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(54) Handling a malfunction of a rail vehicle

(57) The invention relates to a method of handling a malfunction of a rail vehicle, wherein the rail vehicle comprises a plurality of devices (T1) which possibly malfunction, wherein at least one sensor (17) is combined with each device (T1) for sensing a malfunction of the device (T1), wherein at least one actuator (S1) is combined with the device (T1) and/or with the sensor (17) for acting in case of a malfunction and wherein the method comprises
a) identifying possible malfunctions of the devices (T1),
b) identifying at least one sensor (17) which can sense the possible malfunction,
c) identifying for each identified malfunction an actuator (S1) which can be used to handle the malfunction,
d) identifying locations where the identified actuators (S1) can be manipulated in order to handle the malfunctions and
e) detecting a malfunction by analyzing signals from the at least one sensor (17) and determining the location or locations where the respective actuator (S1) can be manipulated in order to handle the detected malfunction.

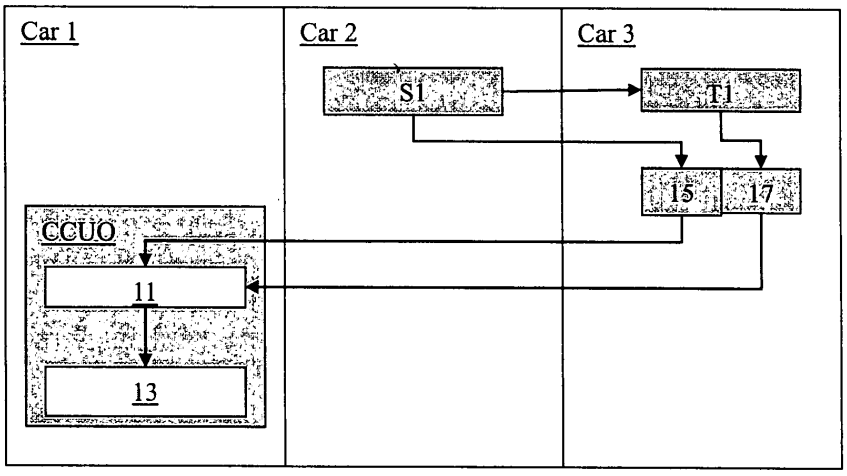

Fig. 1

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Description

[0001] The invention relates to a method of handling a malfunction of a rail vehicle and to a system for handling a malfunction of a rail vehicle.

[0002] Rail vehicles comprise several devices, such as the traction system of the rail vehicle, passenger doors, lights, heating and ventilation devices and the braking system. In particular, during the operation of the rail vehicle, one device or more than one device may malfunction. For example, a passenger door cannot be closed or a part of the traction system is overheated. For safety or operational reasons, the driver of the rail vehicle may not be allowed to continue driving the vehicle. However, the driver may be able to handle the malfunction in such a manner that the rail vehicle is allowed to continue travelling.

[0003] Devices and systems within rail vehicles are complex. The electric system of a door controller for controlling the opening and closing of a passenger door may be located far away from the passenger door. In addition, several sensors for sensing the operating state of the devices within the rail vehicle may be distributed all over the rail vehicle. In order to save space, the sensors or data transfer interfaces to the sensors may be located at different locations as the sensor itself.

[0004] It is an object of the present invention to provide a method of handling a malfunction of a rail vehicle and to provide a system for handling a malfunction of a rail vehicle which increases the chances that operation of the rail vehicle can be continued despite a malfunction.

[0005] The object is solved by a method according to claim 1 and by a system according to claim 4.

[0006] In addition, the invention also includes a rail vehicle which comprises the system for handling a malfunction of the rail vehicle.

[0007] According to a basic idea of the invention, the rail vehicle comprises a plurality of devices which possibly malfunction. At least one sensor is combined with each device for sensing a malfunction of the device. In other words, there is at least one sensor for each device which is to be controlled and the signals of the at least one sensor can be analysed to detect a malfunction of the respective device. It is possible that at least some of the sensors are adapted to detect malfunctions of different devices. Furthermore, at least one actuator is combined with the device and/or with the sensor. The actuator is adapted to act in case of a malfunction. However, the actuator is to be manipulated in order to act and thereby to handle the detected malfunction.

[0008] In order to prepare the handling of possible malfunctions, each possible type of information which can be read from the sensors is identified. For example, the information can be basic information or elaborated information that involves information from other devices or systems of the rail vehicle. For example, the information may be the operational status of a passenger door. In order to detect a malfunction of the door (e.g. the door is open) additional information may be needed from a second sensor, for example a speed sensor which detects if the rail vehicle is travelling or not. If the door is open and the vehicle is travelling, the door is malfunctioning.

[0009] In addition, it is identified for each of the information which can be read from a sensor where the information can be obtained. In particular, it can be obtained at a data interface which is connected to the respective sensor or sensors.

[0010] Furthermore, for each of the information and the location where the information can be obtained, the respective actuator or actuators which can act in order to handle the malfunction is/are identified.

[0011] In order to enable a user to manipulate the actuator or actuators, the location or locations is/are identified where the actuator or actuators can be manipulated. Then, the identified data are processed to build a model which includes the identified location or locations. In particular, the data processing can be performed if a malfunction occurs. For example, one of the several passenger doors of the rail vehicle does not close. By analysing the collected data the location can be determined where the user can manipulate the respective actuator or actuators.

[0012] It might happen that the user needs to manipulate the actuator or actuators at different locations. Preferably, the method includes a step in which a first location is determined where a first respective actuator is to be manipulated first and a second location is to be determined where the first respective actuator or a second respective actuator is to be manipulated afterwards.

[0013] The collected data about the possible malfunctions of the devices, about the respective sensor or sensors which can sense the possible malfunctions and about the respective actuator or actuators which can be used to handle the malfunction can be structured as a tree structure. Each branching point of the tree structure is related to at least one signal of the sensor or sensors so that it can be decided which branch of the tree to follow in order to arrive at an actuator or actuators. Then, the location or locations of the actuator or actuators is/are identified and can be output to the user.

[0014] Preferably, the determined location or locations are output to the user so that the user can manipulate the actuator or actuators at the location or the locations. The system may comprise a corresponding output unit which is adapted to output the determined location or locations to the user. For example, a picture of the rail vehicle may be displayed showing the location or locations.

[0015] By identifying and outputting the location or locations of the actuator or actuators, the availability of the vehicle is increased and time is saved for the user (e.g. the driver). In particular, it can be avoided that the user goes to the location of the malfunctioning device to recognise there that the respective actuator is located at a different location.

[0016] Also, the time which is spent by the user to go to several locations can be minimised, since it is preferably calculated which location should the user to go first, which next and so on. These locations and their sequence can be displayed or output to the user.

[0017] Examples of the present invention are described with reference to the attached Figures. The Figures show:

Fig. 1 schematically an arrangement of three cars of a rail vehicle,

Fig. 2 a table indicating location of sensors, devices and anomaiies of the structure shown in Fig. 1

[0018] Fig. 1 shows three cars of a train. Car 1 comprises a central part CCUO of the system for handling the malfunction of the rail vehicle. The central part CCUO comprises a unit 11 for detecting anomalies, i.e. malfunction. If the detecting unit detects such a malfunction, it outputs a signal to a determination unit 13 which is adapted to determine the location or locations where the respective actuator can be manipulated in order to handle the detected malfunction. The unit 11 is connected to output connections of two different data interfaces 15, 17. The unit 11 receives data from these data interfaces 15, 17. Data interface 17 includes a sensor for sensing the operation state of a device T1, which may be part of the traction system of the vehicle. The device T1 can be manipulated using an actuator S1. Furthermore, an operation state of the actuator S1 is detected or the information about the operation state of the actuator S1 is simply transferred to the data interface 15.

[0019] The device T1 which possibly malfunctions is located in car 3, together with the data interfaces 15, 17. The actuator S1 which can manipulate the operation state of device T1 is located in a different car, car 2.

[0020] Fig. 2 shows a table which is prepared for handling malfunction. The columns of the table refer to the car number. There are four cars. However, car 4 is not shown in Fig. 1.

[0021] The respective location of the devices, sensors and actuators which are listed in column 1 of the table in Fig. 2 are marked by a cross in the respective column of the respective car. It should be noted that the anomaly of the device is detected in car 3 and the respective information is available at the interface 17 in car 3. Furthermore, information about the actuator state is also available in car 3, at interface 15.

[0022] The information about the actual location of the actuator is used by a data operation function called "location mask 1" which is also listed in the first column of Fig. 2. This function uses the information about the location of the actuator to indicate that the actuator is located in car 2 instead of car 3. Consequently, this information, namely that the user should go to car 2 in order to manipulate device T1, can be correctly output to the user, whereas the malfunction is originally detected at another location.

[0023] The alternative functions "location mask 2" and "location mask 3" which are listed in the last two lines in Fig. 2 illustrate that alternative location information might lead to other results. In case of "location mask 2", the user should go to car 4. In case of "location mask 3", the user should go to car 2 and to car 4. Optionally, it can be indicated to the user to which location, either car 2 or car 4, he should go first.

Claims

1. A method of handling a malfunction of a rail vehicle, wherein the rail vehicle comprises a plurality of devices (T1) which possibly malfunction, wherein at least one sensor (17) is combined with each device (T1) for sensing a malfunction of the device (T1), wherein at least one actuator (S1) is combined with the device (T1) and/or with the sensor (17) for acting in case of a malfunction and wherein the method comprises

   a) identifying possible malfunctions of the devices (T1),
   b) identifying at least one sensor (17) which can sense the possible malfunction,
   c) identifying for each identified malfunction an actuator (S1) which can be used to handle the malfunction,
   d) identifying locations where the identified actuators (S1) can be manipulated in order to handle the malfunctions and
   e) detecting a malfunction by analyzing signals from the at least one sensor (17) and determining the location or locations where the respective actuator (S1) can be manipulated in order to handle the detected malfunction.

2. The method of the preceding claim, wherein in step e) a first location is determined where a first respective actuator is to be manipulated first and a second location is determined where the first respective actuator or a second respective actuator is to be manipulated afterwards.

3. The method of one of the preceding claims, wherein the determined location or locations are output to a user so that the user can manipulate the actuator (S1) or actuators at the location or the locations.

4. A system for handling a malfunction of a rail vehicle, wherein the rail vehicle comprises a plurality of devices (T1) which possibly malfunction, wherein at least one sensor (17) is combined with each device (T1) for sensing a malfunction of the device (T1), wherein at least one actuator (S1) is combined with the device (T1) and/or with the sensor (17) for acting

in case of a malfunction, wherein the system comprises data transfer connections to the sensors (17) and a data storage and/or data input for receiving information about

a) possible malfunctions of the devices (T1),
b) at least one sensor (17) which can sense the possible malfunction,
c) an actuator (S1) for each identified malfunction which can be used to handle the malfunction,
d) locations where the identified actuators (S1) can be manipulated in order to handle the malfunctions and

wherein an evaluation unit (CCUO) of the system is adapted - using the information according to items a) to d) - to detect a malfunction by analyzing signals from the at least one sensor and to determine the location or locations where the respective actuator can be manipulated in order to handle the detected malfunction.

5. The system of the preceding claim, wherein the system comprises an output unit which is adapted to output the determined location or locations to a user so that the user can manipulate the actuator (S1) or actuators at the location or the locations.

6. A rail vehicle which comprises a plurality of devices which possibly malfunction, wherein at least one sensor (17) is combined with each device (T1) for sensing a malfunction of the device (T1), wherein at least one actuator (S1) is combined with the device (T1) and/or with the sensor (17) for acting in case of a malfunction, and wherein the rail vehicle further comprises the system of one of the preceding system claims.

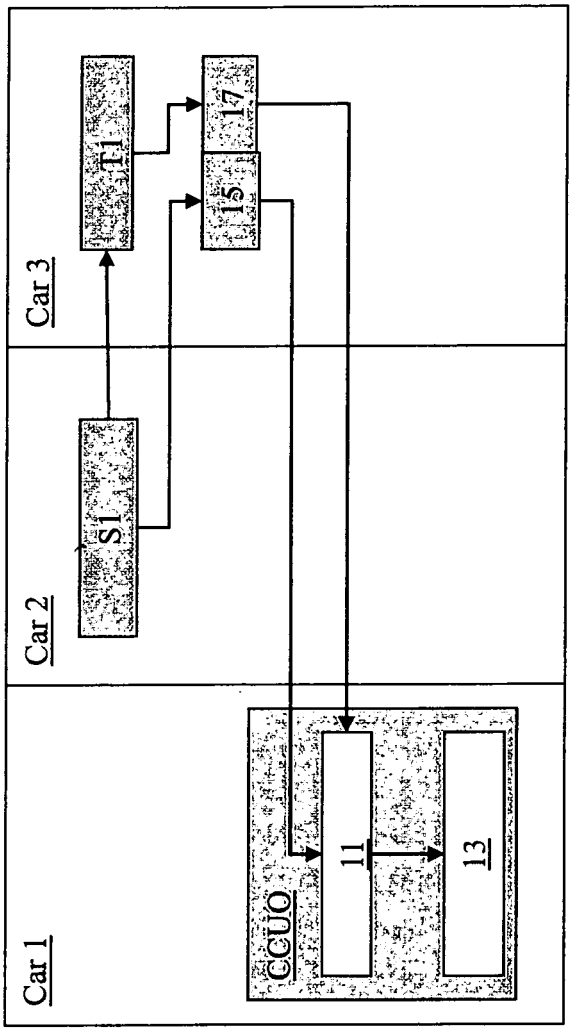

Fig. 1

Car	1	2	3	4
Device/Sensor			x	
Actuator		x		
Device anomaly			x	
Actuator state			x	
Location mask 1		x		
Location mask 2				x
Location mask 3		x		x

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 10 00 5446

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	HEIKO MALY ET AL: "Diagnosetexte in Schienenfahrzeugen" EISENBAHN-REVUE INTERNATIONAL, VERLAG MINIREX, LUZERN, CH, vol. 8-09, 1 August 2005 (2005-08-01), pages 401-405, XP009091817 ISSN: 1421-2811 * the whole document *	1-6	INV. B61L15/00 G01M17/08
A	DE 10 2006 037562 A1 (SIEMENS AG [DE]) 14 February 2008 (2008-02-14) * paragraph [0011] - paragraph [0012] *	1-6	
A	US 5 445 347 A (NG JOSEPH S [US]) 29 August 1995 (1995-08-29) * column 7, line 38 - column 8, line 8 *	1-6	
A	ASTROM P: "Control Electronics On Rail Vehicles" 19920331; 19920331 - 19920402, 31 March 1992 (1992-03-31), pages 107-116, XP010274129 ISBN: 978-0-7918-0372-1 * page 111, left-hand column, paragraph 6 - page 111, right-hand column, last paragraph *	1-6	TECHNICAL FIELDS SEARCHED (IPC) B61L G01M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	7 October 2010	Janhsen, Axel

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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E : earlier patent document, but published on, or after the filing date
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07-10-2010

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82