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(71) Applicant: **KONE Corporation**
00330 Helsinki (FI)

(72) Inventors:
- **HAUTAKORPI, Jani**
  00330 HELSINKI (FI)
- **KINNARI, Jouko**
  00330 HELSINKI (FI)

(74) Representative: **Berggren Oy, Helsinki & Oulu**
P.O. Box 16
Eteläinen Rautatiekatu 10A
00101 Helsinki (FI)

(54) MONITORING OF OPERATIONAL CONDITION OF AN ELEVATOR

(57) The present invention relates to a method for detecting an operational condition of an elevator. In the method sound data is received from a plurality of microphones (160A, 160B, 160C); an indicator value is generated (320), on the basis of the received sound data; the generated indicator value is compared (330) to a reference value; a detection result is set (340), in accordance with a comparison between the generated indicator value and the reference value, to express one of the following: a) the operational condition of the elevator is default, b) the operational condition of the elevator deviates from default. The invention also relates to a data processing device.

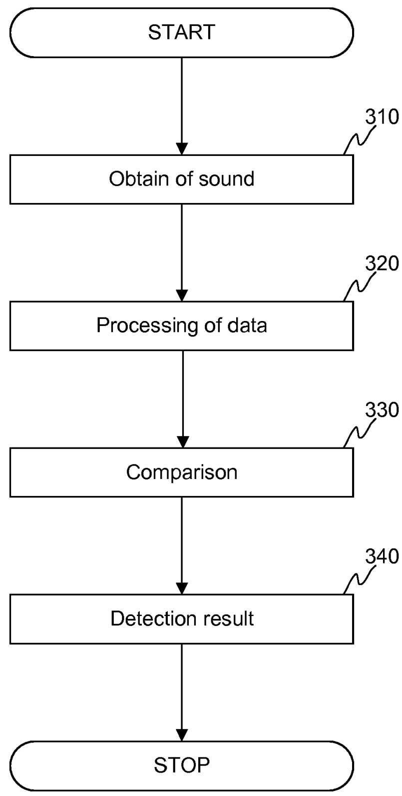

FIGURE 3

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Description

TECHNICAL FIELD

[0001] The invention concerns in general the technical field of elevator systems. More particularly, the invention concerns diagnostic solutions for elevators.

BACKGROUND

[0002] Diagnostics is an important area in a context of devices and systems for monitoring an operational condition of those. In a preferred situation, the diagnostics solutions enable detection of any fault of the device or the system in advance before the device or the system starts malfunctioning due to the fault, or even gets damaged. The detection and maintenance before the device or the system gets damaged is better from an economic point of view than waiting until the device or the system breaks down and the maintenance is done after that.

[0003] In elevator systems, the diagnostics is typically based on solutions which are arranged to monitor certain parameters representing an operation of the elevator. The solutions may be implemented with monitoring circuits comprising e.g. sensors mounted in the elevator for obtaining information. In addition, a data center may be arranged to analyze the obtained data and/or to make decisions as regards to operational condition of the elevator in question.

[0004] The existing diagnostic solutions operate well within the limits of the technology they are based on. However, there is always a possibility and a need to improve existing diagnostic solutions and to improve a capability to make detections on faults.

SUMMARY

[0005] The following presents a simplified summary in order to provide basic understanding of some aspects of various invention embodiments. The summary is not an extensive overview of the invention. It is neither intended to identify key or critical elements of the invention nor to delineate the scope of the invention. The following summary merely presents some concepts of the invention in a simplified form as a prelude to a more detailed description of exemplifying embodiments of the invention.

[0006] An objective of the invention is to present a method and a data processing device for detecting an operational condition of an elevator. Another objective of the invention is that the method and the data processing device for detecting the operational condition of an elevator may be based on a determination of soundscape of the elevator.

[0007] The objectives of the invention are reached by a method and a data processing device as defined by the respective independent claims.

[0008] According to a first aspect, a method for detecting an operational condition of an elevator is provided, the method comprising: receiving sound data from a plurality of microphones, the sound data is obtained at least during an operation of the elevator; generating an indicator value, on the basis of the received sound data, the indicator value representing a soundscape at an instant of time during the operation of the elevator; comparing the generated indicator value to a reference value; setting, in accordance with a comparison between the generated indicator value and the reference value, a detection result to express one of the following: a) the operational condition of the elevator is default, b) the operational condition of the elevator deviates from default.

[0009] The reference value may be generated during a default operation of the elevator.

[0010] The reference value used in the comparison may be selected on a basis of at least one of the following: an instant of time of the operation of the elevator, at least one parameter representing a motion of an elevator car, a load of an elevator car. The parameter representing the motion of the elevator car may be one of the following: a position of the elevator car in its path, a speed of the elevator car, an acceleration of the elevator car, a direction of the movement of the elevator car.

[0011] The reference value may be inquired from data storage.

[0012] A representation of the indicator value and the reference value may be one of the following: two dimensional data array, three dimensional data array, a vector representation.

[0013] According to a second aspect, a data processing device is provided, the data processing device comprising: processing unit; memory unit including computer program code; the memory unit and the computer program code configured to, with the processing unit, cause the data processing device to perform: receive sound data from a plurality of microphones, the sound data is obtained at least during an operation of the elevator; generate an indicator value, on the basis of the received sound data, the indicator value representing a soundscape at an instant of time during the operation of the elevator; compare the generated indicator value to a reference value; set, in accordance with a comparison between the generated indicator value and the reference value, a detection result to express one of the following: a) the operational condition of the elevator is default, b) the operational condition of the elevator deviates from default.

[0014] The data processing device may further be configured to generate the reference value during a default operation of the elevator.

[0015] The data processing device may be further configured to select the reference value used in the comparison on a basis of at least one of the following: an instant of time of the operation of the elevator, at least one parameter representing a motion of an elevator car, a load of an elevator car. The data processing device may be configured to use as the parameter representing the motion of the elevator car one of the following: a position of the elevator car in its path, a speed of the elevator car, an acceleration of the elevator car, a direction of the movement of the elevator car.

[0016] The data processing device may further be configured to inquire the reference value from data storage.

[0017] The data processing device may be configured to use as a representation of the indicator value and the reference value one of the following: two dimensional data array, three dimensional data array, a vector representation.

[0018] The data processing device may be at least one of the following: a processing unit implemented in a device with the microphones, a stand-alone device, an elevator controller, a device implemented in the data center with at least one server device.

[0019] The expression "a number of" refers herein to any positive integer starting from one, e.g. to one, two, or three.

[0020] The expression "a plurality of" refers herein to any positive integer starting from two, e.g. to two, three, or four.

[0021] Various exemplifying and non-limiting embodiments of the invention both as to constructions and to methods of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific exemplifying and non-limiting embodiments when read in connection with the accompanying drawings.

[0022] The verbs "to comprise" and "to include" are used in this document as open limitations that neither exclude nor require the existence of unrecited features. The features recited in dependent claims are mutually freely combinable unless otherwise explicitly stated. Furthermore, it is to be understood that the use of "a" or "an", i.e. a singular form, throughout this document does not exclude a plurality.

BRIEF DESCRIPTION OF FIGURES

[0023] The embodiments of the invention are illustrated by way of example, and not by way of limitation, in the figures of the accompanying drawings.

Figure 1 illustrates schematically an example of an environment in which the present invention may be applied to.

Figures 2a and 2b illustrate schematically examples of representations of the obtained sound according to some embodiments of the invention.

Figure 3 illustrates schematically a method according to an embodiment of the invention.

Figure 4 illustrates schematically a non-limiting example of a data processing device according to an embodiment of the invention.

DESCRIPTION OF THE EXEMPLIFYING EMBODIMENTS

[0024] The specific examples provided in the description given below should not be construed as limiting the scope and/or the applicability of the appended claims. Lists and groups of examples provided in the description given below are not exhaustive unless otherwise explicitly stated.

[0025] Figure 1 schematically illustrates an example of an environment in which the present invention may be applied to. The environment according to an embodiment may comprise an elevator system comprising the devices and means for enabling the elevator to operate. In Figure 1 only some entities of the elevator system are schematically illustrated. These are an elevator car 110 arranged to move in a shaft under control of an elevator controller 120. The elevator controller 120 may e.g. be configured to generate a control signal to an elevator drive in order to produce necessary power for a hoist machine 130, for example. The elevator controller 120 may also be configured to control a number of other entities as well as to receive input e.g. from an elevator calling device (not shown). In some implementation, the elevator system may be communicatively coupled to a data center 140 e.g. through a communication network 150. The data center 140 may comprise one or more computing units, such as servers, configured to perform predetermined tasks, such as monitoring an operation of one or more elevator systems residing in different locations. The communication between the elevator controller 120 and the communication network 150 as well as between the data center 140 and the communication network 150 may be implemented in a wired or in a wireless manner by applying applicable communication technology or technologies. The communication network 150 may refer to a data network or a mobile communication network, for example.

[0026] According to an embodiment as schematically illustrated in Figure 1 a plurality of sound sensing devices called as microphones 160A, 160B, 160C from now on are mounted in the environment in order to obtain sound in the environment in question. Data representing the obtained sound may be transferred, in the described embodiment, to the elevator controller 120 from each of the microphones 160A, 160B, 160C. The elevator controller 120 may be configured to process the data representing the sound obtained with the plurality of microphones 160A, 160B, 160C. The processing of the data may refer to a generation of a representation of a soundscape at least at one instant of time. The representation of the soundscape may refer to a result indicating, or from which it is derivable, at least a direction of the obtained sound and the sound level, i.e. the strength of the sound. The determination of the direction and the signal strength may advantageously be based on the signal obtained from the plurality of microphones 160A, 160B, 160C. For example, in the determination a time differences between obtained sound signal by the different microphones 160A, 160B, 160C may be used as well as the signal strength information of each of the signals. The outcome of the processing of information may e.g. be a two dimensional or three dimensional representation, such as a matrix as schematically illustrated in Figures 2a and 2b. As the two dimensional data array, or matrix, provides at least some information on the soundscape the three dimensional matrix may represent the space, or at least some sub-space of the space, whose soundscape is represented with the matrix at a certain instant of time. Hence, the processing of the data may, in accordance with the described embodiment, to generate a matrix wherein each element of the matrix (e.g. sub-space) may comprise a signal strength value. The signal strength value of each element represents a sound value determined to be originated from the position of the space represented by the element in question. In Figure 2a the signal strength values experienced in the microphones from certain directions may be expressed with signal strength values (S11-S44). In the three dimensional expression signal strength values originating from each sub-space may be determined. In Figure 2b only signal strength values (S111-S441) of the first layer are schematically illustrated due to clarity reasons. For example, the determination may indicate that a sound originates only from a certain sub-space of the space under monitoring. In such a case, the signal strength value is the highest in the sub-space in question, whereas the signal strength values in the other sub-spaces are clearly smaller, or even zero. The matrix as depicted in Figure 2b, or in Figure 2a) is a non-limiting example, and the dimensions, i.e. a number of sub-spaces, may vary in accordance with an accuracy of the system configured to perform the determination. For example, by increasing the number of microphones 160A-160C for obtaining the sound signals from the space under monitoring an increased accuracy may be achieved. In some embodiment, it is possible to determine a vector having a direction and a magnitude which is formed mathematically from the signal strength values of the matrix elements.

[0027] As mentioned above the embodiment as schematically illustrated in Figure 1 is based on an implementation in which the elevator controller 120 is configured to perform the processing of obtained data by the plurality of microphones 160A, 160B, 160C. In some other embodiments, the processing of data may be arranged in some other elements. For example, the data processing may be performed in the data center 140. In that embodiment, the data obtained with the microphones 160A, 160B, 160C may be transferred to the data center for processing 140. The transfer of the data may e.g. be arranged through the elevator controller 120. Moreover, the data processing may be implemented with a dedicated data processing device residing locally in a location of the elevator. For example, the data processing device may be configured to obtain the data from the microphones 160A, 160B, 160C and perform the processing. The data processing device may be communicatively coupled to the elevator controller 120, or it may comprise necessary communication device, such as a wireless modem, for communicating with any external device, such as with the data center 140 through e.g. the communication network 150. In some further embodiment, the processing of data obtained by the microphones 160A, 160B, 160C may be performed by a plurality of processing entities, such as by any combination of the mentioned ones. For example, the dedicated data processing device may perform some pre-processing of data and deliver the pre-processed data to some other entity, such as to the data center 140 for performing the final processing of the data.

[0028] Further, the microphones 160A, 160B, 160C and any data processing device mentioned above may be considered to form a device, such as a so called acoustic camera, which may be understood as an imaging device used to locate sound sources and to characterize them. It may consist of a group of microphones - also called microphone array - that may be simultaneously acquired to form a representation of the location of the sound sources.

[0029] The generation of the soundscape with the implementation as described above may require spatial information on positions of the microphones 160A, 160B, 160C in the space as described. This is especially true if the microphones 160A, 160B, 160C are positioned distinct to each so that it may not be considered, within a limit of accuracy of the system that the microphones 160A, 160B, 160C do not locate at the same position.

[0030] The above described embodiments of the present invention disclose some advantageous implementations of the invention. However, a simple form the invention may be implemented so that two sound sensing devices called i.e. microphones are arranged in a predetermined position within the elevator, such as in the elevator shaft or in the elevator car. With this kind of implementation, it is possible to obtain the sound information for generating a representation of the soundscape wherein the representation may refer to a sound spectrum. Additionally, the direction of the sound may be determined from the data obtained with the microphones.

[0031] Some further aspects of the present invention are described by referring to Figure 3 schematically illustrating an example of a method according to an embodiment of the invention. For a purpose of performing the method as will be described reference value, such as one or more reference values, may be generated in advance. The reference value may refer, in a context of elevator solution where an operation of the elevator is monitored at least in part on a basis of sound information obtained from the location where the elevator operates, to obtained sound data when the elevator operates properly. More specifically, the generation of the reference value may be arranged so that a test drive is arranged with the elevator in question. The test drive may e.g. be arranged so that the elevator is controlled to move a predetermined path and during the motion the reference value is generated by obtaining, i.e. recording, the soundscape. The predetermined path, as a non-limiting example of it, may refer to controlling the elevator car 110 to travel from a top floor to a bottom floor and back and the generated sound from the drive is obtained as a reference value. The obtained reference value may be labeled with time information and/or position information. In this manner, a database storing the reference value may be generated. In some further embodiments, the reference value may be generated for different loads i.e. the elevator car 110 is driven with different loads. This approach is based on an idea that the soundscape may vary, at least in part, in accordance with a total load of the elevator car 110. If the reference value is generated in this manner each reference value may be labeled also with the load information. The labeling may also be performed so that it provides detailed information on the motion of the elevator car. This kind of information may e.g. be direction of the motion of the elevator car 110 (e.g. upwards/downwards/horizontally), a speed of the elevator car 110, an acceleration of the elevator car 110 as well as the already mentioned pieces of information, such as instants of time, a position of the elevator car 110. The generated reference value may be stored in data storage accessible to a data processing unit, or units, performing the method to be described. Depending on the implementation of the invention the generated reference value may be in a similar form as illustrated in Figures 2a or 2b or it may be a vector representing the soundscape, wherein the vector has a direction and a magnitude.

[0032] Now, by referring back to Figure 3 schematically illustrating at least some aspects of the method according to an embodiment it is introduced a solution by means of which it is possible to detect an operational condition of an elevator at least in part. For describing at least some aspects of the method it is hereby assumed, as a non-limiting example, that an elevator controller 120 is configured to perform at least some steps of the method, such as processing of information in a role of data processing unit.

Regarding step 310:

[0033] First, a predetermined number of sound sensing devices i.e. microphones 160A-160C are arranged to one or more positions in a space which positions are selected so that the microphones 160A-160C may obtain sound generated at least by the elevator especially when the elevator car 110 is in motion. The positions of the microphones 160A-160C are known within the space. In some example of the invention the microphones 160A-160C may be activated to capture sound in response to a trigger signal received from a control device, such as from an elevator controller 120. According to some embodiment the trigger signal may be generated in response to a receipt of an elevator call signal in the elevator controller 120.

[0034] In step 310 the microphones are configured to obtain sound from the space and to transform the obtained sound to data signal representing the sound obtained with the microphone 160A-160C in question. The data representing the sound obtained with the microphone in question 160A-160C may be transferred to the data processing unit, such as to the elevator controller 120, for further use.

Regarding step 320:

[0035] Next, the data processing unit may be configured to process the data. The processing of data may refer to a generation of an indicator value representing a soundscape of the space. The indicator value may e. g. be generated at one or more predetermined instants of time or continuously during the movement of the elevator car 110 in a shaft. Moreover, the representations may be associated with a position of the elevator car 110 in its path with any further information, such as direction of the movement, for example. The generated representation, i.e. the indicator value, may correspond to the one schematically illustrated in Figure 2a or Figure 2b. The generated indicator value may be tied to any other parameter in addition or alternatively to the time or the position. For example, the indicator value may be generated with respect to a speed or an acceleration of the elevator car 110 in the shaft, for example. According to an embodiment, the generated indicator value may be furnished with information on a load of the elevator car 110.

[0036] In some other embodiment, the representation of the soundscape i.e. the indicator value may refer to a determination of a vector having a direction and a magnitude. In this kind of implementation, the vector represents a soundscape of the space. As is clear from the above the indicator value may comprise one or more values, such as a value representing a strength of the obtained sound and/or value representing a direction of the obtained sound, which are used for the purpose as described.

Regarding step 330:

[0037] In response to the generation of the indicator value the data processing unit i.e. the elevator controller 120 in the described embodiment, may be configured to inquire at least one reference value from data storage to be used for comparison with the at least one generated indicator value. More specifically, the data processing unit may be configured to inquire the at least one reference value by using at least one selected parameter, such as the instant of time or the position of the elevator car or the speed value or the acceleration value possibly with e.g. the load information as an inquiry parameter. With the inquiry parameter, it is possible to obtain a reference value corresponding to the situation on which the indicator value representing the soundscape is generated. As is clear from the context the similar inquiring of the reference value may be performed continuously in response to a generation of a new indicator value.

[0038] Now, in response to a receipt of the reference value the data processing unit may be configured to compare the generated indicator value to the reference value received from the data storage. In case the representation of the soundscape corresponds to the one shown in Figure 2a or Figure 2b the comparison between the generated indicator value and the reference value may be performed on element by element. As a result of the comparison it may be detected if the soundscape of the obtained sound deviates from the sound used for generating the reference value. On the other hand, if the representation of the soundscape, i.e. the indicator value, is defined as a vector having a direction and a magnitude it is compared to a corresponding representation of the soundscape in a normal operation of the elevator and any deviation between the representations may be detected through comparison.

[0039] As mentioned in the context of step 320 in some embodiment the indicator value generated in the processing step 320 may be furnished with load information, which represents the load of the elevator at the time when the sound data is obtained for generating the indicator value in question. In this embodiment, the load information may be used in the inquiry of the reference data from the data storage. The aim is to use such as reference value in the comparison, which optimally corresponds to the situation from which the sound data for the indicator value is obtained.

[0040] In other words, the comparison may provide information if the soundscape has changed since the test drive from which the reference value is generated, and on the basis of that one or more conclusions on an operational condition of the elevator may be made.

Regarding step 340:

[0041] Step 340 in the method according to the example as schematically illustrated in Figure 3 represents a sub-process in which at least one detection result may be set in accordance with a result of comparison between the indicator value and the reference value. The detection result may be set for expressing at least one of the following: an operational condition of the elevator is default, an operational condition of the elevator deviates from the default. In other words, the detection result tells if the elevator operates properly compared to reference value formed in a manner as described.

[0042] In some embodiment, the setting of the detection result may be arranged so that the detection result indicating that the operational condition of the elevator deviates from the default is only set if the indicator value differs from the reference value more than a predetermined margin defined around the reference value. This kind of implementation leaves at least some room for random deviations in an operation of the elevator.

[0043] The data processing unit, such as the elevator controller 120, may be configured to generate a signal, in response to the set of the detection result to express the deviation in the operational condition to the default, to a predetermined entity. The signal may e.g. be a signal causing stopping an operation of the elevator in question as long as its operation is checked, and repaired if necessary, by a technician. The generation of signal may e. g. be internal in the elevator controller 120, but the elevator controller may also transmit a signal indicating the described situation to the data center 140 which may take necessary actions for managing the situation.

[0044] Moreover, in some sophisticated embodiment when the deviation is detected and the detection result is set accordingly the data processing unit may, in addition to the provision of the detection result, to add data representing the sound data, which, under at least some certainty, caused the deviation in the signal to be transmitted to some external entity, such as to the data center 140. For example, the added data may comprise a position of the sound caused the deviation as well as the sound level, for example. The position and the sound level may e.g. be determined from the three dimensional representation, as schematically illustrated in Figure 2b. Alternatively or in addition, if the soundscape is expressed as a vector, the vector data may be transmitted to the external entity. It is also possible to enclose a sample of the sound assumedly causing the deviation. This may require recording of the sound data obtained with the microphones and possibly some pre-processing, such as capturing the specific sound from the whole sound data in order to save resources in the communication. Moreover, any above described non-limiting example of the added data may be provided with further data identifying the situation from which the sound was obtained. The further data may e.g. refer to time information, position information of the elevator, or any other movement related information as described earlier. Now, when the above described pieces of data are transmitted to the external entity, such as to the data center, the computing device in the data center 140 may utilize the pieces of information for pre-analyzing the root of the sound. By matching the pieces of information to pre-stored data it may be possible to find the reason for the sound and to generate information for the technician on the maintenance work to be performed. This kind of arrangement improves efficiency in the elevator maintenance.

[0045] In further some example of the invention it may be arranged so that prior to taking any actions in response to the detection of deviation from default the elevator car is controlled to re-travel the path which caused the sound data based on which the deviation was detected. This is for avoiding taking actions in response to some random deviation occurred for any reason. The re-traveling may be arranged a predetermined number of times and in case the deviation is re-detected the detection result may be set to express the deviation in the operational condition of the elevator.

[0046] It is also known that the soundscape changes during a lifetime of an elevator. This is due to wear of elevator parts among other things. In order to take into account a development in this regard reference data may be re-generated e.g. through arranging test drive of the elevator according to a predetermined time scheme. When the test drive is successful the old reference data may be replaced in the data storage with the new one.

[0047] The aspects of the invention as described above are brought out in an implementation wherein the microphones 160A-160C are installed in an elevator shaft in a fixed manner. The microphones 160A-160C may form a microphone array wherein the positions of the microphones may be considered to be the same - especially when the space under monitoring is large. On the other hand, the microphones 160A-160C may be positioned distinct to each other and in this kind of implementation the position of each individual microphone in the space shall be known in order to generate the representation of the soundscape as described. In some further embodiment, at least some of the microphones may be mounted to the elevator car i.e. the one or more microphones travel with the elevator car. In this kind of implementation there may be need to have the position of the microphone(s) known at each instant of time in order to generate the representation of the soundscape as described. The microphone array, and possibly the data processing unit, may also be a stand-alone portable device which may be carried by the technician from one monitoring point to another.

[0048] Figure 4 illustrates schematically an example of a data processing device configured to perform at least some steps of the method according to the invention. The data processing device comprises a processing unit 410 including one or more processors, a memory unit 420 including one or more memories and one or more communication interfaces 430 for communicating with external entities. The mentioned elements 410, 420 and 430 may be communicatively coupled to each other e.g. with a data bus. The communication interface 430 may comprise necessary hardware and functionality for coupling the data processing device with the external entities. The communication interface 430 may be at least partly controlled by the processing unit 410 e.g. by executing portions of computer program code 425 stored in the memory unit 420. Moreover, the computer program code 425 may define instructions that cause the data processing device to operate as described when at least one portion of the computer program code 425 is executed by the processing unit 410. Naturally, the data processing device as schematically illustrated in Figure 4 does not comprise all elements of the data processing device. For example, the power related elements needed for inputting electricity in the device are not shown in Figure 4. The data processing device as schematically illustrated in Figure 4 may refer to a processing unit implemented in a device with the microphones, to a stand-alone device, to an elevator controller or to a device implemented in the data center e.g. with one or more server devices.

[0049] A system according to an embodiment of the invention may comprise a plurality of sound sensing devices i.e. microphones and a data processing device having access to an elevator system. The access to the elevator system may refer to an access to an information representing operational information on an elevator car, for example. The information may comprise data from which positional information on the elevator car may be derived at some instant of time, for instance. Such information may be stored in an elevator controller, for example. As described, in some embodiment of the invention the data processing device may perform functions of the elevator controller. The system according to the invention may be configured to detect an operational condition of the elevator in the manner as described.

[0050] As described above the sound sensing device according to the invention may refer to a plurality of individual microphones or dedicated device, such as an acoustic camera, comprising a microphone array within the device as well as further features, such as a capability to capture an image on the monitored area, or space.

[0051] The specific examples provided in the description given above should not be construed as limiting the applicability and/or the interpretation of the appended claims. Lists and groups of examples provided in the description given above are not exhaustive unless otherwise explicitly stated.

Claims

1. A method for detecting an operational condition of an elevator, the method comprising:

   receiving sound data from a plurality of microphones (160A, 160B, 160C), the sound data is obtained at least during an operation of the elevator,
   generating (320) an indicator value, on the basis of the received sound data, the indicator value representing a soundscape at an instant of time during the operation of the elevator,
   comparing (330) the generated indicator value to a reference value,
   setting (340), in accordance with a comparison between the generated indicator value and the reference value, a detection result to express one of the following: a) the operational condition of the elevator is default, b) the operational condition of the elevator deviates from default.

2. The method of claim 1, the method further comprising:

   generating the reference value during a default operation of the elevator.

3. The method of any of the preceding claims, wherein the reference value used in the comparison is selected on a basis of at least one of the following: an instant of time of the operation of the elevator, at least one parameter representing a motion of an elevator car (110), a load of an elevator car (110).

4. The method of claim 3, wherein the parameter representing the motion of the elevator car (110) is one of the following: a position of the elevator car (110) in its path, a speed of the elevator car (110), an acceleration of the elevator car (110), a direction of the movement of the elevator car (110).

5. The method of any of the preceding claims, wherein the reference value is inquired from data storage.

6. The method of any of the preceding claims, wherein a representation of the indicator value and the reference value is one of the following: two dimensional data array, three dimensional data array, a vector representation.

7. A data processing device comprising:

processing unit (410);
memory unit (420) including computer program code;
the memory unit (420) and the computer program code configured to, with the processing unit (410), cause the data processing device to perform:

receive sound data from a plurality of microphones (160A, 160B, 160C), the sound data is obtained at least during an operation of the elevator,
generate (320) an indicator value, on the basis of the received sound data, the indicator value representing a soundscape at an instant of time during the operation of the elevator,
compare (330) the generated indicator value to a reference value,
set (340), in accordance with a comparison between the generated indicator value and the reference value, a detection result to express one of the following: a) the operational condition of the elevator is default, b) the operational condition of the elevator deviates from default.

8. The data processing device of claim 7, wherein the data processing device is further configured to:

generate the reference value during a default operation of the elevator.

9. The data processing device of claim 7 or 8, wherein the data processing device is further configured to select the reference value used in the comparison on a basis of at least one of the following: an instant of time of the operation of the elevator, at least one parameter representing a motion of an elevator car (110), a load of an elevator car (110).

10. The data processing device of claim 9, wherein the data processing device is configured to use as the parameter representing the motion of the elevator car (110) one of the following: a position of the elevator car (110) in its path, a speed of the elevator car (110), an acceleration of the elevator car (110), a direction of the movement of the elevator car (110).

11. The data processing device of any of the claims 7-10, wherein the data processing device is further configured to inquire the reference value from data storage.

12. The data processing device of any of the claims 7-11, wherein the data processing device is configured to use as a representation of the indicator value and the reference value one of the following: two dimensional data array, three dimensional data array, a vector representation.

13. The data processing device of any of the claims 7-12, wherein the data processing device is at least one of the following: a processing unit implemented in a device with the microphones, a stand-alone device, an elevator controller, a device implemented in the data center with at least one server device.

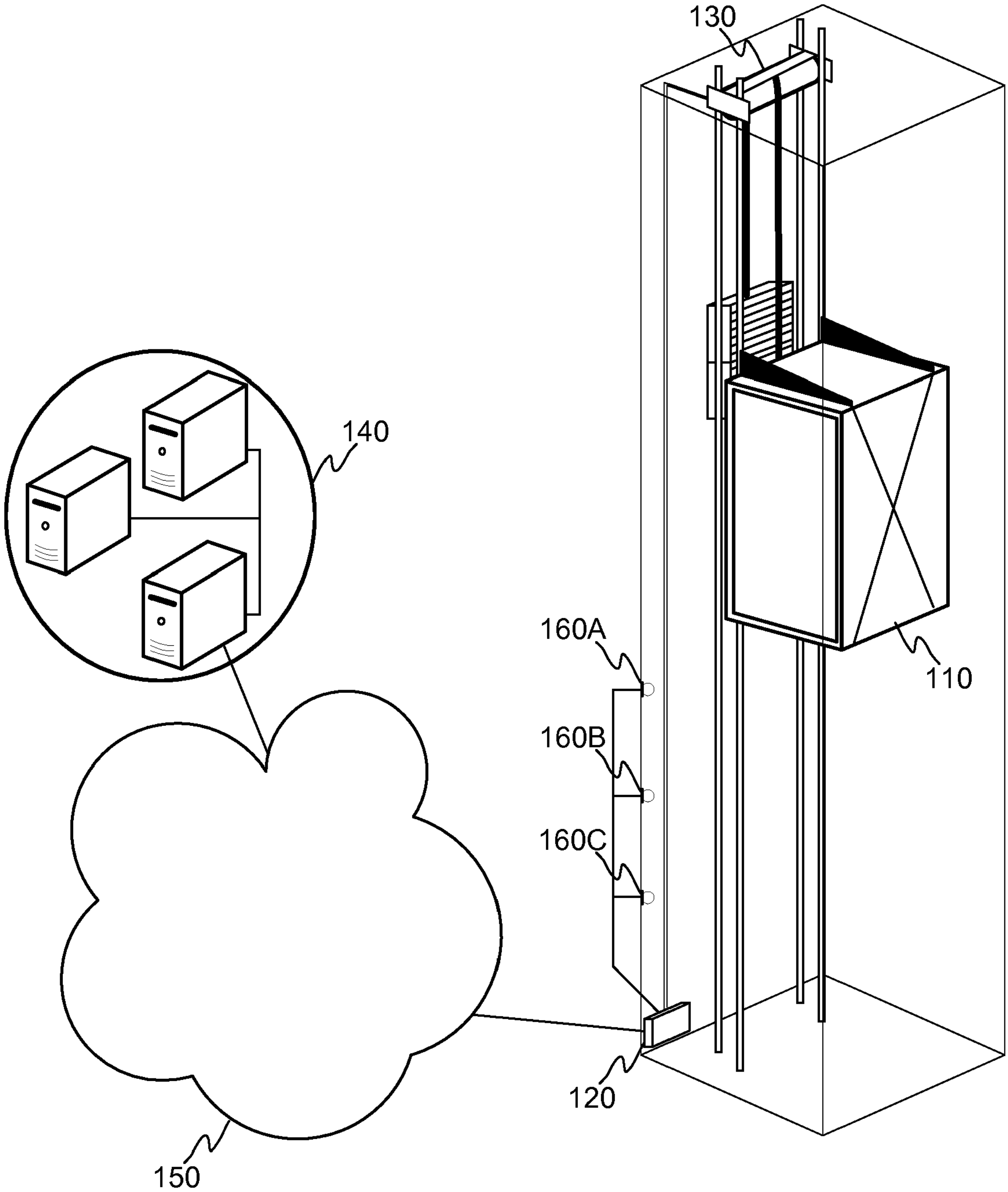

FIGURE 1

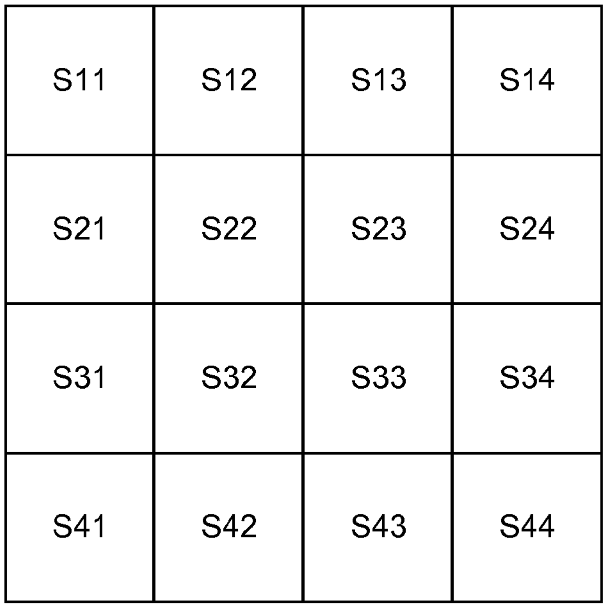

FIGURE 2a

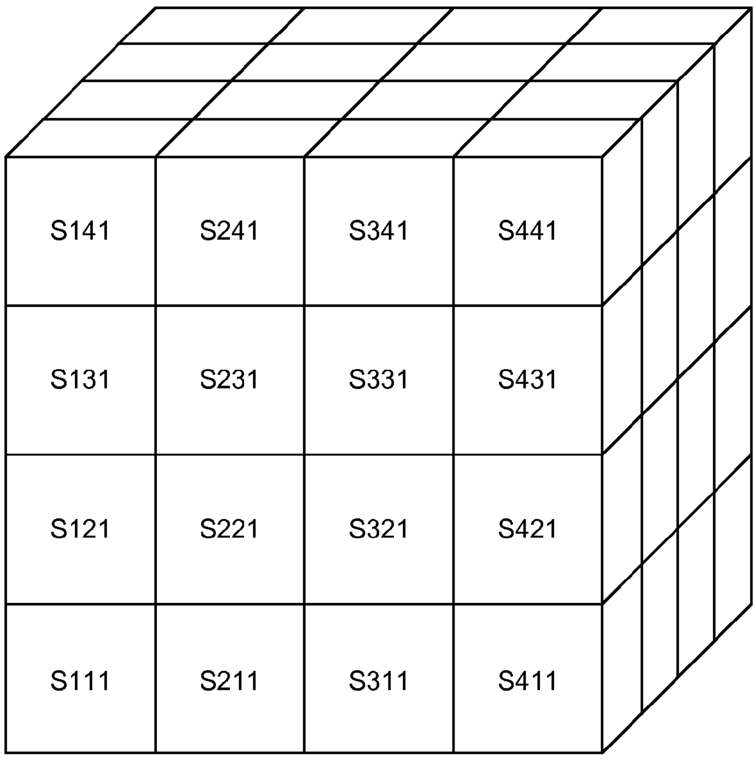

FIGURE 2b

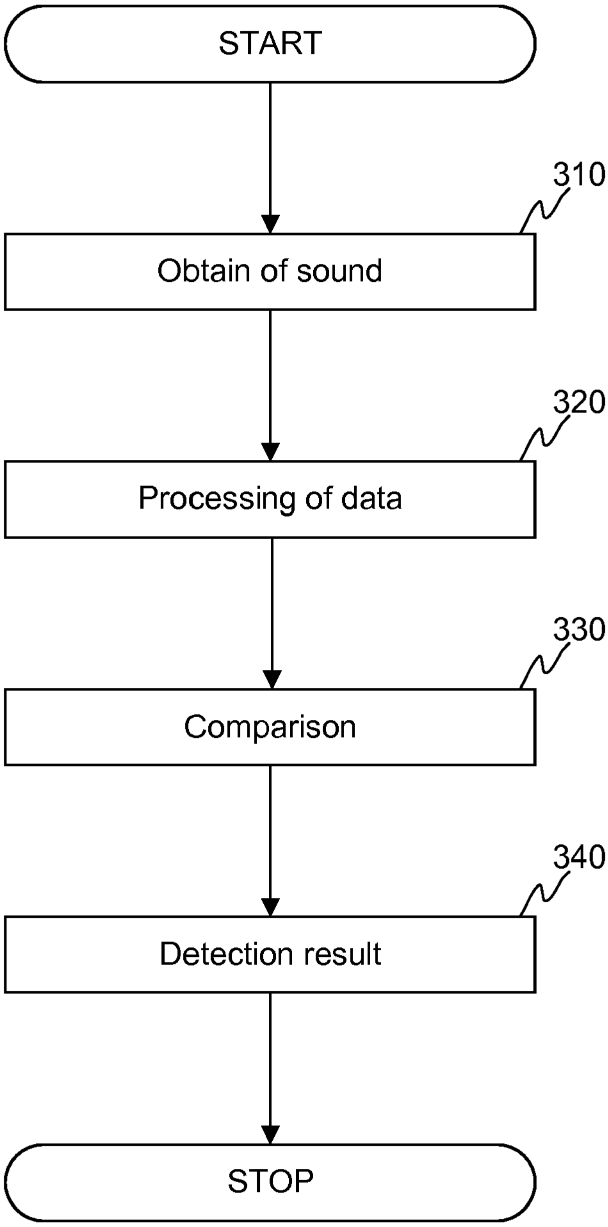
START
310
Obtain of sound
320
Processing of data
330
Comparison
340
Detection result
STOP

FIGURE 3

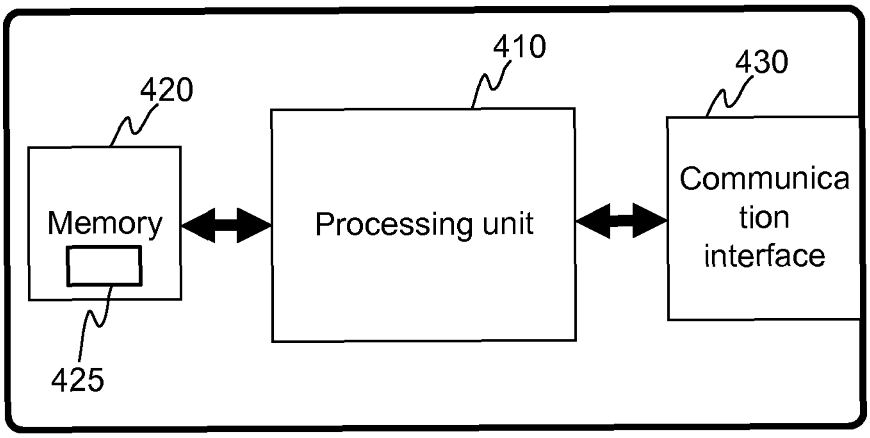
410
420
430
Memory
Processing unit
Communica
tion
interface
425

FIGURE 4

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EUROPEAN SEARCH REPORT

Application Number
EP 17 19 2002

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B66B
G05B

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	26 March 2018	Miklos, Zoltan

CATEGORY OF CITED DOCUMENTS

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26-03-2018

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