing charging station.}$$

- Each station j , when activated should be in sufficient proximity to nearest point of interest, wherein the nearest point of interest is defined as-

$$dist_{jl} y_j \leq \beta \quad \forall j, l \quad (\beta \text{ user input}) \text{ where } l \text{ is the nearest point of interest.}$$

30

- Sufficient distance between any pair of activated charge stations, j, j' :

- $dist_{jj'} \geq \gamma y_{jj'}, \forall j, j' (\gamma \text{ user input})$
- $y_{jj'} \leq y_j$
- $y_{jj'} \leq y_{j'}$
- $y_{jj'} \geq y_j + y_{j'} - 1$

5 Thereafter, the method [300] terminates at step [318].

It is evident from the above disclosure, that the solution provided by the disclosure is technically advanced as compared to the prior known solutions. The present solution offers several technical advantages and effects in the field of electric vehicle charging station (EVCS) location and sizing optimization. Firstly, it introduces a robust city-agnostic
 10 framework, ensuring that the model can be effectively applied across different target cities without the need for substantial user intervention. This addresses the issue of generalizability that previous solutions often face. Secondly, the solution incorporates novel methods for projecting EV charging demand by leveraging related city-specific information. The mapping from socio-economic factors to EV charging demand using machine learning algorithms is a
 15 novel and technically advanced approach. Moreover, the solution directly predicts the yearly EV charging demand in different parts of the target city, providing more accurate estimations than predicting EV sales in each region. Additionally, the present solution employs a MILP-based optimization formulation to find optimal sizing and locations of new EVCS while considering various business constraints. This is achieved through the use of tailor-made city-
 20 agnostic data source APIs. Furthermore, the solution incorporates advanced techniques like the big M method and the Reformulation Linearization Technique (RLT) cut from integer programming to further enhance the optimization process. These technical advancements collectively contribute to an efficient, reliable, and scalable system for determining optimal EVCS locations and sizes, setting it apart from existing prior art in the field.

25 While considerable emphasis has been placed herein on the disclosed embodiments, it will be appreciated that many embodiments can be made and that many changes can be made to the embodiments without departing from the principles of the present disclosure. These and other changes in the embodiments of the present disclosure will be apparent to those skilled in the art, whereby it is to be understood that the foregoing descriptive matter to be implemented is
 30 illustrative and non-limiting.

We Claim:

1. A method for determining at least one optimal location and an optimal size of one or more electric vehicle charging stations (EVCSs), the method comprising:
 - receiving, by an input unit [202], at least a name of a geographical region;
 - 5 - receiving, by a processing unit [204] from a storage unit [206], a set of geographical data associated with the geographical region;
 - identifying, by the processing unit [204], at least a list of potential charging station locations and a list of point of interest locations based on the set of geographical data;
 - 10 - determining, by the processing unit [204] via a data fusion module, a set of updated geographical data associated with the geographical region based on the set of geographical data, and at least one of the list of potential charging station locations and the list of point of interest locations;
 - determining, by the processing unit [204], a list of demand centres associated with
 - 15 the geographical region based on at least one of the set of geographical data and the set of updated geographical data, wherein each demand centre from the list of demand centre comprises at least one of an EV charging centre location and an estimated EV charging centre demand value;
 - identifying, by the processing unit [204], a set of candidate locations associated
 - 20 with at least one demand centre from the list of demand centres based on an existing infrastructure data associated with the set of geographical data, wherein each candidate location from the set of candidate locations is associated with a set of electric vehicle charging station (EVCS) parameters; and
 - determining, by the processing unit [204] using one or more optimization
 - 25 techniques, the at least one optimal location of the one or more electric vehicle charging stations (EVCSs) and the optimal size of the one or more EVCSs, based on the set of candidate locations and at least one parameter from the set of EVCS parameters.
- 30 2. The method as claimed in claim 1, wherein the set of geographical data comprises at least a road network data, a list of existing electronic vehicle charging station data, a population data, and the existing infrastructure data.

3. The method as claimed in claim 1, wherein the set of updated geographical data comprises at least an updated road network data, an updated list of electronic vehicle charging station data, an updated population data and an updated infrastructure data.
- 5 4. The method as claimed in claim 2, wherein determining the list of demand centres associated with the geographical region further comprises:
 - retrieving, by the processing unit [204] from the storage unit [206], at least the road network data associated with the geographical region and the population data associated with the geographical region,
 - 10 - determining, by the processing unit [204], a set of an electric vehicle (EV) charging centre locations based on at least the road network data and the population data,
 - retrieving, by a processing unit [204] from the storage unit [206], a population data associated with each EV charging centre location from the set of EV charging centre location,
 - 15 - determining, by the processing unit [204], an estimated EV charging centre demand value associated with said each EV charging centre location based on at least the set of EV charging centre locations and the population data associated with said each EV charging centre location, and
 - 20 - determining, by the processing unit [204], the list of demand centre based on the set of EV charging centre locations and the estimated EV charging centre demand value associated with said each EV charging centre location.
- 25 5. The method as claimed in claim 4, wherein the estimated EV charging centre demand value associated with said each EV charging centre location is determined by the processing unit [204] based on one or more demand value projection techniques.
6. The method as claimed in claim 1, wherein the set of EVCS parameters comprises at least an EVCS deployment cost parameter, an EVCS access parameter, an EVCS infrastructure size parameter, and an EVCS charging demand type parameter.
- 30 7. A system for determining at least one optimal location and an optimal size of one or more electric vehicle charging stations (EVCSs), the system comprises:
 - an input unit [202], configured to receive, at least a name of a geographical region; and
 - 35

- a processing unit [204], configured to:
 - receive from a storage unit [206], a set of geographical data associated with the geographical region,
 - identify, at least a list of potential charging station locations and a list of point of interest locations based on the set of geographical data,
 - determine via a data fusion module, a set of updated geographical data associated with the geographical region based on the set of geographical data, and at least one of the list of potential charging station locations and the list of point of interest locations,
 - determine, a list of demand centres associated with the geographical region based on at least one of the set of geographical data and the set of updated geographical data, wherein each demand centre from the list of demand centre comprises at least one of an EV charging centre location and an estimated EV charging centre demand value,
 - identify, a set of candidate locations associated with at least one demand centre from the list of demand centres based on an existing infrastructure data associated with the set of geographical data, wherein each candidate location from the set of candidate locations is associated with a set of electric vehicle charging station (EVCS) parameters, and
 - determine using one or more optimization techniques, the at least one optimal location of the one or more electric vehicle charging stations (EVCSs) and the optimal size of the one or more EVCSs based on the set of candidate locations and at least one parameter from the set of EVCS parameters.
8. The system as claimed in claim 7, wherein the set of geographical data comprises at least a road network data, a list of existing electronic vehicle charging station data, a population data, and the existing infrastructure data.
9. The system as claimed in claim 7, wherein the set of updated geographical data comprises at least an updated road network data, an updated list of electronic vehicle charging station data, an updated population data and an updated infrastructure data.

10. The system as claimed in claim 8, wherein to determine the list of demand centres associated with the geographical region, the processing unit [204] is configured to:
- retrieve from the storage unit [206], at least the road network data associated with the geographical region and the population data associated with the geographical region,
 - determine, a set of an electric vehicle (EV) charging centre locations based on at least the road network data and the population data,
 - retrieve from the storage unit [206], a population data associated with each EV charging centre location from the set of EV charging centre location,
 - determine, an estimated EV charging centre demand value associated with said each EV charging centre location based on at least the set of EV charging centre locations and the population data associated with said each EV charging centre location, and
 - determine, the list of demand centres based on the set of EV charging centre locations and the estimated EV charging centre demand value associated with said each EV charging centre location.
11. The system as claimed in claim 10, wherein the estimated EV charging centre demand value associated with said each EV charging centre location is determined by the processing unit [204] based on one or more demand value projection techniques.
12. The system as claimed in claim 7, wherein the set of EVCS parameters comprises at least an EVCS deployment cost parameter, an EVCS access parameter, an EVCS infrastructure size parameter, and an EVCS charging demand type parameter.