



US012664522B2

(12) **United States Patent**  
**Derouen**

(10) **Patent No.:** **US 12,664,522 B2**  
(45) **Date of Patent:** **Jun. 23, 2026**

(54) **METHOD FOR DIRECTING, SCHEDULING,  
AND FACILITATING MAINTENANCE  
REQUIREMENTS FOR AUTONOMOUS  
VEHICLE**

2050/0075 (2013.01); B60W 2050/046  
(2013.01); B60W 2555/20 (2020.02); B60W  
2556/10 (2020.02); B60W 2556/40 (2020.02);  
B60W 2556/50 (2020.02)

(71) Applicant: **Jeffery Derouen**, Pineville, LA (US)

(58) **Field of Classification Search**

None

See application file for complete search history.

(72) Inventor: **Jeffery Derouen**, Pineville, LA (US)

(\*) Notice: Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
U.S.C. 154(b) by 191 days.

(56)

**References Cited**

**U.S. PATENT DOCUMENTS**

10,670,411 B2 \* 6/2020 Starns ..... G05D 1/0088  
2014/0327752 A1 \* 11/2014 Tsuda ..... G06V 20/593  
348/77

(Continued)

*Primary Examiner* — Abdhesh K Jha

(74) *Attorney, Agent, or Firm* — Patent 360; Barry  
Choobin

(21) Appl. No.: **18/472,627**

(22) Filed: **Sep. 22, 2023**

(65) **Prior Publication Data**

US 2024/0013164 A1 Jan. 11, 2024

**Related U.S. Application Data**

(63) Continuation-in-part of application No. 17/847,042,  
filed on Jun. 22, 2022, and a continuation-in-part of  
(Continued)

(51) **Int. Cl.**

**G06Q 10/20** (2023.01)  
**B60W 40/06** (2012.01)  
**B60W 50/04** (2006.01)  
**B60W 60/00** (2020.01)  
**G06Q 10/02** (2012.01)  
**G06Q 10/1093** (2023.01)

(Continued)

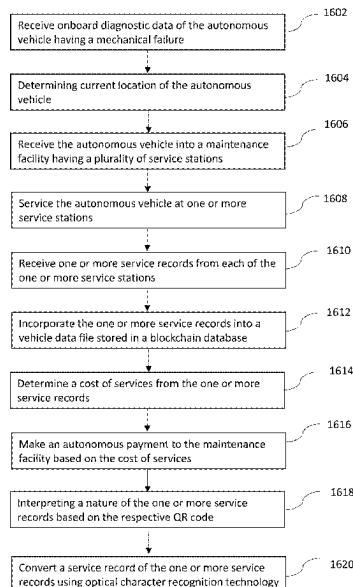
(52) **U.S. Cl.**

CPC ..... **G06Q 10/20** (2013.01); **B60W 40/06**  
(2013.01); **B60W 50/045** (2013.01); **B60W**  
**60/0016** (2020.02); **G06Q 10/02** (2013.01);  
**G06Q 10/1093** (2013.01); **G07C 5/006**  
(2013.01); **G07C 5/0808** (2013.01); **B60W**

**ABSTRACT**

A method for performing automatic maintenance of an autonomous vehicle is disclosed. The method includes receiving a maintenance request from the autonomous vehicle, wherein the maintenance request includes diagnostic data. Further, the method includes analyzing the diagnostic data to identify at least one recommended car service for the autonomous vehicle and comparing a vehicle location against a plurality of facility locations to identify a closest facility from a plurality of maintenance facilities, wherein the plurality of facility locations is associated with the locations of the plurality of maintenance facilities. Further, the method includes receiving a work schedule of the closest facility and generating an appointment reservation with the closest facility in the one or more facility locations based on the received one or more work schedules. Moreover, the method includes sending the appointment reservation to the autonomous vehicle.

**8 Claims, 16 Drawing Sheets**



**Related U.S. Application Data**

application No. 17/695,781, filed on Mar. 15, 2022, now Pat. No. 12,067,535, and a continuation of application No. 17/320,076, filed on May 13, 2021, now Pat. No. 11,308,458, and a continuation of application No. 17/108,815, filed on Dec. 1, 2020, now Pat. No. 11,049,079, and a continuation-in-part of application No. 16/002,746, filed on Jun. 7, 2018, now abandoned.

(60) Provisional application No. 63/238,468, filed on Aug. 30, 2021.

(51) **Int. Cl.**

**G07C 5/00** (2006.01)  
**G07C 5/08** (2006.01)  
*B60W 50/00* (2006.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

|              |      |         |              |              |
|--------------|------|---------|--------------|--------------|
| 2017/0192428 | A1 * | 7/2017  | Vogt .....   | G01C 21/3461 |
| 2019/0197177 | A1 * | 6/2019  | Bielby ..... | G06N 3/045   |
| 2019/0378352 | A1 * | 12/2019 | Dey .....    | G07C 5/008   |
| 2021/0284044 | A1 * | 9/2021  | Wood .....   | B60S 5/02    |

\* cited by examiner

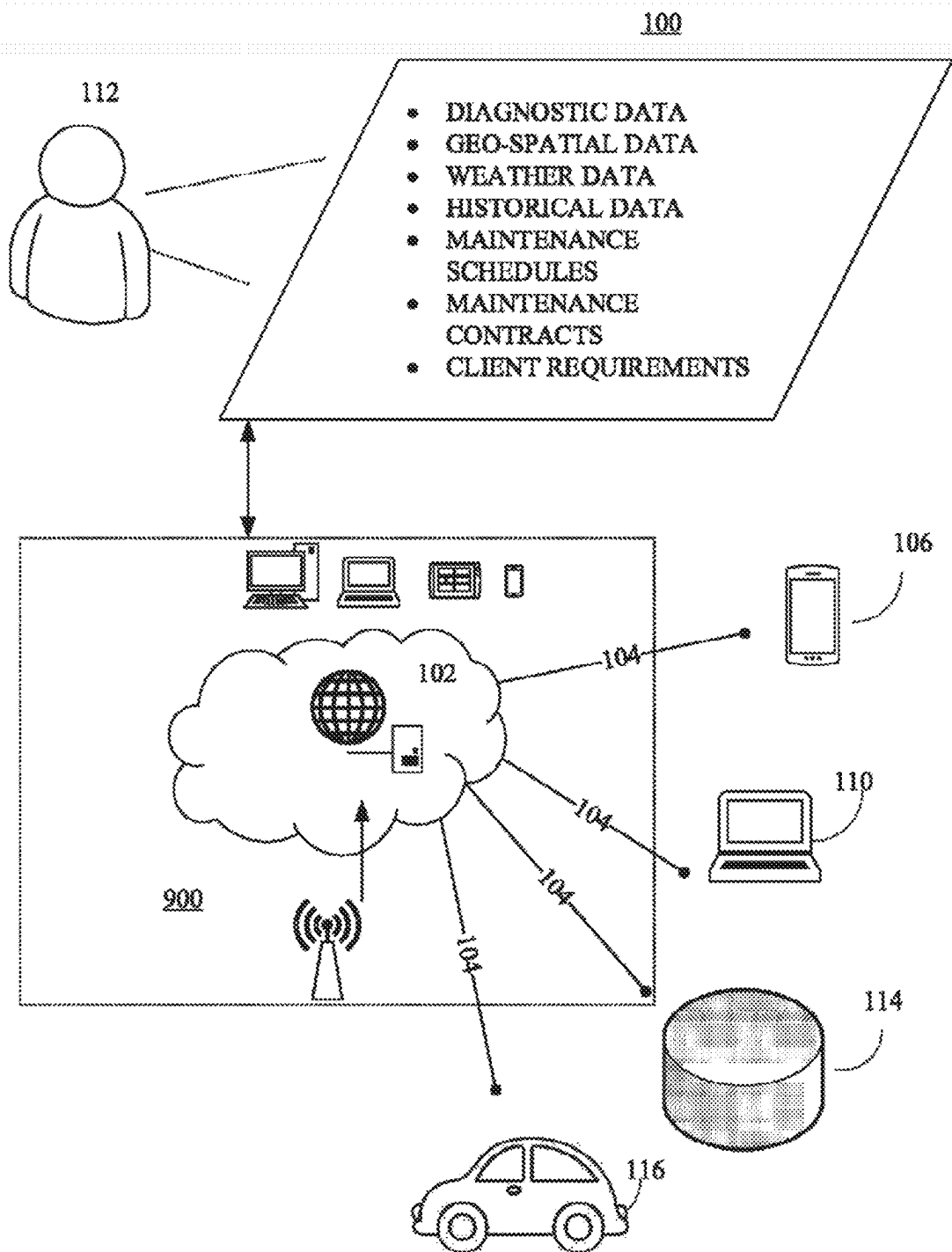


Fig. 1

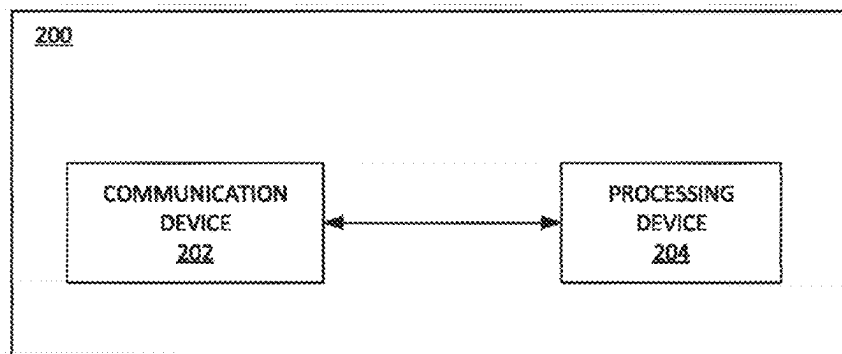


Fig. 2

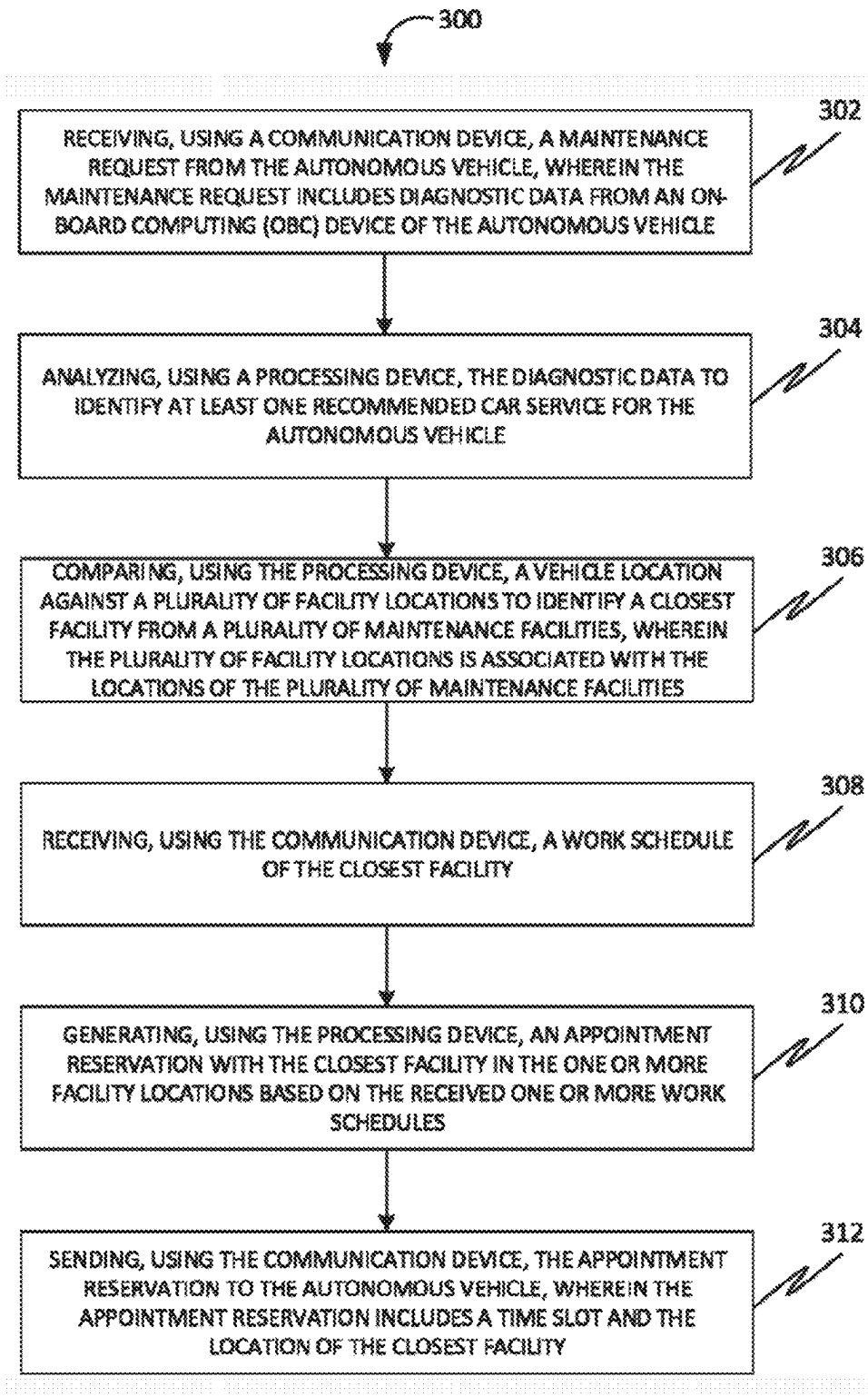
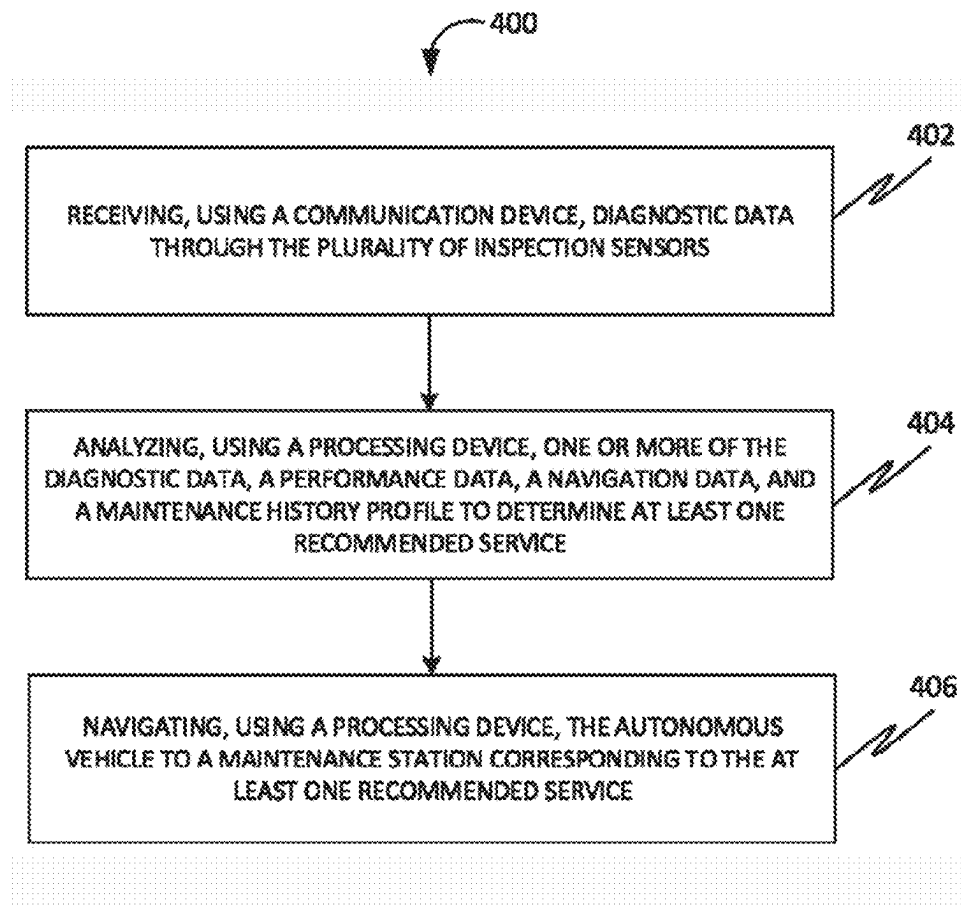
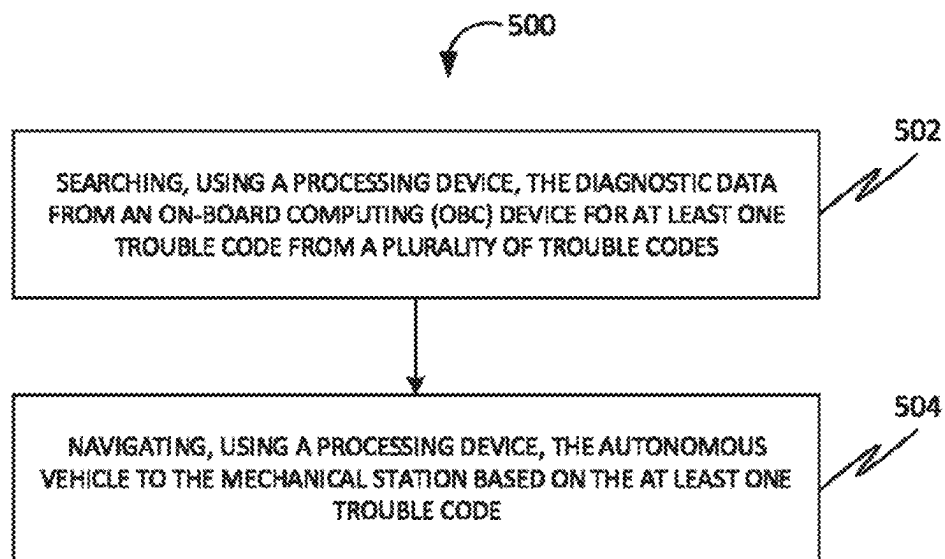


Fig. 3

**FIG. 4**

**FIG. 5**

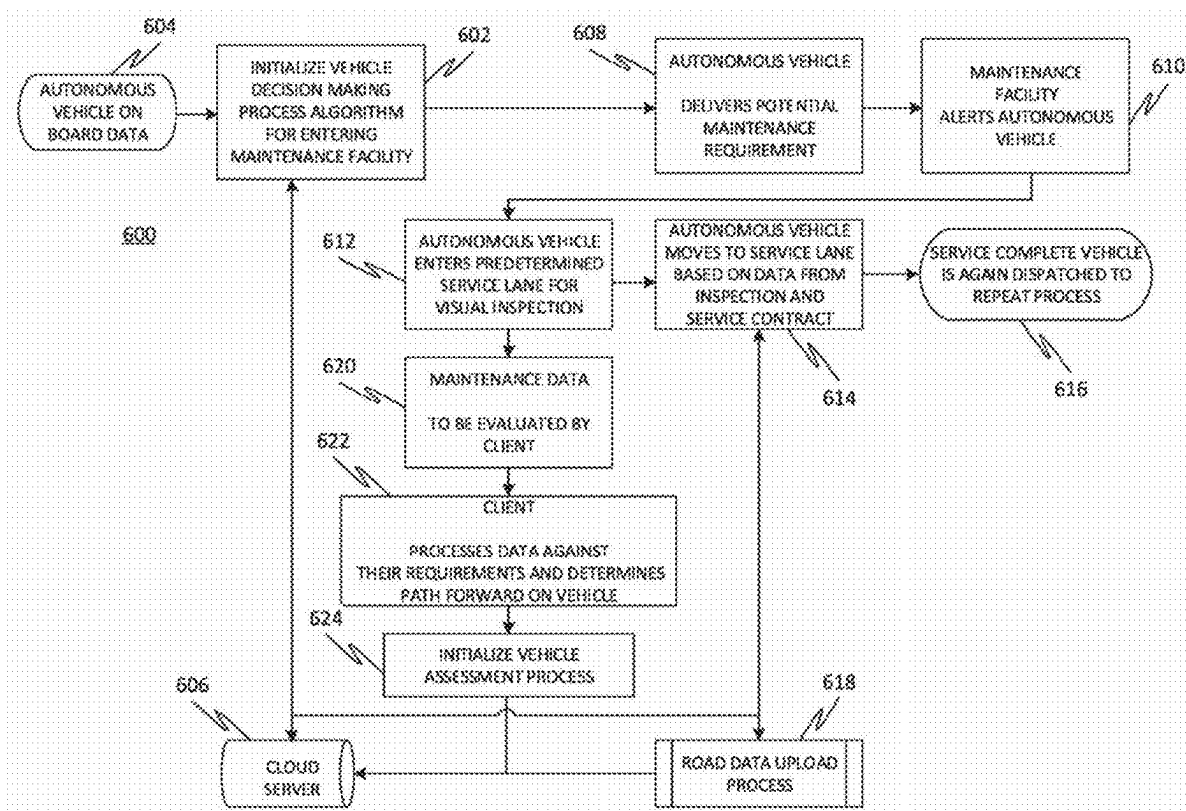


Fig. 6

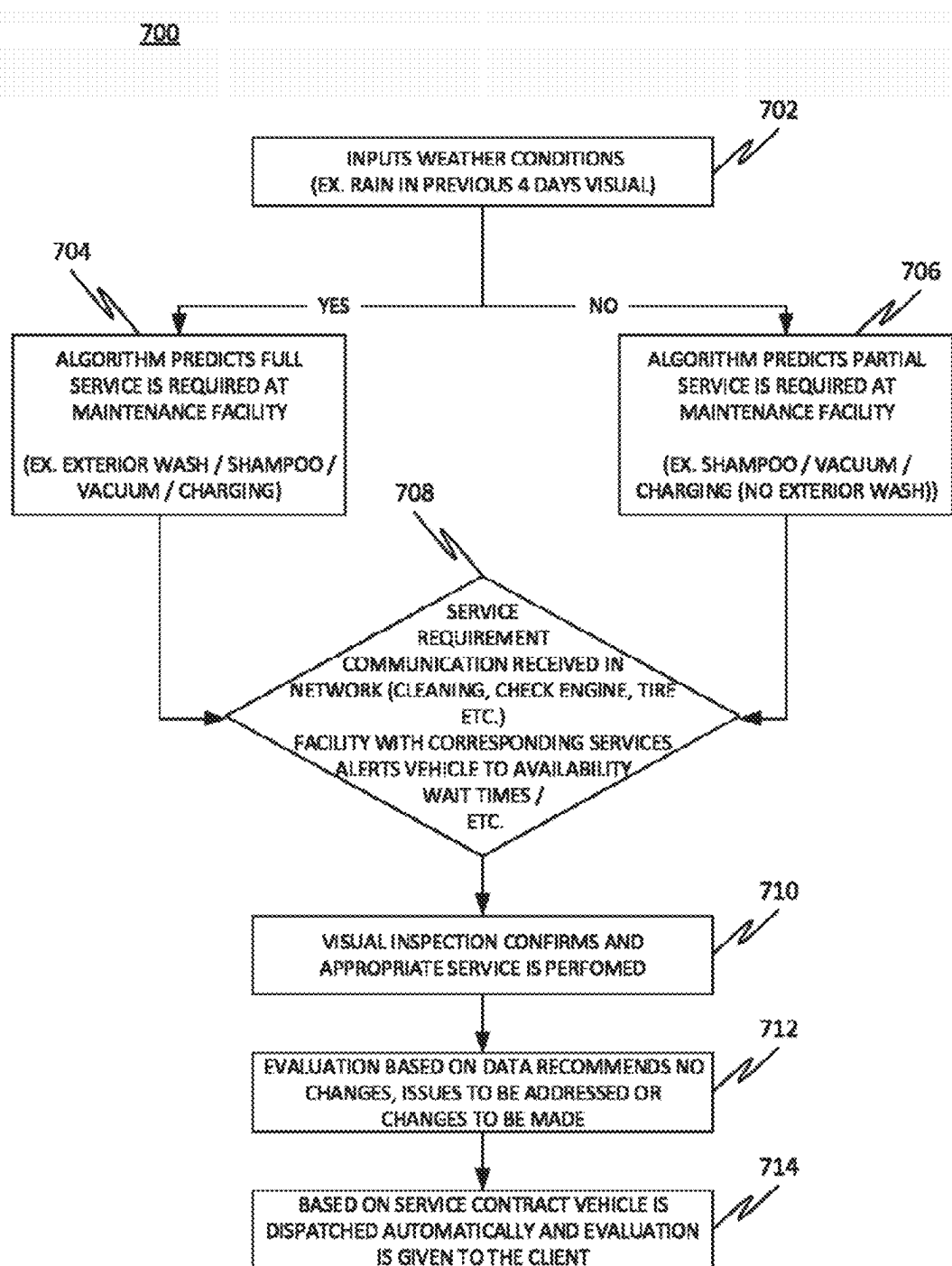


Fig. 7

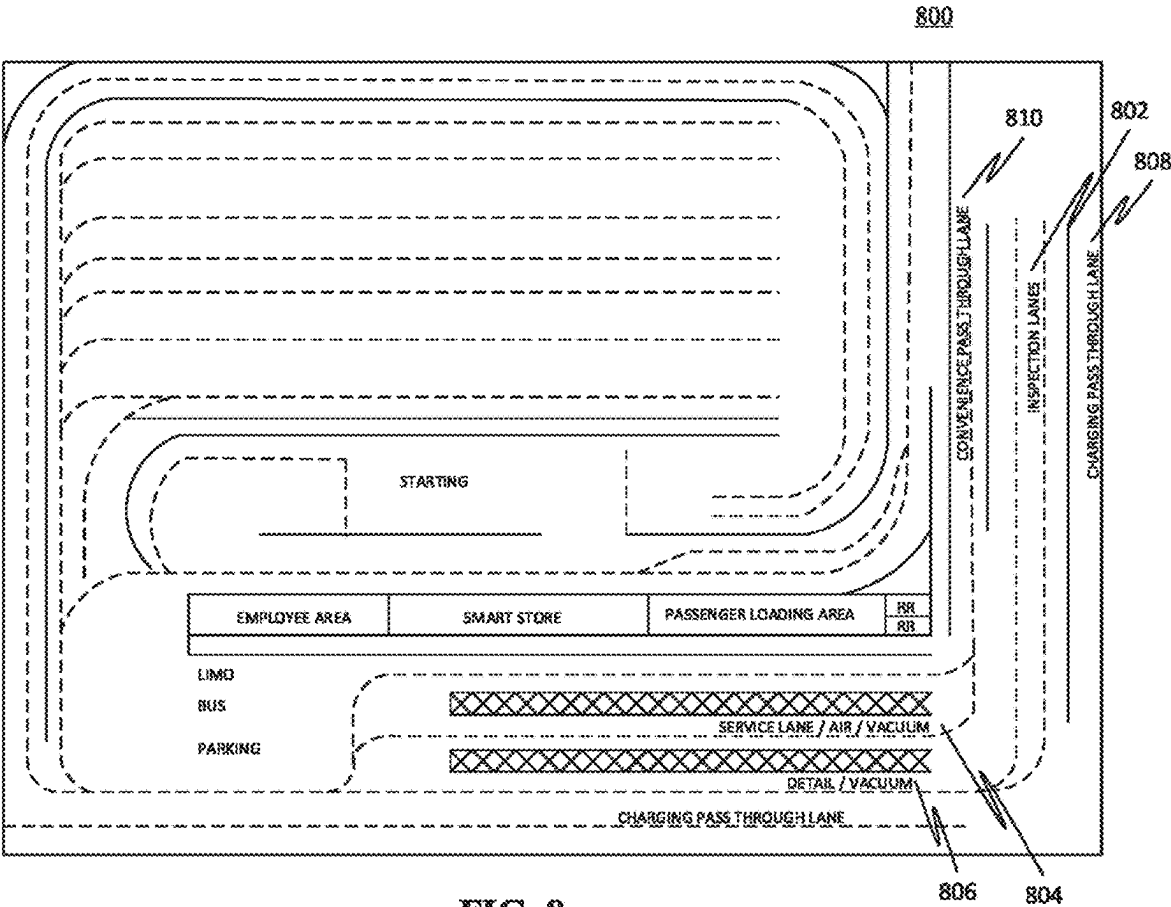


FIG. 8

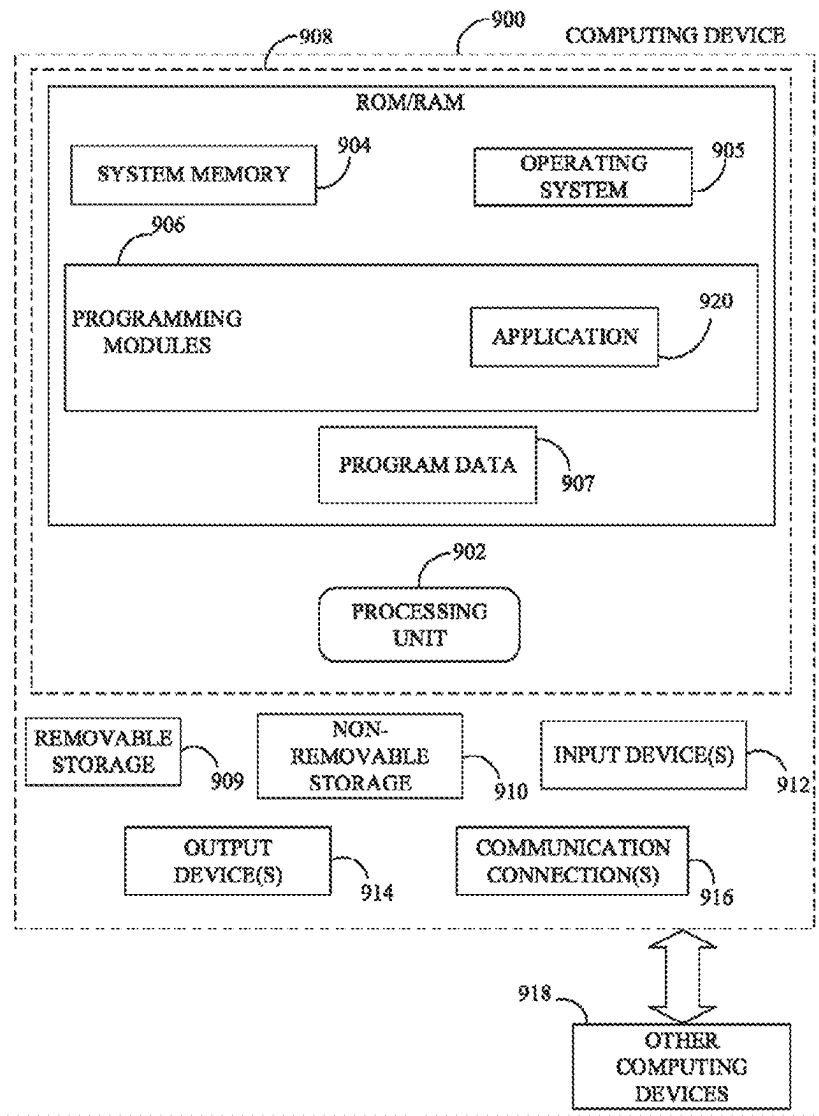
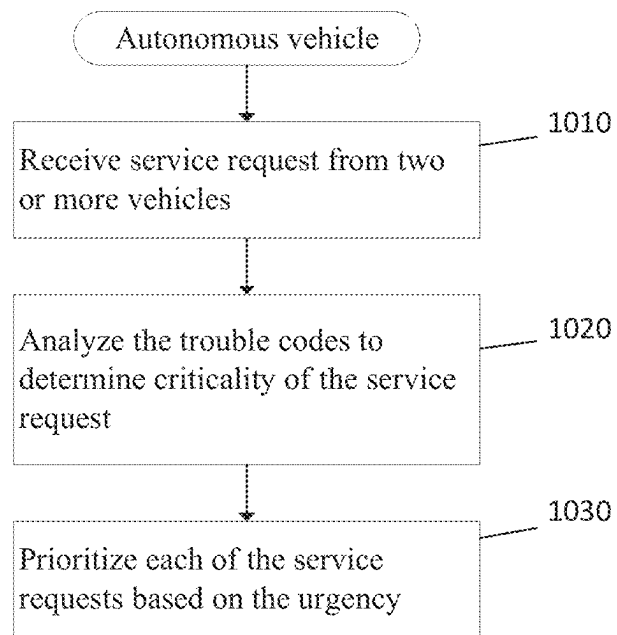


Fig. 9

**Fig. 10**

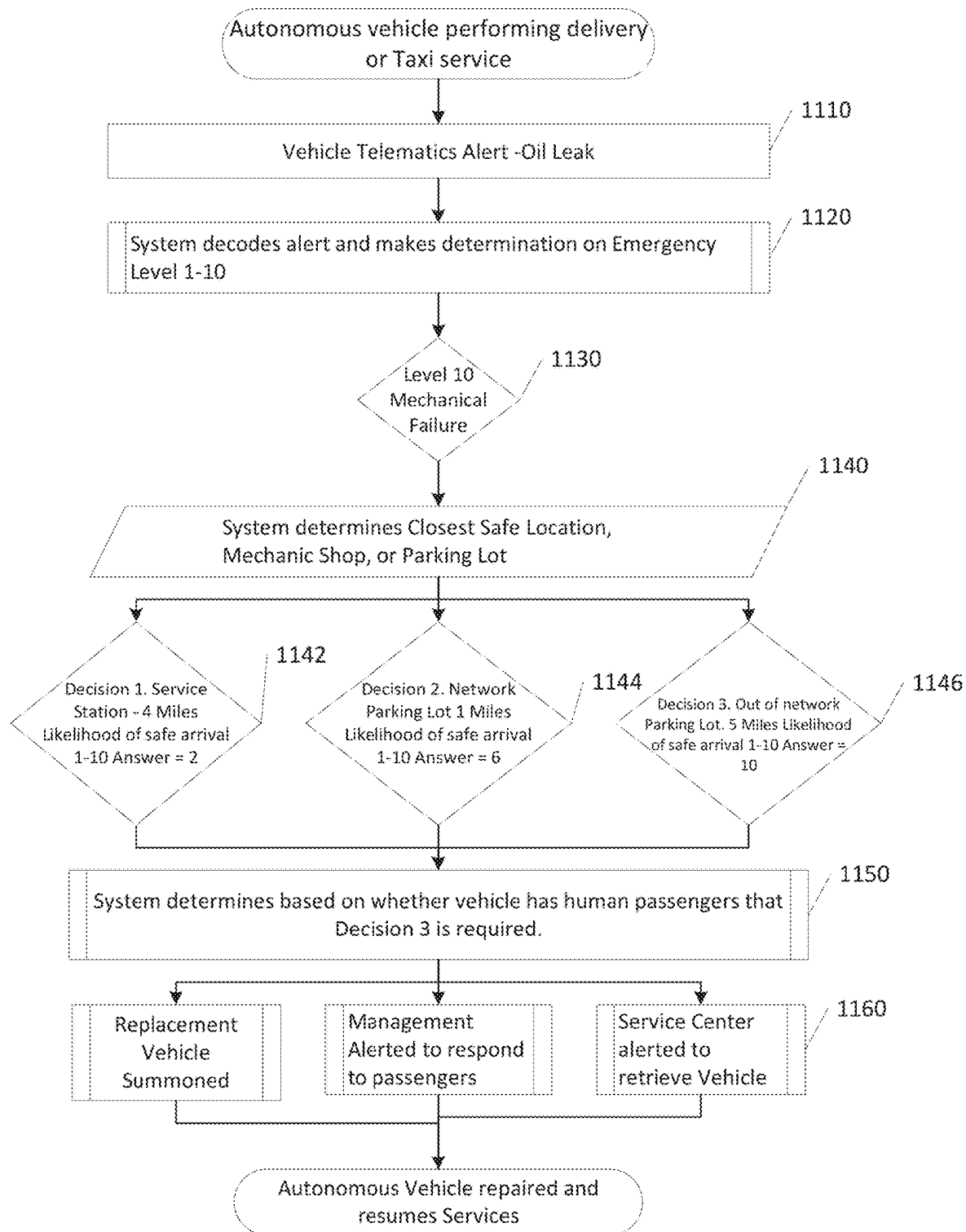


Fig. 11

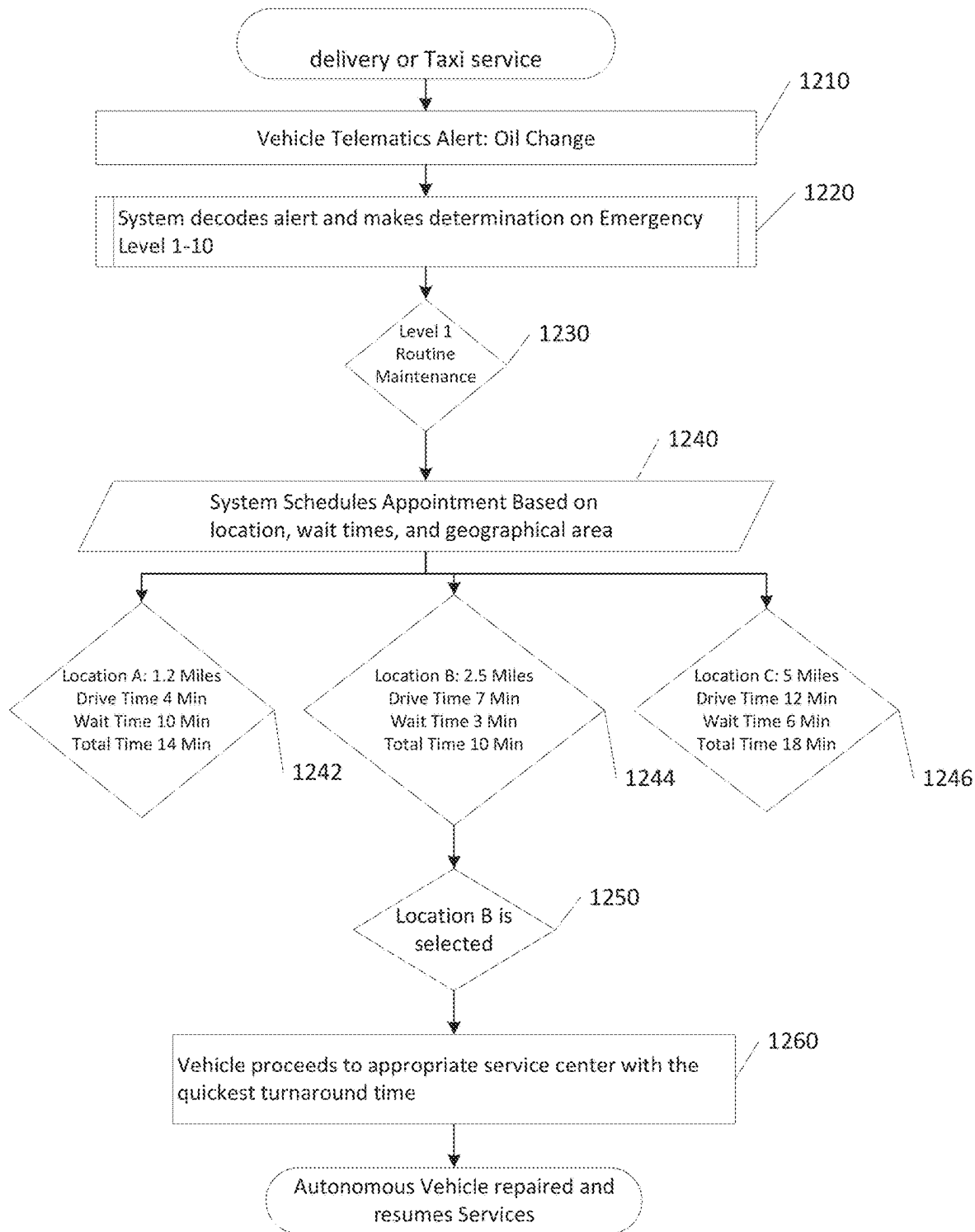
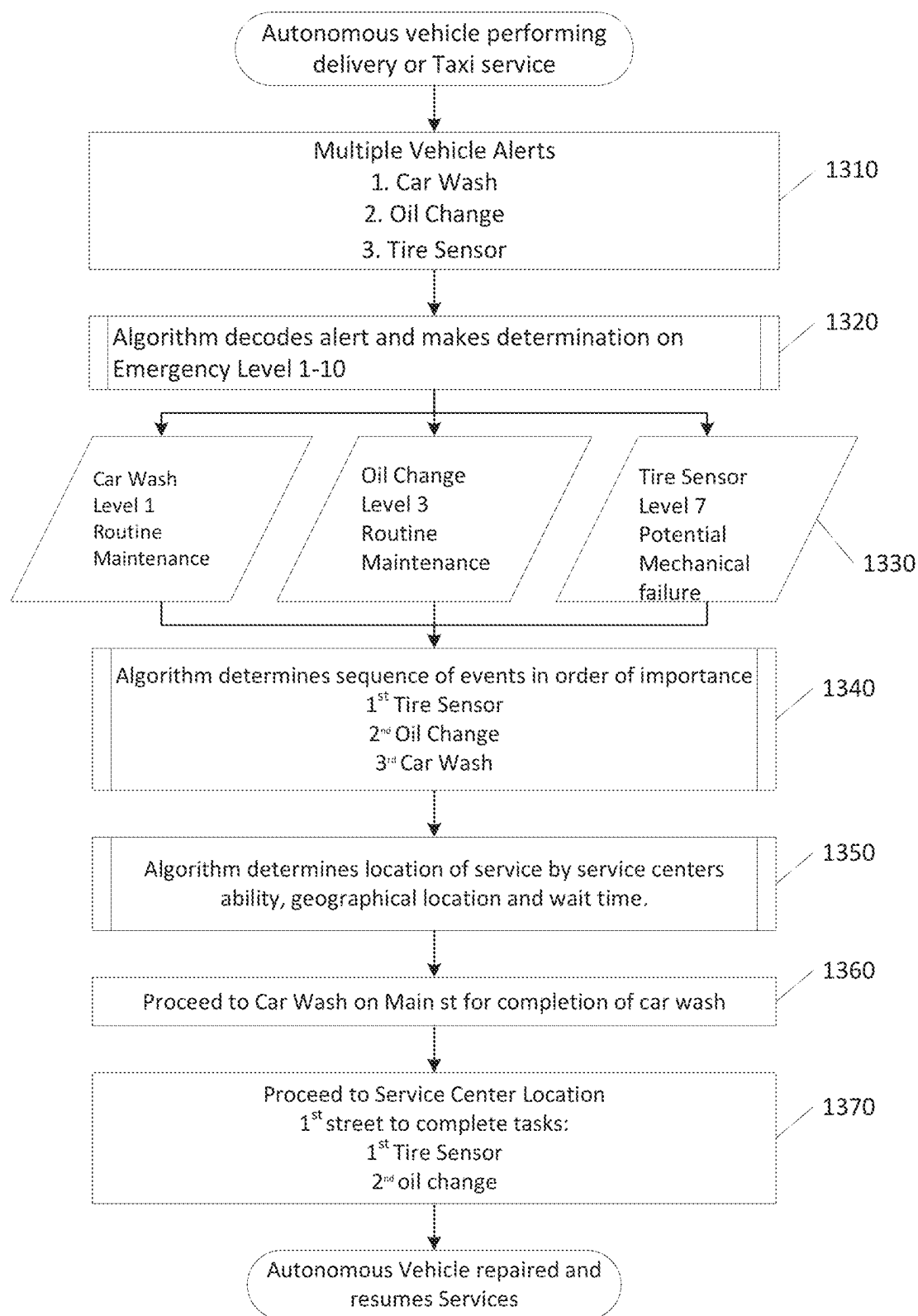
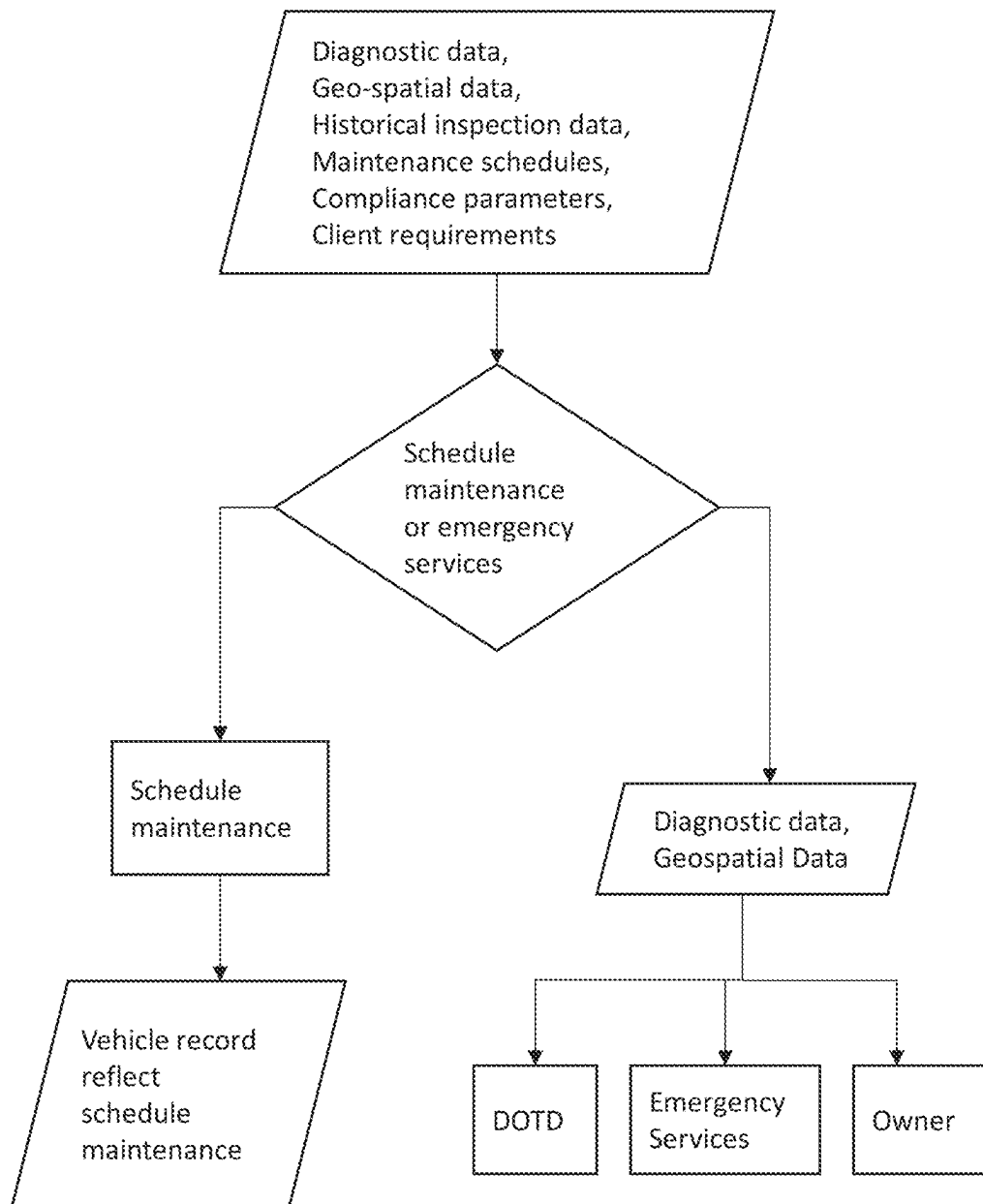
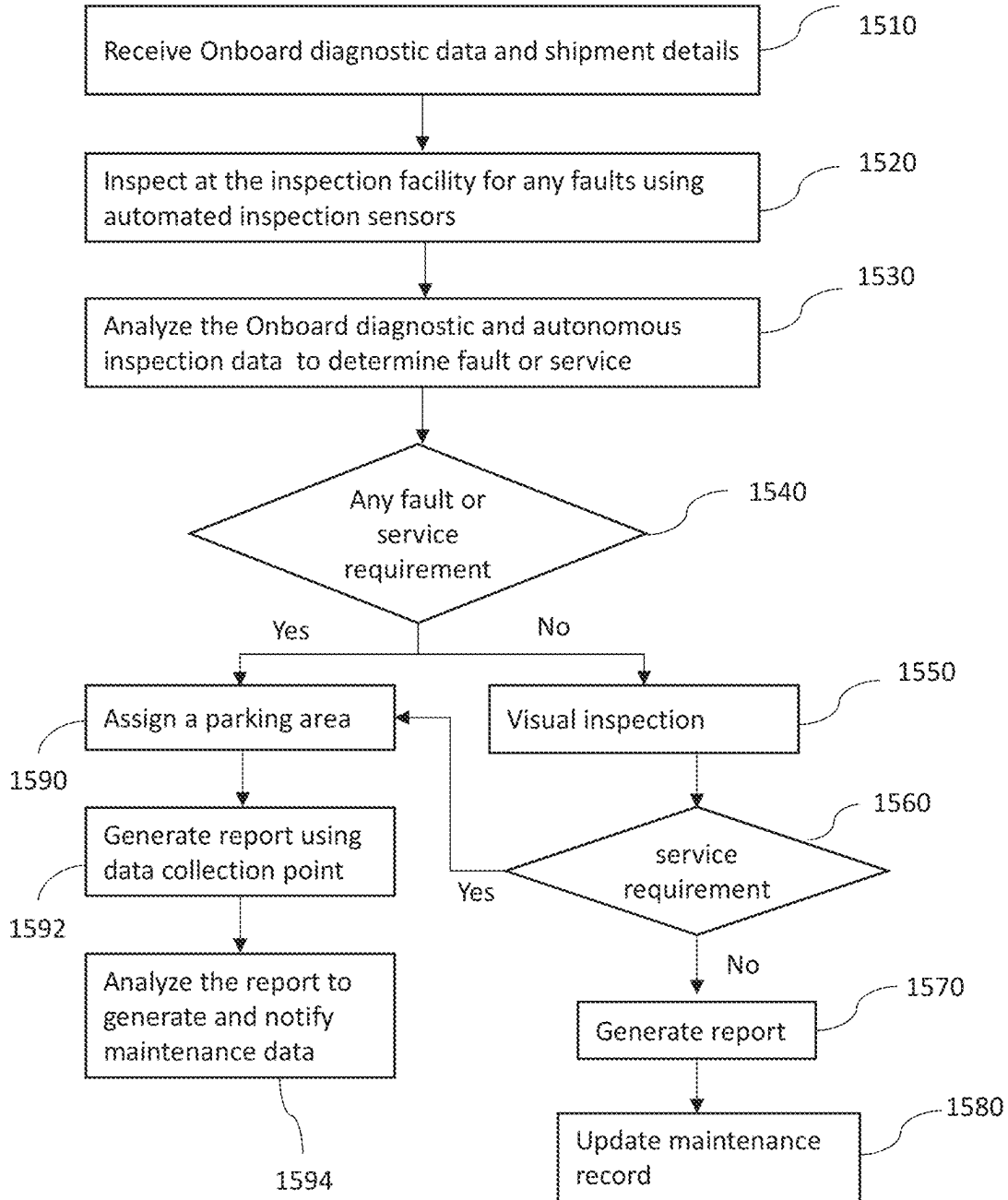
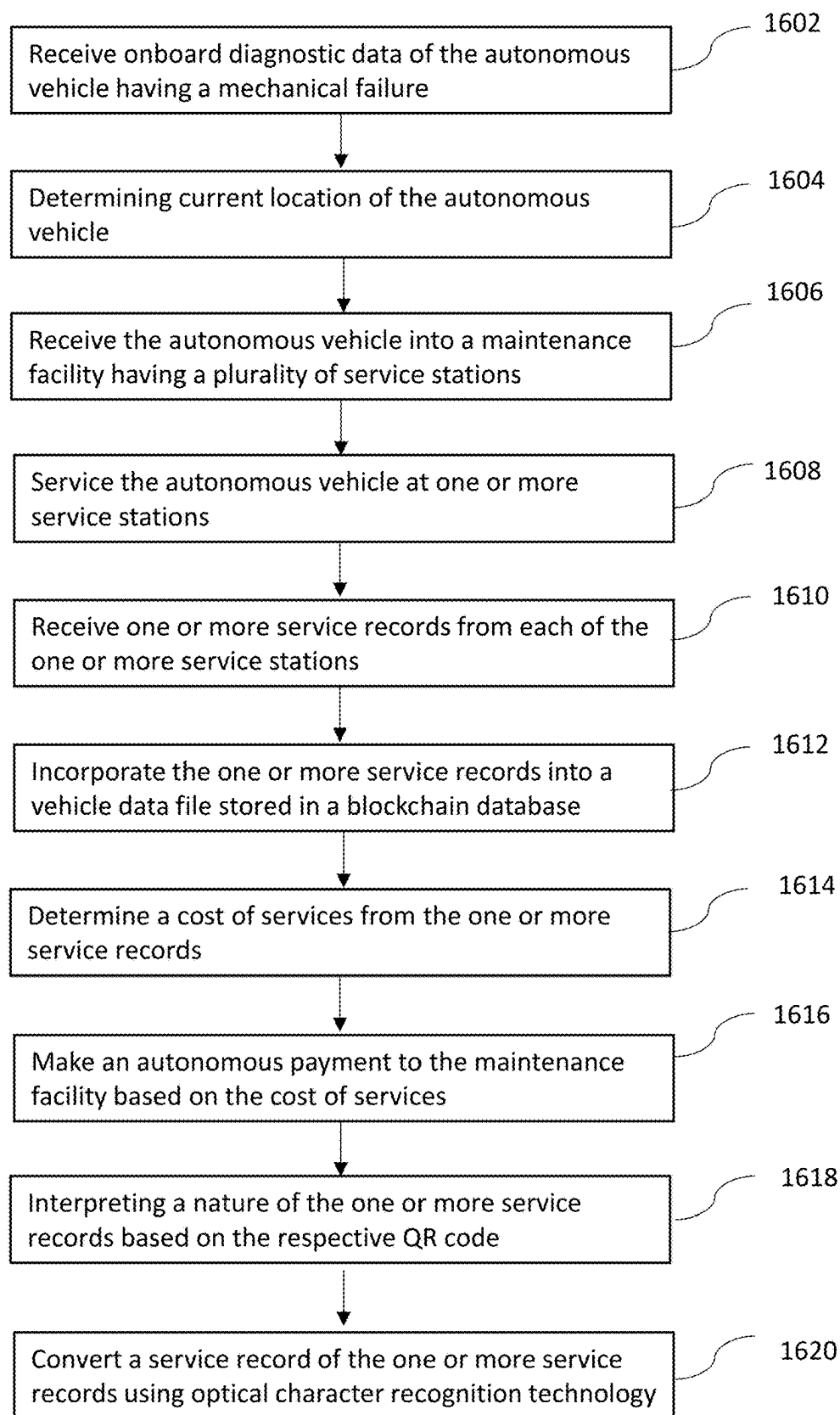


Fig. 12

**Fig. 13**

**Fig. 14**

**Fig. 15**

**Fig. 16**

1

# **METHOD FOR DIRECTING, SCHEDULING, AND FACILITATING MAINTENANCE REQUIREMENTS FOR AUTONOMOUS VEHICLE**

## **CROSS-REFERENCE TO RELATED APPLICATIONS**

This application is a continuation-in-part of a U.S. patent application Ser. No. 17/847,042 filed on Jun. 22, 2022, which is a continuation-in-part of a U.S. patent application Ser. No. 17/695,781 filed on Mar. 15, 2022, which is a continuation of a U.S. patent application Ser. No. 17/320,076 filed on May 13, 2021, which is a continuation of a U.S. patent application Ser. No. 17/108,815 filed on Dec. 1, 2020, which is a continuation-in-part of a U.S. patent application Ser. No. 16/002,746 filed on Jun. 7, 2018, the contents of all the above applications are incorporated herein by reference in its entirety. This application also claim priority from a U.S. Provisional patent appl. No. 63/238,468 filed on Aug. 30, 2021, which is incorporated herein by reference in its entirety

## **FIELD OF THE INVENTION**

The present invention relates to the field of autonomous vehicles. More specifically, the present disclosure relates to methods and systems for performing maintenance of autonomous vehicles.

## **BACKGROUND OF THE INVENTION**

Known methods for vehicle maintenance are unable to utilize the data acquired by a fully autonomous vehicle to determine the type of maintenance required by the vehicle. Further, conventional methods require intervention by users to navigate the vehicle to a suitable maintenance facility.

Moreover, the conventional methods are unable to navigate the vehicle via a predetermined path of travel through the maintenance facility in sequential steps to receive the maintenance required to fulfill mechanical and safety standards set by a predetermined data set based on one or more of manufacturer requirements, owner requirements, and government regulations.

Therefore, there is a need for improved methods and systems for automatically performing maintenance of autonomous vehicles that may overcome one or more of the abovementioned problems and/or limitations.

The term vehicle herein includes road vehicles, airborne vehicles, and waterborne vessels. Examples of the vehicle include an automobile, public transit vehicles, buses, cars, ships, and airplanes, and the like.

## **SUMMARY**

This summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This summary is not intended to identify key features or essential features of the claimed subject matter. Nor is this summary intended to be used to limit the claimed subject matter's scope.

According to some aspects, a method for performing automatic maintenance of an autonomous vehicle is disclosed. The method includes receiving, using a communication device, a maintenance request from the autonomous vehicle, wherein the maintenance request includes diagnostic data from an On-Board Computing (OBC) device of the

2

autonomous vehicle. Hereinafter the terms “maintenance request” and “service request” are interchangeable used. Furthermore, the method includes analyzing, using a processing device, the diagnostic data to identify at least one recommended car service for the autonomous vehicle. Yet further, the method includes comparing, using the processing device, a vehicle location against a plurality of facility locations to identify a closest maintenance or service facility from a plurality of maintenance facilities, wherein the plurality of facility locations is associated with the locations of the plurality of maintenance facilities. Further, the method includes receiving, using the communication device, a work schedule of the closest facility. Yet further, the method includes generating, using the processing device, an appointment reservation with the closest facility in the one or more facility locations based on the received one or more work schedules. Moreover, the method includes sending, using the communication device, the appointment reservation to the autonomous vehicle, wherein the appointment reservation includes a time slot and the location of the closest facility.

According to some aspects, a system is disclosed for performing automatic maintenance of an autonomous vehicle. The system includes a communication device configured to receive a maintenance request from the autonomous vehicle, wherein the maintenance request includes diagnostic data from an On-Board Computing (OBC) device of the autonomous vehicle. Further, the communication device is configured to receive a work schedule of a closest facility. Moreover, the communication device is configured to send an appointment reservation to the autonomous vehicle, wherein the appointment reservation includes a time slot and the location of the closest facility. Furthermore, the system includes a processing device configured to analyze the diagnostic data to identify at least one recommended car service for the autonomous vehicle. Further, the processing device is configured to compare a vehicle location against a plurality of facility locations to identify the closest facility from a plurality of maintenance facilities, wherein the plurality of facility locations is related to the locations of the plurality of maintenance facilities. Moreover, the processing device is configured to generate appointment reservations with the closest facility in the one or more facility locations based on the received one or more work schedules.

In one aspect, disclosed is a system that prioritizes the services of the autonomous vehicles based on criticality of the service request received from the vehicle. Autonomous vehicles which when need a service can be routed, by the system disclosed herein, to the nearest facility or the parking area, based on a predetermined set of criteria. For example, if three vehicles which need the service, first needs oil change, the second one needs muffler replacement, and the third needs a breaks replacement, the system based on the trouble codes received from the autonomous vehicles can give priority to the one that has break malfunction. Break malfunction is considered by the system as a mechanical failure and critical as compared to the other service requests, which are maintenance requests and do not need immediate assistance.

In one aspect, the disclosed system determines if any autonomous vehicles are having passengers. If any of the autonomous vehicles has passengers, the system can instruct the autonomous vehicle having the passengers to the workstation despite having lower criticality compared to other service requests.

In one aspect, the system receives two service requests from two autonomous vehicles, a first autonomous vehicle and a second autonomous vehicle. Both service requests can

be critical, however, the first autonomous vehicle has at least one passenger, while the second autonomous vehicle has no passenger. The system can instruct the first autonomous vehicle to move to the service center and the second vehicle is instructed by the system to move to the parking lot.

In one aspect, the system receives a first service request from a first autonomous vehicle and a second service request from a second autonomous vehicle. The first service request is related to malfunction of the first autonomous vehicle and the second service request related to maintenance of the second autonomous vehicle. The first autonomous vehicle can be instructed by the system to move to a service station and the second autonomous vehicle is instructed by the system to move to a wash station. The service station and the wash station are units within a service center or a maintenance facility. Upon completion of the service of the first autonomous vehicle, the second autonomous vehicle can be instructed to move to the service station.

In one aspect, the system receives a first service request from a first autonomous vehicle, a second service request from a second autonomous vehicle, and a third service request from a third autonomous vehicle. The first service request related to the malfunction of the first autonomous vehicle. The second service request related to malfunction of the second autonomous vehicle. The third service request related to maintenance of the third autonomous vehicle. The criticality of the first service request can be higher than the second service request. Accordingly, the system can instruct the first autonomous vehicle to move to a service station, the second autonomous vehicle is instructed to move to a parking lot, and the third autonomous vehicle is instructed to move to a wash station. Upon completion of the service of the first autonomous vehicle, the second autonomous vehicle is instructed to move to the service station.

In one aspect, disclosed is a method for performing automatic maintenance of an autonomous vehicle, the method includes the steps of receiving a plurality of maintenance requests from a plurality of autonomous vehicles, wherein each of the plurality of maintenance requests includes a current location of the autonomous vehicle. Receiving in near real time work schedule of a plurality of service centers. Determining for each autonomous vehicle of the plurality of the autonomous vehicles, drive times to each of the plurality of service centers. Thereafter, determining wait times for each of the plurality of service centers. Total times are then calculated based on the drive times and the wait times; Appointments can be scheduled for each of the plurality of the autonomous vehicles based on the total times.

In one aspect, the method also includes the steps of receiving diagnostic data from an On-Board Computing (OBC) device and navigation data from each of the plurality of the autonomous vehicles, the navigation data including GPS locations of a path traveled by an autonomous vehicle and times the autonomous vehicle was at these GPS locations. Determining environmental conditions at the GPS locations during the associated times, the environmental conditions comprising road condition and weather condition. Analyzing the environmental conditions to obtain one or more adverse events the autonomous vehicle was subjected to. Finally, at least one maintenance service can be identified for each autonomous vehicle based on one or more adverse events.

In one aspect, a geospatial map is disclosed, which GPS locations and at least one weather condition associated with

each of the GPS locations. The geospatial map can be used to determine one or more adverse events an autonomous vehicle may be subjected to.

Both the foregoing summary and the following detailed description provide examples and are explanatory only. Accordingly, the foregoing summary and the following detailed description should not be considered to be restrictive. Further, features or variations may be provided in addition to those set forth herein. For example, embodiments may be directed to various feature combinations and sub-combinations described in the detailed description.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of this disclosure, illustrate various embodiments of the present disclosure. The drawings contain representations of various trademarks and copyrights owned by the Applicants. In addition, the drawings may contain other marks owned by third parties and are being used for illustrative purposes only. All rights to various trademarks and copyrights represented herein, except those belonging to their respective owners, are vested in and the property of the applicants. The applicants retain and reserve all rights in their trademarks and copyrights included herein, and grant permission to reproduce the material only in connection with reproduction of the granted patent and for no other purpose.

Furthermore, the drawings may contain text or captions that may explain certain embodiments of the present disclosure. This text is included for illustrative, non-limiting, explanatory purposes of certain embodiments detailed in the present disclosure.

FIG. 1 is a block diagram showing certain embodiments of the present disclosure.

FIG. 2 is a block diagram of a system for performing automatic maintenance of an autonomous vehicle, in accordance with some embodiments.

FIG. 3 is a flowchart of a method for performing automatic maintenance of an autonomous vehicle, in accordance with some embodiments.

FIG. 4 is a flowchart of a method for navigating the autonomous vehicle to a maintenance station in one or more maintenance stations, in accordance with some embodiments.

FIG. 5 is a flowchart of a method for navigating the autonomous vehicle to a maintenance station in one or more maintenance stations, in accordance with some embodiments.

FIG. 6 is a flowchart of a method for performing automatic maintenance of an autonomous vehicle, in accordance with some embodiments.

FIG. 7 is a flowchart of a method for performing automatic maintenance of an autonomous vehicle based on external data, in accordance with an exemplary embodiment.

FIG. 8 is a schematic of a maintenance facility, in accordance with an exemplary embodiment.

FIG. 9 is a block diagram of a computing device for implementing the methods disclosed herein, in accordance with some embodiments.

FIG. 10 is a flow chart showing a method for providing prioritizing service requests, in accordance with some embodiments.

FIG. 11 shows an exemplary embodiment of the method for scheduling service of an autonomous vehicle based on severity of the service request.

5

FIG. 12 is a flowchart showing a method of scheduling the service of an autonomous vehicle based on location and timing.

FIG. 13 is a flow chart showing a method for prioritizing service requests from multiple vehicles.

FIG. 14 is a communication diagram that shows the flow of information in the event an autonomous semi-truck and trailer have maintenance issues.

FIG. 15 is a flowchart showing an exemplary embodiment of the present invention.

FIG. 16 is a flowchart showing another embodiment of the invention for autonomous maintenance of autonomous vehicles.

## DETAIL DESCRIPTIONS OF THE INVENTION

As a preliminary matter, it will readily be understood by one having ordinary skill in the relevant art that the present disclosure has broad utility and application. As should be understood, any embodiment may incorporate only one or a plurality of the above-disclosed aspects of the disclosure and may further incorporate only one or a plurality of the above-disclosed features. Furthermore, any embodiment discussed and identified as being “preferred” is considered to be part of a best mode contemplated for carrying out the embodiments of the present disclosure. Other embodiments also may be discussed for additional illustrative purposes in providing a full and enabling disclosure. Moreover, many embodiments, such as adaptations, variations, modifications, and equivalent arrangements, will be implicitly disclosed by the embodiments described herein and fall within the scope of the present disclosure.

Accordingly, while embodiments are described herein in detail in relation to one or more embodiments, it is to be understood that this disclosure is illustrative and exemplary of the present disclosure and are made merely for the purposes of providing a full and enabling disclosure. The detailed disclosure herein of one or more embodiments is not intended, nor is to be construed, to limit the scope of patent protection afforded in any claim of a patent issuing here from, which scope is to be defined by the claims and the equivalents thereof. It is not intended that the scope of patent protection be defined by reading into any claim a limitation found herein that does not explicitly appear in the claim itself.

Thus, for example, any sequence(s) and/or temporal order of steps of various processes or methods that are described herein are illustrative and not restrictive. Accordingly, it should be understood that, although steps of various processes or methods may be shown and described as being in a sequence or temporal order, the steps of any such processes or methods are not limited to being carried out in any particular sequence or order, absent an indication otherwise. Indeed, the steps in such processes or methods generally may be carried out in various different sequences and orders while still falling within the scope of the present invention. Accordingly, it is intended that the scope of patent protection is to be defined by the issued claim(s) rather than the description set forth herein.

Additionally, it is important to note that each term used herein refers to that which an ordinary artisan would understand such term to mean based on the contextual use of such term herein. To the extent that the meaning of a term used herein—as understood by the ordinary artisan based on the contextual use of such term—differs in any way from any

6

particular dictionary definition of such term, it is intended that the meaning of the term as understood by the ordinary artisan should prevail.

Furthermore, it is important to note that, as used herein, “a” and “an” each generally denotes “at least one,” but does not exclude a plurality unless the contextual use dictates otherwise. When used herein to join a list of items, “or” denotes “at least one of the items,” but does not exclude a plurality of items of the list. Finally, when used herein to join a list of items, “and” denotes “all of the items of the list.”

The following detailed description refers to the accompanying drawings. Wherever possible, the same reference numbers are used in the drawings and the following description to refer to the same or similar elements. While many embodiments of the disclosure may be described, modifications, adaptations, and other implementations are possible. For example, substitutions, additions, or modifications may be made to the elements illustrated in the drawings, and the methods described herein may be modified by substituting, reordering, or adding stages to the disclosed methods. Accordingly, the following detailed description does not limit the disclosure. Instead, the proper scope of the disclosure is defined by the appended claims. The present disclosure contains headers. It should be understood that these headers are used as references and are not to be construed as limiting upon the subjected matter disclosed under the header.

The present disclosure includes many aspects and features. Moreover, while many aspects and features relate to, and are described in, the context of autonomous vehicles, in accordance with some embodiments, embodiments of the present disclosure are not limited to use only in this context.

Disclosed is a system, and method for responding to a need of an autonomous vehicle for guidance, inspection, cleaning, and mechanical maintenance of fully autonomous (driverless) vehicles at a maintenance facility is disclosed. The disclosed system may include a web-based software that may utilize data received from an autonomous vehicle, weather conditions, historical data of the vehicle’s maintenance, maintenance schedules of the vehicle, maintenance contracts of the vehicle, and client preferences regarding servicing of the vehicle. The system may alert the autonomous vehicles in its network through internet connectivity with regards to required service. Once a vehicle has entered a service zone of the maintenance facility, the system disclosed herein can receive diagnostic data from the vehicle and may also retrieve historical data of the vehicle’s maintenance, maintenance schedules of the vehicle, maintenance contracts of the vehicle, client preferences, and optionally navigation data of the vehicle. The diagnostic data may be analyzed to determine the preliminary service requirements of the vehicle. Further, the vehicle may be instructed to proceed to an inspection station at the maintenance facility. At the inspection station, a visual inspection may be performed to confirm the required services. A job sheet may be prepared by the system based on required services. The job sheet includes the list of services and schedule. The schedule may allow the vehicle to travel through a series of maintenance stations addressing the specific needs of the vehicle. For example, the specific needs of the vehicle may include, but are not limited to, charging, fueling, cleanliness, interior conditioning, exterior conditioning, mechanical conditioning, and safety assessment.

Furthermore, a proprietary set of data values may allow the complete assessment of the vehicle with regards to its physical and mechanical condition. The data may be relayed to the vehicle’s owner for further instruction. The informa-

tion generated through the inspection and maintenance process may be of special interest to the owners of vehicles associated with ride-hailing companies. The proprietary data sets may be utilized to assist the ride-hailing companies in rating and determining the appropriate use of the vehicles in their fleets.

According to some embodiments, a method for communicating with and alerting fully autonomous (driverless) vehicles requiring service (cleaning, repair, inspection etc.) is disclosed. The method may identify the maintenance requirements of the vehicles based on vehicle data and a predetermined data set, thus directing the vehicle through a series of inspection and maintenance stations with the ability to communicate requirements to the vehicle's owners through an application on a computer, mobile phone or any other connected device. In further embodiments, the method may utilize diagnostic data from the vehicle, historical data of the vehicle's maintenance, maintenance schedules of the vehicle, maintenance contracts of the vehicle, client preferences, and optionally navigation data of the vehicle.

According to some embodiments, a method and system for assessing, and controlling the maintenance and repair of a fully autonomous vehicle is disclosed. The method includes providing maintenance criteria associated with at least one corresponding station from a plurality of maintenance stations in a maintenance facility. Further, the maintenance criteria may include a planned preventative maintenance (PPM) criterion, wherein the PPM criterion includes a wear-and-tear threshold and is associated with a general maintenance station from the plurality of maintenance stations. Further, the method includes providing a geospatial map, wherein the geospatial map includes a plurality of GPS locations with each of the GPS locations being associated with at least one road condition. Yet further, the method includes extracting a traveled path from navigation data with a remote server. The traveled path may include a plurality of traveled GPS locations from the plurality of GPS locations. Further, the method includes analyzing the road condition associated with each of the plurality of traveled GPS locations to determine a wear-and-tear level for the autonomous vehicle with the remote server. Further, the method includes designating the PPM criterion as the met criterion if the wear-and-tear level is greater than the wear-and-tear threshold. Moreover, the method includes navigating the autonomous vehicle to the general maintenance station.

In further embodiments, the method includes providing a maintenance history profile for the autonomous vehicle being managed by the remote server. Further, the method includes providing a plurality of car services, wherein each of the maintenance station is associated with at least one car service from the plurality of car services. Furthermore, the method includes providing a user account for the autonomous vehicle being managed by the remote server. The user account can be assessed from the user computing device. Furthermore, the user account can further be associated with an on-board computing (OBC) device of the autonomous vehicle. Further, the method includes navigating the autonomous vehicle to the evaluation station of the maintenance facility. Further, the method includes receiving an inspection report for the autonomous vehicle from an evaluation station by the remote server. Further, the method includes analyzing one or more of the inspection reports, the maintenance criterion, the performance data, the navigation data, and the maintenance history profile by the remote server to determine at least one recommended service from the plurality of car services. Further, the method includes sending one or more of the recommended services, the inspection report,

the maintenance history profile, the plurality of service levels, the performance data, and the met maintenance criterion to the user computing device from the remote server. Further, the method includes prompting the user associated with the user account to select an at least one from the plurality of car services with the user computing device. Furthermore, the method includes receiving at least one owner-selected service with the remote server through the user computing device, wherein the owner-selected service is from the plurality of car services. Further, the method includes navigating the autonomous vehicle to the corresponding station of the owner-selected service with the remote server through the GPS device.

In further embodiments, the method includes providing the maintenance criteria includes a wash criterion, wherein the wash criterion includes a plurality of wash conditions being managed by the remote server. Accordingly, the plurality of maintenance stations includes a car wash station. Further, the method includes providing a geospatial map database being managed by the remote server, wherein the geospatial map database includes a plurality of GPS locations. Further, the method includes providing each of the plurality of GPS locations includes recorded weather data. Further, the method includes extracting a traveled path from the navigation data with the remote server, wherein the traveled path includes a plurality of traveled GPS locations from the plurality of GPS locations. Further, the method includes analyzing the recorded weather data for each of the plurality of traveled GPS locations to identify a met wash condition from the plurality of wash conditions by the remote server. Further, the method includes designating the wash criterion as the met criterion and navigating the autonomous vehicle to the car wash station if the met wash condition is identified.

Referring now to figures, FIG. 1 is an illustration of a platform consistent with various embodiments of the present disclosure. By way of non-limiting example, the online platform **100** for performing automatic maintenance of an autonomous vehicle may be hosted on a centralized server **102**, such as, for example, a cloud computing service. The centralized server **102** may communicate with other network entities, such as, for example, a mobile device **106** (such as a smartphone, a laptop, a tablet computer etc.), other electronic devices **110** (such as desktop computers, server computers etc.), databases **114** and an autonomous car **116** (specifically an On-Board Computing (OBC) device of the autonomous car **116**), over a communication network **104**, such as, but not limited to, the Internet. Further, users of the platform may include relevant parties such as one or more autonomous car users, employees at autonomous car manufacturers, autonomous car technicians, and autonomous car maintenance facilities etc. Accordingly, electronic devices operated by one or more relevant parties may be in communication with the online platform **100**.

A user **112**, such as the one or more relevant parties, may access online platform **100** through a web-based software application or browser. The web-based software application may be embodied as, for example, but not be limited to, a website, a web application, a desktop application, and a mobile application compatible with a computing device **900**.

According to some embodiments, the online platform **100** may communicate with a system **200** for performing automatic maintenance of an autonomous vehicle.

FIG. 2 is a block diagram of a system **200** for performing automatic maintenance of an autonomous vehicle (such as the autonomous car **116**), in accordance with some embodiments. The system **200** may include a communication device

**202** configured for receiving a maintenance request from the autonomous vehicle. The maintenance request includes diagnostic data from an On-Board Computing (OBC) device of the autonomous vehicle. For example, the diagnostic data may include data received from one or more sensors selected from a group comprising a Mass Air Flow Sensor, an Engine Speed Sensor, an Oxygen Sensor, a Manifold Absolute Pressure Sensor, a Spark Knock Sensor, a Fuel Temperature Sensor, a Voltage Sensor, a GPS sensor, a Crank Position sensor, a Cam Position sensor, Engine Coolant temperature sensor, Manifold Absolute Pressure sensor, a throttle position sensor (TPS), an Accelerator pedal position sensor (APPS), a Heated Oxygen sensor in exhaust, a Wheel Speed Sensor, a Tire Pressure sensor (TPMS), an Intake/Ambient Air Temp (IAT), Oxygen/Lambda Sensor, Fuel Pressure Sensor, Vehicle Speed Sensor (VSS). The diagnostic data may be stored in database **114**.

Further, the communication device **202** may be configured for receiving a work schedule of a closest facility.

Moreover, the communication device **202** may be configured for sending an appointment reservation to the autonomous vehicle, wherein the appointment reservation includes a time slot and the location of the closest facility.

Further, the system **200** may include a processing device **204** configured for analyzing the diagnostic data to identify at least one recommended car service for the autonomous vehicle. For example, the at least one recommended car service may include one or more of a regular service, a premium service, a safety service, an interim service, a full service, a car wash service, a car interior care service, a car exterior care service, a mechanical service, wheel alignments and balancing service, brake and clutch service, and tire service.

The processing device **204** may be configured to compare a vehicle location against a plurality of facility locations to identify the closest facility from a plurality of maintenance facilities. The plurality of facility locations may be related to the locations of the plurality of maintenance facilities.

Further, the processing device **204** may be configured to generate the appointment reservation with the closest facility in the one or more facility locations based on the received one or more work schedules. In further embodiments, the processing device may be configured to navigate the autonomous vehicle to the closest facility. The closest facility provides the recommended car service for the autonomous vehicle.

In further embodiments, the processing device **204** may be configured to identify the at least one recommended car service for the autonomous vehicle based on one or more of weather conditions, historical data, maintenance schedules, maintenance contracts and client requirements. Further, information including one or more weather conditions, historical data, maintenance schedules, maintenance contracts and client requirements may be stored in the databases **114**.

In some embodiments, each of the plurality of maintenance facilities may include one or more maintenance stations, wherein each of the one or more maintenance stations may be associated with at least one car service from a plurality of car services. Further, maintenance criteria may be associated with each maintenance station in one or more maintenance stations.

Further, one or more maintenance stations may include an evaluation station, wherein the evaluation station includes a plurality of inspection sensors.

In some embodiments, the communication device **202** may be further configured to receive diagnostic data through

the plurality of inspection sensors. The processing device **204** may be configured to analyze one or more of the diagnostic data, performance data, navigation data, and a maintenance history profile to determine at least one recommended service. Further, processing device **204** may be configured to navigate the autonomous vehicle to a maintenance station corresponding to at least one recommended service. The maintenance history profile may include one or more warranty contracts, service contracts, client requirements, and service history.

In further embodiments, processing device **204** may be further configured to search the diagnostic data from an On-Board Computing (OBC) device for at least one trouble code from a plurality of trouble codes. Further, processing device **204** may be configured to navigate the autonomous vehicle to the maintenance station based on the at least one trouble code.

FIG. **3** is a flowchart of a method **300** for performing automatic maintenance of an autonomous vehicle (such as the autonomous car **116**), in accordance with some embodiments. At **302**, the method **300** includes receiving, using a communication device (such as the communication device **202**), a maintenance request from the autonomous vehicle, wherein the maintenance request includes diagnostic data from an On-Board Computing (OBC) device of the autonomous vehicle. For example, the diagnostic data may include data received from one or more sensors selected from a group comprising a Mass Air Flow Sensor, an Engine Speed Sensor, an Oxygen Sensor, a Manifold Absolute Pressure Sensor, a Spark Knock Sensor, a Fuel Temperature Sensor, a Voltage Sensor, a GPS sensor, a Crank Position sensor, a Cam Position sensor, Engine Coolant temperature sensor, Manifold Absolute Pressure sensor, a throttle position sensor (TPS), an Accelerator pedal position sensor (APPS), Oxygen sensor in exhaust, a Wheel Speed Sensor, a Tire Pressure sensor (TPMS), an Intake/Ambient Air Temp (IAT), Oxygen/O2/Lambda Sensor, Fuel Pressure Sensor, and Vehicle Speed Sensor (VSS).

At **304**, method **300** includes analyzing, using a processing device (such as the processing device **204**), the diagnostic data to identify at least one recommended car service for the autonomous vehicle. For example, the at least one recommended car service may include one or more of a regular service, a premium service, a safety service, an interim service, a full service, a car wash service, a car interior care service, a car exterior care service, a mechanical service, wheel alignments and balancing service, brake and clutch service, and tire service.

In further embodiments, the analyzing may include identifying, using a processing device, the at least one recommended car service for the autonomous vehicle based on one or more of weather conditions, historical data, maintenance schedules, maintenance contracts and client requirements.

At **306**, the method **300** includes comparing, using the processing device, a vehicle location against a plurality of facility locations to identify a closest facility from a plurality of maintenance facilities, wherein the plurality of facility locations may be associated with the locations of the plurality of maintenance facilities.

At **308**, the method **300** includes receiving, using the communication device, a work schedule of the closest facility.

At **310**, method **300** includes generating, using the processing device, an appointment reservation with the closest facility in the one or more facility locations based on the

## 11

received one or more work schedules. The closest facility provides the recommended car service for the autonomous vehicle

At **312**, method **300** includes sending, using the communication device, the appointment reservation to the autonomous vehicle, wherein the appointment reservation includes a time slot and the location of the closest facility.

In further embodiments, the method **300** may include navigating, using a processing device, the autonomous vehicle to the closest facility.

FIG. **4** is a flowchart of a method **400** for navigating the autonomous vehicle (such as the autonomous car **116**) to a maintenance station in one or more maintenance stations, in accordance with some embodiments. Each of the plurality of maintenance facilities may include the one or more maintenance stations. Each of the one or more maintenance stations may be associated with at least one car service from a plurality of car services. For example, the one or more maintenance stations may include an evaluation station, wherein the evaluation station includes a plurality of inspection sensors.

At **402**, the method **400** may include receiving, using the communication device, diagnostic data through the plurality of inspection sensors.

At **404**, the method **400** may include analyzing, using a processing device, one or more of the diagnostic data, a performance data, a navigation data, and a maintenance history profile to determine at least one recommended service.

At **406**, the method **400** may include navigating, using a processing device, the autonomous vehicle to a maintenance station corresponding to the at least one recommended service.

FIG. **5** is a flowchart of a method **500** for navigating the autonomous vehicle (such as the autonomous car **116**) to a maintenance station in one or more maintenance stations, in accordance with some embodiments. At **502**, the method **500** may include searching, using a processing device, the diagnostic data from an On-Board Computing (OBC) device for at least one trouble code from a plurality of trouble codes. Further, at **504**, the method **500** may include navigating, using a processing device, the autonomous vehicle to the mechanical station based on the at least one trouble code.

FIG. **6** is a flowchart of a method **600** for performing automatic maintenance of an autonomous vehicle (such as the autonomous car **116**), in accordance with some embodiments. One or more steps of the method **600** may be performed by the system **200** in conjunction with the autonomous vehicle and the client either by an automated process or by an individual through a web-based dashboard.

At **602**, a vehicle decision making process algorithm for entering a maintenance facility (such as a maintenance facility **800** shown in FIG. **8**) may be initiated. The vehicle decision making process algorithm may obtain Autonomous Vehicle On Board Data **604** to determine one or more parameters such as battery life of the autonomous vehicle. Further, the vehicle decision making process algorithm may obtain data related to previous inspections from a cloud server **606** (similar to the centralized server **102**). Further, the vehicle decision making process algorithm may determine potential maintenance requirements based on data collection from previously documented routes. For example, certain routes will produce higher levels of debris. Further, certain routes will produce higher levels of wear and tear on vehicles.

At **608**, the vehicle decision making process algorithm may determine and deliver potential maintenance require-

## 12

ment. For example, the maintenance requirement may include one or more of a regular service, a premium service, a safety service, an interim service, a full service, a car wash service, a car interior care service, a car exterior care service, a mechanical service, wheel alignments and balancing service, brake and clutch service, and tire service.

Thereafter, at **610**, the method **600** may include alerting the autonomous vehicle to appropriate service location and inspection lane (such as inspection lane **802** shown in FIG. **8**) for vehicle entry based on predetermined maintenance requirements (or service level requirement). At **612**, the autonomous vehicle may enter the predetermined service lane for visual inspection (such as the inspection lane **802**). The results of the visual inspection may be inputted into an algorithm based on one or more of a service contract level, maintenance costs to date and value of the vehicle.

At **614**, the autonomous vehicle may move to the service lane based on data from inspection and service contract. For example, the service lane may be one of an air/vacuum service lane **804**, a detail/vacuum service lane **806**, a charging pass through lane **808** and a convenience pass through lane **810**. Thereafter, at **616**, the service complete vehicle may be dispatched to repeat the process. Further, the data from inspection may be sent to a road data upload process **618**. Moreover, the data from inspection may be stored in the cloud server **606** (such as in the databases **114**).

Further, at **620**, maintenance data is collected for evaluation by the client. The maintenance data may include one or more of maintenance costs, value, potential mechanical or maintenance costs. The maintenance data may be stored in the cloud server **606** (such as in the databases **114**).

Thereafter, at **622**, the client may process maintenance data against their requirements and determine path forward on vehicle. Further, at **624**, the client may adjust service contract and move vehicle from higher tier to lower tier. Moreover, the client may determine to replace or remove the vehicle from a fleet.

FIG. **7** is a flowchart of a method **700** for performing automatic maintenance of an autonomous vehicle (such as the autonomous car **116**) based on external data, in accordance with an exemplary embodiment. Autonomous vehicles are part of a fleet for a ride-hailing service. In an exemplary scenario, the autonomous vehicle may be operating in a northern area of the city, which is a business district. Therefore, autonomous vehicles may be mainly serving as taxi service for lunch and business-to-business commuting.

At **702**, external data may be obtained such as weather data. For example, the weather data may indicate rain in the previous four days. This may lead to checking if the autonomous vehicle needs servicing due to driving in rain for the past four days.

At **704**, an algorithm may determine that full service is required at a maintenance facility. For example, the full service may include an exterior wash, shampoo, vacuum, and charging.

Alternative, at **706**, the algorithm may determine that a partial service is required at the maintenance facility. For example, the partial service may include shampoo, vacuum and charging but the exterior wash is not required.

Based on the determination by the system, a service requirement may be communicated to a network (such as the centralized server **102**) at **708**. For example, the service requirement may include one or more cleaning, check engine, and tire etc. A maintenance facility with corresponding services may send alerts to the autonomous vehicle about the available wait times etc.

13

Then, at 710, visual inspection may be performed to confirm the service requirement. Thereafter, the appropriate service may be performed.

Further, at 712, an evaluation based on data may be performed which may recommend one or more of no changes required, issues to be addressed and changes to be made. Finally, at 714, based on service contract the autonomous vehicle may be dispatched automatically and the evaluation may be given to the client.

FIG. 9 is a block diagram of a computing device for implementing the methods disclosed herein, in accordance with some embodiments. Consistent with an embodiment of the disclosure, the aforementioned storage device and processing device may be implemented in a computing device, such as computing device 900 of FIG. 9. Any suitable combination of hardware, software, or firmware may be used to implement the memory storage and processing unit. For example, the storage device and the processing device may be implemented with computing device 900 or any of other computing devices 918, in combination with computing device 900. The aforementioned system, device, and processors are examples and other systems, devices, and processors may comprise the aforementioned storage device and processing device, consistent with embodiments of the disclosure.

With reference to FIG. 9, a system consistent with an embodiment of the disclosure may include a computing device or cloud service, such as computing device 900. In a basic configuration, computing device 900 may include at least one processing unit 902 and a system memory 904. Depending on the configuration and type of computing device, system memory 904 may comprise, but is not limited to, volatile (e.g., random access memory (RAM)), nonvolatile (e.g., read-only memory (ROM)), flash memory, or any combination. System memory 904 may include operating system 905, one or more programming modules 906, and may include a program data 907. Operating system 905, for example, may be suitable for controlling computing device 900's operation. Furthermore, embodiments of the disclosure may be practiced in conjunction with a graphics library, other operating systems, or any other application program and is not limited to any particular application or system. This basic configuration is illustrated in FIG. 9 by those components within a dashed line 908.

Computing device 900 may have additional features or functionality. For example, computing device 900 may also include additional data storage devices (removable and/or non-removable) such as, for example, magnetic disks, optical disks, or tape. Such additional storage is illustrated in FIG. 9 by a removable storage 909 and a non-removable storage 910. Computer storage media may include volatile and nonvolatile, removable, and non-removable media implemented in any method or technology for storage of information, such as computer-readable instructions, data structures, program modules, or other data. System memory 904, removable storage 909, and non-removable storage 910 are all computer storage media examples (i.e., memory storage.) Computer storage media may include, but is not limited to, RAM, ROM, electrically erasable read-only memory (EEPROM), flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store information and which can be accessed by computing device 900. Any such computer storage media may be part of device 900. Computing device 900 may also have input device(s) 912 such as a

14

keyboard, a mouse, a pen, a sound input device, a touch input device, etc. Output device(s) 914 such as a display, speakers, a printer, etc. may also be included. The aforementioned devices are examples and others may be used.

Computing device 900 may also contain a communication connection 916 that may allow device 900 to communicate with other computing devices 918, such as over a network in a distributed computing environment, for example, an intranet or the Internet. Communication connection 916 is one example of communication media. Communication media may typically be embodied by computer readable instructions, data structures, program modules, or other data in a modulated data signal, such as a carrier wave or other transport mechanism, and includes any information delivery media. The term "modulated data signal" may describe a signal that has one or more characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media may include wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, radio frequency (RF), infrared, and other wireless media. The term computer readable media as used herein may include both storage media and communication media.

As stated above, a number of program modules and data files may be stored in system memory 904, including operating system 905. While executing on processing unit 902, programming modules 906 (e.g., application 920) may perform processes including, for example, one or more stages of methods 300-500, algorithms, systems, applications, servers, databases as described above. The process is an example, and processing unit 902 may perform other processes. Other programming modules that may be used in accordance with embodiments of the present disclosure may include sound encoding/decoding applications, machine learning application, acoustic classifiers etc.

In one aspect, the system disclosed herein can receive service requests from multiple autonomous vehicles. The service request is accompanied by at least one trouble code. Referring to FIG. 10, disclosed is a method for prioritizing the autonomous vehicle routing based on the severity of the problems in the vehicle. Typically, the method allows scheduling available resources of a maintenance facility based on an urgency/criticality of the vehicle. The system, disclosed herein, can receive service requests from two or more vehicles, at step 1010. The system can then analyze the trouble codes to determine criticality/urgency of the service request, at step 1020. Based on the analysis of the trouble codes, the system can then prioritize each of the service requests depending on urgency and other predetermined criteria, at step 1030. For example, the system can receive service request from three vehicles, wherein first service request from the first vehicle can be related to oil change. The second request relates to muffler replacement, and the third request relates to brake replacement. The system can compare the first request with the second request and rank each request. In one case, the system can rank the first request i.e., oil change as of higher priority than the second request. Thereafter, the system can compare the first request, which is of higher priority, with the third request. On comparison, the system based on predetermined criteria assumes the third request of higher priority than the first request i.e., brake replacement is having urgency when compared to the oil change. The system, therefore, ranked the request in ascending order being second ranked lowest, followed by the first request, and the third request having highest rank. Based on the rank, the system can prioritize the third service request.

15

In one aspect, the system can prioritize different recommended services for a same vehicle. For example, the vehicle is recommended three main services i.e., oil change, muffler replacement, and brake replacement. While preparing the job sheet of the vehicle, the system can rank the three services. For example, first the brakes are replaced, then oil change, and last the muffler is replaced.

In one embodiment, the system and method disclosed herein can, for an autonomous vehicle performing delivery or providing taxi services, be serviced. The system, disclosed herein, can receive a service request from an autonomous vehicle having a severe malfunction, at step 1110. For example, the system can receive a trouble code from an autonomous vehicle indicating an oil leak. Based on a predetermined algorithm, the system can rank the service request on a scale, for example between 1 to 10, at step 1120. In one case, the system ranks the service request "10" as mechanical failure, at step 1130. The scale can be of any range having the lowest value and a highest value, wherein values are increment from low value to the highest value. The lowest value may indicate the service request is having least criticality, while the highest value may indicate the service request is comparatively of higher criticality. Upon determining the level of the service request on the scale, the system can determine the closest maintenance facility or a parking lot, at step 1140. Based on the predetermined algorithm, the system can determine multiple logics. For example, FIG. 11 shows three logics 1142, 1144, and 1146. The first logic determines that the closest maintenance facility is 4 miles from the current location of the autonomous vehicle. The algorithm can rank the logic for the likelihood of safe arrival. The first logic is ranked 2. The second logic determines a network parking lot is within 1 mile and the likelihood of safe arrival is ranked 6. The third logic determines out of network parking lot 5 miles from the current location and the likelihood of safe arrival is 10. The vehicle can determine based on the vehicle that has passengers that logic 3 is appropriate, at step 1150. The algorithm can then summon the replacement vehicle, alerts the management to respond to the passengers, and the maintenance facility can be instructed to retrieve the vehicle, at step 1160.

Referring to FIG. 12 wherein the system receives a service request for oil change, at step 1210. The predetermined algorithm decodes the service request and an urgency level of the service request on a scale of 1 to 10, at step 1220. In FIG. 12, the algorithm determines the emergency level as 1 i.e., routine maintenance, at step 1230. Thereafter, the algorithm can schedule an appointment based on location, wait times, and geographical area, at step 1240. For example, the system can evaluate three maintenance facilities location A, Location B, and Location C. At location A, the total time including the time to reach the maintenance facility and wait time was determined to be 14 minutes, at step 1242. At location B, the total time will be 10 min, at step 1244. At location C, the total time will be 18 minutes, at step 1246. Location B despite being 1.3 miles farther from location A has a total time of 4 minutes less than location A. This is due to less wait time at location B. The system can set location B for appointment, at step 1250. The Vehicle proceeds to the appropriate service center with the quickest turnaround time, at step 1260.

Referring to FIG. 13 which shows the automatic routing of an autonomous vehicle performing delivery or taxi services. The system, disclosed herein, can receive service requests from multiple vehicles, at step 1310. FIG. 13 shows the service requests received from three vehicles. The first service request relates to a car wash. The second service

16

request relates to oil change. The third service requests are for the tire sensor. The system decodes the service requests and determines the urgency of each service requests, at step 1320. Each service request can be accessed on a scale of 1-10. The system determines the first service request of Level 1 i.e., routine maintenance. The second service request is shown to be accessed as Level 3 which is routine maintenance. The third service request is accessed as Level 7 which is mechanical failure. The system ranks the service requests based on the urgency levels. Third service request is marked having highest priority, followed by second service request, and the first service request having the lowest priority. The system can then determine the location of services by service center's ability, geographical location, and the wait time. The vehicle with car wash request can be sent to the car wash station, while the third vehicle is serviced first for tire sensor, followed by the second vehicle having it oil changed.

In one embodiment disclosed is a system and method for routing autonomous vehicles based on the severity or urgency of the service request. For example, vehicles with mechanical failure can be prioritized compared to those with routine maintenance. With regard to the proper direction for self-driving cars in an automated service environment, the system is designed to distribute the vehicles to maintenance facilities based on the severity of the maintenance required and the in the order of imminent failure to maintenance. A vehicle in the service network is in communication with the system and when trouble codes are produced by a vehicle, the codes can be received by the system and upon receiving the codes, the system can then determine the criticality or urgency. Now based on the criticality of the code and the potential for harm or inconvenience to its passengers, the vehicle can be directed to the appropriate repair facility or parking area. The system can determine from the codes produced whether the vehicle could continue through to its original destination or if it must report immediately to a service facility. If the vehicle is determined to be in imminent failure, the system could also direct the vehicle to a parking area to await a replacement and towing services. Proper navigation is critical for fully automated vehicles without drivers in emergency situations for the safety of its passengers. For example, if the automated vehicle produces a trouble code signaling low tire pressure, the system can communicate to the vehicle that needs to go to facility. The decision of the system is based on the fact that the service station that can repair the malfunction is located nearby. It serves no purpose to send a vehicle needing tire repair to a facility that only does oil changes. If the tire pressure is decreasing at a rate that it cannot reach such a facility then the system can find the nearest parking area, such a store, fast food, and like to wait for help.

Autonomous semi-trucks have additional maintenance requirements in comparison to personal and passenger vehicles. In the maintenance of the semi-trucks, also commonly referred to as tractor-trailer combinations, maintenance records must be communicated in a useful or systematic manner to the owners of the vehicles and more importantly in a systematic way to the Department of Transportation (D.O.T.) inspectors who routinely inspect semi-trucks for potential issues or failures of compliance to ensure public safety. The disclosed system and method can also provide for autonomous communication of the maintenance requirements and inspection data of autonomous semi-trucks to the maintenance providers and the emergency services and transportation governing agencies. As described in the above embodiments, the disclosed system

and method can utilize the maintenance, diagnostic, compliance, and visual inspection data to determine the maintenance requirements of autonomous semi-trucks. Especially, for autonomous semi-trucks, the disclosed system and methods can provide for autonomous inspection, record-keeping, compliance, and maintenance of semi-trucks autonomously. The data can be shared in a systemic way with the Department of Transportation (D.O.T.) inspectors who routinely inspect the semi-trucks for potential issues or failures of compliance to ensure public safety. The autonomous maintenance of semi-trucks can help prevent accidents and critical breakdowns on the roadways and highways.

Unlike the passenger autonomous vehicles, the autonomous (driverless) semi-truck and trailer combinations pose a significant risk of injury and other hazards if they experience critical breakdowns on the roadway and highways. In this event, emergency services and maintenance services as well as the governing agency must be notified at the earliest sign of failure. The disclosed system and method address the aforesaid requirements in maintaining the autonomous semi-trucks.

In one implementation, the method includes the steps of receiving, using a communication device, a maintenance request from the autonomous semi-truck or auxiliary trailer. The communication device can be any communication device including a third-party communication device. The maintenance request can include diagnostic data from an On-Board Computing (OBC) device of the autonomous semi-truck. The onboard computing device can keep diagnosing different parameters of the autonomous semi-truck, and such diagnostic data can be used to evaluate the condition of the autonomous semi-truck or any fault in the autonomous semi-truck. The second source of diagnostic data from the autonomous semi-truck can be external inspection sensors. The third source of the diagnostic data from the autonomous semi-truck can be a visual inspection of the autonomous semi-truck. It is understood that the disclosed system can receive diagnostic data from more than one source, and a combination of diagnostic data can be analyzed by the disclosed system. The diagnostic data can be received from the inspection sensors and/or visual inspection directly by the disclosed system. The disclosed system can receive the maintenance request from the autonomous semi-truck. Alternatively, the maintenance request can be determined from the diagnostic data received from any of the above sources. Based on the maintenance request, the disclosed system and method can compare, using the processing device, the location of the autonomous semi-truck against a plurality of mobile service providers or the closest maintenance facility within a plurality of maintenance locations and schedule the required maintenance based on one or more work schedules of the maintenance facility. Moreover, the method includes, using the communication device, either on-board or external device by inspecting party or external equipment to deliver maintenance requirements, the appointment reservation to the autonomous vehicle, and the time and location of the service. The inspection equipment can receive the maintenance details from the system and can communicate the same autonomously to the autonomous semi-truck. The autonomous semi-truck can also directly receive the maintenance details from the server along with the inspection equipment/facility.

The inspection facility having the inspection equipment and/or visual inspections, also referred to as inspection or weigh stations, allows for inspecting the heavy vehicles during their transit to ensure the fitness of such heavy vehicles. Such inspection facilities can provide for auto-

nomous inspection and communication with the disclosed system for reporting diagnostic data and receiving maintenance details. The communication of the fault codes and/or service requirements of the autonomous semi-truck to the inspecting authority (Department of Transportation or otherwise) is imperative to navigate the autonomous semi-truck through inspection stations. If an autonomous semi-truck or its trailer is experiencing faults, this information is delivered to the inspection station to alert them of the autonomous semi-truck requiring maintenance. The inspection station can then assign a parking area to the autonomous semi-truck to await maintenance or repair services. If the autonomous semi-truck is free of fault codes within its onboard system, it would deliver a message of "clear" to the upcoming inspection station and enter its visual inspection and/or automated inspection with the inspection station. Gathered data from the inspection station is communicated and then used to continually enhance the maintenance profile of the autonomous semi-truck and trailer. It may be determined that the autonomous semi-truck and/or trailer may be unsuitable for travel and be directed to a parking area while awaiting the mobile maintenance unit and or recovery vehicle.

The path of travel and final assigned parking area may be communicated via a third-party inspection device, to the onboard communication device, and/or the external inspection equipment during the inspection process.

The maintenance profile of the vehicle is utilized to rate the safety and reliability of the autonomous semi-truck and trailer. Based on safety parameters as dictated by the Department of Transportation, the autonomous semi-truck owner, the company for which the autonomous semi-truck is operating (Hired out) can determine the continued use of the autonomous vehicle.

Referring to FIG. 14 is a communication diagram that shows the flow of information in the event an autonomous semi-truck and trailer have maintenance issues. The regulatory body (DOTD) must be informed of any issue and can determine whether the truck can continue to a repair facility, enter the nearest parking area, or must pull to the side of the road. In the event of critical failure, all parties must be notified, and emergency roadside service dispatched to the failed vehicle.

Referring to FIG. 15 is a flowchart showing an exemplary embodiment of the present invention. First, an autonomous semi-truck and trailer can be received into an inspection facility. Before the physical entry of the autonomous semi-truck and trailer, the details such as Onboard diagnostic data, maintenance data, and shipment details can be received from the autonomous semi-truck and trailer, at step 1510. The autonomous semi-truck and trailer can then be inspected at the inspection facility for any faults using automated inspection sensors, at step 1520. The onboard diagnostic data and the autonomous inspection data from the sensors can be analyzed to determine any faults or service requests, at step 1530. A check for any fault or service requirement can be made at step 1540. If no faults are detected or service is needed at step 1530, the autonomous semi-truck and trailer can be moved for visual inspection at step 1550. If the vehicle is flagged due to any fault or service requirement, at step 1560, the flagged vehicle can proceed to the holding area, at step 1590. There, the inspection equipment can collect all the diagnostic data and send the same to the disclosed system, at step 1592. Thereafter, the concerned persons can be notified about the holding of the vehicle and the reason for holding the vehicle, at step 1594. Maintenance data can be created based on the reported/determined fault or

service or request that includes the details of maintenance including the faults, service request, maintenance facility, and appointment schedule. The same can be autonomously communicated to the onboard computing device of the autonomous semi-truck. However, if the vehicle passes the visual inspection as well, the diagnostic data can be recorded by the inspection equipment which can process the diagnostic data for reporting the same to DOTD, at step 1570. Finally, the maintenance records of the vehicle can be updated, at step 1580.

If at step 1540 the vehicle is flagged due to fault or service requirement, the vehicle can be moved to the holding area, and steps 1590 to 1594, as described above, can be repeated. If the vehicle has a maintenance code before arrival, the inspection equipment can direct the vehicle to the holding area. Depending on the fault code the appropriate services would be alerted i.e., company dispatch, mechanic, or towing service. A vehicle may not show any fault codes but may fail visual inspection, and at this point, the inspector via the disclosed system can flag the vehicle and direct the vehicle to proceed to the assigned parking area. It is understood that certain embodiments of the disclosed system can be implemented at the maintenance facility/inspection equipment without departing from the scope of the present invention.

The embodiment described above with reference to general autonomous vehicles and passenger autonomous vehicles are also applicable for autonomous semi-trucks and hence not repeated here. For example, the maintenance facility can be determined based on the current location of the autonomous semi-truck, the maintenance facility nearby the autonomous semi-truck. The maintenance facility and appointment may further depend upon the working schedule of the maintenance facility as described in the above embodiments. The appointment schedule for the autonomous vehicle can further depend upon the criticality and urgency of the autonomous semi-truck. For example, the autonomous semi-trucks carrying certain essential commodity may require urgent service and based on criticality, the autonomous semi-truck can be moved to maintenance facility while the autonomous semi-truck that has no urgency can be assigned a suitable parking area.

In one implementation, the data collected from the onboard computer including but not limited to Trailer Brake Air Pressure; Hub Seal; Tractor Tire Pressure 1,2,3,4,5,6,7,8,9,10; Trailer Tire Pressure 11,12,13,14,15,16,17,18; Electric Motor Fault No 1; Electric Motor Fault No 2; Electric Motor Fault No 3; Electric Motor Fault No 4; Electric Motor Fault No 5; Electric Motor Fault No 6; Engine 1—ENGINE—ENG; Automatic transmission—Trans; Anti-lock Braking System (ABS); Panel, Left—Instrument Cluster; Panel, Right—Instrument Cluster; Diagnostic System; Black Box; Satellite System; ACPU—A/C; Radar—VO-RAD; Cellular Communication System; Panel, Right 2—Instrument Cluster; Position of the throttle pedal; Intercooler Temperature; Synchronizer clutch; Synchronizer Brake; Position of the Control Shift Finger; Status of the range—Switch Range; Activator status 2—transmission 2 Actuator 2; Gear Shift Gear Controller Status; Gear Shift Motor Status; Position Shift Gear Shift; Status of the Parking Brake Activator; Status of Motor Brake—Retard Inhibitor; Activator status 1—transmission 1 Actuator 1; Switch Status Directions; Status of the Brake Switch; Vehicle Enabling Component Status; Status Switch Connections Transmission; Torque Limiting Factor; Two-Speed Axis Switch Status; Status Idle Timer; Air Valve Position in Air Conditioner; Auxiliary Pump Pressure; Max. Travel Speed; Front Axle Oils Temperature; Axle Lift Axle Pressure; Medium Oils

Temperature; Outer Axle Oils Temperature; Road Coverage Temperature; Washer Fluid Level; Pressure in the Particle Trap; Pressure of the Pneumatic Starter System; Status Movement Speed Limits; Movement Speed; Cruise Switch; Cruise Switch—Set Speed; Cruise Switch—High-Set; Cruise Switch—Low-Set; Status of Power Capture Boxes; PTO Oil Temp; Position of the Throttle Pedal; Percent Load on Engine; Output Torque; Fuel Injection Pressure; Difference of Pressure through the Fuel Filter; Fuel Level; Indicator of Water in Fuel; Oil Level in the Engine; Pressure Difference; Oil Pressure; Pressure of Crankcase Gases; Pressure Added by Turbocharger; Turbocharger Speed; Oil Pressure in Turbocharger; Pressure in the Collector; Air Pressure Entering the Pressure difference; Barometric Pressure; Cooling Fluid Pressure; Cooling Fluid Temperature; Coolant Level; Pressure Difference Through Antifreeze Filter; Compressor Regulator Range; Current of Battery Pack (amps); Current of the Generator (amperes); Working Pressure Brakes; Pressure of the 1st Receiver; Pressure of the 2nd Receiver; Hydraulic Retarder Pressure; Hydraulic Retarder Oil Temperature; Status of Motor Brake; Percent of Motor Brake; Clutch Pressure; Oil level in the gearbox; Oil Level Indicator in the Transmission; Differential Pressure via Oil Filter; Oil Pressure; Additional I/O Status 2; Additional I/O Status 1; Total Pressure Distribution System Nozzle; Total Pressure Feed System Injectors; Switching Voltage of Batteries; Gas Feed Pressure (not diesel); Secondary Shaft Speed; Input Shaft Speed; Position Switch “Range” of the gearbox; Range Attained; Injection Control Pressure; Compass; Engine Power Rating; Voltage on the Generator; Voltage on Rechargeable Batteries; Temperature Inside Body; Temperature Inside Cabins; Outdoor Air Temperature; Temperature in the air inlet; Exhaust Gas Temperature; Fuel Temperature; OIL Temperature in Engine; Oils Temperature in Turbocharger; Oils Temperature in the Transmission; Front Axle Load; Rear Axle Load; Trailer weight; Cargo Weight; Number of Fuel Per Trip; Fuel Consumption; Instantaneous Fuel Consumption; Average Fuel Consumption; Speed of Power Pick Box; Restricted Power Pick Box; Idle Turn Speeds; Engine Speed Rating; Engine Speed; Output Speed of the TRANCE; Correction DGPS DGPS DIF CRCTN DGPS; Factory setting POWER UNIT—; Total Hours Under Idle; Total Fuel When Idling; VIN; Direction of Velocity of Movement; Machine position (GPS); Factory setting Code; Tire Pressure; Temperature Wheel; Identifying Components; TRIP Distance; Total Run; The Total of the Working Hours of the Machine; Total Engine Hour Hours; The Total of the Working Hours of the PTO; Total Engine Revolutions; Total Incineration Fuel; Clock; Date; Total Clock ECM; Injector Cylinder 1; Injector Cylinder 2; Cylinder Nozzle 3; Injector Cylinder 4; Cylinder Nozzle 5; Cylinder Nozzle 6; Cylinder Nozzle 7; Cylinder Nozzle 8; Cylinder Nozzle 9; Injector Cylinder 10; Injector Cylinder 11; Injector Cylinder 12; Injector Cylinder 13; Injector Cylinder 14; Injector Cylinder 15; Cylinder Injector 16; Fuel Shut Off Main Valve; Fuel Management Control Valve; Bypass valve of the accelerator; Mechanism, Controlling the Distribution; Crankshaft Position Sensor; Sensor Distrib. Timing sensor; Fuel Plate Mechanism; Fuel Stack Position Sensor; System Signal Protecting the Engine Protect; Auxiliary Driver 1; Controller Mechanism 1 Turbocharger; Controller Engine 2 Turbocharger; Fuel System Signal Input; Speed Signal Input; Tachometer signal; Turbocharger Bypass Valve Driver; Control Pneumatic; Exhaust Pressure Sensor; Solenoid Exhaust Pressure Regulation; Glow Plug Lamp; Power Relays; System Relay Candles; Starter Relay; Auxiliary Driver 2; ECM 8-Volt Power Sup-

ply ECM; Regulator Pressure Injectors; High Speed Auto Shift Control; Low Speed Automatic Shift Control; Neutral Auto Shift Controller; Earth Auto Chain Circuit (minus); Injector Cylinder 17; Injector Cylinder 18; Injector Cylinder 19; Injector Cylinder 20; Additional Input Driver 3; Additional Input Driver 4; Auxiliary Driver 5; Auxiliary Driver 6; Auxiliary Driver 7; Additional Input Driver 8; Additional PWM 1; Additional PWM 2; Additional PWM #3; Additional PWM #4; Valve Mixing Formation; Prestroke Sensor; Prestroke Actuator; Engine Speed Sensor #2; Oxygen Sensor; Combustion Control Signal; Ignition Distribution Signal; Pressure in the Second Turbocharger Inlet; Intercooler temperature; Input air heating 1; Input air heating 2; Injector Cylinder 21; Injector Cylinder 22; Injector Cylinder 23; Injector Cylinder 24; Knock Sensor; Control valve for gas supply; Fuel Pump Controller; ABS sensor, 1st Axle, Left (front); ABS sensor, 1st Axle, Right (front); ABS sensor, 2nd Axis, Left (middle); ABS sensor, 2nd Axis, Right (middle) WH SNSR AXL 2R Wh Sensor Axl 2R; ABS sensor, 3rd Axle, Left (rear); ABS sensor, 3rd Axle, Right (rear); ABS modulator, 1st Axis, Left (front); ABS modulator, 1st Axis, Right (front); ABS modulator, 2nd Axis, Left (middle); ABS modulator, 2nd Axis, Right (middle); ABS modulator, 3rd Axis, Left (rear); ABS modulator, 3rd Axis, Right (rear); Motor Brake Relay; Relays, Diagonal Voltage 1; Relays, Diagonal Voltage 2; ABS switch; ASR switch; Valve DIF 1-ASR; Valve DIF 2-ASR; Pneumatic Control Engine; Electric Control Engine; Speedometer sensor; Lamp ABS; Lamp ASR; Average Speed of Front Axle ABS Sensors; Average Speed of Sensors ABS of the Forward Reducer; Average Speed of Sensors ABS Rear Gearbox; Modulator of ABS Valve for Gearboxes; Pressure Sensor for ABS Valve for Gearboxes; Master Relay; Front Trailer Bridge, Left Brake, Adjustment Wrong; Front Trailer Bridge, Right Brake, Adjustment Wrong BR; Rear Trailer Bridge, Left Brake, Adjustment Wrong; Front Trailer Bridge, Right Brake, Adjustment Wrong; Front Axle of the Tractor, Left Brake, Adjustment Wrong; Front Axle Tractor, Right Brake, Adjustment Fault; Front Traction Gearbox, Left Brake, Adjustment Wrong; Front Traction Gearbox, Right Brake, Adjustment Fault; Rear Tractor Reducer, Left Brake, Adjustment Wrong; Rear Tractor Reducer, Right Brake, Adjustment Wrong; Relay Heights Suspension; Holding Valve Solenoid-Axis 1 Left; Holding Valve Solenoid-Axis 1 Right; Holding Valve Solenoid-Axis 2 Left; Holding Valve Solenoid-Axis 2 Right; Holding Valve Solenoid-Axis 3 Left; Holding Valve Solenoid-Axis 3 Right; Valve Flushing Solenoid-Axis 1 Left; Valve Reset Solenoid-Axis 1 Right; Reset Valve Solenoid-Axis 2 Left; Valve Reset Solenoid-Axis 2 Right; Valve Reset Solenoid-Axis 3 Left; Valve Relief Solenoid-Axis 3 Right; Motor Hydraulic pump; Brake Light Switch 1; Brake Light Switch 2; Electrical Pressure Control, 1st Axle; Spare System Pressure Monitoring, Axis 1; Pressure Brakes, Axis 1; Electrical Pressure Control, 2nd Axis; Pressure Control of the Spare System, Axis 2; Pressure Brakes, Axis 2.

A method for autonomous maintenance of an autonomous semi-truck, the method comprises the steps of receiving, autonomously, from an onboard computing device of an autonomous semi-truck, onboard diagnostic data and shipment details of the autonomous semi-truck; subjecting, autonomously, the autonomous semi-truck to a plurality of inspection sensors for generating an autonomous inspection data; analyzing, autonomously, the onboard diagnostic data and the autonomous inspection data to determine a service requirement; upon determining the service requirement, assigning, autonomously, a parking area for the autonomous

semi-truck; upon assigning the parking area, generating a maintenance data based on the service requirement, wherein the maintenance data comprises details of a fault, the service requirement, a maintenance facility, and an appointment schedule; and communicating, autonomously, the maintenance data to the onboard computing device of the autonomous semi-truck.

In one implementation of the method, the method further comprises the steps of processing the maintenance data to a predetermined format; and transmitting the formatted maintenance data to an external server of a governing agency. The method further comprises the step of retrieving the autonomous semi-truck from the parking area to the maintenance facility. The method further comprises the steps of determining criticality and urgency of the service requirement; and based on the criticality and urgency, assigning, autonomously, a new parking area for the autonomous semi-truck. The maintenance facility is selected from a plurality of maintenance facilities based on distances of the plurality of maintenance facilities from the autonomous semi-truck and working schedules of the plurality of maintenance facilities.

In one aspect, disclosed is a system for autonomous maintenance of an autonomous semi-truck, the system comprising a processor and a memory, the system configured to implement the above method.

Consistent with embodiments of the disclosure, program modules may include routines, programs, components, data structures, and other types of structures that may perform particular tasks or that may implement particular abstract data types. Moreover, embodiments of the disclosure may be practiced with other computer system configurations, including hand-held devices, multiprocessor systems, microprocessor-based or programmable consumer electronics, minicomputers, mainframe computers, and the like. Embodiments of the disclosure may also be practiced in distributed computing environments where tasks are performed by remote processing devices that are linked through a communications network. In a distributed computing environment, program modules may be located in both local and remote memory storage devices.

Furthermore, embodiments of the disclosure may be practiced in an electrical circuit comprising discrete electronic elements, packaged or integrated electronic chips containing logic gates, a circuit utilizing a microprocessor, or on a single chip containing electronic elements or microprocessors. Embodiments of the disclosure may also be practiced using other technologies capable of performing logical operations such as, for example, AND, OR, and NOT, including but not limited to mechanical, optical, fluidic, and quantum technologies. In addition, embodiments of the disclosure may be practiced within a general-purpose computer or in any other circuits or systems.

Embodiments of the disclosure, for example, may be implemented as a computer process (method), a computing system, or as an article of manufacture, such as a computer program product or computer readable media. The computer program product may be a computer storage media readable by a computer system and encoding a computer program of instructions for executing a computer process. The computer program product may also be a propagated signal on a carrier readable by a computing system and encoding a computer program of instructions for executing a computer process. Accordingly, the present disclosure may be embodied in hardware and/or in software (including firmware, resident software, micro-code, etc.). In other words, embodiments of the present disclosure may take the form of a computer program product on a computer-usable or com-

23

puter-readable storage medium having computer-usable or computer-readable program code embodied in the medium for use by or in connection with an instruction execution system. A computer-usable or computer-readable medium may be any medium that can contain, store, communicate, propagate, or transport the program for use by or in connection with the instruction execution system, apparatus, or device.

The computer-usable or computer-readable medium may be, for example but not limited to, an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, device, or propagation medium. More specific computer-readable medium examples (a non-exhaustive list), the computer-readable medium may include the following: an electrical connection having one or more wires, a portable computer diskette, a random-access memory (RAM), a read-only memory (ROM), an erasable program-mable read-only memory (EPROM or Flash memory), an optical fiber, and a portable compact disc read-only memory (CD-ROM). Note that the computer-usable or computer-readable medium could even be paper or another suitable medium upon which the program is printed, as the program can be electronically captured, via, for instance, optical scanning of the paper or other medium, then compiled, interpreted, or otherwise processed in a suitable manner, if necessary, and then stored in a computer memory.

Embodiments of the present disclosure, for example, are described above with reference to block diagrams and/or operational illustrations of methods, systems, and computer program products according to embodiments of the disclosure. The functions/acts noted in the blocks may occur out of order as shown in any flowchart. For example, two blocks shown in succession may in fact be executed substantially concurrently or the blocks may sometimes be executed in the reverse order, depending upon the functionality/acts involved.

Above embodiments have been described for an autonomous car and an autonomous semi-truck; however, the embodiments of the present invention can be applied to any autonomous vehicle, such as ships and airplanes, wherein any of the autonomous vehicle is within the scope of the present invention. The disclosed system can be centralized so that all communications can be sent to a centralized system. Any vehicle experiencing mechanical issues can send a communication to the central system alerting the system of the issue or impending vehicle failure. If the vehicle failure is imminent or has occurred, and the vehicle contains occupants, a response vehicle and a replacement vehicle can be autonomously dispatched. The disclosed system can prevent any procedural delays and being centralized, the disclosed system can locate nearby response vehicles and replacement vehicle, and dispatch the same. It is understood, however, that the replacement vehicle can be optional.

Autonomous vehicles often may be required to return to or report to a service center for various maintenance reasons or any internally required reasons that can be triggered automatically. For example, this may be due to non-payment, routine maintenance, or inspection resulting from a potential incident. The disclosed system can determine the nearest service provider based on the current location of the autonomous vehicle. The autonomous vehicle can autonomously reach the service center advised by the system.

In certain implementations, the disclosed system can provide for automated organizing and managing the maintenance records of the autonomous vehicles. The maintenance records are of particular importance in the well

24

keeping of autonomous vehicles and smooth operation. Autonomously organizing and managing the maintenance records of the vehicles allows the disclosed system to automatically determine the status of the vehicle and report the same. Moreover, proper maintenance and record keeping is vital to track the safety and value of the vehicle. The maintenance records are used to determine replacement vehicle for the autonomous vehicle as and when needed. Through the maintenance records, the disclosed system can also determine the cost of services rendered by the vendors who perform maintenance in their facilities. The disclosed system can also provide for centralized clearing of payments to the vendors. All the cost and payments related details can be accessed by the vendors the disclosed centralized system. Also, any ambiguity or error in transactions can be reported and corrected by the disclosed system.

It is preferable that the disclosed system can provide for autonomous management of maintenance records and payments; however, semi-automation of the process is within the scope of the present invention. For example, many of the vendors may not be ready to integrate with the fully autonomous system. For such vendors, manual interventions can be made as and when required.

For ensuring trust, security, transparency, and the traceability in the maintenance records, at full automation, blockchain based file storing systems can be used. The method utilized to store documents in the file system and/or on the blockchain may vary. One method may be a "drag and drop" method, the creator of the service record may input the record into the disclosed system and must do required manual labeling of the documents as they are entered. In certain implementations, optical character recognition (OCR) technology may be used to eliminate some of the manual labor involved in this process. The disclosed system may receive the documents and add the same to the vehicle data file, either manually or automatically. The updated vehicle datafile can be stored in the blockchain based database. The vehicle maintenance records, and other essential data can be accessed via the system or by a machine-readable code QR or otherwise.

The disclosed system may provide an interface for the vendor devices to interact with the disclosed system. Through the interface, the vendors can integrate their devices with the disclosed system. The interface allows the vendors to integrate their devices with the disclosed system for automated management. The interface may also allow manual entry of information by the vendors. The interface can be provided in a form of software application that can be downloaded and installed on the vendor devices. The interface can also be provided through a web application and can be accessed from the vendor device through the world wide web or similar protocols. The disclosed system supports various protocols for data transfer over network in a secure way. Both digital and manual records can be uploaded to the disclosed system. The disclosed system may also support encrypted transfer of information to ensure authenticity and safety of data.

For manual entry of information by the vendor, the interface may provide several options to ease and quicken data entry. Examples of such options include drag and drop and upload using file browser of the device. It is preferred however that most of the information including data regarding servicing of the vehicle can be autonomously generated by stations in the service facility and the same can be received by the disclosed system, and relevant vehicle

25

maintenance records can be updated. The system may use optical character recognition to eliminate some manual aspects of the filing process.

In certain implementations, the disclosed system may provide for generation of QR codes or similar machine-readable codes. These codes can be used in maintenance records to identify and retrieve data. The different steps in maintenance or repairs, relevant document generation, and the like steps can be tracked using the QR codes.

The maintenance records are updated, and noted in the blockchain ledger for the individual vehicle as a result of the maintenance process with the information gathered from hardware, software, and human entry of information regarding the maintenance being performed. For EX. Vehicle ID 10000001 Maintenance Code 4451 Left Turn Signal Failure Maintenance Location 70520-001 Vehicle Accepted 202306014 8:30 AM Vehicle Inspection VI2002 202306014 8:35 Vehicle Repaired 202306014 9:15 AM Part #4500023 \$125.00 Left Turn Signal 83.55 Total Duration 45:00 Minutes \$75.00.

Referring to FIG. 16, disclosed is a method for autonomous maintenance of an autonomous vehicle, the method comprising receiving, autonomously, from an onboard computing device of the autonomous vehicle, at step 1602, onboard diagnostic data of the autonomous vehicle, wherein the autonomous vehicle has a mechanical failure, or the mechanical failure is imminent; determining, autonomously, a current location of the autonomous vehicle, at step 1604; receiving, autonomously, the autonomous vehicle into a maintenance facility, the maintenance facility comprises a plurality of service stations, at step 1606; servicing the autonomous vehicle at one or more service stations of the plurality of service stations, at step 1608; receiving, autonomously, one or more service records from each of the one or more service stations, at step 1610; and incorporating, autonomously, the one or more service records into a vehicle data file of the autonomous vehicle, wherein the vehicle data file is stored in a blockchain database, at step 1612. The method further comprises determining, autonomously, a cost of services from the one or more service records, at step 1614. The method further comprises making an autonomous payment to the maintenance facility based on the cost of services, at step 1616. The method further comprises determining an occupancy of the autonomous vehicle; and determining, autonomously based on the occupancy, a replacement vehicle and a response vehicle closest to the autonomous vehicle. The maintenance facility is autonomously selected from a plurality of maintenance facilities based on a closest distance from the autonomous vehicle. The one or more service records have a QR code, wherein the method further comprises interpreting a nature of the one or more service records based on the respective QR code, at step 1618. The method further comprises converting a service record of the one or more service records using optical character recognition technology, at step 1620.

What is claimed is:

1. A method for autonomous maintenance of an autonomous vehicle, the method comprising: receiving, autonomously, from an onboard computing device of the autonomous vehicle, onboard diagnostic data of the autonomous vehicle, wherein the autonomous vehicle has a mechanical failure, or the mechanical failure is imminent; receiving, by the system, navigation data from the autonomous vehicle, the navigation data comprises GPS locations of a path traveled by the autonomous vehicle and times the autonomous vehicle was at these GPS locations; upon receiving the navigation data, determining, by the system, environmental

26

conditions at the GPS locations during the associated times, the environmental conditions comprising road conditions at the GPS locations; analyzing, by the system, the environmental conditions to obtain one or more adverse events the autonomous vehicle was subjected to; processing, by the system, the one or more adverse events to identify at least one maintenance service for the autonomous vehicle; determining, autonomously, a current location of the autonomous vehicle; receiving, autonomously, the autonomous vehicle into a maintenance facility, the maintenance facility comprises a plurality of service stations; servicing the autonomous vehicle at one or more service stations of the plurality of service stations; receiving, autonomously, one or more service records from each of the one or more service stations;

wherein, the autonomous vehicle is controlled to move to a selected service station, the selected service station comprising at least one of an air or vacuum service station, a detail or vacuum service station, a charging pass-through station, or a convenience pass-through station, and wherein, upon completion of service, the autonomous vehicle is dispatched to repeat the inspection and service process, and wherein inspection data is transmitted to a road-data upload process and stored in a cloud server

and incorporating, autonomously, the one or more service records into a vehicle data file of the autonomous vehicle, wherein the vehicle data file is stored in a blockchain database.

2. The method according to claim 1, wherein the method further comprises:

determining, autonomously, a cost of services from the one or more service records.

3. The method according to claim 1, wherein the method further comprises: making an autonomous payment to the maintenance facility based on the cost of services.

4. The method according to claim 1, wherein the method further comprises:

determining an occupancy of the autonomous vehicle; and determining, autonomously based on the occupancy, a replacement vehicle and a response vehicle closest to the autonomous vehicle.

5. The method according to claim 1, wherein the maintenance facility is autonomously selected from a plurality of maintenance facilities based on a closest distance from the autonomous vehicle.

6. The method according to claim 1, wherein the one or more service records have a QR code, wherein the method further comprises: interpreting a nature of the one or more service records based on the QR code.

7. The method according to claim 1, wherein the method further comprises: converting a service record of the one or more service records using optical character recognition technology.

8. A system for autonomous maintenance of an autonomous vehicle, the system configured to implement a method comprising: receiving, autonomously, from an onboard computing device of the autonomous vehicle, onboard diagnostic data of the autonomous vehicle, wherein the autonomous vehicle has a mechanical failure, or the mechanical failure is imminent; determining, autonomously, a current location of the autonomous vehicle; receiving, autonomously, the autonomous vehicle into a maintenance facility, the maintenance facility comprises a plurality of service stations; receiving, autonomously, one or more service records from one or more service stations of the plurality of

service station, wherein the autonomous vehicle is serviced at the one or more service stations;

wherein, the autonomous vehicle is controlled to move to a selected service station, the selected service station comprising at least one of an air or vacuum service station, a detail or vacuum service station, a charging pass-through station, or a convenience pass-through station, and wherein, upon completion of service, the autonomous vehicle is dispatched to repeat the inspection and service process, and wherein inspection data is transmitted to a road-data upload process and stored in a cloud server; and

incorporating, autonomously, the one or more service records into a vehicle data file of the autonomous vehicle, wherein the vehicle data file is stored in a blockchain database, wherein maintenance records are updated in a blockchain ledger, providing for centralized clearing of payments to a plurality of vendors, wherein cost and payments related details are stored in the system which is centralized and accessible to the plurality of vendors for automated management.

\* \* \* \* \*