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Remarks:
Amended claims in accordance with Rule 137(2) EPC.

(54) An electronic control unit and a method of performing diagnosis in a vehicle

(57) The invention discloses an electronic control device and a method of performing diagnosis in a vehicle. The electronic control unit of the invention is capable of being operated in a diagnostic mode where the resources of the electronic control unit are utilized for diagnostic functions. The method allows activation of a diagnostic mode in the vehicle components which enables communication of diagnostic information between the electronic control units, the vehicle components and a testing device over a communication network.

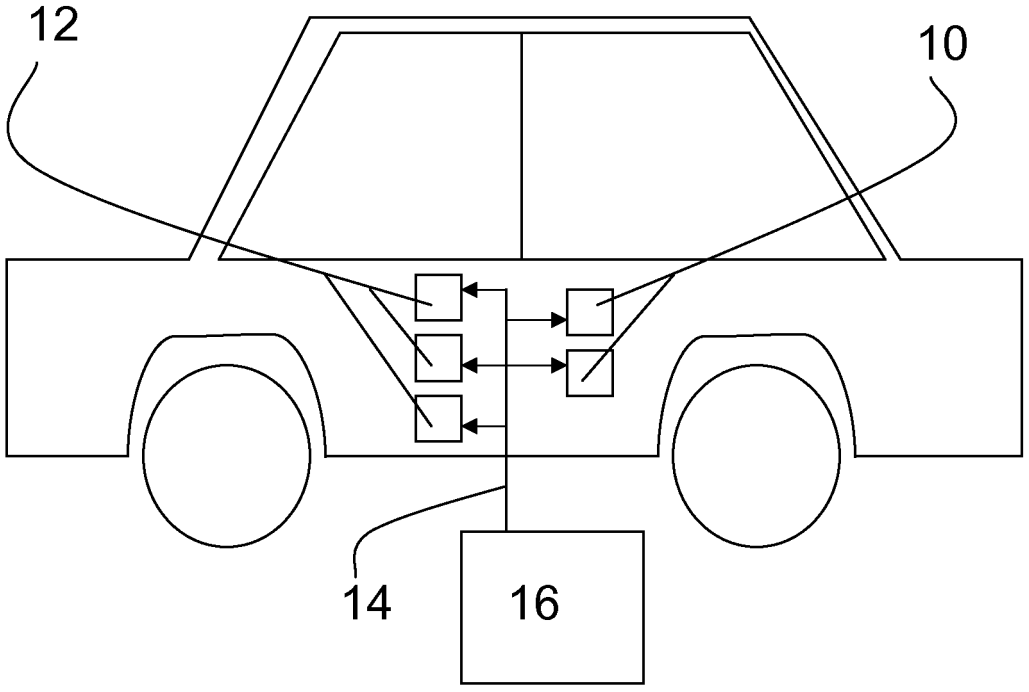

FIGURE 1

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Description

Field of invention

[0001] This invention relates to an electronic control unit and a method of performing diagnosis in a vehicle.

State of the art

[0002] US patent number 7,013,241 discloses an electronic control unit comprising two computers and a method of operating the two computers for performing diagnostic operation in a vehicle, wherein the first computer and the second computer have diagnostic means. Further the first computer performs a set of first diagnostic operations through comparison with predetermined values and the second computer performs diagnosis based on the values obtained from the set of first diagnostic operations.

Advantages of this invention

[0003] The electronic control unit and the method of performing diagnosis of this invention have the following advantages.

[0004] The activation of a diagnostic mode in the electronic control unit provides better allocation of resources in the electronic control unit. The better allocation of resources helps communicate diagnostic information in a more efficient way. The allocation of resources also facilitates better diagnosis as more resources are available as compared to when the electronic control unit was used in a non-diagnostic mode. Also in the diagnostic mode not all operating functions of the normal mode are performed, the resources of the electronic control units thus can be utilized for communicating diagnostic information. Since more resources are available in the diagnostic mode the diagnosis is faster. Examples for the resources which are utilized more efficiently are the working memory and the processing time of the microcontroller of the electronic control units.

[0005] Further the method of performing diagnosis in the diagnostic mode where the diagnostic information is communicated takes place through the existing communication network. Thus no extra hardware would be required for the working of the electronic control unit in the diagnostic mode. Since no extra hardware is required this not only reduces the cost but also makes the process of diagnosis easier.

[0006] Further improvements and/or advantages are realised by the features of the dependent patent claims.

[0007] In the diagnostic mode since all vehicle control functions are not performed, the resources are now available for communicating diagnostic information. Since major part of the resources can be utilized the diagnosis can be performed faster and more efficiently.

[0008] As a diagnostic mode can be activated in the vehicle components, the vehicle components can communicate diagnostic information thus not requiring a testing device to be individually connected to the vehicle components in case multiple faults occur. This reduces the time required for performing diagnosis in the vehicle.

[0009] The diagnostic program can also be loaded onto the electronic control units and the vehicle components this provides the advantage that additional diagnostic features can be provided in comparison to the diagnostic program stored in the memory.

[0010] The method of performing diagnosis wherein the electronic control unit is capable of operating in a normal mode and a diagnostic mode provides better allocation of the resources which helps not only in diagnosing faster but also increases the efficiency of the diagnosis.

[0011] The varied utilization of the working memory in the normal mode and diagnostic mode helps faster communication of the diagnostic information in the diagnostic mode.

[0012] The varying processing time used by the microcontrollers of the electronic control units in the normal mode and the diagnostic mode, allows the electronic control unit to use the microcontroller entirely for the purpose of communicating diagnostic information thus reducing the time required for such communication.

Brief description of the accompanying drawings

[0013] Different modes of the invention are disclosed in detail in the description and illustrated in the accompanying drawing:

Figure 1 illustrates a vehicle in which plurality of electronic control units and vehicle components are connected to a testing device through a communication network in a vehicle.

Detailed description of the embodiments

[0014] Figure 1 illustrates a vehicle in which plurality of electronic control units 10 and vehicle components 12 are connected through a communication network 14 in a vehicle. The connection via the communication network facilitates the electronic control units 10 and the vehicle components 12 to interact with each other. Further Figure 1 shows a testing device 16 which is externally connected to the communication network 14. This connection between the testing device 16 and the communication network 14 allows the testing device 16 to communicate with the electronic control unit 10 and the vehicle components 12.

[0015] Electronic control units 10 form a part of every system provided in a car. Electronic control units 10 are linked to components 12 which are sensor, actuators and the like. Such a link between the electronic control units 10 and the sensors and actuators is realized using a communication network 14 such as a bus system. The sensors and actuators continuously provide information to

the electronic control units 10 regarding the functioning of the vehicle components 12 such as the engine, fuel injection systems, braking systems, airbag system and the like. Electronic control units 10 not only control the function of the sensors and actuators and the vehicle components 12 but also monitor the functioning vehicle components 12 through the sensors, actuators and the like.

[0016] A testing device 16 is externally connected to the electronic control units 10 for communicating diagnostic information and diagnosing the faults occurring in the vehicle components 12 or the electronic control units 10 themselves. The connection between the testing device 16 and the electronic control units 10 is provided through the communication network 14.

[0017] The electronic control unit 10 is capable of operating in a normal mode and a diagnostic mode.

[0018] In the normal mode the electronic control unit 10 performs control functions of controlling the vehicle components 12. In the normal mode the electronic control units 10 are programmed in a manner such that major part of the resources available in the electronic control units 10 such as the working memory capacity is used for storing the diagnostic program and the microcontroller utilizing its processing time to perform normal control function in the vehicle via the components 12. Thus the resources available for diagnosing the vehicle and the components 12 and communicating of the thereby obtained diagnostic information are low. Hence generating and communicating diagnostic information is slow and inefficient.

[0019] Further if we consider a case where it is tried to perform service diagnosis using the normal mode, then major part of the resources such as the working memory and the processing time of the microcontroller are utilized for performing normal control functions. Only a small overhead of the resources would be available for executing the diagnostic programs and communicating diagnostic information. Thus the limited resources such as lower working memory capacity and lower processing capacity of the microcontroller not only increase the time for diagnosis but also not all relevant diagnostic functions can be performed.

[0020] Further, usually the vehicle components 12 cannot communicate diagnostic information with the testing device 16. This would require individually connecting the testing device 16 to the vehicle components 12, which would require extra hardware, which in turn would increase cost. Also in case of multiple faults in the vehicle component 12 and the electronic control unit 10, unless the testing device 16 is separately connected to the electronic control units 10 and the vehicle component 12, it would be difficult to pin point where the fault occurred. Hence efficient diagnosis of the vehicle cannot be performed. So it is advantageous that the components 12 also have a normal mode and a diagnostic mode.

[0021] In the diagnostic mode the electronic control unit 10 is programmed such as to perform a diagnosis and communicate diagnostic information with vehicle components 12 and the testing device 16. The electronic control unit 10 in the diagnostic mode does not perform all the vehicle control functions as it does in the normal mode, since during diagnostic mode the resources of the electronic control unit 10 are dedicated to performing diagnostic functions.

[0022] If a vehicle enters a workshop for service diagnosis and diagnosis is to be performed. Then for communicating diagnostic information, first a connection is established between the testing device 16 and the communication network 14. The connection between the testing device 16 and the communication network 14 enables electronic control units 10, the testing device 16 and the vehicle components 12 to communicate with each other over the communication network 14.

[0023] The testing device 16 activates a diagnostic mode in the electronic control units 10, wherein a diagnostic program in the electronic control units 10 is activated which helps in communicating the diagnostic information between the electronic control unit 10, testing device 16 and the vehicle components 12. In this diagnostic mode the electronic control units 10 are programmed such that the working memory capacity of the electronic control units and the processing time of microcontroller is utilized for processing the diagnostic program. Further there is also a possibility of activating a diagnostic mode in the vehicle components 12. In the diagnostic mode a diagnostic program in the vehicle components 12 is executed by software using a local mini-microcontroller or special hardware meant for executing diagnostic programs. This allows the testing device 16 to communicate not only with the electronic control units 10 but also with the vehicle components 12. Further in the diagnostic mode internal information in the electronic control units 10 or components 12 which are normally not communicated to the outside of the electronic control units 10 or components 12 may be given onto the network 14. In the diagnostic mode the functions performed by the electronic control unit 10 and the vehicle components 12 vary in comparison with their operation in the normal mode.

[0024] In the diagnostic mode major part of working memory and major part of processing time of the microcontroller is utilized for processing the diagnostic program. Thus due to efficient utilization of the working memory capacity and the microcontroller, whenever multiple faults are detected, either originating from the electronic control units 10 or from the vehicle components 12. Information regarding these faults can be communicated to the testing device 16 quickly and more efficiently.

[0025] The diagnostic program is either stored in the memory of the electronic control units 10 and vehicle components 12 or can be loaded onto the memory of the electronic control unit 10 and the vehicle components 12 from the testing device 16 via the communication network.

[0026] The method of performing diagnosis in a diagnostic mode is useful in the case of service diagnosis. In

service diagnosis since the vehicle is not operating in the normal operating conditions the utilization of the memory capacity and the usage of the microcontroller in the electronic control units 10 in the diagnostic mode provides faster and efficient communication of diagnostic information. Further the diagnostic program also provides that the vehicle components 12 are capable of communicating diagnostic information with the electronic control units 10 and the testing device 16. Also since the communication of the diagnostic information is effected over the existing communication network, this reduces the cost for extra hardware, which may be otherwise incurred for individually connecting the testing device 16 to the vehicle components 12 and the electronic control units 10.

Claims

1. An electronic control unit in a vehicle, said electronic control unit adapted to be operated in a normal mode and a diagnostic mode, in said normal mode said electronic control unit performing control functions of the vehicle and in said diagnostic mode the electronic control unit adapted to communicate diagnostic information with components in a vehicle and a testing device.

2. An electronic control unit as claimed in claim 1, wherein the electronic control in said diagnostic mode said electronic control unit is adapted such that not all vehicle control functions of the normal mode are performed.

3. A method of performing diagnosis in a vehicle, said method comprising following steps:

   (i) establishing a connection between a vehicle testing device and a communication network, said communication network allowing said vehicle testing device to communicate with electronic control units and components in a vehicle;
   (ii) activating a diagnostic mode in said electronic control units, in said diagnostic mode a diagnostic program in said electronic control unit is activated;
   (iii) communicating in said diagnostic mode diagnostic information between said testing device, said electronic control units and said components, said communication effected over the communication network.

4. A method as claimed in claim 3, wherein said diagnostic mode is activated in said vehicle components.

5. A method as claimed in claim 3, wherein while activating a diagnostic mode a diagnostic program stored in a memory of said electronic control units and components in a vehicle is activated.

6. A method as claimed in claim 3, wherein while activating diagnostic mode a diagnostic program is loaded onto said electronic control units and component in a vehicle from said vehicle testing device.

7. A method as claimed in claim 3, wherein said electronic control unit is adapted to operate in a normal mode, in said normal mode said electronic unit performing normal control function in a vehicle.

8. A method as claimed in claim 3, wherein said electronic control unit is adapted to operate in said diagnostic mode, in said diagnostic mode said electronic control unit is adapted such that not all vehicle control functions of the normal mode are performed.

9. A method as claimed in claims 5 to 8, wherein said electronic control unit comprising a working memory (RAM), said working memory adapted such that in said normal mode major part of said working memory is utilized to perform normal control functions in a vehicle and in said diagnostic mode major part of said working memory is utilized to communicate diagnostic information.

10. A method as claimed in claims 5 to 9, **characterized in that** said electronic control unit comprising a microcontroller having a processing time, in said normal mode major part of the processing time is utilized to perform normal control operations in a vehicle and in said diagnostic mode major part of said processing time is utilized to communicate diagnostic information.

Amended claims in accordance with Rule 137(2) EPC.

1. An electronic control unit in a vehicle, said electronic control unit adapted to be operated in a normal mode and a diagnostic mode, in said normal mode said electronic control unit performing control functions of the vehicle and in said diagnostic mode the electronic control unit adapted to communicate diagnostic information with components in a vehicle and a testing device
characterized in that in said diagnostic mode the resources of said electronic control unit are dedicated to performing diagnostic functions (pg 5 line 15).

2. A method of performing diagnosis in a vehicle, said method comprising following steps:

   (i) establishing a connection between a vehicle testing device and a communication network, said communication network allowing said vehicle testing device to communicate with electronic control units and components in a vehicle;

(ii) activating a diagnostic mode in said electronic control units, in said diagnostic mode a diagnostic program in said electronic control unit is activated;
(iii) communicating in said diagnostic mode diagnostic information between said testing device, said electronic control units and said components, said communication effected over the communication network

characterized in that dedicating the resources of said electronic control unit for performing diagnostic functions in said diagnostic mode (pg 5 line 15)

3. A method as claimed in claims 2, wherein said electronic control unit comprising a working memory (RAM), said working memory adapted such that in said normal mode major part of said working memory is utilized to perform normal control functions in a vehicle and in said diagnostic mode major part of said working memory is utilized to communicate diagnostic information.

4. A method as claimed in claims 2, **characterized in that** said electronic control unit comprising a microcontroller having a processing time, in said normal mode major part of the processing time is utilized to perform normal control operations in a vehicle and in said diagnostic mode major part of said processing time is utilized to communicate diagnostic information.

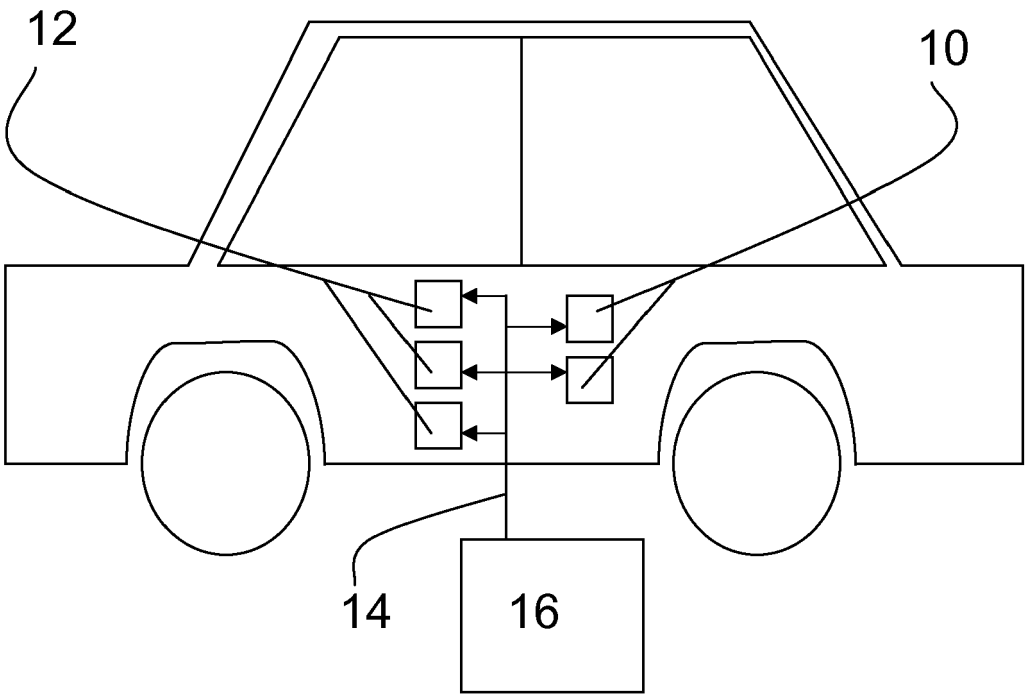

FIGURE 1

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EUROPEAN SEARCH REPORT

Application Number
EP 08 10 3494

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)

G07C
G06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	17 September 2008	Van der Haegen, D

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