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United States of America

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The Director

of the United States Patent and Trademark Office has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this United States

Patent

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If the application for this patent was filed on or after June 8, 1995, the term of this patent begins on the date on which this patent issues and ends twenty years from the filing date of the application or, if the application contains a specific reference to an earlier filed application or applications under 35 U.S.C. 120, 121, 365(c), or 386(c), twenty years from the filing date of the earliest such application ("the twenty-year term"), subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b), and any extension as provided by 35 U.S.C. 154(b) or 156 or any disclaimer under 35 U.S.C. 253.

If this application was filed prior to June 8, 1995, the term of this patent begins on the date on which this patent issues and ends on the later of seventeen years from the date of the grant of this patent or the twenty-year term set forth above for patents resulting from applications filed on or after June 8, 1995, subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b) and any extension as provided by 35 U.S.C. 156 or any disclaimer under 35 U.S.C. 253.

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(54) **SYSTEM AND METHOD FOR CONTROLLING OPERATION OF AN AUTONOMOUS VEHICLE**

(71) Applicant: **City University of Hong Kong**, Kowloon (HK)

(72) Inventors: **Kai Hau Alan Yeung**, Kowloon (HK); **Moshe Zukerman**, Kowloon (HK)

(73) Assignee: **City University of Hong Kong**, Kowloon (HK)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 261 days.

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G05D 1/02 (2020.01)
H04L 29/06 (2006.01)

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CPC ***G05D 1/0077*** (2013.01); ***G05D 1/0088*** (2013.01); ***G05D 1/0285*** (2013.01); *H04L 63/145* (2013.01)

(58) **Field of Classification Search**
CPC .. G05D 1/0077; G05D 1/0088; G05D 1/0285; H04L 63/145
See application file for complete search history.

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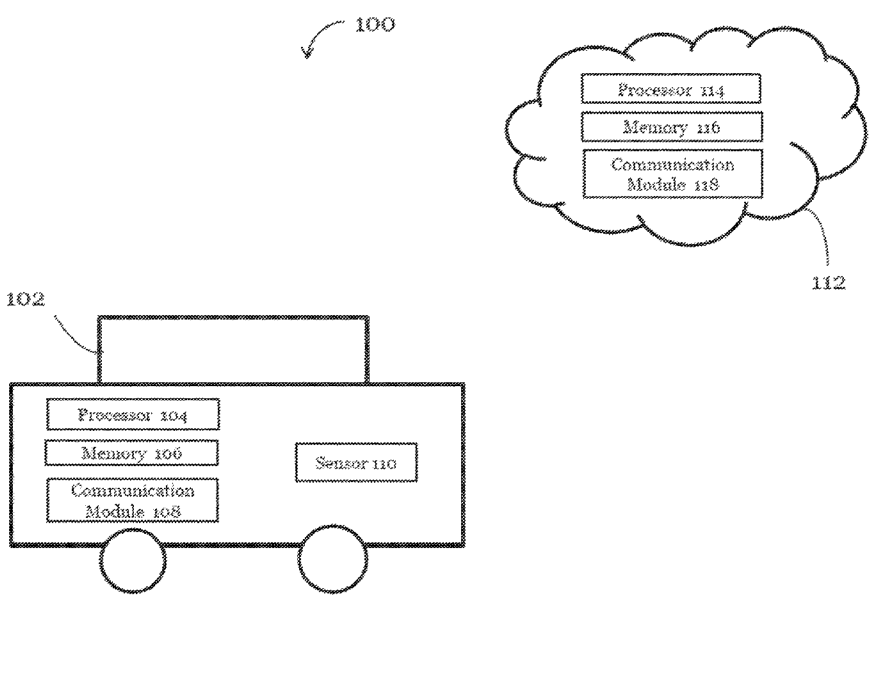
Primary Examiner — Michael D Lang
(74) *Attorney, Agent, or Firm* — Renner Kenner Greive Bobak Taylor & Weber

(57) **ABSTRACT**

A method for controlling operation of an autonomous vehicle includes: comparing, at a remote computing system operably connected with a processor in the autonomous vehicle, a first signal indicative of an environment in which the autonomous vehicle is arranged and a second signal indicative of the environment in which the autonomous vehicle is arranged; and generating a restriction command to restrict operation of the autonomous vehicle if the comparison indicates that the first signal and the second signal do not correspond. The first signal is determined by the processor in the autonomous vehicle and the second signal is determined by the remote computing system.

25 Claims, 4 Drawing Sheets



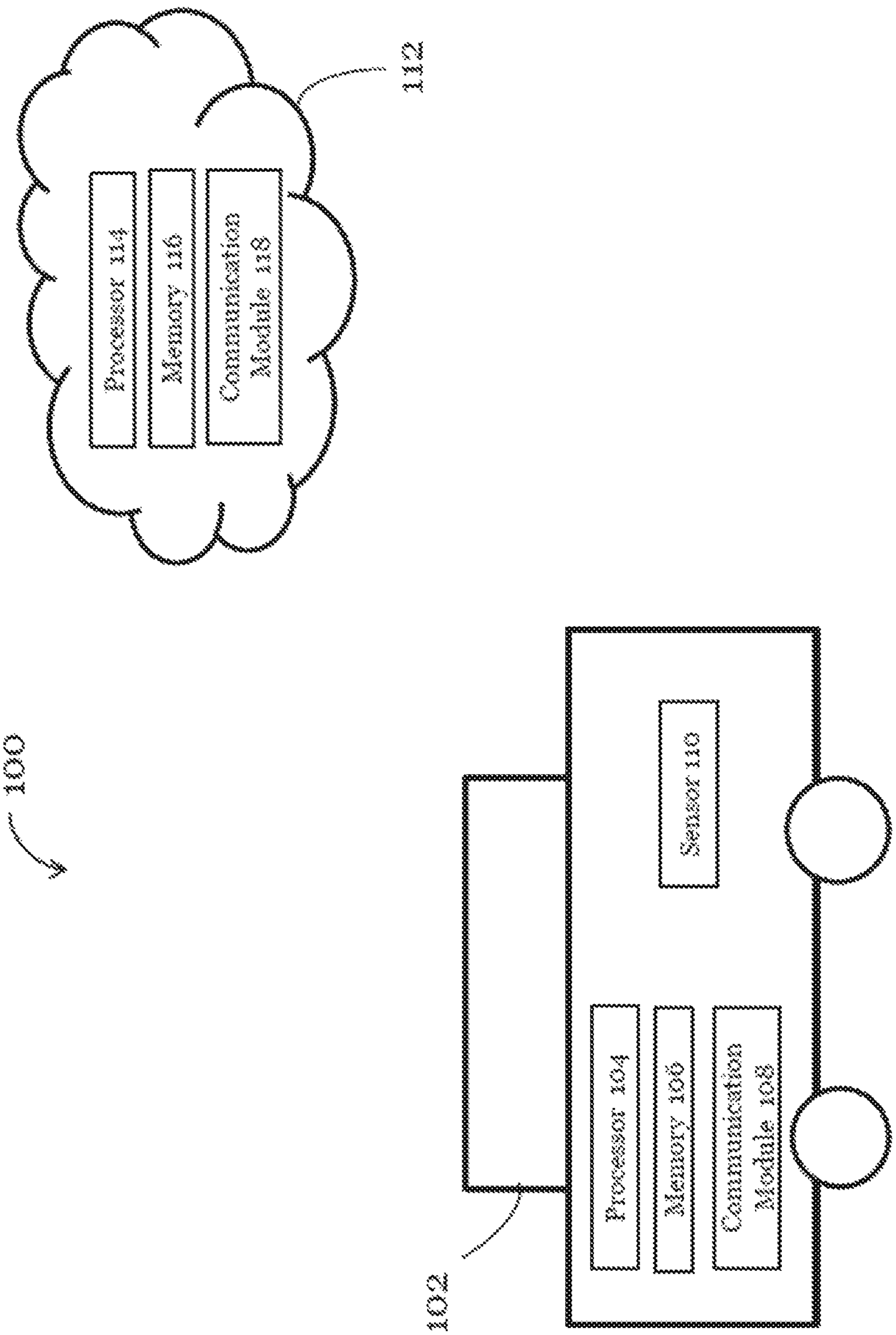

100
112
Processor 114
Memory 116
Communication Module 118
102
Processor 104
Memory 106
Communication Module 108
Sensor 110

Figure 1

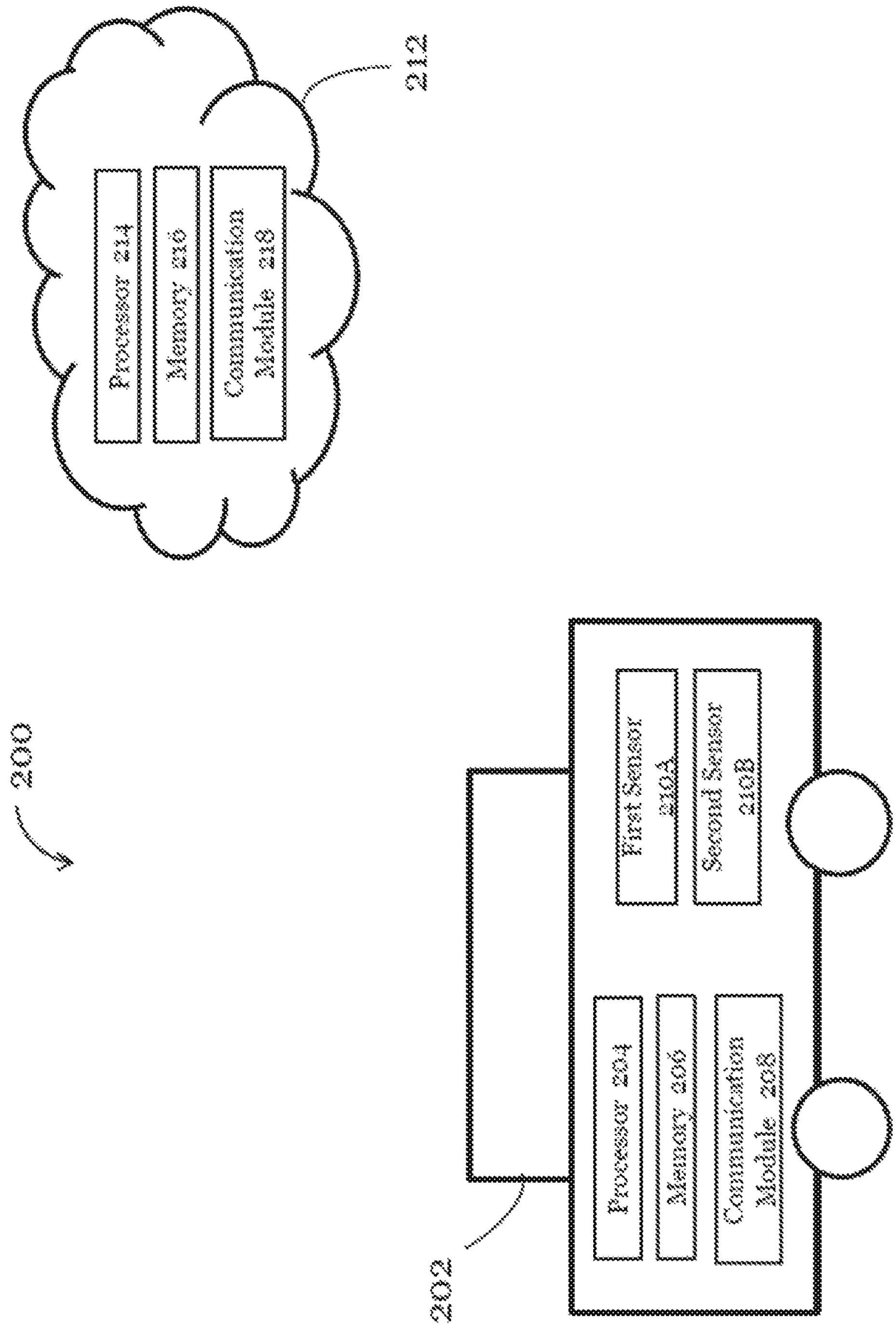

200
212
Processor 214
Memory 216
Communication Module 218
202
Processor 204
Memory 206
Communication Module 208
First Sensor 210A
Second Sensor 210B

Figure 2

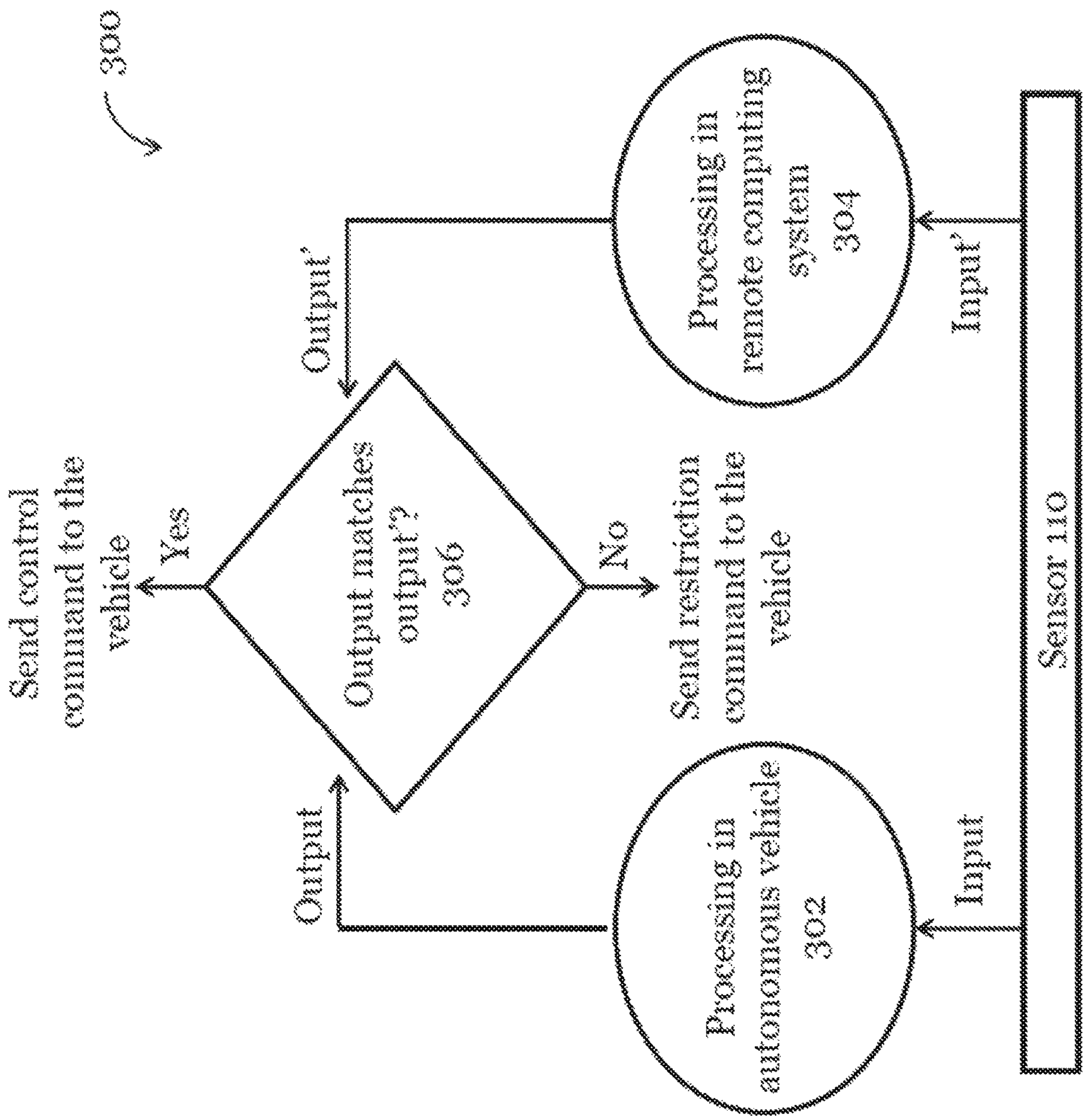

300
Processing in remote computing system
304
Output'
Input'
Send control command to the vehicle
Yes
Output matches output'?
306
No
Send restriction command to the vehicle
Output
Processing in autonomous vehicle
302
Input
Sensor 110

Figure 3

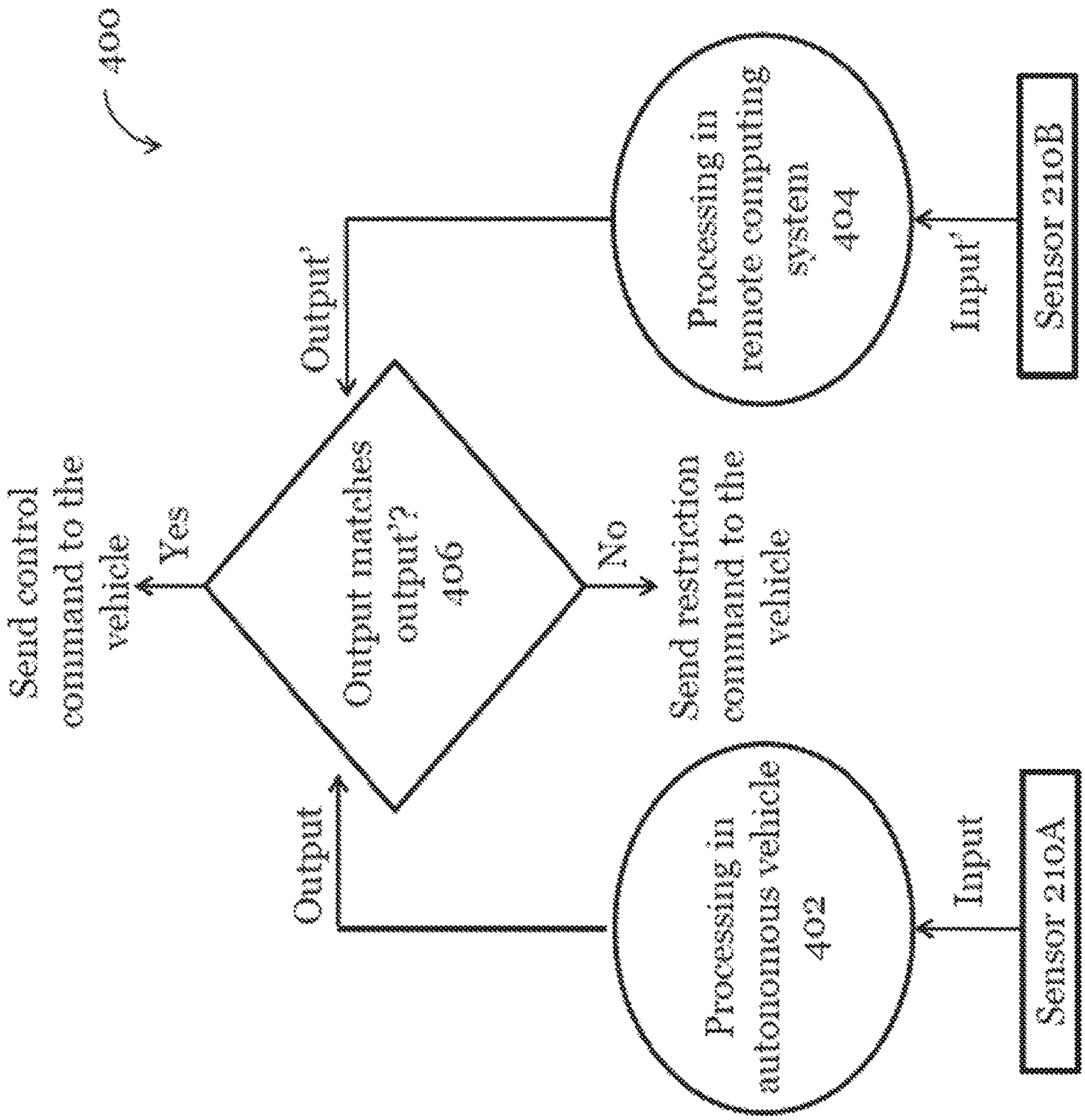

400
Send control command to the vehicle
Yes
Output matches output'? 406
No
Send restriction command to the vehicle
Output
Output'
Processing in autonomous vehicle 402
Processing in remote computing system 404
Input
Input'
Sensor 210A
Sensor 210B

Figure 4

SYSTEM AND METHOD FOR CONTROLLING OPERATION OF AN AUTONOMOUS VEHICLE

TECHNICAL FIELD

The present invention relates to a system and method for controlling operation of an autonomous vehicle. Particularly, although not exclusively, the invention relates to a system and method for improving safety control of an autonomous vehicle.

BACKGROUND

To reduce road related accidents due to human (driver) errors, self-driving cars and autonomous vehicles are developed. In one application, autonomous vehicles can be connected to each other and to central controller, to form connected autonomous vehicles. Safety is the main concern with operation of the autonomous vehicles. For autonomous vehicles to be safe, it is required that, with very high level of certainty, the vehicle will reach its destination without collision with any other vehicles or obstacles throughout its travel.

Despite efforts to improve safety of operation of autonomous vehicles using detection schemes and anomaly behavior analysis, autonomous vehicles remain prone to cyberattacks, as well as tampering by malware and viruses. These factors are detrimental to the safe operation of autonomous vehicles.

SUMMARY OF THE INVENTION

It is an object of the invention to address the above needs, to overcome or substantially ameliorate the above disadvantages or, more generally, to provide a system and method for controlling operation of an autonomous vehicle.

Accordingly, the present invention, in the first aspect, provides a method for controlling operation of an autonomous vehicle, comprising: comparing, at a remote computing system operably connected with a processor in the autonomous vehicle, a first signal indicative of an environment in which the autonomous vehicle is arranged and a second signal indicative of the environment in which the autonomous vehicle is arranged; and generating a restriction command to restrict operation of the autonomous vehicle if the comparison indicates that the first signal and the second signal do not correspond; wherein the first signal is determined by the processor in the autonomous vehicle, and the second signal is determined by the remote computing system.

Preferably, the operation restriction includes at least one of: restricting travel of the autonomous vehicle, stopping the autonomous vehicle, and disabling a function of the autonomous vehicle.

In one embodiment of the first aspect, the method may further comprise transmitting the first signal from the autonomous vehicle to the remote computing system.

Preferably, the generation step is performed at the remote computing system. More preferably, the method further comprises transmitting the restriction command to the autonomous vehicle.

Alternatively, the generation step is performed at the autonomous vehicle.

In one embodiment of the first aspect, the method further comprises determining the first signal based on processing a sensing signal obtained from a first sensor on the autonomous vehicle; and determining the second signal based on processing a sensing signal obtained from a second sensor on the autonomous vehicle; wherein the first and second sensors are of the same type, and are arranged to sense an environment in which the autonomous vehicle is arranged. Each of the first and second sensors may comprise an optical sensor, an electric sensor, an electromagnetic sensor, or an ultrasonic sensor.

In another embodiment of the first aspect, the method further comprises determining the first signal based on processing a sensing signal obtained from a sensor on the autonomous vehicle; and determining the second signal based on processing a sensing signal obtained from the sensor on the autonomous vehicle; wherein the sensor is arranged to sense an environment in which the autonomous vehicle is arranged. The sensor may comprise an optical sensor, an electric sensor, an electromagnetic sensor or an ultrasonic sensor.

In a preferred embodiment of the first aspect, the remote computing system comprises a cloud computing system.

In one embodiment of the first aspect, the method may further comprise generating a control command to control operation of the autonomous vehicle if the comparison indicates that the first signal corresponds to the second signal; wherein the control command comprises a response to be performed by the autonomous vehicle that is responsive to the environment in which the autonomous vehicle is arranged.

Preferably, the generation step is performed at the remote computing system. More preferably, the method further comprises transmitting the control command to the autonomous vehicle.

Alternatively, the generation step is performed at the autonomous vehicle.

Preferably, the method further comprises generating an alarm if the comparison indicates that the first signal and the second signal do not correspond. The alarm may be generated at the autonomous vehicle, or may be provided to an information handling system (phone, tablet, desktop computer, notebook computer, etc.) operably connected with the remote computing system.

In the second aspect, the present invention provides a system for controlling operation of an autonomous vehicle, comprising a processor at a remote computing system, operably connected with a processor in the autonomous vehicle, arranged to: compare a first signal indicative of an environment in which the autonomous vehicle is arranged and a second signal indicative of the environment in which the autonomous vehicle is arranged; and generate a restriction command to restrict operation of the autonomous vehicle if the comparison indicates that the first signal and the second signal do not correspond; wherein the first signal is determined by the processor in the autonomous vehicle, and the second signal is determined by the remote computing system.

Preferably, the operation restriction includes at least one of: restricting travel of the autonomous vehicle, stopping the autonomous vehicle, and disabling a function of the autonomous vehicle.

In one embodiment of the second aspect, the first signal is determined based on processing a sensing signal obtained from a first sensor on the autonomous vehicle; and the second signal is determined based on processing a sensing signal obtained from a second sensor on the autonomous vehicle; wherein the first and second sensors are of the same type, and are arranged to sense an environment in which the autonomous vehicle is arranged. Each of the first and second sensors may comprise an optical sensor, an electric sensor, an electromagnetic sensor, or an ultrasonic sensor.

In another embodiment of the second aspect, the first signal is determined based on processing a sensing signal obtained from a sensor on the autonomous vehicle; and the second signal is determined based on processing a sensing signal obtained from the sensor on the autonomous vehicle; wherein the sensor is arranged to sense an environment in which the autonomous vehicle is arranged. The sensor may comprise an optical sensor, an electric sensor, an electromagnetic sensor, or an ultrasonic sensor.

In a preferred embodiment of the second aspect, the remote computing system comprises a cloud computing system.

Preferably, the processor at the remote computing system is further arranged to: generate a control command to control operation of the autonomous vehicle if the comparison indicates that the first signal corresponds to the second signal; wherein the control command comprises a response to be performed by the autonomous vehicle that is responsive to the environment in which the autonomous vehicle is arranged.

In the third aspect, the present invention provides a method for controlling operation of an autonomous vehicle, comprising: transmitting, to the remote computing system operably connected with the autonomous vehicle, a first signal indicative of an environment in which the autonomous vehicle is arranged; transmitting, to the remote computing system, a sensing signal obtained from a sensor on the autonomous vehicle to the remote computing system for determination of a second signal indicative of the environment in which the autonomous vehicle is arranged; and receiving, from the remote computing system, a restriction command when the remote computing system determines that the first signal and the second signal do not correspond; wherein the sensor is arranged to sense an environment in which the autonomous vehicle is arranged; and wherein the first signal is determined by the processor in the autonomous vehicle.

Preferably, the operation restriction includes at least one of: restricting travel of the autonomous vehicle, stopping the autonomous vehicle, and disabling a function of the autonomous vehicle.

In one embodiment of the third aspect, the method may further include: processing, at a processor in the autonomous vehicle, a sensing signal obtained from a sensor on the autonomous vehicle to determine the first signal.

Preferably, the sensor providing the sensing signal to be processed to provide the first signal and the sensor providing the sensing signal to be processed to provide the second signal are of the same type, and are arranged to sense an environment in which the autonomous vehicle is arranged.

More preferably, the sensor providing the sensing signal to be processed to provide the first signal is the sensor providing the sensing signal to be processed to provide the second signal. The sensor may comprise an optical sensor, an electric sensor, an electromagnetic sensor, or an ultrasonic sensor.

In a preferred embodiment of the third aspect, the remote computing system comprises a cloud computing system.

Preferably, the method further includes: receiving, from the remote computing system, a control command to control operation of the autonomous vehicle when the remote computing system determines that the first signal corresponds to the second signal; wherein the control command comprises a response to be performed by the autonomous vehicle that is responsive to the environment in which the autonomous vehicle is arranged.

Preferably, the method further includes generating an alarm when the remote computing system determines that the first signal and the second signal do not correspond.

In the fourth aspect, the present invention provides a system for controlling operation of an autonomous vehicle, comprising: an autonomous vehicle including a sensor is arranged to sense an environment in which the autonomous vehicle is arranged, a processor, and a communication module that are operably connected with each other; wherein the communication module is arranged to: transmit, to a remote computing system operably connected with the autonomous vehicle, a first signal indicative of an environment in which the autonomous vehicle is arranged; transmit, to the remote computing system, a sensing signal obtained from the sensor for determination of a second signal indicative of the environment in which the autonomous vehicle is arranged; and receive, from the remote computing system, a restriction command when the remote computing system determines that the first signal and the second signal do not correspond; and wherein the first signal is determined by the processor in the autonomous vehicle.

Preferably, the operation restriction includes at least one of: restricting travel of the autonomous vehicle, stopping the autonomous vehicle, and disabling a function of the autonomous vehicle.

Preferably, the processor is arranged to process a sensing signal obtained from a sensor on the autonomous vehicle to determine the first signal.

Preferably, the sensor providing the sensing signal to be processed to provide the first signal and the sensor providing the sensing signal to be processed to provide the second signal are of the same type, and are arranged to sense an environment in which the autonomous vehicle is arranged.

More preferably, the sensor providing the sensing signal to be processed to provide the first signal is the sensor providing the sensing signal to be processed to provide the second signal. The sensor may comprise an optical sensor, an electric sensor, an electromagnetic sensor or an ultrasonic sensor.

In a preferred embodiment of the fourth aspect, the remote computing system comprises a cloud computing system.

Preferably, the communication module is arranged to: receive, from the remote computing system, a control command to control operation of the autonomous vehicle when the remote computing system determines that the first signal corresponds to the second signal; wherein the control command comprises a response to be performed by the autonomous vehicle that is responsive to the environment in which the autonomous vehicle is arranged.

In the fifth aspect, the present invention provides a method comprising the method of the first and third aspects.

In the sixth aspect, the present invention provides a system comprising the system of the second and fourth aspects.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings in which:

FIG. **1** is a schematic diagram of a system for controlling operation of an autonomous vehicle according to one embodiment of the invention;

FIG. **2** is a schematic diagram of a system for controlling operation of an autonomous vehicle according to another embodiment of the invention;

FIG. **3** is a flow diagram illustrating a method for controlling operation of an autonomous vehicle in FIG. **1**; and

FIG. **4** is a flow diagram illustrating a method for controlling operation of an autonomous vehicle in FIG. **2**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **1** shows a schematic diagram of a system **100** for controlling operation of an autonomous vehicle **102** according to one embodiment of the invention. The system **100** includes a processor **114** at a remote computing system **112** operably connected with a processor **104** in the autonomous vehicle **102**. The processor **104** in the autonomous vehicle **102** is arranged to determine a first signal indicative of an environment in which the autonomous vehicle **102** is arranged. The processor **114** in the remote computing system **112** is arranged to determine a second signal indicative of an environment in which the autonomous vehicle **102** is arranged.

Each of the first and second signals is determined based on the processing of a sensing signal obtained from a sensor **110** on the autonomous vehicle **102**. The sensor **110** is arranged to sense an environment in which the autonomous vehicle **102** is arranged. The sensor **110** may be positioned at the front, side, or rear of the autonomous vehicle **102**. the sensor **110** may be an optical sensor, an electric sensor, an electromagnetic sensor or an ultrasonic sensor. For example, the sensor **110** may be a camera, a LIDAR sensor, a SONAR sensor, GPS sensor, IMU sensor, motion sensor, etc. The system **100** further includes a communication module **108** in the autonomous vehicle **102** and a communication module **118** in the remote computing system **112** for communicating data, signals, and commands.

The remote computing system **112** is a cloud computing system. The processor **114** in the remote computing system **112** is arranged to compare the first signal with the second signal. If the processor **114** determines that the first signal and the second signal do not correspond to each other, the processor **114** would generate a restriction command to restrict the operation of the autonomous vehicle **102**.

When the processing system in the autonomous vehicle **102** is compromised, abnormal operation may occur. By comparing, at the processor **114**, the first signal determined at the autonomous vehicle **102** with the second signal determined at the remote computing system **112**, any mismatch between the signals may suggest that the autonomous vehicle **102** is tampered, or is under cyberattacks. Responsive safety precaution or action can thus be executed to prevent occurrence of accidents.

In one application, upon determining a mismatch between the first and second signals, the operation restriction limits the travel of the autonomous vehicle **102**. For example, the autonomous vehicle **102** may be forced to stop after travelling for a certain distance. The autonomous vehicle **102** may also be forced to park at the nearest available parking space, or other designated places. The operation restriction may also stop the autonomous vehicle **102** immediately, or disable a function of the autonomous vehicle **102**. The disabling function may include setting an upper limit on the speed of travel, disabling acceleration of the vehicle **102**, disabling the local processor **104** at the autonomous vehicle **102** to control the vehicle **102** using information processed in the cloud computing system **112**.

If the processor **114** determines that the first signal and the second signal correspond to each other, the processor **114** then generates a control command to control the operation of the autonomous vehicle **102**. The control command is a response to be performed by the autonomous vehicle **102**, responsive to the environment in which the autonomous vehicle **102** is arranged. For example, the control command may contain instructions for continuing on the planned route, or taking actions to respond to the changes in environment (decelerate, turn, accelerate, etc.), or the like.

FIG. **2** shows a schematic diagram of a system **200** for controlling operation of the autonomous vehicle **202** according to another embodiment of the invention. The system **200** is similar to the system **100** shown in FIG. **1**. In system **200**, the first signal is determined based on processing a sensing signal obtained from a first sensor **210**A on the autonomous vehicle **202** and the second signal is determined based on processing a sensing signal obtained from a second sensor **210**B on the autonomous vehicle **202**. The first sensor **210*a*** and second sensor **210*b*** are duplicated sensors, i.e., they are of the same type. The sensors **210*a***, **210*b*** are arranged to sense an environment in which the autonomous vehicle **202** is arranged. The first sensor **210*a*** and the second sensor **210*b*** may be placed adjacent each other, and may be positioned at the front, sides, or rear of the autonomous vehicle **202**. The first and second sensors **210*a***, **210*b*** may be optical sensors, electric sensors, electromagnetic sensors, or ultrasonic sensors. Example sensors include those described with respect to sensor **110**.

FIG. **3** is a flow diagram illustrating a method **300** for controlling operation of the autonomous vehicle **102** in FIG. **1**. In FIG. **3**, the sensor **110** on the autonomous vehicle **102** provides a sensing signal to the processor **104** in the autonomous vehicle. In step **302**, the processor **104** in the autonomous vehicle **102** then processes the sensing signal to determine a first signal indicative of the environment in which the autonomous vehicle is arranged. The sensor **110** on the autonomous vehicle also inputs the sensing signal to the processor **114** in a remote computing system **112**. In step **304**, and the processor **114** in the remote computing system **112** then processes the sensing signal to determine a second signal indicative of the environment in which the autonomous vehicle is arranged.

In the method **300**, the first signal is then transmitted from the autonomous vehicle **102** to the remote computing system **112**. In step **306**, the processor **114** in the remote computing system **112** then compares the first signal with the second signal. The processor **114** may generate the restriction command (described above) to restrict the operation of the autonomous vehicle if the comparison indicates that the first signal and the second signal do not match. Alternatively, if the comparison indicates that the first and second signals match, the processor **114** in the remote computing system **112** generates a control command to the vehicle **102** to control its operation. The control command may be a response to be performed by the autonomous vehicle that is responsive to the environment in which the autonomous vehicle is arranged, as described above.

FIG. **4** is a flow diagram illustrating a method **400** for controlling operation of the autonomous vehicle **202** in FIG. **2**. The method **400** is similar to the method **300** shown in FIG. **3**. The only difference is that two duplicated sensors **210**A, **210**B are used instead of one sensor in the example of FIGS. **1** and **3**.

The remote computing system **112**, **212** in FIGS. **1** and **2** can be a server or an information processing system. Preferably, the system **112**, **212** may have different configurations, and it generally includes suitable components necessary to receive, store and execute appropriate computer instructions or codes. The main components of the system **112**, **212** are a processing unit **114**, **214** and a memory unit **116**, **216**. The processing unit **114**, **214** is a processor such as a CPU, an MCU, etc. The memory unit **116**, **216** may include a volatile memory unit (such as RAM), a non-volatile unit (such as ROM, EPROM, EEPROM and flash memory) or both. Preferably, the system **112**, **212** further includes one or more input devices (not shown) such as a keyboard, a mouse, a stylus, a microphone, a tactile input device (e.g., touch sensitive screen) and a video input device (e.g., camera). The system **112**, **212** may further include one or more output devices (not shown) such as one or more displays, speakers, disk drives, and printers. The displays may be a liquid crystal display, a light emitting display or any other suitable display that may or may not be touch sensitive. The system **112**, **212** may further include one or more disk drives which may encompass solid state drives, hard disk drives, optical drives, flash drive, and/or magnetic tape drives. A suitable operating system may be installed in the system **112**, **212**, e.g., on the disk drive or in the memory unit **116**, **216** of the system **112**, **212**. The memory unit **116**, **216** and the disk drive may be operated by the processing unit **114**, **214**. The system **112**, **212** also preferably includes a communication module **118**, **218** for establishing one or more communication links (not shown) with one or more other computing devices in the autonomous vehicle such as a server, personal computers, terminals, wireless or handheld computing devices. The communication module **118**, **218** may be a modem, a Network Interface Card (NIC), an integrated network interface, a radio frequency transceiver, an optical port, an infrared port, a USB connection, or other interfaces (Wi-Fi, cellular network, ZigBee, Bluetooth, etc). The communication links may be wired or wireless for communicating commands, instructions, information and/or data. Preferably, the processing unit **114**, **214**, the memory unit **116**, **216**, and optionally the input devices, the output devices, the communication module **118**, **218** and the disk drives are connected with each other through a bus, a Peripheral Component Interconnect (PCI) such as PCI Express, a Universal Serial Bus (USB), and/or an optical bus structure. In one embodiment, some of these components may be connected through a network such as the Internet or a cloud computing network. A person skilled in the art would appreciate that the systems **112**, **212** shown in FIGS. **1** and **2** are merely exemplary, and that alternative systems with different configurations are applicable.

Although not required, the embodiments described with reference to the Figures can be implemented as an application programming interface (API) or as a series of libraries for use by a developer or can be included within another software application, such as a terminal or personal computer operating system or a portable computing device operating system. Generally, as program modules include routines, programs, objects, components and data files assisting in the performance of particular functions, the skilled person will understand that the functionality of the software application may be distributed across a number of routines, objects or components to achieve the same functionality desired herein.

It will also be appreciated that where the methods and systems of the invention are either wholly implemented by computing system or partly implemented by computing systems then any appropriate computing system architecture may be utilized. This will include stand-alone computers, network computers and dedicated hardware devices. Where the terms "computing system" and "computing device" are used, these terms are intended to cover any appropriate arrangement of computer hardware capable of implementing the function described.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments. The present embodiments are to be considered in all respects as illustrative and not restrictive.

For example, in some embodiments, the system may include more than one autonomous vehicle operably connected and communicative to the remote computing system and to each other. One or more connected autonomous vehicles may also be warned if the operation of one of the vehicles is determined to be abnormal. The processing may be performed distributively at the processors of the vehicle and the cloud. One or both of the restriction command and control command may be generated at the remote computing system then subsequently transmitted to the autonomous vehicle, or may be generated at the vehicle locally based on information received from the remote computing system. The sensor may include more than one sensor, meaning that the determination may be based on inputs from two or more types of sensors.

The invention claimed is:

1. A method for controlling operation of an autonomous vehicle, comprising:

receiving, at a remote computing system operably connected with a processor in the autonomous vehicle, a first signal indicative of an environment in which the autonomous vehicle is arranged, the first signal being determined by the processor in the autonomous vehicle processing a sensing signal provided by a first sensor of the autonomous vehicle;

receiving, at the remote computing system, a sensing signal provided by a second sensor of the autonomous vehicle;

processing, at the remote computing system, the sensing signal provided by the second sensor of the autonomous vehicle to determine a second signal indicative of the environment in which the autonomous vehicle is arranged;

comparing, at the remote computing system the first signal and the second signal;

generating a restriction command to restrict operation of the autonomous vehicle if the comparison indicates that the first signal and the second signal do not correspond; and

generating a control command to control operation of the autonomous vehicle if the comparison indicates that the first signal corresponds to the second signal, wherein the control command comprises a response to be performed by the autonomous vehicle that is responsive to the environment in which the autonomous vehicle is arranged.

2. The method of claim **1**, wherein the operation restriction includes restricting travel of the autonomous vehicle.

3. The method of claim **1**, wherein the operation restriction includes stopping the autonomous vehicle.

4. The method of claim **1**, wherein the operation restriction includes disabling a function of the autonomous vehicle.

5. The method of claim **1**, further comprising transmitting the first signal from the autonomous vehicle to the remote computing system.

6. The method of claim 1, wherein the generation of the restriction command is performed at the remote computing system.

7. The method of claim 6, further comprising transmitting the restriction command to the autonomous vehicle.

8. The method of claim 1, wherein the generation of the restriction command is performed at the autonomous vehicle.

9. The method of claim 1, wherein the first and second sensors are duplicated sensors of the same type, and are arranged to sense an environment in which the autonomous vehicle is arranged.

10. The method of claim 9, wherein each of the first and second sensors comprises an optical sensor, an electric sensor, an electromagnetic sensor or an ultrasonic sensor.

11. The method of claim 1, wherein the first and second sensors are provided by a single sensor.

12. The method of claim 11, wherein the single sensor comprises an optical sensor, an electric sensor, an electromagnetic sensor or an ultrasonic sensor.

13. The method of claim 1, wherein the remote computing system comprises a cloud computing system.

14. The method of claim 1, wherein the generation of the control command is performed at the remote computing system.

15. The method of claim 14, further comprising transmitting the control command to the autonomous vehicle.

16. The method of claim 1, wherein the generation of the control command is performed at the autonomous vehicle.

17. The method of claim 1, further comprising generating an alarm if the comparison indicates that the first signal and the second signal do not correspond.

18. A system for controlling operation of an autonomous vehicle, comprising:

a first processor at a remote computing system, operably connected with a second processor in the autonomous vehicle, and arranged to:

receive a first signal indicative of an environment in which the autonomous vehicle is arranged, the first signal being determined by the second processor in the autonomous vehicle processing a sensing signal provided by a first sensor of the autonomous vehicle;

receive a sensing signal provided by a second sensor of the autonomous vehicle;

process the sensing signal provided by the second sensor of the autonomous vehicle to determine a second signal indicative of the environment in which the autonomous vehicle is arranged;

compare the first and the second;

generate a restriction command to restrict operation of the autonomous vehicle if the comparison indicates that the first signal and the second signal do not correspond; and

generate a control command to control operation of the autonomous vehicle if the comparison indicates that the first signal corresponds to the second signal, wherein the control command comprises a response to be performed by the autonomous vehicle that is responsive to the environment in which the autonomous vehicle is arranged.

19. The system of claim 18, wherein the operation restriction includes:

restricting travel of the autonomous vehicle;

stopping the autonomous vehicle; or

disabling a function of the autonomous vehicle.

20. The system of claim 18, wherein the first and second sensors are duplicated sensors of the same type, and are arranged to sense an environment in which the autonomous vehicle is arranged.

21. The system of claim 20, wherein each of the first and second sensors comprises an optical sensor, an electric sensor, an electromagnetic sensor or an ultrasonic sensor.

22. The system of claim 18, wherein the first and second sensors are provided by a single sensor.

23. The system of claim 22, wherein the single sensor comprises an optical sensor, an electric sensor, an electromagnetic sensor or an ultrasonic sensor.

24. The system of claim 18, wherein the remote computing system comprises a cloud computing system.

25. The system of claim 18, further comprising the second processor in the autonomous vehicle.

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