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(54) **SYSTEM, METHOD, AND COMPUTER-READABLE STORAGE MEDIUM FOR AUTOMATED MANUFACTURING DEFECT DETECTION**

(71) Applicant: **TOYOTA MOTOR NORTH AMERICA, INC.**, Plano, TX (US)

(72) Inventors: **Raja Shekar KILARU**, Plano, TX (US); **Joshua BATIE**, Frisco, TX (US)

(73) Assignee: **TOYOTA MOTOR NORTH AMERICA, INC.**, Plano, TX (US)

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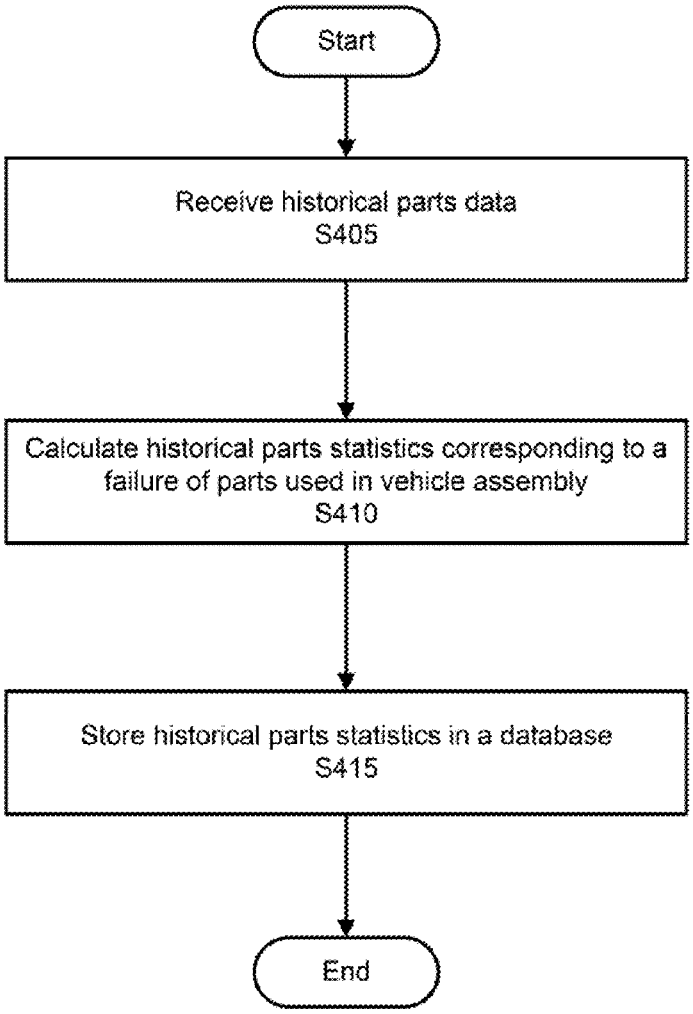
(52) **U.S. Cl.**

CPC ***G05B 23/024*** (2013.01); ***G07C 5/008*** (2013.01); ***G05B 19/41875*** (2013.01); ***B62D 65/005*** (2013.01)

(57) **ABSTRACT**

An automated manufacturing defect detection system includes processing circuitry configured to receive historical parts statistics corresponding to a failure of parts used in a vehicle assembly, receive vehicle sensor statistics corresponding to a failure of parts of post manufactured vehicles, and receive historical assembly line statistics corresponding to a failure of assembly of parts during the vehicle assembly. Additionally, the processing circuitry is configured to generate a profile for one or more parts used in the vehicle assembly, receive an analysis of each of the one or more parts of the assembled vehicle, determine whether any of the one or more analyzed parts deviate from the profile generated for that part, and in response to a determination that any of the one or more analyzed parts deviate from the profile generated for that part by greater than an expected quality threshold, automatically communicate an alert corresponding to the deviation.



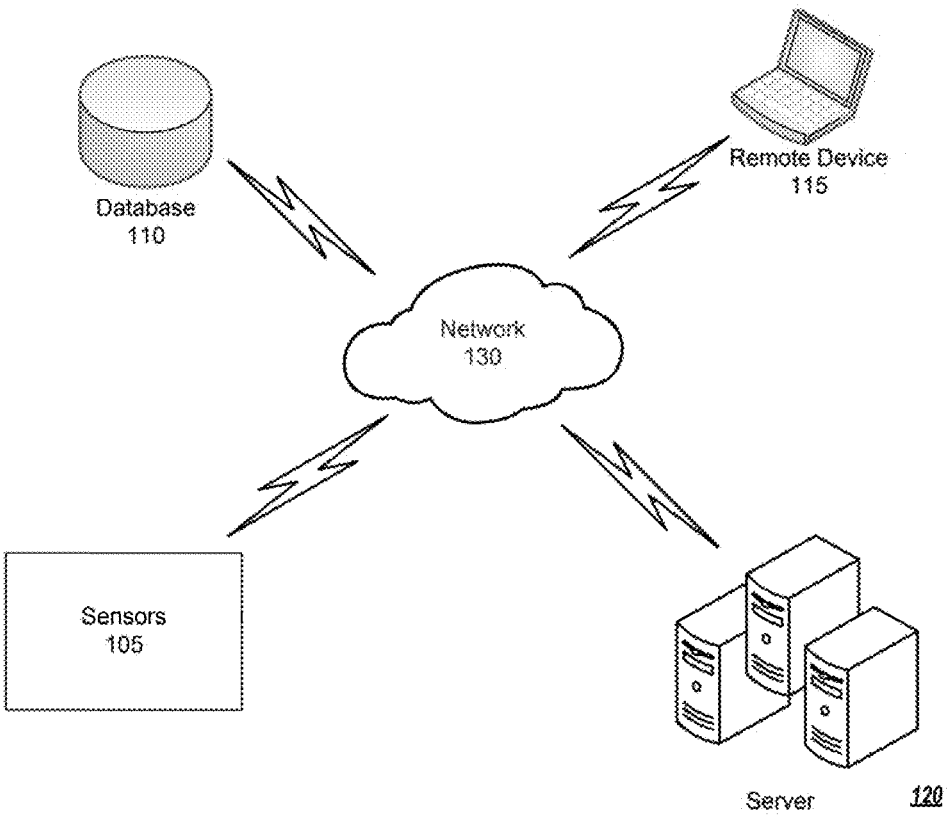

Database
110
Remote Device
115
Network
130
Sensors
105
Server
120

Fig. 1

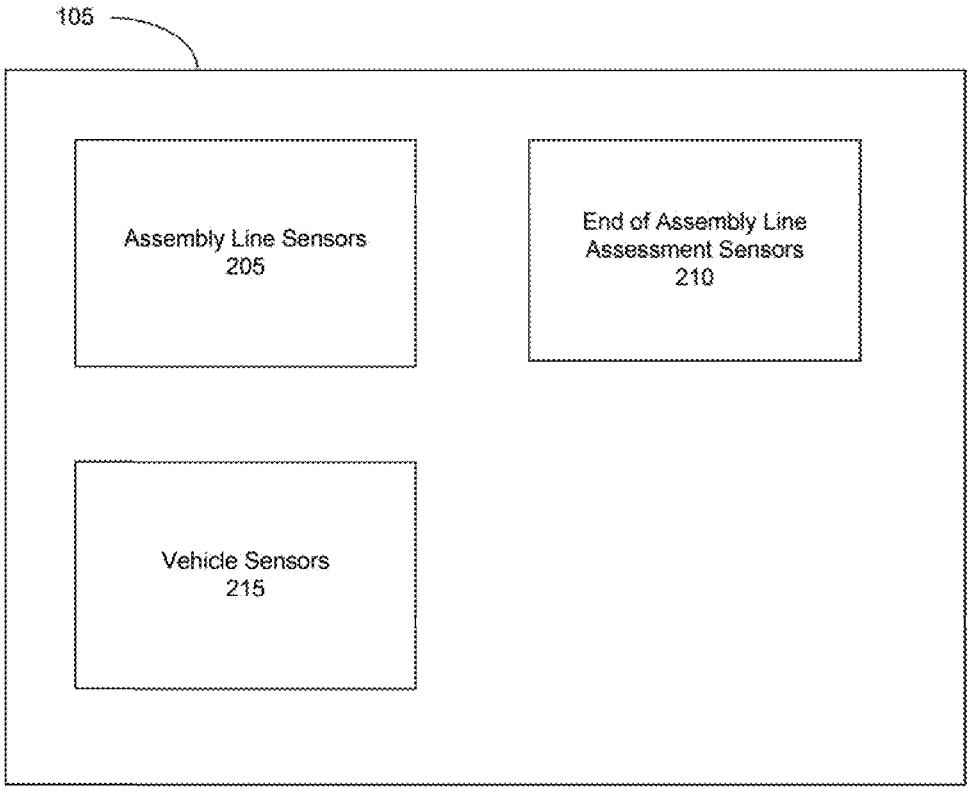

105
Assembly Line Sensors
205
End of Assembly Line
Assessment Sensors
210
Vehicle Sensors
215

Fig. 2

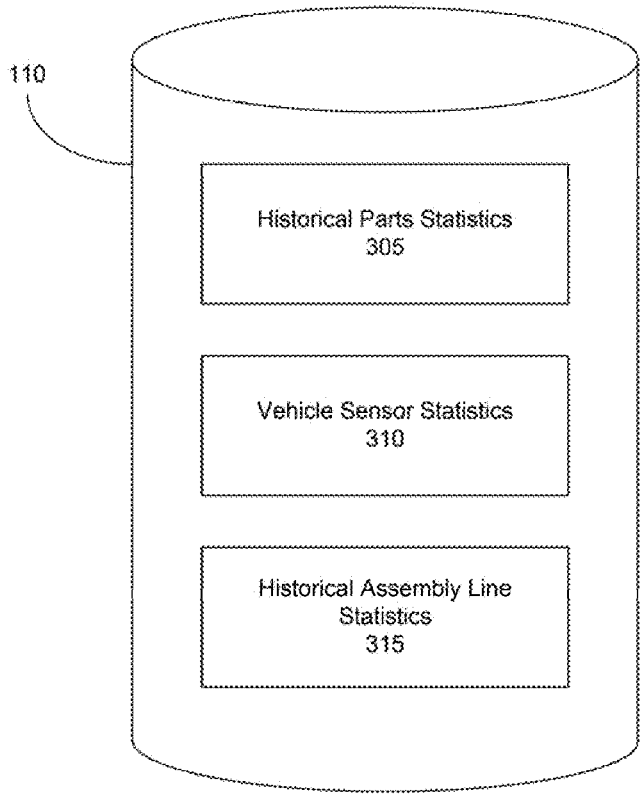

110
Historical Parts Statistics
305
Vehicle Sensor Statistics
310
Historical Assembly Line
Statistics
315

Fig. 3

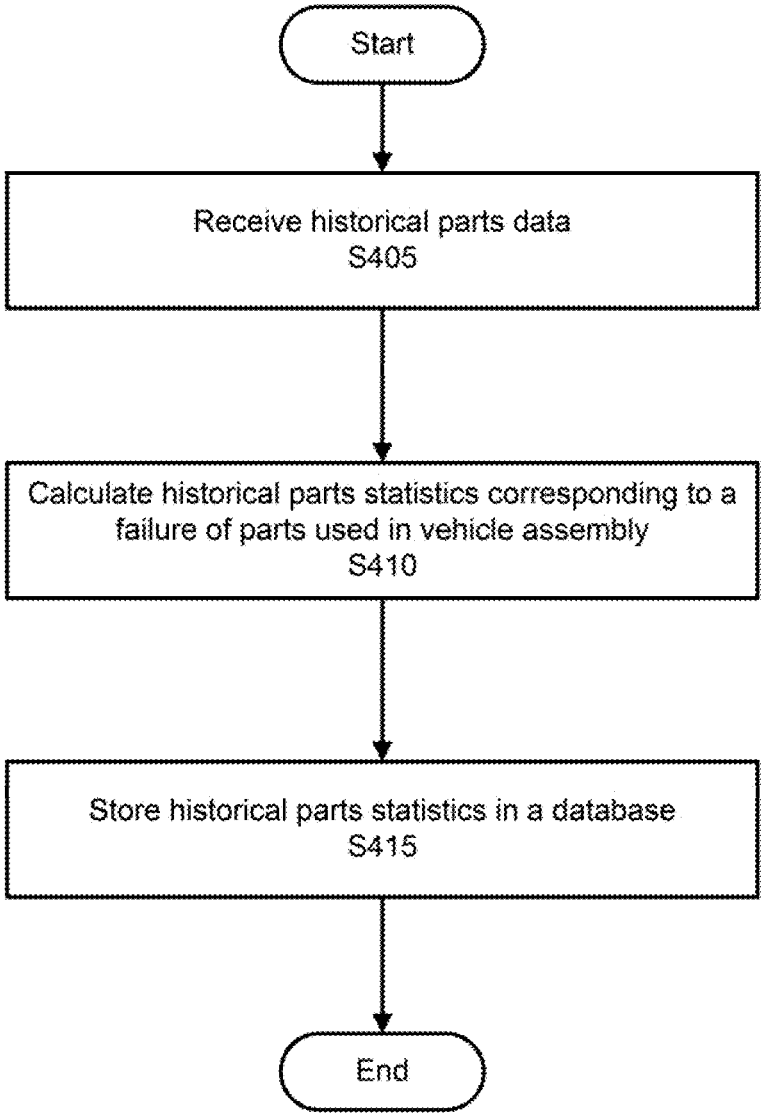

Start
Receive historical parts data
S405
Calculate historical parts statistics corresponding to a failure of parts used in vehicle assembly
S410
Store historical parts statistics in a database
S415
End

Fig. 4

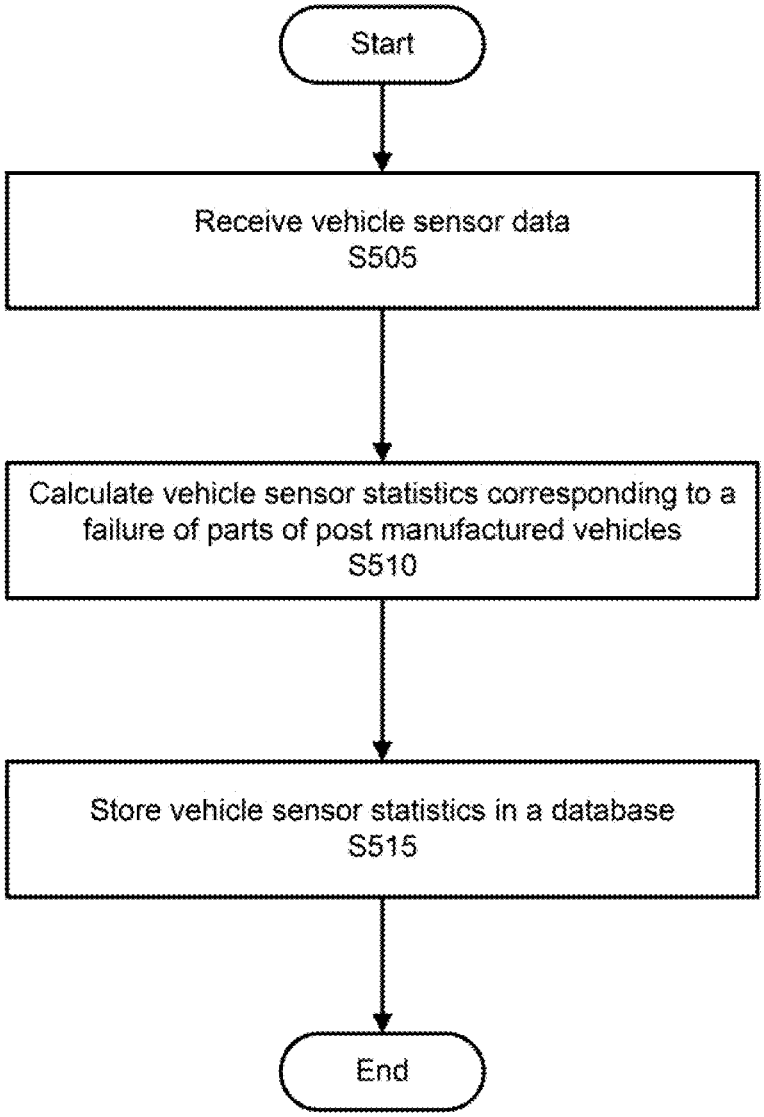

Start
Receive vehicle sensor data
S505
Calculate vehicle sensor statistics corresponding to a failure of parts of post manufactured vehicles
S510
Store vehicle sensor statistics in a database
S515
End

Fig. 5

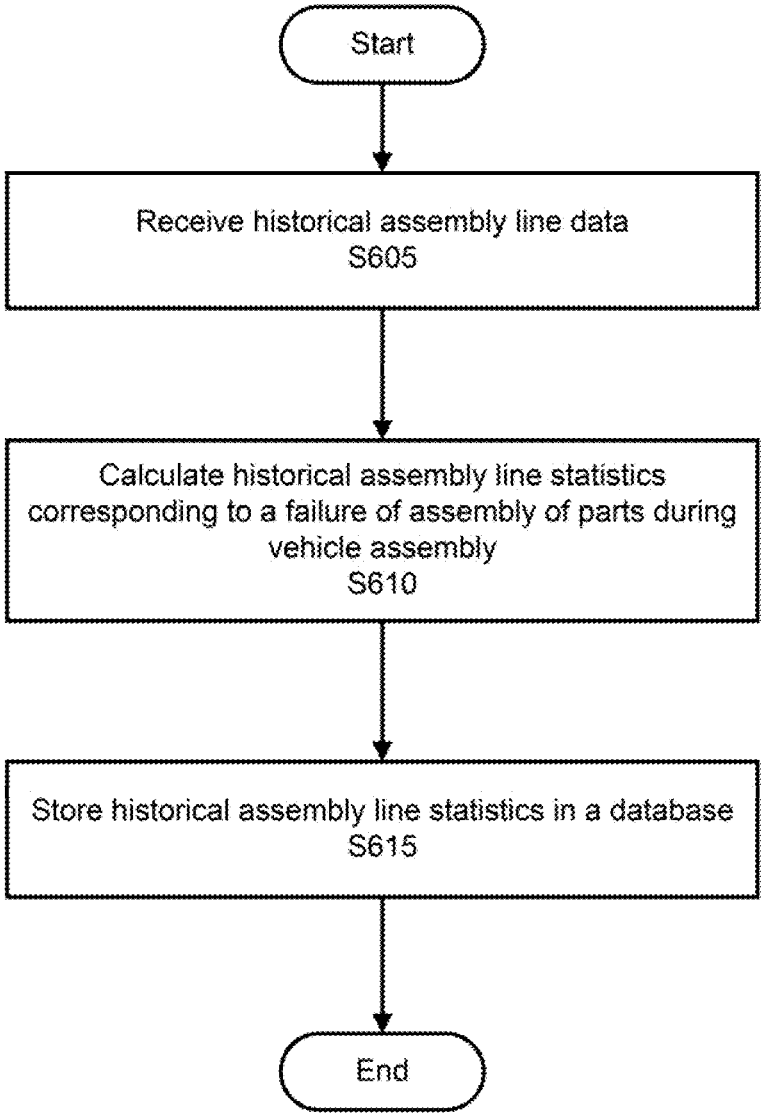

Start
Receive historical assembly line data
S605
Calculate historical assembly line statistics corresponding to a failure of assembly of parts during vehicle assembly
S610
Store historical assembly line statistics in a database
S615
End

Fig. 6

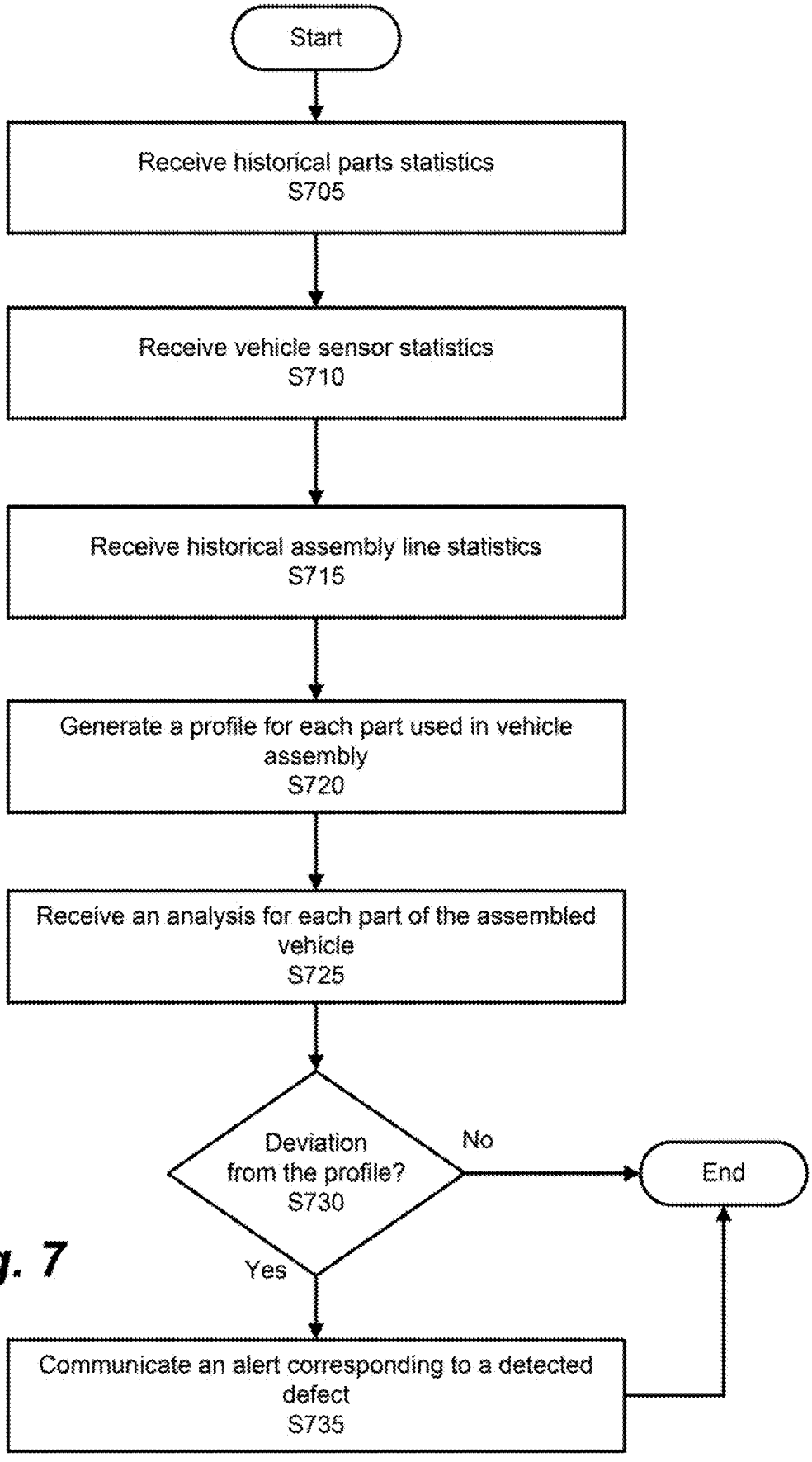

Start
Receive historical parts statistics
S705
Receive vehicle sensor statistics
S710
Receive historical assembly line statistics
S715
Generate a profile for each part used in vehicle assembly
S720
Receive an analysis for each part of the assembled vehicle
S725
Deviation from the profile?
S730
No
End
Yes
Communicate an alert corresponding to a detected defect
S735

Fig. 7

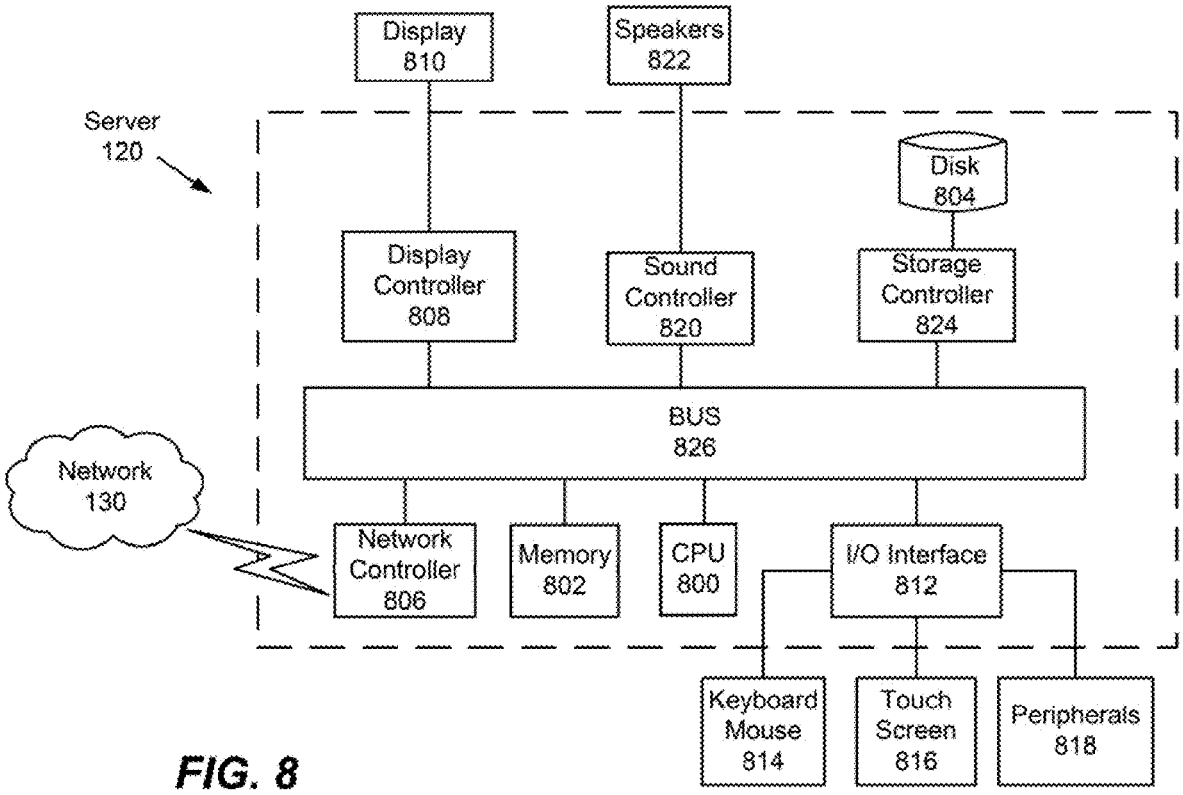

Display
810
Speakers
822
Server
120
Disk
804
Display
Controller
808
Sound
Controller
820
Storage
Controller
824
BUS
826
Network
130
Network
Controller
806
Memory
802
CPU
800
I/O Interface
812
Keyboard
Mouse
814
Touch
Screen
816
Peripherals
818

FIG. 8

SYSTEM, METHOD, AND COMPUTER-READABLE STORAGE MEDIUM FOR AUTOMATED MANUFACTURING DEFECT DETECTION

BACKGROUND

[0001] The "background" description provided herein is for the purpose of generally presenting the context of the disclosure. Work of the presently named inventors, to the extent it is described in this background section, as well as aspects of the description which may not otherwise qualify as prior art at the time of filing, are neither expressly or impliedly admitted as prior art against the present invention.

[0002] Identifying manufacturing defects in vehicles is important for driver safety and decreases fmancial risk (e.g., recalls, lawsuits, etc.). Commonly, manufacturing defects of vehicle parts/systems may be identified using random spot-checks where newly manufactured vehicles are inspected for defects. However, random spot-checks typically involve inspecting a few vehicles sampled from a larger manufactured fleet of vehicles. By examining only a few selected vehicles, there is an increased likelihood of multiple manufacturing defects (that may be present in any vehicle not selected for inspection) going unnoticed. As a result, accuracy of the overall inspection process during manufacturing may be compromised.

SUMMARY

[0003] According to aspects of the disclosed subject matter, an automated manufacturing defect detection system includes processing circuitry configured to receive historical parts statistics corresponding to a failure of parts used in a vehicle assembly, receive vehicle sensor statistics corresponding to a failure of parts of post manufactured vehicles, and receive historical assembly line statistics corresponding to a failure of assembly of parts during the vehicle assembly. Additionally, the processing circuitry is configured to generate a profile for one or more parts used in the vehicle assembly, receive an analysis of each of the one or more parts of the assembled vehicle, determine whether any of the one or more analyzed parts deviate from the profile generated for that part, and in response to a determination that any of the one or more analyzed parts deviate from the profile generated for that part by greater than an expected quality threshold, automatically communicate an alert corresponding to the deviation.

[0004] The foregoing paragraphs have been provided by way of general introduction, and are not intended to limit the scope of the following claims. The described embodiments, together with further advantages, will be best understood by reference to the following detailed description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] A more complete appreciation of the disclosure and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

[0006] FIG. **1** illustrates an exemplary overview of an automated manufacturing defect detection system according to one or more aspects of the disclosed subject matter;

[0007] FIG. **2** illustrates a block diagram of a plurality of sensors in the automated manufacturing defect detection system according to one or more aspects of the disclosed subject matter;

[0008] FIG. **3** illustrates a block diagram of a database in the automated manufacturing defect detection system according to one or more aspects of the disclosed subject matter;

[0009] FIG. **4** is an algorithmic flow chart of a method for determining historical parts statistics according to one or more aspects of the disclosed subject matter;

[0010] FIG. **5** is an algorithmic flow chart of a method for determining vehicle sensor statistics according to one or more aspects of the disclosed subject matter;

[0011] FIG. **6** is an algorithmic flow chart of a method for determining historical assembly line statistics according to one or more aspects of the disclosed subject matter;

[0012] FIG. **7** is an algorithmic flow chart of a method for automated detection of manufacturing defects according to one or more aspects of the disclosed subject matter; and

[0013] FIG. **8** is a hardware block diagram of a server according to one or more exemplary aspects of the disclosed subject matter.

DETAILED DESCRIPTION

[0014] The description set forth below in connection with the appended drawings is intended as a description of various embodiments of the disclosed subject matter and is not necessarily intended to represent the only embodiment (s). In certain instances, the description includes specific details for the purpose of providing an understanding of the disclosed subject matter. However, it will be apparent to those skilled in the art that embodiments may be practiced without these specific details. In some instances, well-known structures and components may be shown in block diagram form in order to avoid obscuring the concepts of the disclosed subject matter.

[0015] Reference throughout the specification to "one embodiment" or "an embodiment" means that a particular feature, structure, characteristic, operation, or function described in connection with an embodiment is included in at least one embodiment of the disclosed subject matter. Thus, any appearance of the phrases "in one embodiment" or "in an embodiment" in the specification is not necessarily referring to the same embodiment. Further, the particular features, structures, characteristics, operations, or functions may be combined in any suitable manner in one or more embodiments. Further, it is intended that embodiments of the disclosed subject matter can and do cover modifications and variations of the described embodiments.

[0016] It must be noted that, as used in the specification and the appended claims, the singular forms "a," "an," and "the" include plural referents unless the context clearly dictates otherwise. That is, unless clearly specified otherwise, as used herein the words "a" and "an" and the like carry the meaning of "one or more." Additionally, terms such as "first," "second," "third," etc., merely identify one of a number of portions, components, points of reference, operations and/or functions as described herein, and likewise do not necessarily limit embodiments of the disclosed subject matter to any particular configuration or orientation.

[0017] Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views.

[0018] FIG. **1** illustrates an exemplary overview of an automated manufacturing defect detection system (herein referred to as the system **100**) according to one or more aspects of the disclosed subject matter. As will be discussed in more detail later, one or more methods according to various embodiments of the disclosed subject matter can be implemented using the system **100** or portions thereof. Put another way, system **100**, or portions thereof, can perform the functions or operations described herein regarding the various methods or portions thereof (including those implemented using a non-transitory computer-readable storage medium storing a program that, when executed, configures or causes a computer to perform or cause performance of the described method(s) or portions thereof).

[0019] The system **100** can include sensors **105**, a database **110**, a remote device **115**, a server **120**, and a network **130** communicably coupling the sensors **105**, the database **110**, the remote device **115**, and the server **120**.

[0020] Generally speaking, data analytics can be applied to expedite and automate the identification of manufacturing defects of vehicles. The automation and reduced inspection time can allow for each manufactured vehicle to be inspected (e.g., in the assembly line), without adding substantial delays to the manufacturing process. Also, the innovation can address the limitations of random spot-checks, thereby improving the accuracy of inspecting manufactured vehicles.

[0021] More specifically, the system **100** can be used to identify manufacturing defects of a vehicle, at least in part, using big data analytics. Big data relating to the manufacturing of vehicles can be gathered using big data sources (e.g., assembly line sensors, car line sensors, parts manufacturing data, etc.) and/or vehicle sensors/subsystems. In some cases, data can be gathered during manufacturing and post-manufacture throughout the life-cycle of the vehicles. Analysis of the collected data can be applied to derive one or more profiles that correspond to parts/systems of manufactured vehicles. For example, the profiles can define normal function or degradation of the respective part. Moreover, information from a vehicle being assessed (e.g., collected once a vehicle is at the end of an assembly line) can be gathered in real-time and analyzed to identify whether any of the assessed parts deviate from properties within the profiles of nominal parts/systems. The identified deviations may be indicative of a manufacturing defect and/or improper assembly, for example. Further, in response to detecting a defect and/or improper assembly, the system **100** can automatically communicate an alert when the defect and/or improper assembly are detected. Thus, each vehicle can be checked on the assembly line automatically using data rather than random spot checks. Big data analytics may also be used to refine the algorithm applied to identify deviating properties.

[0022] The sensors **105** can represent one or more sensors in the system **100** communicably coupled to the database **110**, the remote device **115**, and the server **120** via the network **130**. For example, the sensors **105** can be configured to receive data from vehicles, assembly lines, and end of assembly line assessments. Additionally, the sensors **105** can be configured to transmit the data to one or more of the database **110**, the remote device **115**, and the server **120**.

[0023] The database **110** can represent one or more local and/or external databases and/or memory communicably coupled to the sensors **105**, the remote device **115**, and the server **120** via the network **130**. For example, the database **110** can store various statistical information used to assist in automatically identifying manufacturing defects of vehicles.

[0024] The remote device **115** can represent one or more remote devices communicably coupled to the sensors **105**, the database **110**, and the server **120** via the network **130**. For example, the remote device **115** can include a computer, laptop, smartphone, tablet, PDA, smart watch, and the like. The remote device **115** can include processing circuitry configured to operate the system **100** remotely, gather data from the sensors **105**, receive statistical information from the database **110**, receive/transmit a defect alert, and the like.

[0025] The server **120** can represent one or more servers communicably coupled to the sensors **105**, the database **110**, and the remote device **115** via the network **130**. For example, the server **120** can include processing circuitry configured to operate the system **100**, receive data from the sensors **105**, receive statistical information from the database **110**, receive/transmit a defect alert, and the like.

[0026] The processing circuitry of the remote device **115** and the server **120** can carry out instructions to perform or cause performance of various functions, operations, steps or processes of the system **100**. The processing circuitry can be configured to store information in memory, operate the system **100**, and receive and send information in the form of signal(s) between the sensors **105**, the database **110**, the remote device **115**, and the server **120**.

[0027] The network **130** can represent one or more networks connecting the sensors **105**, the database **110**, the remote device **115**, and the server **120**. The network **130** can be a public network, such as the Internet, or a private network such as a local area network (LAN) or a wide area network (WAN) network, or any combination thereof and can also include a public switched telephone network (PSTN) or integrated services for digital network (ISDN) sub-networks. The network **130** can also be wired, such as an Ethernet network or a USB port, or can be wireless such as a cellular network including EDGE, 3G 4G, and LTE/LTE-A wireless cellular systems. The wireless network can also be Wi-Fi, Bluetooth, or any other wireless form of communication that is known.

[0028] FIG. **2** illustrates a block diagram of a plurality of sensors (e.g., sensors **105**) in the automated manufacturing defect detection system **100** according to one or more aspects of the disclosed subject matter. The sensors **105** can include assembly line sensors **205**, end of assembly line assessment sensors **210**, and vehicle sensors **215**.

[0029] For example, assembly line sensors **205** can include sensors used to monitor a vehicle assembly line. The assembly line sensors **205** may be configured to monitor operation of the assembly machines, monitor progress of the assembly of the vehicle, monitor the assembly of specific components, and the like. The assembly sensors **205** can gather various assembly line data and transmit the assembly line data to the server **120**, for example.

[0030] The end of assembly line assessment sensors **210** can includes sensors configured to inspect the assembled vehicle at the end of the assembly line. At this stage, the end of assembly line assessment sensors **210** can perform a full evaluation of the vehicle including assessing one or more parts of the vehicle, a quality of the specific systems of the vehicle, an overall quality of the assembly of the vehicle, and the like. In other words, the end of assembly line assessment sensors **210** can gather various vehicle assess-

ment data of the completely assembled vehicle and transmit the end of assembly line assessment data to the server **120**, for example.

[0031] The vehicle sensors **215** can include sensors configured to monitor various parts of the assembled vehicle. For the example, the vehicle sensors **215** can monitor parts of the vehicle while the vehicle is operating. For example, the vehicle sensors **215** can monitor wheel parts, engine parts, oil filters, and the like. The vehicles sensors **215** can monitor and gather this vehicle part data throughout the lifetime of the vehicle. For example, the vehicle sensors **215** can monitor wear and tear of parts which may be caused by how the part was manufactured, how the part was assembled with the vehicle in the vehicle assembly line, and the like, which can assist in identifying defects or incorrect assembly in the assembly line for any subsequent vehicles that are assembled with that part and/or using that assembly technique. In other words, the vehicle sensors **215** can gather various part and assembly information throughout the lifetime of the vehicle and transmit the vehicle sensor data to the server **120**, for example. Accordingly, the system **100** can use the vehicle sensor data to assist in identifying defects and improper assembly based on information from the vehicle sensors **205**.

[0032] FIG. **3** illustrates a block diagram of a database (e.g., database **110**) in the automated manufacturing defect detection system **100** according to one or more aspects of the disclosed subject matter. The database **110** can include historical part statistics **305**, vehicle sensors statistics **310**, and historical assembly line statistics **315**. Each of the historical part statistics **305**, vehicle sensors statistics **310**, and historical assembly line statistics **315** can have been previously calculated at the server **120**, for example, using data from the sensors **105** before subsequently being stored in the database **110**. The database **110** can also store any data detected by the sensors **105** as the data from the sensors **105** can be used for various calculations, comparisons, analytics, and the like.

[0033] FIG. **4** is an algorithmic flow chart of a method for determining historical parts statistics **305** according to one or more aspects of the disclosed subject matter.

[0034] In S**405**, the system **100** receives historical parts data at the server **120**, for example. The historical parts data can be received from parts manufacturers regarding failure of parts. The historical parts data may include information on weak points of the parts, failure points to look out for, warnings from the manufacturer, instructions for proper installation and use, and the like.

[0035] In S**410**, historical parts statistics **305** corresponding to a failure of parts used in vehicle assembly can be calculated based on the historical parts data. The calculation can be performed by the server **120**, for example. The historical parts statistics **305** can correspond to the results of data analysis on the historical parts data.

[0036] In S**415**, the historical parts statistics **305** can be stored in a database (e.g., the database **110**).

[0037] FIG. **5** is an algorithmic flow chart of a method for determining vehicle sensor statistics **310** according to one or more aspects of the disclosed subject matter.

[0038] In S**505**, the system **100** receives vehicle sensor data at the server **120** from the vehicle sensors **215**, for example. The vehicle sensor data may include information regarding parts throughout the lifetime of the vehicle. For example, the vehicle sensor data can include information regarding the failure of parts of post manufactured vehicles.

[0039] In S**510**, the server **120** can calculate vehicle sensor statistics **310** corresponding to a failure of parts of post manufactured vehicles based on the vehicle sensor data. For example the vehicle sensor statistics **310** can correspond to the results of data analysis on the vehicle sensor data. Tracking and analyzing the parts throughout the lifetime of the vehicle (e.g., determining why a part failed) can reveal failures that may not have otherwise been discovered. As a result, the opportunity to identify the cause of this failure as early as during the assembly of the vehicle can significantly reduce failure during the lifetime of the vehicle.

[0040] In S**515**, the vehicle sensor statistics **310** can be stored in the database **110**.

[0041] FIG. **6** is an algorithmic flow chart of a method for determining historical assembly line statistics **315** according to one or more aspects of the disclosed subject matter.

[0042] In S**605**, the system **100** receives historical assembly line data at the server **120** from the assembly line sensors **210**, for example. The historical assembly line data may include information regarding failure of parts and/or improper assembly during the assembly of the vehicle.

[0043] In S**610**, the server **120** can calculate historical assembly line statistics **315** corresponding to a failure of parts and/or improper assembly during vehicle assembly based on the historical assembly line data. For example, historical assembly line statistics **315** can correspond to the results of data analysis of the historical assembly line data. The historical assembly line statistics **315** can assist in identifying failure points of parts during assembly. Additionally, historical assembly line statistics **315** can assist in identifying improper assembly (e.g., when and where to look for improper assembly, what the end result of improper assembly looks like, etc.).

[0044] In S**615**, the historical assembly line statistics **315** can be stored in the database **110**.

[0045] It should be appreciated that each of the historical parts statistics **305**, the vehicle sensor statistics **310**, and the historical assembly line data **315** can be continuously updated as new data for each is received. The calculations may be updated in real-time, for example, when any new information from the various sensors (e.g., assembly line sensors **205** and vehicle sensors **215**) is received. Additionally, the analysis and corresponding statistics can be organized for specific makes and models of vehicles.

[0046] FIG. **7** is an algorithmic flow chart of a method for automated detection of manufacturing defects according to one or more aspects of the disclosed subject matter.

[0047] In S**705**, the server **120** can receive historical parts statistics **305**. The historical parts statistics **305** can be received from the database **110** and/or from memory in the server **120** (e.g., the historical parts statistics **305** can be used in real-time after the calculation in S**410**).

[0048] In S**710**, the server **120** can receive the vehicle sensor statistics **310**. The vehicle sensor statistics **310** can be received from the database **110** and/or from memory in the server **120** (e.g., the vehicle sensor statistics **310** can be used in real-time after the calculation in S**510**).

[0049] In S**715**, the server **120** can receive the assembly line statistics **315**. The assembly line statistics **315** can be received from the database **110** and/or from memory in the server **120** (e.g., the assembly line statistics **315** can be used in real-time after the calculation in S**610**).

[0050] In S**720**, the server **120** can generate a profile for one or more parts used in the vehicle assembly. The profile for each part can define an expected quality threshold. The expected quality threshold can be used to assess whether or not a part looks to be installed correctly, whether the part has any flaws, whether the part is showing any wear, and the like. In other words, the expected quality threshold can correspond to how the part should look and/or operate, and any analysis that reveals that the quality of the part and/or the installation of the part is outside of the quality threshold can correspond to a defect. For example, the distribution statistics for engine revolutions per minute (rpm) can be calculated that constitutes mean, median, inter quartile range, standard deviation, and variance based on historical data. Any new vehicle to be tested can be compared to these statistics, for example, in order to identify a potential defect.

[0051] In S**725**, the server **120** can receive an analysis for each part of the assembled vehicle. For example, the analysis for each part of the assembled vehicle can be performed by the end of assembly line assessment sensors **210**, and the end of assembly line assessment sensors **210** can transmit results of the assessment to the server **120**.

[0052] In S**730**, it can be determined if there is a deviation from the profile generated in S**720**. For example, the results from the analysis of each part can be compared to the corresponding profile for that part generated in S**720**, and if the results of the analysis for the part deviate from the profile generated for that part greater than a predetermined amount, the part may have a defect. To determine whether the part deviates from the profile for that part, it can be determined if the results of the analysis of the part in S**725** indicate that the part is not within the quality threshold for that part defined by the profile for that part generated in S**720**. If it is determined that the part does not deviate from the profile by greater than a predetermined amount (i.e., the part is not outside of the quality threshold defined by the profile generated for that part), then the process can end. However, if it is determined that the part does deviate from the profile by greater than a predetermined amount (i.e., the part is outside of the quality threshold defined by the profile generated for that part), then the system **100** can communicate an alert indicating that a defect is detected in S**735**.

[0053] It should be appreciated that the same process for generating a profile, analysis, and comparison in S**720**-S**730** can also be used to determine an incorrect assembly.

[0054] In S**735**, the system **100** can communicate an alert (e.g., lights, sounds, one or more messages displayed on various displays throughout the system **100**, etc.), corresponding to a detected defect in response to the analysis of the part (or assembly) being outside of the quality threshold defined by the profile generated in S**720**. After the alert is communicated, the process can end.

[0055] The system **100** includes various advantages including being able to check each car in an assembly line rather than a random spot check. The system **100** utilizes the technical solution of generating a unique profile for each part of a vehicle and comparing that profile to an assessment of the assembled vehicle to provide an automated defect detection system. This technical solution solves the technical problem of increasing the overall detection of defects, while also increasing the efficiency of the detection of defects. The technical solution uniquely includes data from various sources including vehicle sensors and assembly line sensors and performs the inspection at the assembly line.

[0056] For example, the system **100** can utilize big data (e.g., analyzing data from a variety of sensors and information from manufacturers) to precisely identify statistics regarding the parts and assembly for the vehicle, which can then be compared to the vehicle to assist in identify any defects. Additionally, the process described herein that is used to identify deviations can continuously be refined and improved as more data is received and the statistics are updated accordingly. In other words the quality threshold defined by the profile generated for each part in S**720** can be continuously refined to increase accuracy in identifying defects. As a result of identifying the defect, the cause of the defect can be investigated and the total number of defects can be decreased, thereby increasing safety for drivers and increasing efficiency for manufacturers.

[0057] In the above description of FIGS. **4**-**7**, any processes, descriptions or blocks in flowcharts can be understood as representing modules, segments or portions of code which include one or more executable instructions for implementing specific logical functions or steps in the process, and alternate implementations are included within the scope of the exemplary embodiments of the present advancements in which functions can be executed out of order from that shown or discussed, including substantially concurrently or in reverse order, depending upon the functionality involved, as would be understood by those skilled in the art. The various elements, features, and processes described herein may be used independently of one another, or may be combined in various ways. All possible combinations and sub-combinations are intended to fall within the scope of this disclosure.

[0058] Next, a hardware description of a server (e.g., the server **120** and/or remote device **115**) according to exemplary embodiments is described with reference to FIG. **8**. The hardware description described herein can also be a hardware description of the processing circuitry. In FIG. **8**, the server **120** includes a CPU **800** which performs one or more of the processes described above/below. The process data and instructions may be stored in memory **802**. These processes and instructions may also be stored on a storage medium disk **804** such as a hard drive (HDD) or portable storage medium or may be stored remotely. Further, the claimed advancements are not limited by the form of the computer-readable media on which the instructions of the inventive process are stored. For example, the instructions may be stored on CDs, DVDs, in FLASH memory, RAM, ROM, PROM, EPROM, EEPROM, hard disk or any other information processing device with which the server **120** communicates, such as a server or computer.

[0059] Further, the claimed advancements may be provided as a utility application, background daemon, or component of an operating system, or combination thereof, executing in conjunction with CPU **800** and an operating system such as Microsoft Windows, UNIX, Solaris, LINUX, Apple MAC-OS and other systems known to those skilled in the art.

[0060] The hardware elements in order to achieve the server **120** may be realized by various circuitry elements. Further, each of the functions of the above described embodiments may be implemented by circuitry, which includes one or more processing circuits. A processing circuit includes a particularly programmed processor, for example, processor (CPU) **800**, as shown in FIG. **8**. A processing circuit also includes devices such as an applica-

tion specific integrated circuit (ASIC) and conventional circuit components arranged to perform the recited functions.

[0061] In FIG. **8**, the server **120** includes a CPU **800** which performs the processes described above. The server **120** may be a general-purpose computer or a particular, special-purpose machine. In one embodiment, the server **120** becomes a particular, special-purpose machine when the processor **800** is programmed to perform automated manufacturing defect detection (and in particular, any of the processes discussed with reference to FIGS. **4-7**).

[0062] Alternatively, or additionally, the CPU **800** may be implemented on an FPGA, ASIC, PLD or using discrete logic circuits, as one of ordinary skill in the art would recognize. Further, CPU **800** may be implemented as multiple processors cooperatively working in parallel to perform the instructions of the inventive processes described above.

[0063] The server **120** in FIG. **8** also includes a network controller **806**, such as an Intel Ethernet PRO network interface card from Intel Corporation of America, for interfacing with network **130**. As can be appreciated, the network **130** can be a public network, such as the Internet, or a private network such as an LAN or WAN network, or any combination thereof and can also include PSTN or ISDN sub-networks. The network **130** can also be wired, such as an Ethernet network, or can be wireless such as a cellular network including EDGE, **3**G and **4**G wireless cellular systems. The wireless network can also be WiFi, Bluetooth, or any other wireless form of communication that is known.

[0064] The server **120** further includes a display controller **808**, such as a graphics card or graphics adaptor for interfacing with display **810**, such as a monitor. A general purpose I/O interface **812** interfaces with a keyboard and/or mouse **814** as well as a touch screen panel **816** on or separate from display **810**. General purpose I/O interface also connects to a variety of peripherals **818** including printers and scanners.

[0065] A sound controller **820** is also provided in the server **120** to interface with speakers/microphone **822** thereby providing sounds and/or music.

[0066] The general purpose storage controller **824** connects the storage medium disk **804** with communication bus **826**, which may be an ISA, EISA, VESA, PCI, or similar, for interconnecting all of the components of the server **120**. A description of the general features and functionality of the display **810**, keyboard and/or mouse **814**, as well as the display controller **808**, storage controller **824**, network controller **806**, sound controller **820**, and general purpose I/O interface **812** is omitted herein for brevity as these features are known.

[0067] The exemplary circuit elements described in the context of the present disclosure may be replaced with other elements and structured differently than the examples provided herein. Moreover, circuitry configured to perform features described herein may be implemented in multiple circuit units (e.g., chips), or the features may be combined in circuitry on a single chipset.

[0068] The functions and features described herein may also be executed by various distributed components of a system. For example, one or more processors may execute these system functions, wherein the processors are distributed across multiple components communicating in a network. The distributed components may include one or more client and server machines, which may share processing, in addition to various human interface and communication devices (e.g., display monitors, smart phones, tablets, personal digital assistants (PDAs)). The network may be a private network, such as a LAN or WAN, or may be a public network, such as the Internet. Input to the system may be received via direct user input and received remotely either in real-time or as a batch process. Additionally, some implementations may be performed on modules or hardware not identical to those described. Accordingly, other implementations are within the scope that may be claimed.

[0069] Having now described embodiments of the disclosed subject matter, it should be apparent to those skilled in the art that the foregoing is merely illustrative and not limiting, having been presented by way of example only. Thus, although particular configurations have been discussed herein, other configurations can also be employed. Numerous modifications and other embodiments (e.g., combinations, rearrangements, etc.) are enabled by the present disclosure and are within the scope of one of ordinary skill in the art and are contemplated as falling within the scope of the disclosed subject matter and any equivalents thereto. Features of the disclosed embodiments can be combined, rearranged, omitted, etc., within the scope of the invention to produce additional embodiments. Furthermore, certain features may sometimes be used to advantage without a corresponding use of other features. Accordingly, Applicant(s) intend(s) to embrace all such alternatives, modifications, equivalents, and variations that are within the spirit and scope of the disclosed subject matter.

1. An automated manufacturing defect detection system, comprising:

processing circuitry configured to

receive historical parts statistics corresponding to a failure of parts used in a vehicle assembly,

receive vehicle sensor statistics corresponding to a failure of parts of post manufactured vehicles,

receive historical assembly line statistics corresponding to a failure of assembly of parts during the vehicle assembly,

generate a profile for one or more parts used in the vehicle assembly,

receive an analysis of each of the one or more parts of the assembled vehicle,

determine whether any of the one or more analyzed parts deviate from the profile generated for that part, and

in response to a determination that any of the one or more analyzed parts deviate from the profile generated for that part by greater than an expected quality threshold, automatically communicate an alert corresponding to the deviation.

2. The system of claim **1**, wherein the processing circuitry is further configured to

receive historical parts data,

calculate the historical parts statistics corresponding to the failure of parts used in the vehicle assembly based on the historical parts data, and

store the historical parts statistics in a database.

3. The system of claim **1**, wherein the processing circuitry is further configured to

receive vehicle sensor data,

calculate the vehicle sensor statistics corresponding to the failure of parts of post manufactured vehicles based on the vehicle sensor data, and

store the vehicle sensor statistics in a database.

4. The system of claim **1**, wherein the processing circuitry is further configured to

receive historical assembly line data,

calculate the historical assembly line statistics corresponding to the failure of assembly of parts during the vehicle assembly, and

store the historical assembly statistics in a database.

5. The system of claim **1**, wherein the profile generated for each of the one or more parts defines the expected quality threshold for the respective part.

6. The system of claim **1**, wherein the deviation being greater than the expected quality threshold corresponds to a manufacturing defect.

7. The system of claim **1**, wherein the deviation being greater than the expected quality threshold corresponds to improper assembly.

8. A method for automated detection of manufacturing defects, comprising:

receiving, via processing circuitry, historical parts statistics corresponding to a failure of parts used in a vehicle assembly;

receiving, via the processing circuitry, vehicle sensor statistics corresponding to a failure of parts of post manufactured vehicles;

receiving, via the processing circuitry, historical assembly line statistics corresponding to a failure of assembly of parts during the vehicle assembly;

generating, via the processing circuitry, a profile for one or more parts used in the vehicle assembly;

receiving, via the processing circuitry, an analysis of each of the one or more parts of the assembled vehicle;

determining, via the processing circuitry, whether any of the one or more analyzed parts deviate from the profile generated for that part; and

in response to a determination that any of the one or more analyzed parts deviate from the profile generated for that part by greater than an expected quality threshold, automatically communicating, via the processing circuitry, an alert corresponding to the deviation.

9. The method of claim **8**, further comprising:

receiving historical parts data;

calculating the historical parts statistics corresponding to the failure of parts used in the vehicle assembly based on the historical parts data; and

storing the historical parts statistics in a database.

10. The method of claim **8**, further comprising:

receiving vehicle sensor data;

calculating the vehicle sensor statistics corresponding to the failure of parts of post manufactured vehicles based on the vehicle sensor data; and

storing the vehicle sensor statistics in a database.

11. The method of claim **8**, further comprising:

receiving historical assembly line data;

calculating the historical assembly line statistics corresponding to the failure of assembly of parts during the vehicle assembly; and

storing the historical assembly statistics in a database.

12. The method of claim **8**, wherein the profile generated for each of the one or more parts defines the expected quality threshold for the respective part.

13. The method of claim **8**, wherein the deviation being greater than the expected quality threshold corresponds to a manufacturing defect.

14. The method of claim **8**, wherein the deviation being greater than the expected quality threshold corresponds to improper assembly.

15. A non-transitory computer-readable storage medium storing computer-readable instructions thereon which, when executed by a computer, cause the computer to perform a method, the method comprising:

receiving historical parts statistics corresponding to a failure of parts used in a vehicle assembly;

receiving vehicle sensor statistics corresponding to a failure of parts of post manufactured vehicles;

receiving historical assembly line statistics corresponding to a failure of assembly of parts during the vehicle assembly;

generating a profile for one or more parts used in the vehicle assembly;

receiving an analysis of each of the one or more parts of the assembled vehicle;

determining whether any of the one or more analyzed parts deviate from the profile generated for that part; and

in response to a determination that any of the one or more analyzed parts deviate from the profile generated for that part by greater than an expected quality threshold, automatically communicating an alert corresponding to the deviation.

16. The non-transitory computer-readable storage medium of claim **15**, further comprising:

receiving historical parts data;

calculating the historical parts statistics corresponding to the failure of parts used in the vehicle assembly based on the historical parts data; and

storing the historical parts statistics in a database.

17. The non-transitory computer-readable storage medium of claim **15**, further comprising:

receiving vehicle sensor data;

calculating the vehicle sensor statistics corresponding to the failure of parts of post manufactured vehicles based on the vehicle sensor data; and

storing the vehicle sensor statistics in a database.

18. The non-transitory computer-readable storage medium of claim **15**, further comprising:

receiving historical assembly line data;

calculating the historical assembly line statistics corresponding to the failure of assembly of parts during the vehicle assembly; and

storing the historical assembly statistics in a database.

19. The non-transitory computer-readable storage medium of claim **15**, wherein the profile generated for each of the one or more parts defines the expected quality threshold for the respective part.

20. The non-transitory computer-readable storage medium of claim **15**, wherein the deviation being greater than the expected quality threshold corresponds to one or more of a manufacturing defect and improper assembly.

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