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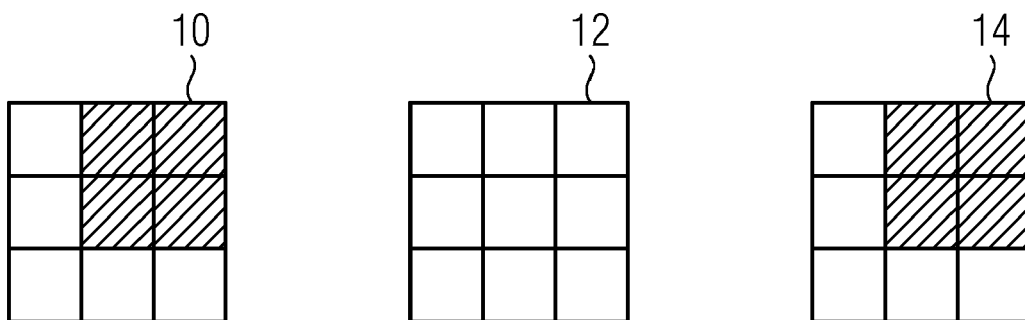
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(54) **METHOD FOR RECOGNISING POLLUTION OF A DOMESTIC APPLIANCE AND POL-LUTION
RECOGNITION SYSTEM FOR A DOMESTIC APPLIANCE**

(57) The present invention relates to a method for recognising pollution of a domestic appliance. Said method comprises the steps of providing a reference image (12) of a cavity or portion of the domestic appliance, detecting a current image (10) of the same cavity or portion, respectively, comparing the current image (10) with the

reference image (12) and generating a difference image (14) of the same cavity or portion, respectively, and checking if a pixel and/or a group of adjacent pixels of the difference image (14) exceeds a predefined threshold value.

FIG 1



Description

[0001] The present invention relates to a method for recognising pollution of a domestic appliance. Further, the present invention relates to a pollution recognition system for a domestic appliance.

[0002] Currently, the user decides by himself if an oven cavity, a cooking hob, a fridge or another domestic appliance must be cleaned or not. The oven cavity, the cooking hob and the fridge are cleanable manually by the user or automatically. For example, the oven cavity is cleanable by a pyrolytic cleaning function.

[0003] However, the pollution of the domestic appliance is not always recognisable by the user. Further, the user cannot estimate if the pollution increases the energy consumption of the domestic appliance or not. On the one hand, the pollution may increase the energy consumption of the cooking process. On the other hand, an unnecessary pyrolytic cleaning consumes also energy.

[0004] It is an object of the present invention to provide a method for recognising pollution of a domestic appliance and a pollution recognition system for the domestic appliance, which allows a reliable recognition if a cleaning process is necessary or not.

[0005] The object is achieved by the method for recognising pollution of a domestic appliance according to claim 1.

[0006] According to the present invention a method for recognising pollution of a domestic appliance is provided, wherein said method comprises the steps of:

- providing a reference image of a cavity or portion of the domestic appliance,
- detecting a current image of the same cavity or portion, respectively,
- comparing the current image with the reference image and generating a difference image of the same cavity or portion, respectively, and
- checking if a pixel and/or a group of adjacent pixels of the difference image exceeds a predefined threshold value.

[0007] The core of the present invention is the detection of the current image and the comparison with the reference image of the same cavity or portion. The resulting difference image shows the changes of said cavity or portion, respectively. The changes of the cavity or portion are quantitatively measured. Said changes are a result of the pollution, which increases the energy consumption. On the one hand, a cleaning process in good time saves energy, which is recognised by the inventive method. On the other hand, an unnecessary cleaning process costs energy, which may be prevented by the inventive method.

[0008] For example, the method comprises the further step of outputting a signal that a cleaning process of the domestic appliance should be performed, if the pixel and/or the group of adjacent pixels of the difference im-

age exceeds the predefined threshold value.

[0009] Alternatively, the method comprises the further step of starting an automatic cleaning process of the domestic appliance, if the pixel and/or the group of adjacent pixels of the difference image exceeds the predefined threshold value.

[0010] Preferably, the method comprises the further step of updating the reference image, so that signs of use and aging of the domestic appliance are contained in said reference image.

[0011] Further, the current image and the reference image may be recorded by a camera of the domestic appliance, wherein said camera is directable or directed to the cavity or portion of the domestic appliance.

[0012] Moreover, the difference image may be generated by a control device of the domestic appliance.

[0013] For example, the method is provided for recognising pollution in an oven cavity of a cooking oven.

[0014] Further, the method may be provided for recognising pollution on a surface of a cooking hob.

[0015] Particularly, the cleaning process is a pyrolytic cleaning and/or a stream cleaning of the oven cavity of the cooking oven.

[0016] Furthermore, the cleaning process may be defrosting of the cavity of a refrigerator or freezer.

[0017] Moreover, the predefined threshold value may correlate with a deviation between the intensities of the corresponding pixels and/or groups of adjacent pixels of the current image and the reference image, wherein said deviation is between 10 % and 50 %, particularly between 20 % and 40 %, preferably about 30 %.

[0018] The object of the present invention is further achieved by the pollution recognition system according to claim 11.

[0019] According to the present invention a pollution recognition system for a domestic appliance is provided, wherein said system comprises:

- a camera directable or directed to a cavity or portion of the domestic appliance, wherein preferably said cavity or portion is exposed to heat, humidity and/or light,
- a calculation device for comparing a current image of the cavity or portion with a reference image of the same cavity or portion, respectively, and for generating a difference image from said current image and reference image, and
- an evaluation device for checking if a pixel and/or a group of adjacent pixels of the difference image exceeds a predefined threshold value.

[0020] In particular, the calculation device uses a calculation algorithm for comparing the current image with the reference image, while the evaluation device uses an evaluation algorithm for checking if the pixel and/or group of adjacent pixels of the difference image exceeds the predefined threshold value.

[0021] For example, the system comprises an output

device for indicating a signal that a cleaning process of the domestic appliance should be performed, if the pixel and/or the group of adjacent pixels of the difference image exceeds the predefined threshold value.

[0022] Alternatively, the system comprises a control device for starting an automatic cleaning process of the domestic appliance, if the pixel and/or the group of adjacent pixels of the difference image exceeds the predefined threshold value.

[0023] Particularly, the camera is directable or directed to a cooking surface of a cooking hob and/or into a cavity of a cooking oven, a steam cooking oven, a fridge or a freezer.

[0024] At last, the system is provided for a method mentioned above.

[0025] Novel and inventive features of the present invention are set forth in the appended claims.

[0026] The present invention will be described in further detail with reference to the drawings, in which

FIG 1 illustrates a schematic view of a set of symbolic images of the domestic appliance for the pollution recognition system according to a preferred embodiment of the present invention, and

FIG 2 illustrates a schematic view of a further set of symbolic images of the domestic appliance for the pollution recognition system according to the preferred embodiment of the present invention.

[0027] FIG 1 illustrates a schematic view of a set of symbolic images of the domestic appliance for the pollution recognition system according to a preferred embodiment of the present invention.

[0028] The set of symbolic images comprises a current image 10, a reference image 12 and a difference image 14. Each image 10, 12 and 14 represents the same portion of the domestic appliance. For example, the domestic appliance may be a cooking hob, a cooking oven, a steam cooking oven, a fridge or a freezer. In the first case, the images 10, 12 and 14 are recorded by a camera arranged above the cooking hob. In the second case, the images 10, 12 and 14 are recorded by a camera arranged inside or in front of a cavity of the domestic appliance, for example an oven cavity of a cooking oven.

[0029] Each image 10, 12 and 14 consists of a plurality of pixels arranged as a rectangular or square matrix. For convenience, each image 10, 12 and 14 in FIG 1 and 2 is represented as a three-by-three matrix.

[0030] The current image 10 is made automatically according to a predetermined time scheme and/or manually by the user. The current image 10 shows the current state of the domestic appliance. The reference image 12 is made when the domestic appliance is clean. In this example, the reference image 12 is made when the cooking appliance is new and/or unused.

[0031] In the current image 10 four pixels in the upper

corner on the right-hand side are shaded, while the other pixels are white. The shaded pixels have another intensity than the white pixels. In the reference image 12 all nine pixels are white. In the difference image 14 each pixel corresponds with the intensity difference of the corresponding pixels of the current image 10 and the reference image 12.

[0032] The intensity of the pixel or pixel group as well as the colour of the pixel or pixel group are criteria for the pollution. The intensity of the pixel or pixel group depends on the age of the dirt and/or on the operating time of the domestic appliance. The number of pixels of the pixel group depends on the size of the dirt. The number of pixel groups is an indication for the quantity of dirt. The darkness of the pixel or pixel group is an evidence for the age of the dirt. Pale pixels or pixel groups represent young dirt. A small number of only pale pixels or pale pixel groups indicates a clean cavity or portion.

[0033] If the intensity of one pixel or of a group of adjacent pixels in the difference image 14 exceeds a predetermined threshold value, then a pollution of the domestic appliance is determined. In this case, either the pollution of the domestic appliance is indicated, so that the user can manually start a cleaning process or said cleaning process is started automatically.

[0034] For example, the predetermined threshold value for the intensity of one pixel or of the group of adjacent pixels in the difference image 14 may be 30 %, i.e. the corresponding pixel or group of adjacent pixels in the current image 10 and reference image 12 differ more than 30 %.

[0035] Optionally, several predetermined threshold values are defined, which correspond with different degrees of pollution. These different degrees of pollution may correspond with cleaning processes of different intensities.

[0036] FIG 2 illustrates a schematic view of a further set of symbolic images of the domestic appliance for the pollution recognition system according to the preferred embodiment of the present invention.

[0037] The set of symbolic images comprises the current image 10, the reference image 12 and the difference image 14, wherein each image 10, 12 and 14 represents the same portion of the domestic appliance.

[0038] The current image 10 is made automatically according to a predetermined time scheme and/or manually by the user and shows the current state of the domestic appliance. The reference image 12 is made when the domestic appliance is clean. However, the reference image 12 in FIG 2 shows signs of use and aging. Preferably, the reference image 12 is updated, when the domestic appliance shows signs of use and aging. A continuous update of the reference image 12 prevents that signs of use and aging are identified as pollution.

[0039] The pollution of the domestic appliance is determined, if the intensity of one pixel or of a group of adjacent pixels in the difference image 14 exceeds the predetermined threshold value. Either the pollution of the

cooking appliance is indicated, so that the user can manually start the cleaning process or said cleaning process is started automatically.

[0040] The camera of the pollution recognition system may be further used for controlling and/or monitoring food stuff during a cooking or baking process in the oven cavity of the cooking oven. The camera may detect the change of the colour of the food stuff during the cooking or baking process, so that the duration, the temperature and/or the heating mode may be modified. The use of the camera may avoid that the food stuff is burned. Further, the information from the camera may be used in combination with the consumed energy and the core temperature, weight and/or shape of the food stuff for controlling the cooking or baking process. Moreover, the camera may be used for a remote control of the cooking process.

[0041] The pollution recognition system according to the present invention may be applied to arbitrary domestic appliances, e.g. refrigerators, washing machines, laundry dryers, dishwashers.

[0042] Although an illustrative embodiment of the present invention has been described herein with reference to the accompanying drawings, it is to be understood that the present invention is not limited to that precise embodiment, and that various other changes and modifications may be affected therein by one skilled in the art without departing from the scope or spirit of the invention. All such changes and modifications are intended to be included within the scope of the invention as defined by the appended claims.

List of reference numerals

[0043]

- 10 current image
- 12 reference image
- 14 difference image

Claims

1. A method for recognising pollution of a domestic appliance, wherein said method comprises the steps of:

- providing a reference image (12) of a cavity or portion of the domestic appliance,
- detecting a current image (10) of the same cavity or portion, respectively,
- comparing the current image (10) with the reference image (12) and generating a difference image (14) of the same cavity or portion, respectively, and
- checking if a pixel and/or a group of adjacent pixels of the difference image (14) exceeds a predefined threshold value.

2. The method according to claim 1,

characterised by

the further step of outputting a signal that a cleaning process of the domestic appliance should be performed, if the pixel and/or the group of adjacent pixels of the difference image (14) exceeds the predefined threshold value.

3. The method according to claim 1,

characterised by

the further step of starting an automatic cleaning process of the domestic appliance, if the pixel and/or the group of adjacent pixels of the difference image (14) exceeds the predefined threshold value.

4. The method according to any one of the preceding claims,

characterised by

the further step of updating the reference image (12), so that signs of use and aging of the domestic appliance are contained in said reference image (12).

5. The method according to any one of the preceding claims,

characterised in that

the current image (10) and the reference image (12) are recorded by a camera of the domestic appliance, wherein said camera is directable or directed to the cavity or portion, respectively, of the domestic appliance.

6. The method according to any one of the preceding claims,

characterised in that

the difference image (14) is generated by a calculation device of the domestic appliance.

7. The method according to any one of the preceding claims,

characterised in that

the method is provided for recognising pollution in an oven cavity of a cooking oven and/or on a surface of a cooking hob.

8. The method according to any one of the claims 2 to 8,

characterised in that

the cleaning process is a pyrolytic cleaning and/or a steam cleaning of the oven cavity of the cooking oven.

9. The method according to any one of the claims 2 to 8,

characterised in that

the cleaning process is defrosting of the cavity of a refrigerator or freezer.

10. The method according to any one of the preceding claims,

characterised in that

the predefined threshold value correlates with a de-

viation between the intensities of the corresponding pixels and/or groups of adjacent pixels of the current image (10) and the reference image (12), wherein said deviation is between 10 % and 50 %, particularly between 20 % and 40 %, preferably about 30 %. 5

11. A pollution recognition system for a domestic appliance, wherein said system comprises:

- a camera directable or directed to a cavity or portion of the domestic appliance, wherein preferably said cavity or portion is exposed to heat, humidity and/or light, 10
- a calculation device for comparing a current image (10) of the cavity or portion with a reference image (12) of the same cavity or portion, respectively, and for generating a difference image (14) from said current image (10) and reference image (12), and 15
- an evaluation device for checking if a pixel and/or a group of adjacent pixels of the difference image (14) exceeds a predefined threshold value. 20

12. The pollution recognition system according to claim 11, 25

characterised by

the system comprises an output device for indicating a signal that a cleaning process of the domestic appliance should be performed, if the pixel and/or the group of adjacent pixels of the difference image (14) exceeds the predefined threshold value. 30

13. The pollution recognition system according to claim 11, 35

characterised by

the system comprises a control device for starting an automatic cleaning process of the domestic appliance, if the pixel and/or the group of adjacent pixels of the difference image (14) exceeds the predefined threshold value. 40

14. The pollution recognition system according to any one of the claims 11 to 13, 45

characterised in that

the camera is directable or directed to a cooking surface of a cooking hob and/or into a cavity of a cooking oven, a steam cooking oven an fridge or a freezer.

15. The pollution recognition system according to any one of the claims 11 to 14, 50

characterised in that

the system is provided for a method according to any one of the claims 1 to 10. 55

FIG 1

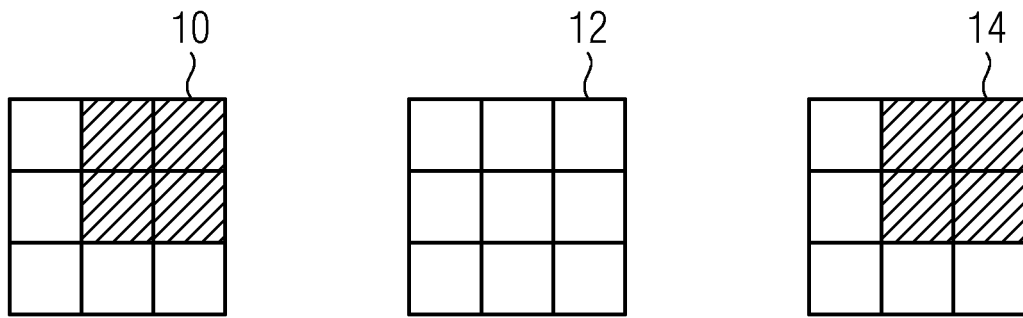
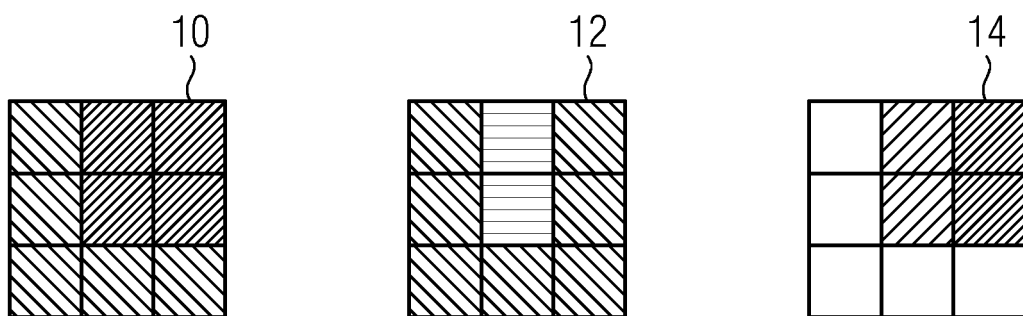


FIG 2





EUROPEAN SEARCH REPORT

 Application Number
 EP 19 18 6612

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	DE 10 2016 206483 A1 (CONVOTHERM ELEKTROGERÄTE GMBH [DE]) 19 October 2017 (2017-10-19) * paragraph [0084]; figure 2a *	1-8,10,15	INV. F24C14/00 F25D21/02 F24C7/08
X	US 2015/302569 A1 (ARMSTRONG JAMES LEE [US] ET AL) 22 October 2015 (2015-10-22) * paragraphs [0033], [0035], [0050] *	11-14	
Y	DE 10 2017 206058 A1 (BSH HAUSGERÄTE GMBH [DE]) 11 October 2018 (2018-10-11) * paragraph [0070] *	1-10,15	
Y	WO 2011/122887 A2 (LG INNOTEK CO LTD [KR]; KIM SEOYOUNG [KR]) 6 October 2011 (2011-10-06) * the whole document *	4	
Y	US 2011/094245 A1 (KIM SEOYOUNG [KR]) 28 April 2011 (2011-04-28) * the whole document *	9	
			TECHNICAL FIELDS SEARCHED (IPC)
			F24C F25D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 2 December 2019	Examiner Rodriguez, Alexander
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 19 18 6612

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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02-12-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102016206483 A1	19-10-2017	DE 102016206483 A1	19-10-2017
		EP 3446040 A1	27-02-2019
		US 2019093901 A1	28-03-2019
		WO 2017182214 A1	26-10-2017

US 2015302569 A1	22-10-2015	NONE	

DE 102017206058 A1	11-10-2018	DE 102017206058 A1	11-10-2018
		WO 2018188912 A1	18-10-2018

WO 2011122887 A2	06-10-2011	KR 20110110984 A	10-10-2011
		WO 2011122887 A2	06-10-2011

US 2011094245 A1	28-04-2011	KR 20110044014 A	28-04-2011
		US 2011094245 A1	28-04-2011
