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Apparatus for controlling access of vehicle diagnostic device and method thereof

Abstract

Disclosed is an apparatus for controlling access of a vehicle diagnostic device and a method thereof, in which the apparatus includes a communicator that provides a communication interface with the vehicle diagnostic device, a connector that provides a connection interface with an electronic control unit (ECU) in a vehicle, and a controller that performs primary authentication of the vehicle diagnostic device when the vehicle diagnostic device requests a diagnosis from the ECU, transmits a first response ID and a first failure message to the vehicle diagnostic device when the primary authentication fails, and forwards the first response ID and a second failure message from the ECU to the vehicle diagnostic device when the primary authentication is successful.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

(1) This application claims under 35 U.S.C. § 119(a) the benefit of Korean Patent Application No. 10-2021-0178008, filed in the Korean Intellectual Property Office on Dec. 13, 2021, the entire contents of which are incorporated herein by reference.

BACKGROUND

Technical Field

(2) The present disclosure relates to technology for controlling access of a vehicle diagnostic device to a vehicle by performing authentication of the vehicle diagnostic device.

Description of the Related Art

(3) There is a rapid increase in the type and number of electronic components used for a vehicle, thus increasing the type and number of electronic apparatuses (e.g., electronic control unit) mounted in the vehicle. Here, the electronic apparatus may be mounted in a power train control system, a body control system, a chassis control system, a vehicle network, a multimedia system or the like.

(4) The power train control system may indicate an engine control system, an automatic transmission control system or the like. The body control system may indicate a body electrical-equipment control system, a convenience device control system, a lamp control system or the like. The chassis control system may indicate a steering actuator control system, a brake control system, a suspension control system or the like. The vehicle network may indicate a controller area network (CAN), a FlexRay-based network, a media oriented system transport (MOST)-based network or the

like. The multimedia system may indicate a navigator system, a telematics system, an infotainment system or the like.

(5) The electronic apparatuses mounted in such a system may be connected to each other through the vehicle network, and each electronic apparatus may be connected to a different vehicle network, based on a characteristic of the electronic apparatus. The CAN may have a transmission rate of up to 1 Mbps, may automatically retransmit a collided frame, and may perform error detection based on cyclic redundancy check (CRC). The FlexRay-based network may have a transmission rate of up to 10 Mbps, may simultaneously transmit data through two channels, may perform synchronous data transmission or the like. The MOST-based network may be a communication network for high-quality multimedia and may have a transmission rate of up to 150 Mbps.

(6) Meanwhile, the telematics system, infotainment system, advanced safety system or the like of the vehicle may each require a high transmission rate, system scalability or the like. However, the CAN, the FlexRay-based network or the like fails to fully satisfy these requirements. The MOST-based network may have a higher transmission rate compared to the CAN and the FlexRay-based network. However, it may require a lot of cost to use the MOST-based network in all networks of the vehicle. An Ethernet-based network may be considered as the vehicle network because of these problems. The Ethernet-based network may support bidirectional communications by using a pair of wires, and may have a transmission rate of up to 10 Gbps.

(7) Such a vehicle network may include a central gateway (CGW) and the plurality of ECUs, the CGW may perform primary authentication on an external vehicle diagnostic device when the vehicle diagnostic device requests a diagnosis from a specific ECU, the specific ECU may perform secondary authentication on the vehicle diagnostic device when the primary authentication is successful, and the specific ECU may provide a diagnosis result to the vehicle diagnosis device when the secondary authentication is successful. Here, the CGW may transmit a response ID (e.g., 0x700) and a response message (e.g., NRC AA) to the vehicle diagnostic device, and may forward no diagnostic request from the vehicle diagnostic device to the specific ECU, when the primary authentication fails. Here, the specific ECU may transmit the response ID (e.g., 0x700) and the response message (e.g., NRC AA) to the vehicle diagnostic device through the CGW when the primary authentication is successful and the secondary authentication fails. The vehicle diagnostic device may thus be unable to confirm whether the response ID (e.g., 0x700) and response message (e.g., NRC AA) transmitted from the vehicle may be transmitted from the CGW or the specific ECU.

(8) As a result, the response ID and response message transmitted to the vehicle diagnostic device when the CGW fails the authentication and the response ID and response message transmitted to the vehicle diagnostic device when the ECU fails the authentication may be identical to each other. Conventional technology for controlling access of a vehicle diagnostic device is unable to confirm which component rejects the authentication of the vehicle diagnostic device.

(9) The above information disclosed in this background section is provided only to assist in understanding of the present disclosure, and may thus include information not included in the existing technology already known to those skilled in the art to which the present disclosure pertains.

SUMMARY

(10) The present disclosure has been made to solve the above-mentioned problems occurring in the existing technology while advantages achieved by the existing technology may be maintained intact.

(11) An exemplary embodiment of the present disclosure may provide an apparatus for controlling access of a vehicle diagnostic device, and a method thereof, in which the vehicle diagnostic device may be allowed to confirm which component rejects the authentication of the vehicle diagnostic device by performing primary authentication of the external vehicle diagnostic device when the

vehicle diagnostic device requests a diagnosis from an electronic control unit (ECU) positioned in the vehicle, by transmitting a first response ID and a first failure message to the vehicle diagnostic device when the primary authentication fails, and by forwarding the first response ID and a second failure message from the ECU to the vehicle diagnostic device when the primary authentication is successful.

(12) The technical problems to be solved by the present disclosure are not limited to the aforementioned problems, and any other technical problems not mentioned herein will be clearly understood from the following description by those skilled in the art to which the present disclosure pertains.

(13) According to an exemplary embodiment of the present disclosure, an apparatus for controlling access of a vehicle diagnostic device includes a communicator that provides a communication interface with the vehicle diagnostic device, a connector that provides a connection interface with an electronic control unit (ECU) in a vehicle, and a controller that performs primary authentication of the vehicle diagnostic device when the vehicle diagnostic device requests a diagnosis from the ECU, transmits a first response ID and a first failure message to the vehicle diagnostic device when the primary authentication fails, and forwards the first response ID and a second failure message from the ECU to the vehicle diagnostic device when the primary authentication is successful.

(14) The controller may transmit no diagnostic request from the vehicle diagnostic device to the ECU when the primary authentication fails.

(15) The controller may forward the first response ID and the second failure message from the ECU to the vehicle diagnostic device when the ECU fails in secondary authentication of the vehicle diagnostic device.

(16) The controller may forward the first response ID and diagnostic data from the ECU to the vehicle diagnostic device when the ECU succeeds in secondary authentication of the vehicle diagnostic device.

(17) The vehicle diagnostic device may confirm an authentication failure in the apparatus for controlling access of a vehicle diagnostic device, based on the first failure message.

(18) The vehicle diagnostic device may confirm an authentication failure in the ECU, based on the second failure message.

(19) The controller may perform the authentication of the vehicle diagnostic device when the vehicle diagnostic device requests the diagnosis from the controller, and the controller may transmit a second response ID and the second failure message to the vehicle diagnostic device when the authentication fails.

(20) The vehicle diagnostic device may confirm an authentication failure in the apparatus for controlling access of a vehicle diagnostic device, based on the second failure message.

(21) The communicator may provide a wired communication interface with the vehicle diagnostic device or a wireless communication interface with the vehicle diagnostic device.

(22) The connector may provide a connection interface with a vehicle network to which the ECU may be connected.

(23) According to an exemplary embodiment of the present disclosure, a method of controlling access of a vehicle diagnostic device includes requesting, by a vehicle diagnostic device, a diagnosis from an electronic control unit (ECU), performing, by a controller, primary authentication of the vehicle diagnostic device, transmitting, by the controller, a first response ID and a first failure message to the vehicle diagnostic device when the primary authentication fails, and forwarding, by the controller, the first response ID and a second failure message from the ECU to the vehicle diagnostic device when the primary authentication is successful.

(24) The transmitting of the first response ID and the first failure message to the vehicle diagnostic device may include forwarding no diagnostic request from the vehicle diagnostic device to the ECU.

(25) The forwarding of the first response ID and the second failure message from the ECU to the

vehicle diagnostic device may include forwarding the first response ID and the second failure message from the ECU to the vehicle diagnostic device when the ECU fails in secondary authentication of the vehicle diagnostic device, and forwarding the first response ID and diagnostic data from the ECU to the vehicle diagnostic device when the ECU succeeds in the secondary authentication of the vehicle diagnostic device.

(26) The transmitting of the first response ID and the first failure message to the vehicle diagnostic device may include confirming, by the vehicle diagnostic device, an authentication failure in the apparatus for controlling access of a vehicle diagnostic device, based on the first failure message.

(27) The forwarding of the first response ID and the second failure message from the ECU to the vehicle diagnostic device may include confirming, by the vehicle diagnostic device, an authentication failure in the ECU, based on the second failure message.

(28) The method may further include performing, by the controller, the authentication of the vehicle diagnostic device when the vehicle diagnostic device requests the diagnosis from the controller, and transmitting, by the controller, a second response ID and the second failure message to the vehicle diagnostic device when the authentication fails.

(29) The transmitting of the second response ID and the second failure message to the vehicle diagnostic device may include confirming, by the vehicle diagnostic device, an authentication failure in the apparatus for controlling access of a vehicle diagnostic device, based on the second failure message.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) The above and other objects, features and advantages of the present disclosure will be more apparent from the following detailed description taken in conjunction with the accompanying drawings:

(2) FIG. **1** is an exemplary view of a system for controlling access of a vehicle diagnostic device to which an embodiment of the present disclosure is applied;

(3) FIG. **2** is a block diagram of an apparatus for controlling access of a vehicle diagnostic device according to an embodiment of the present disclosure;

(4) FIG. **3** is an exemplary view showing an operation of a controller positioned in the apparatus for controlling access of a vehicle diagnostic device according to an embodiment of the present disclosure;

(5) FIG. **4** is a flowchart of a method of controlling access of a vehicle diagnostic device according to another embodiment of the present disclosure; and

(6) FIG. **5** is a block diagram showing a computing system executing the method of controlling access of a vehicle diagnostic device according to another embodiment of the present disclosure.

DETAILED DESCRIPTION

(7) It is understood that the term “vehicle” or “vehicular” or other similar tem as used herein is inclusive of motor vehicles in general such as passenger automobiles including sports utility vehicles (SUV), buses, trucks, various commercial vehicles, watercraft including a variety of boats and ships, aircraft, and the like, and includes hybrid vehicles, electric vehicles, plug-in hybrid electric vehicles, hydrogen-powered vehicles and other alternative fuel vehicles (e.g. fuels derived from resources other than petroleum). As referred to herein, a hybrid vehicle is a vehicle that has two or more sources of power, for example both gasoline-powered and electric-powered vehicles.

(8) The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the disclosure. As used herein, the singular forms “a,” “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. These terms are merely intended to distinguish one component from another component,

and the terms do not limit the nature, sequence or order of the constituent components. It will be further understood that the terms “comprises” and/or “comprising,” when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. As used herein, the term “and/or” includes any and all combinations of one or more of the associated listed items. Throughout the specification, unless explicitly described to the contrary, the word “comprise” and variations such as “comprises” or “comprising” will be understood to imply the inclusion of stated elements but not the exclusion of any other elements. In addition, the terms “unit”, “er”, “or”, and “module” described in the specification mean units for processing at least one function and operation, and can be implemented by hardware components or software components and combinations thereof.

(9) Although exemplary embodiment is described as using a plurality of units to perform the exemplary process, it is understood that the exemplary processes may also be performed by one or plurality of modules. Additionally, it is understood that the term controller/control unit refers to a hardware device that includes a memory and a processor and is specifically programmed to execute the processes described herein. The memory is configured to store the modules and the processor is specifically configured to execute said modules to perform one or more processes which are described further below.

(10) Further, the control logic of the present disclosure may be embodied as non-transitory computer readable media on a computer readable medium containing executable program instructions executed by a processor, controller or the like. Examples of computer readable media include, but are not limited to, ROM, RAM, compact disc (CD)-ROMs, magnetic tapes, floppy disks, flash drives, smart cards and optical data storage devices. The computer readable medium can also be distributed in network coupled computer systems so that the computer readable media is stored and executed in a distributed fashion, e g., by a telematics server or a Controller Area Network (CAN).

(11) Unless specifically stated or obvious from context, as used herein, the term “about” is understood as within a range of normal tolerance in the art, for example within 2 standard deviations of the mean. “About” can be understood as within 10%, 9%, 8%, 7%, 6%, 5%, 4%, 3%, 2%, 1%, 0.5%, 0.1%, 0.05%, or 0.01% of the stated value. Unless otherwise clear from the context, all numerical values provided herein are modified by the term “about”.

(12) Hereinafter, some embodiments of the present disclosure will be described in detail with reference to the exemplary drawings. In adding the reference numerals to the components of each drawing, it should be noted that the identical or equivalent component may be designated by the identical numeral even when they may be displayed on other drawings. Further, in describing the embodiment of the present disclosure, a detailed description of the related known configuration or function will be omitted when it is determined that it interferes with the understanding of the embodiment of the present disclosure.

(13) In describing the components of the exemplary embodiments according to the present disclosure, terms such as first, second, A, B, (a), (b), and the like may be used. These terms are merely intended to distinguish the components from other components, and the terms do not limit the nature, order or sequence of the components. Unless otherwise defined, all terms including technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this disclosure belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

(14) FIG. **1** is an exemplary view of a system for controlling access of a vehicle diagnostic device to which an embodiment of the present disclosure is applied, and the description describes that an apparatus for controlling access of a vehicle diagnostic device according to an embodiment of the

present disclosure may be exemplary implemented as a vehicle gateway **200**.

(15) As shown in FIG. **1**, the system for controlling access of a vehicle diagnostic device to which an embodiment of the present disclosure is applied may include a vehicle diagnostic device **100**, a vehicle gateway **200** and an electronic control unit (ECU) **300**. The system may include one or more electronic control units.

(16) A vehicle may be equipped with a vehicle control system, a driving assistance system and a driver comfort system, and each of which may be equipped with an ECU **300**. Here, the ECUs **300** may be connected to each other through a vehicle network to transmit and receive data. Here, the ECU **300** may include not only a function of collecting information from a sensor and a camera, but also a function (information processing function) of generating new information by performing a calculation according to a preset program based on the collected information.

(17) The plurality of ECUs **300** may be connected to each other by a sub-network structure via the vehicle gateway **200**. The vehicle gateway **200** may include a computer or software that allows communication between networks using different communication networks and protocols within the vehicle network. The vehicle gateway **200** may be a network point that serves as an entrance to different networks, or may serve as a passage between different types of networks.

(18) The vehicle may include at least one vehicle gateway **200**, and here, the number of vehicle gateways **200** included in the vehicle may be determined corresponding to the number of ECUs **300** mounted in the vehicle and its connection type.

(19) The external vehicle diagnostic device **100** that requests a fault diagnosis from the plurality of ECUs **300** mounted on the vehicle may be connected to the vehicle gateway **200** by wire or wirelessly. The vehicle diagnostic device **100** may request the diagnosis from the plurality of ECUs **300** connected through the vehicle networks of different communication methods. The vehicle diagnostic device **100** may be physically separated from the vehicle, and may be connected through terminals mounted in the vehicle.

(20) A connection interface module requesting for a diagnostic process and transmitting a diagnosis result may be positioned between the vehicle diagnostic device **100** and the vehicle gateway **200**. Here, the connection interface module may include an on-board diagnostics (OBD) terminal positioned in the vehicle. Here, the on-board diagnostics (OBD) may refer to a diagnostic standard for confirming and controlling an operation state of the vehicle. Even though initially used to improve a maintenance efficiency of an electronic component such as an engine, the OBD may also serve as an interface such as a trip computer that shows various vehicle information to a driver in addition to this purpose.

(21) The vehicle may include an Ethernet terminal. The vehicle may not need the Ethernet terminal when the vehicle network includes only a controller area network (CAN). However, Ethernet communication may be additionally applied to the vehicle network in addition to the CAN as the number of the plurality of ECUs **300** mounted in the vehicle may be increased and an amount of the data transmitted and received by the plurality of ECU **300** may be increased. For example, 1 Mbps may be a maximum transmission bandwidth of CAN communication. At such a speed, there may be a limitation in configuring the vehicle network when the number of plurality of ECUs **300** in the vehicle is increased and data traffic is increased due to real-time video transmission (e.g., top view monitoring). Meanwhile, a data transmission rate of the CAN with flexible data-rate (CAN-FD) may be up to 2 Mbit/s in a multi-drop network and 5 Mbit/s in point-to-point communication, and a speed of the Ethernet may be up to 1 Gbps.

(22) In addition, a telematics device mounted in a vehicle may be used as the connection interface module. A telematics device may be an example of a device which may provide comprehensive multimedia services for a vehicle using location information and a wireless communication network, may provide the driver with safe driving, emergency rescue, traffic guidance service or the like, and may provide a passenger with an infotainment services such as internet, movies, games, multimedia or the like In addition, the telematics device may be linked with the vehicle

diagnostic device **100** to check the plurality of ECUs **300** mounted in the vehicle, may forward a diagnostic request message to the plurality of ECUs **300**, and may transmit diagnostic data from the plurality of ECUs **300** to the vehicle diagnostic device **100**.

(23) The vehicle may include the plurality of ECUs **300**, the vehicle network of different communication methods of connecting the plurality of ECUs **300** to each other, and at least one vehicle gateway **200** that connects the vehicle networks of different communication methods to each other. Here, the vehicle network may include the Ethernet communication, the controller area network (CAN) communication, the CAN with flexible data-rate (CAN-FD), local interconnect network (LIN) communication, media oriented systems transport (MOST) communication or the like

(24) The vehicle gateway **200** may allow the vehicle diagnostic device **100** to confirm which component rejects the authentication of the vehicle diagnostic device by performing primary authentication of the vehicle diagnostic device **100** when the external vehicle diagnostic device **100** requests a diagnosis from the ECU **300** positioned in the vehicle, by transmitting a first response ID and a first failure message to the vehicle diagnostic device **100** when the primary authentication fails, and by forwarding the first response ID and a second failure message from the ECU **300** to the vehicle diagnostic device **100** when the primary authentication is successful.

(25) Hereinafter, the description specifically describes a configuration of the apparatus for controlling access of vehicle diagnostic device implemented as the vehicle gateway **200**.

(26) FIG. **2** is a block diagram of the apparatus for controlling access of a vehicle diagnostic device according to an embodiment of the present disclosure.

(27) As shown in FIG. **2**, the apparatus for controlling access of a vehicle diagnostic device according to an embodiment of the present disclosure may include a storage **10**, a communicator **20**, a connector **30** and a controller **40**. Here, each component may be coupled with each other and implemented as one, or some components may be omitted based on a method of implementing the apparatus for controlling access of a vehicle diagnostic device according to an embodiment of the present disclosure.

(28) Provided here is a description of each of the above components. First, the storage **10** may store various logics, algorithms and programs required in processes of performing the primary authentication of the vehicle diagnostic device **100** when the external vehicle diagnostic device **100** requests the diagnosis from the ECU **300** positioned in the vehicle, transmitting the first response ID and the first failure message to the vehicle diagnostic device **100** when the primary authentication fails, and forwarding the first response ID and the second failure message from the ECU **300** to the vehicle diagnostic device **100** when the primary authentication is successful.

(29) The storage **10** may store the first response ID (e.g., 0x701) and a second response ID (e.g., 0x700), and may also store the first failure message (e.g., NRC CC) and the second failure message (e.g., NRC AA).

(30) The storage **10** may include at least one type of a storage medium among types of memories such as a flash memory, a hard disk memory, a micro memory and a card memory (e.g., secure digital (SD) card or extreme digital (XD) card), or types of memories such as a random access memory (RAM), a static RAM (SRAM), a read-only memory (ROM), a programmable ROM (PROM), an electrically erasable PROM (EEPROM), a magnetic memory (or a magnetic RAM (MRAM)), a magnetic disk and an optical disk memory.

(31) The communicator **20** may include a wired communication interface module and a wireless communication interface module. The wireless communication interface module may include at least one of a mobile communication module, a wireless internet module or a short-range communication module.

(32) The mobile communication module may communicate with the vehicle diagnostic device **100** through mobile communication network constructed based on a technical standard or a communication method for mobile communication (e.g., global system for mobile communication

(GSM), code division multi access (CDMA), code division multi access 2000 (CDMA2000), enhanced voice-data optimized or enhanced voice-data only (EV-DO), wideband CDMA (WCDMA), high speed downlink packet access (HSDPA), high speed uplink packet access (HSUPA), long term evolution (LTE) or long term evolution-advanced (LTE-A).

(33) The wireless internet module may be a module for wireless internet access, and may communicate with the vehicle diagnostic device **100** through wireless local area network (i.e., wireless LAN (WLAN)), wireless-fidelity (Wi-Fi), wireless fidelity (Wi-Fi) direct, digital living network alliance (DLNA), wireless broadband (WiBro), world interoperability for microwave access (WiMAX), high speed downlink packet access (HSDPA), high speed uplink packet access (HSUPA), long term evolution (LTE), long term evolution-advanced (LTE-A) or the like

(34) The short-range communication module may support communication with the vehicle diagnostic device **100** by using at least one technology of BLUETOOTH™, radio frequency identification (RFID), infrared data association (IrDA), ultra wideband (UWB), zigbee, near field communication (NFC), wireless universal serial bus (USB).

(35) The connector **30** may be a module that provides a connection interface to the vehicle network, and may transmit the diagnostic request message to the ECU **300** connected to the vehicle network or receive the diagnosis result (diagnostic data) from the ECU **300**.

(36) The controller **40** may perform an overall control of each of the above components so that each component normally performs its function. The controller **40** may be implemented in hardware, or may be implemented in software, or may be implemented in a combination of hardware and software. The controller **40** may be implemented as a microprocessor, but may not be limited thereto.

(37) In particular, the controller **40** may perform various controls in the processes of performing the primary authentication of the vehicle diagnostic device **100** when the external vehicle diagnostic device **100** requests the diagnosis from the ECU **300** positioned in the vehicle, transmitting the first response ID and the first failure message to the vehicle diagnostic device **100** when the primary authentication fails, and forwarding the first response ID and the second failure message from the ECU **300** to the vehicle diagnostic device **100** when the primary authentication is successful.

(38) Hereinafter, the description specifically describes an operation of the controller **40** with reference to FIG. **3**.

(39) FIG. **3** is an exemplary view showing an operation of a controller positioned in the apparatus for controlling access of a vehicle diagnostic device according to an embodiment of the present disclosure, and the description describes Case #1, Case #2 and Case #3 as examples.

(40) As shown in FIG. **3**, Case #1 indicates a case where the controller **40** of the vehicle gateway **200** fails to authenticate the vehicle diagnostic device **100** when the vehicle diagnostic device **100** requests the diagnosis from the ECU **300**. Here, the controller **40** of the vehicle gateway **200** may transmit the first response ID and the first failure message to the vehicle diagnostic device **100** rather than forwarding the diagnostic request from the vehicle diagnostic device **100** to the ECU **300**. The vehicle diagnostic device **100** may then confirm that the vehicle gateway **200** may be the component that rejects the authentication of the vehicle diagnostic device, based on the first failure message.

(41) That is, the vehicle diagnostic device **100** may transmit, to the vehicle gateway **200**, '0x701' which may be an ID (i.e., Request ID) requesting the diagnosis from the ECU **300** among a plurality of IDs requesting for the diagnosis. Here, the controller **40** of the vehicle gateway **200** may perform the authentication of the vehicle diagnostic device **100** before forwarding '0x701' to the ECU **300**. The controller **40** of the vehicle gateway **200** may then forward '0x701' to the ECU **300** when the authentication result is successful. However, the controller **40** may transmit, to the vehicle diagnostic device **100**, '0x709' which may be a response ID corresponding to '0x701', and 'NRC CC' which may be a message indicating that the authentication fails, rather than forwarding '0x701' to the ECU **300** when the authentication result is a failure. Here, the vehicle diagnostic

device **100** may be unable to receive any ID other than '0x709' as a response to '0x701' (by masking-processed as '0x709'). The vehicle diagnostic device **100** may thus receive 'NRC CC' transmitted along with '0x709' from the vehicle gateway **200**, and confirm that the vehicle gateway **200** may be the component that rejects the authentication, based on 'NRC CC'.

(42) Case #2 indicates a case where the controller **40** of the vehicle gateway **200** succeeding in authenticating the vehicle diagnostic device **100** when the vehicle diagnostic device **100** requests the diagnosis from the ECU **300**. Here, the controller **40** of the vehicle gateway **200** may forward the diagnostic request from the vehicle diagnostic device **100** to the ECU **300**, and forward the first response ID and the second failure message from the ECU **300** to the vehicle diagnostic device **100**. The vehicle diagnostic device **100** may then confirm that the ECU **300** may be the component that rejects the authentication, based on the second failure message.

(43) That is, the vehicle diagnostic device **100** may transmit, to the vehicle gateway **200**, '0x701' which may be the ID (i.e., Request ID) requesting the diagnosis from the ECU **300** among the plurality of IDs requesting for the diagnosis. The controller **40** of the vehicle gateway **200** may then perform the authentication of the vehicle diagnostic device **100**, and forward '0x701' to the ECU **300** when the authentication is successful. Here, the controller **40** may perform the same operation as Case #1 when the authentication fails. The ECU **300** may then perform the authentication of the vehicle diagnostic device **100**, and the ECU **300** may transmit '0x709' which may be the response ID corresponding to '0x701', and 'NRC AA' which may be a message indicating that the authentication fails, to the vehicle diagnostic device **100** through the vehicle gateway **200** when the authentication result is the failure. Here, the vehicle gateway **200** may perform a routing function. Here, the vehicle diagnostic device **100** may be unable to receive any ID other than '0x709' as a response to '0x701' (by masking-processed as '0x709'). The vehicle diagnostic device **100** may thus receive 'NRC AA' transmitted along with '0x709' from the vehicle gateway **200**, and confirm that the ECU **300** may be the component that rejects the authentication, based on 'NRC AA'.

(44) In addition, the ECU **300** may perform the diagnosis when succeeding in authenticating the vehicle diagnostic device **100** and forward the diagnosis result to the vehicle diagnostic device **100** through the vehicle gateway **200**. Here, the vehicle gateway **200** may perform the routing function.

(45) Case #3 indicates a case where the controller **40** of the vehicle gateway **200** fails to authenticate the vehicle diagnostic device **100** when the vehicle diagnostic device **100** requests the diagnosis from the vehicle gateway **200**. Here, the controller **40** of the vehicle gateway **200** may forward the second response ID and the second failure message to the vehicle diagnostic device **100**. Here, the vehicle diagnostic device **100** requests the diagnosis from the vehicle gateway **200**, and may thus confirm that the vehicle gateway **200** may be the component that rejects the authentication.

(46) That is, the vehicle diagnostic device **100** may transmit, to the vehicle gateway **200**, '0x700' which may be the ID (i.e., Request ID) requesting the diagnosis from the vehicle gateway **200** among the plurality of IDs requesting for the diagnosis. Here, the controller **40** of the vehicle gateway **200** may transmit, to the vehicle diagnostic device **100**, '0x708' which may be a response ID corresponding to '0x700', and 'NRC AA' which may be the message indicating that the authentication fails when the controller **40** fails to authenticate the vehicle diagnostic device **100**. Here, the vehicle diagnostic device **100** may be unable to receive any ID other than '0x708' as a response to '0x700' (by masking-processed as '0x708'). The vehicle diagnostic device **100** may thus receive 'NRC AA' transmitted along with '0x708' from the vehicle gateway **200**, and confirm that the vehicle gateway **200** is the component that rejects the authentication, based on '0x708'.

(47) In addition, the vehicle gateway **200** may perform the diagnosis when succeeding in authenticating the vehicle diagnostic device **100** and forward the diagnosis result to the vehicle diagnostic device **100**.

(48) FIG. **4** is a flowchart of a method of controlling access of a vehicle diagnostic device according to another embodiment of the present disclosure.

(49) First, a vehicle diagnostic device **100** may request a diagnosis from an electronic control unit (ECU) **300** through a vehicle gateway **200** (**401**).
(50) A controller **40** of the vehicle gateway **200** may then perform primary authentication of the vehicle diagnostic device **100** (**402**).
(51) The controller **40** may transmit a first response ID and a first failure message to the vehicle diagnostic device **100** when the primary authentication fails (**403**).
(52) The controller **40** may forward the first response ID and a second failure message from the ECU **300** to the vehicle diagnostic device when the primary authentication is successful (**404**). Here, the controller **40** may forward (or route) the first response ID and the second failure message from the ECU **300** to the vehicle diagnostic device **100** when the ECU **300** fails in secondary authentication of the vehicle diagnostic device **100**, and forward (or route) the first response ID and diagnostic data from the ECU **300** to the vehicle diagnostic device **100** when the ECU **300** succeeds in the secondary authentication of the vehicle diagnostic device **100**.
(53) FIG. **5** is a block diagram showing a computing system executing the method of controlling access of a vehicle diagnostic device according to another embodiment of the present disclosure.
(54) Referring to FIG. **5**, a computing system may also implement the method of controlling access of a vehicle diagnostic device according to another embodiment of the present disclosure described above. A computing system **1000** may include at least one processor **1100**, a memory **1300**, a user interface input device **1400**, a user interface output device **1500**, a storage **1600** and a network interface **1700**, which may be connected to each other by a system bus **1200**.
(55) The processor **1100** may be a central processing unit (CPU) or a semiconductor device that processes instructions stored in the memory **1300** and/or the storage **1600**. The memory **1300** and the storage **1600** may include various types of volatile or non-volatile storage media. For example, the memory **1300** may include a read only memory (ROM) **1310** and a random access memory (RAM) **1320**.
(56) Thus, the operations of the method or the algorithm described in connection with the embodiments disclosed herein may be embodied directly in hardware or a software module executed by the processor **1100**, or in a combination thereof. The software module may reside on a storage medium (that is, the memory **1300** and/or the storage **1600**) such as a RAM, a flash memory, a ROM, an erasable programming ROM (EPROM), an electrically erasable programming ROM (EEPROM), a register, a hard disk, a removable disk, a compact disk-ROM (CD-ROM). The exemplary storage medium may be coupled to the processor **1100**, and the processor **1100** may read information out of the storage medium and may record information in the storage medium. Alternatively, the storage medium may be integrated with the processor **1100**. The processor and the storage medium may reside in an application specific integrated circuit (ASIC). The ASIC may reside in a user terminal. In another case, the processor and the storage medium may reside in the user terminal as separate components.
(57) As set forth above, the apparatus for controlling access of a vehicle diagnostic device and the method thereof according to the embodiments of the present disclosure may allow the vehicle diagnostic device to confirm which component rejects the authentication of the vehicle diagnostic device by performing the primary authentication of the external vehicle diagnostic device when the vehicle diagnostic device requests the diagnosis from the ECU positioned in the vehicle, by transmitting the first response ID and the first failure message to the vehicle diagnostic device when the primary authentication fails, and by forwarding the first response ID and the second failure message from the ECU to the vehicle diagnostic device when the primary authentication is successful.
(58) Hereinabove, although the present disclosure has been described with reference to the embodiments and the accompanying drawings, the present disclosure is not limited thereto, and may be variously modified and altered by those skilled in the art to which the present disclosure

pertains without departing from the spirit and scope of the present disclosure claimed in the following claims.

Claims

1. An apparatus for controlling access of a vehicle diagnostic device, the apparatus comprising: a communicator including a transceiver and configured to provide a communication interface with the vehicle diagnostic device; a connector including a transceiver and configured to provide a connection interface with an electronic control unit (ECU) in a vehicle; and a controller including a processor and configured to: perform primary authentication of the vehicle diagnostic device when the vehicle diagnostic device requests a diagnosis from the ECU, transmit a first response ID and a first failure message to the vehicle diagnostic device when the primary authentication fails, forward the first response ID and a second failure message from the ECU to the vehicle diagnostic device when the primary authentication is successful, forward no diagnostic request from the vehicle diagnostic device to the ECU when the primary authentication fails; and forward the first response ID and the second failure message from the ECU to the vehicle diagnostic device when the ECU fails in secondary authentication of the vehicle diagnostic device.
2. The apparatus of claim 1, wherein the controller is configured to forward the first response ID and diagnostic data from the ECU to the vehicle diagnostic device when the ECU succeeds in secondary authentication of the vehicle diagnostic device.
3. The apparatus of claim 1, wherein the vehicle diagnostic device is configured to confirm an authentication failure in the apparatus for controlling access of the vehicle diagnostic device, based on the first failure message.
4. The apparatus of claim 1, wherein the vehicle diagnostic device is configured to confirm an authentication failure in the ECU, based on the second failure message.
5. The apparatus of claim 1, wherein the controller is configured to perform an authentication of the vehicle diagnostic device when the vehicle diagnostic device requests the diagnosis from the controller, and the controller is configured to transmit a second response ID and the second failure message to the vehicle diagnostic device when the authentication fails.
6. The apparatus of claim 5, wherein the vehicle diagnostic device is configured to confirm an authentication failure in the apparatus for controlling access of the vehicle diagnostic device, based on the second failure message.
7. The apparatus of claim 1, wherein the communicator is configured to provide a wired communication interface with the vehicle diagnostic device or a wireless communication interface with the vehicle diagnostic device.
8. The apparatus of claim 1, wherein the connector is configured to provide the connection interface with a vehicle network to which the ECU is connected.
9. A method of controlling access of a vehicle diagnostic device, the method comprising: requesting, by the vehicle diagnostic device, a diagnosis from an electronic control unit (ECU); performing, by a controller, primary authentication of the vehicle diagnostic device; transmitting, by the controller, a first response ID and a first failure message to the vehicle diagnostic device when the primary authentication fails; and forwarding, by the controller, the first response ID and a second failure message from the ECU to the vehicle diagnostic device when the primary authentication is successful, wherein the transmitting of the first response ID and the first failure message to the vehicle diagnostic device includes forwarding no diagnostic request from the vehicle diagnostic device to the ECU; and wherein forwarding of the first response ID and the second failure message from the ECU to the vehicle diagnostic device includes forwarding the first response ID and the second failure message from the ECU to the vehicle diagnostic device when the ECU fails in secondary authentication of the vehicle diagnostic device.
10. The method of claim 9, wherein the forwarding of the first response ID and the second failure

message from the ECU to the vehicle diagnostic device further includes: forwarding the first response ID and diagnostic data from the ECU to the vehicle diagnostic device when the ECU succeeds in the secondary authentication of the vehicle diagnostic device.

11. The method of claim 9, wherein the transmitting of the first response ID and the first failure message to the vehicle diagnostic device includes: confirming, by the vehicle diagnostic device, an authentication failure in the apparatus for controlling access of the vehicle diagnostic device, based on the first failure message.

12. The method of claim 9, wherein the forwarding of the first response ID and the second failure message from the ECU to the vehicle diagnostic device includes confirming, by the vehicle diagnostic device, an authentication failure in the ECU, based on the second failure message.

13. The method of claim 9, further comprising: performing, by the controller, an authentication of the vehicle diagnostic device when the vehicle diagnostic device requests the diagnosis from the controller; and transmitting, by the controller, a second response ID and the second failure message to the vehicle diagnostic device when the authentication fails.

14. The method of claim 13, wherein the transmitting of the second response ID and the second failure message to the vehicle diagnostic device includes confirming, by the vehicle diagnostic device, an authentication failure in an apparatus for controlling access of a vehicle diagnostic device, based on the second failure message.