



(51) International Patent Classification:

F25D 29/00 (2006.01)

G08B 17/00 (2006.01)

(21) International Application Number:

PCT/TR2020/050563

(22) International Filing Date:

01 July 2020 (01.07.2020)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

2019/08897

14 June 2019 (14.06.2019)

TR

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ,

UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

- without international search report and to be republished upon receipt of that report (Rule 48.2(g))
- with information concerning request for restoration of the right of priority in respect of one or more priority claims (Rules 26bis.3 and 48.2(b)(vii))
- in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE

(54) Title: A METHOD OF PREDICTING AND DETECTING A FIRE IN A DOMESTIC APPLIANCE AND A DOMESTIC APPLIANCE

(57) Abstract: The present invention relates to a method of predicting and detecting a fire in a domestic appliance and a related domestic appliance (1). The domestic appliance (1) comprises a body (2) in which the electrical and/or electronics components for performing the operations of the domestic appliance (1) are housed, at least a first sensor (3) which is located inside the body (2) and configured to continuously determine the electrical current received from a mains supply and at least a second sensor (4) which is located inside the body (2) and configured to continuously determine infrared radiations emitted from at least one electrical and/or electronics component and a controller (5) which is capable of communicating with at least one first sensor (3) and at least one second sensor (4) in order to receive electrical signals generated by these sensors (3, 4).



**A METHOD OF PREDICTING AND DETECTING A FIRE IN A
DOMESTIC APPLIANCE AND A DOMESTIC APPLIANCE**

- 5 The present invention relates to a method of predicting and detecting a fire in a domestic appliance and a related domestic appliance.

In domestic appliances such as refrigerators, dryers, washers etc.; electrical and/or electronics components employed for performing the operations of the appliance
10 such as electronic cards and power connectors are exposed to electrical and temperature stress. As the degree of combinations of these stresses increases, the probability of failure in these components also increases.

Although designs can be carried out to tolerate possible nonconformities in high
15 voltage, temperature, humidity, physical and component production tolerance it can sometimes trigger fire start if several of these factors occur at the same time. For example, before the fire starts the components begin to radiate infrared signals because of the heat.

20 In the state of the art there are some solutions about detecting the fire inside the domestic appliances. However, these solutions can only detect the fire after starting. For this reason, there is a need in the state of the art to predict the upcoming fire before occurring and informing the user accordingly.

25 CN102313436 discloses a refrigerator and an automatic fire alarm method thereof. The invention disclosed in said document relates to a refrigerator characterized by having an automatic fire alarm safety device comprising; a detection probe, a control unit and an alarm device. The detecting probe is installed in a fire-prone portion of the refrigerator and transmits a detection signal
30 to the control unit continuously. The control unit determines whether a fire occurs

according to the detection signal and when it is determined that a fire occurs, the control unit refers to the alarm device sending an alarm signal.

5 An objective of the present invention is to provide a fire prediction and detection method predicting the occurrence of a fire before the fire starts or detecting the existence of a fire and a domestic appliance employing said method.

10 This objective has been achieved by the fire prediction and detection method as defined in claim 1, and the domestic appliance as defined in claim 8. Further advantages of the invention have been attained by the technical features defined in the dependent claims.

15 In the domestic appliance which comprises; a body in which the electrical and/or electronics components for performing the operations of the domestic appliance are housed, at least a first sensor which is located inside the body and configured to continuously determine the electrical current received from the mains supply and at least a second sensor which is located inside the body and configured to continuously determine the infrared radiations emitted from at least one electrical and/or electronics component of the present invention the controller which
20 communicates with at least one first sensor and at least one second sensor in order to take electrical signals generated by these sensors is programmed to; receive the electrical signals indicating the current taken from the mains supply from the first sensor and the electrical signals indicating infrared radiation of at least one electrical and/or electronics component from the second sensor; process the
25 received electrical signals independently in order to determine whether there is an upcoming fire or fire existence inside the domestic appliance and if it is determined that there is an upcoming fire or fire existence inside the domestic appliance inform the user at least audible and/or visually. By processing the electrical signals indicating the electrical current taken from the mains supply and
30 radiation of at least one electrical and/or electronics component of the domestic

appliance, it is easily possible to predict upcoming fire inside the domestic appliance or beginning of the fire.

5 In an embodiment of the invention in order to process the electrical signals indicating the current taken from the mains supply, the controller further programmed to make the signal stationary; suppress the obtained stationary signal to obtain a smoothed signal; calculate the amplitude of the smoothed signal and apply a predetermined current threshold in order to predict whether there is an upcoming fire.

10

In an exemplary embodiment of the invention the controller is programmed to apply 3rd order difference on the electrical signal in order to make said signal stationary. Since the electrical signal received from first sensor is not stationary regarding to variance, applying 3rd order difference on the received electrical
15 signal enables to obtain an electrical signal that is almost stationary regarding to variance.

In an exemplary embodiment of the invention the controller is programmed to apply an exponential filter on the stationary signal to obtain a smoothed signal.
20 After applying 3rd order difference on the electrical signal received from first sensor the obtained stationary signal becomes wide sense stationary regarding to variance, except the part when fire occurs. Said pattern mismatching should be used to predict the fire occurrence. In order to find or to predict the anomaly part in the obtained stationary signal, the exponential filter is applied to the output of
25 the differentiated signal for suppressing that differentiated signal. As a result of this, a smoothed signal is obtained.

In an exemplary embodiment of the invention the controller is programmed to apply a Hilbert filter on the positive part of the smoothed signal to find the
30 amplitude of the signal.

In an exemplary embodiment of the invention controller is programmed to apply a predetermined current threshold to the obtained signal amplitude and detect that there is an upcoming fire ignition if the value of the output of the Hilbert filter applied signal amplitude is greater than the value of the current threshold. By this way, it is possible to predict upcoming fire ignition by detecting the changes in the pattern of the electrical current usage of the domestic appliance.

In an embodiment of the invention in order to process the electrical signals indicating the infrared radiation of at least one electrical and/or electronics component, the controller further programmed to; smooth the signal by applying both a high and low exponential filters independently on the signal received from second sensor and obtain a higher smoothed signal and lower smoothed signal; calculate the difference between higher smoothed signal and lower smoothed signal; count the number of incidents in which the calculated difference crosses a predetermined infrared threshold consecutively and compare the counted value with a predetermined threshold value. If the value of the counted value is greater than the predetermined threshold value, the controller detects that there is an existing fire, or at least a flame, inside the domestic appliance. By this way, it is possible to predict existence of a fire, or at least a flame, inside the domestic appliance by detecting that the intensity of the infrared radiation emitted by at least one electrical and/or electronics component exceeds a predetermined threshold.

The present invention also relates to a method for predicting and/or detecting a fire inside the domestic appliance which comprises a body in which the electrical and/or electronics components for performing the operations of the domestic appliance are housed, at least a first sensor which is located inside the body and configured to continuously determine the electrical current received from the mains supply and at least a second sensor which is located inside the body and configured to continuously determine the infrared radiations emitted from at least

one electrical and/or electronics component and a controller which is capable of communicating with at least one first sensor and at least one second sensor in order to take electrical signals generated by these sensors wherein the method comprises; a step of generating the electrical signals indicating the current taken
5 from the mains supply and the electrical signals indicating infrared radiation of at least one electrical and/or electronic component; a step of processing the received electrical signals independently in order to determine whether there is a risk of fire inside the domestic appliance or there is a fire existence inside the domestic appliance and a step of informing the user if it is determined that there is a fire or
10 a risk of fire inside the domestic appliance after processing said electrical signals.

In an embodiment of the invention in order to process the electrical signals indicating the electric current taken from the mains supply the method further comprises; a step of making the signal stationary; a step of obtaining a smoothed
15 signal by suppressing the obtained stationary signal; a step of evaluating the smoothed signal in order to predict whether there is an upcoming fire ignition.

In a preferred embodiment of the invention the step of making the signal stationary comprises; application of 3rd order difference on the signal in order to
20 make the signal stationary. Since the electrical signal received from first sensor is not stationary regarding to variance, applying 3rd order difference on the received electrical signal enables to obtain an electrical signal that is almost stationary regarding to variance.

25 In a preferred embodiment of the invention the step of obtaining a smoothed signal by suppressing the obtained stationary signal comprises; application of an exponential filter on the stationary signal. After applying 3rd order difference on the electrical signal received from first sensor the obtained stationary signal becomes wide sense stationary regarding to variance, except the part when fire
30 occurs. Said pattern mismatching should be used to predict the fire occurrence. In

order to find or to predict the anomaly part in the obtained time series, the exponential filter is applied to the output of the differentiated signal for suppressing that differentiated signal. As a result of this, a smoothed signal is obtained.

5

In a preferred embodiment of the invention the step of evaluating the smoothed signal in order to predict whether there is an upcoming fire ignition comprises; a step of obtaining the absolute value of the smoothed signal obtained by applying an exponential filter on the output of the stationary signal; a step of applying a Hilbert filter on the positive part of the smoothed signal to find the amplitude of the signal and a step of applying a predetermined threshold to the obtained signal amplitude. If it is determined after the step of applying a predetermined threshold to the obtained signal amplitude that the value of the amplitude of the signal is greater than the value of the threshold, the step of informing the user is performed.

15

In an embodiment of the invention in order to process the electrical signals indicating infrared radiation of at least one electrical and/or electronic component the method further comprises; a step of applying both a high exponential filter and low exponential filter independently on the signal received from second sensor and obtain a higher smoothed signal and lower smoothed signal; a step of calculating the difference between higher smoothed signal and lower smoothed signal; a step of counting the number of incidents in which the calculated difference crosses a predetermined threshold consecutively and a step of comparing the counted value with a predetermined threshold value. If it is determined after the step of comparing the counted value with a predetermined threshold value that the counted value is greater than the predetermined threshold value, the step of informing the user is performed.

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The present invention also relates to a computer readable program which comprises codes for causing a domestic appliance to execute the method steps of the present invention.

- 5 The present invention also relates to a computer readable recording medium which stores the computer readable program of the present invention.

According to present invention, by employing at least one first sensor and at least one second sensor which generate the electrical signals indicating the electrical
10 current taken from the mains supply and radiation of at least one electrical and/or electronics component of the domestic appliance respectively, it is possible to predict an upcoming fire inside the domestic appliance by appropriately processing the electrical signals received from the first sensor and existence of a fire, or at least a flame, by appropriately processing the electrical signals received
15 from the from the second sensor.

Additional advantages of the fire prediction and detection method according to the present invention and the domestic appliance according to the present invention will become apparent with the detailed description of the embodiments with
20 reference to the accompanying drawings in which;

Figure 1 schematically shows an embodiment of the domestic appliance according to the present invention.

Figure 2 shows a flow chart showing the steps of a method for fire prediction and
25 detection inside the domestic appliance of Fig. 1 according to an embodiment of the present invention.

The reference signs appearing on the drawings relate to the relevant technical features:

- 30 1. Domestic appliance

- 2. Body
 - 3. First sensor
 - 4. Second sensor
 - 5. Controller
- 5 TH_current: predetermined current threshold
 f[n]: signal received from the second sensor
 f_h[n]: higher smoothed signal
 f_l[n]: lower smoothed signal
 df[n]: difference between higher smoothed signal and lower smoothed signal
- 10 TH_infrared: predetermined infrared threshold
 #df(n): number of incidences in which the difference between higher smoothed signal and lower smoothed signal crosses the predetermined infrared threshold consecutively
 TH_value: predetermined threshold value
- 15
- A domestic appliance (1) comprises; a body (2) in which the electrical and/or electronics components for performing the operations of the domestic appliance (1) are housed, at least a first sensor (3) which is located inside the body (2) and configured to continuously determine the electrical current received from a mains
- 20 supply and at least a second sensor (4) which is located inside the body (2) and configured to continuously determine infrared radiations emitted from at least one electrical and/or electronics component. The domestic appliance (1) such as a refrigerator, a washer, a dryer etc. includes the electrical and/or electronics components such as a compressor, a fan, an electronic card etc. which are
- 25 performing the specified tasks for the proper operation of the domestic appliance (1) inside the body (2). While the first sensor (3) is positioned inside the body (2) such as to receive data related to the current taken from the mains supply and can generate electrical signals indicating the electrical current received from the mains supply, the second sensor (4) is positioned inside the body (2) such as to receive
- 30 data related to the infrared radiation of at least one electrical and/or electronics

component and can generate electrical signals indicating the infrared radiation of at least one electrical and/or electronics component. In an exemplary embodiment of the invention in which the domestic appliance (1) is a tumble dryer the second sensor (4) is located in a machinery compartment of the tumble dryer such as to
5 sense the infrared radiation emitted from a compressor of the tumble dryer. In an another exemplary embodiment of the invention in which the domestic appliance (1) is a refrigerator two second sensors (3) are employed wherein the first one is located in a machinery compartment of the refrigerator such as to sense the infrared radiation emitted from a compressor of the refrigerator and the other one
10 is located inside a control panel of the refrigerator such as to sense the infrared radiation emitted from an electronic card of the refrigerator.

The domestic appliance (1) according to this invention comprises a controller (5) which is capable of communicating with at least one first sensor (3) and at least
15 one second sensor (4) in order to receive electrical signals generated by these sensors (3, 4) and configured to; receive the electrical signals indicating the current taken from the mains supply from the first sensor (3) and the electrical signals indicating infrared radiation of at least one electrical and/or electronics component from the second sensor (4); process the received electrical signals
20 independent of each other in order to determine whether there is an upcoming fire or fire existence inside the domestic appliance (1) and if it is determined that there is an upcoming fire or fire existence inside the domestic appliance (1) inform the user accordingly. By this way, it is possible to predict an upcoming fire inside the domestic appliance (1) by appropriately processing the electrical signals received
25 from the first sensor (3) and existence of a fire, or at least a flame, by appropriately processing the electrical signals received from the from the second sensor (4).

In an embodiment of the invention in order to process the electrical signals taken
30 from the first sensor (3), the controller (5) is configured to; make the signal

stationary; obtain a smoothed signal by suppressing the stationary signal; calculate the amplitude of the smoothed signal and apply a predetermined threshold (TH_{current}) in order to predict whether there is an upcoming fire.

- 5 In an exemplary embodiment of the invention the controller (5) is further configured to apply 3rd order difference on the signal received from first sensor (3) in order to make the signal stationary.

10 In an exemplary embodiment of the invention the controller (5) is further configured to apply an exponential filter on the stationary signal to obtain a smoothed signal.

15 In an exemplary embodiment of the invention the controller (5) is further configured to apply a Hilbert filter on the positive part of the smoothed signal in order to calculate the amplitude of the signal.

20 In an exemplary embodiment of the invention controller (5) is further configured to apply a predetermined threshold (TH_{current}) to the obtained signal amplitude and detect that there is an upcoming fire ignition if the value of the signal amplitude is greater than the value of the threshold (TH_{current}). By this way, it is possible to predict upcoming fire ignition by detecting the changes in the pattern of the electrical current usage of the domestic appliance (1).

25 In an embodiment of the invention in order to process the electrical signals (f[n]) taken from the second sensor (4), the controller (5) is configured to; smooth the signal (f[n]) by applying both a high and low exponential filters independently on the signal (f[n]) received from second sensor (4) and obtain a higher smoothed signal (f_h[n]) and lower smoothed signal (f_l[n]); calculate the difference (df[n]) between higher smoothed signal (f_h[n]) and lower smoothed signal (f_l[n]);
30 count the number of incidents (#df(n)) in which the calculated difference (df[n])

crosses a predetermined infrared threshold consecutively and compare the counted value (#df(n)) with a predetermined threshold value (TH_value). By this way, it is possible to predict existence of a fire, or at least a flame, inside the domestic appliance (1) by detecting that the intensity of the infrared radiation emitted by at least one electrical and/or electronics component exceeds a predetermined threshold consecutively in a predetermined number.

The present invention also relates to a method for predicting and detecting a fire inside the domestic appliance (1) which comprises a body (2) in which the electrical and/or electronics components for performing the operations of the domestic appliance (1) are housed, at least a first sensor (3) which is located inside the body (2) and configured to continuously determine the electrical current received from the mains supply and at least a second sensor (4) which is located inside the body (2) and configured to continuously determine the infrared radiations emitted from at least one electrical and/or electronics component and a controller (5) which is capable of communicating with at least one first sensor (3) and at least one second sensor (4) in order to take electrical signals generated by these sensors (3, 4) wherein the method comprises; a step of generating (S1) the electrical signals indicating the current taken from the mains supply and the electrical signals indicating infrared radiation of at least one electrical and/or electronic component; a step of processing (S2) the received electrical signals independently in order to determine whether there is a risk of fire inside the domestic appliance (1) or there is a fire existence inside the domestic appliance (1) and a step of informing (S3) the user if it is determined that there is a fire or a risk of fire inside the domestic appliance (1).

In an embodiment of the invention in order to process the electrical signals indicating the electric current taken from the mains supply the method further comprises; a step of making (S4) the signal stationary; a step of obtaining (S5) a smoothed signal by suppressing the obtained stationary signal; a step of

evaluating (S6) the smoothed signal in order to predict whether there is an upcoming fire ignition.

5 In a preferred embodiment of the invention the step of making (S4) the signal stationary comprises; application of 3rd order difference on the signal in order to make the signal stationary.

10 In a preferred embodiment of the invention the step of obtaining (S5) a smoothed signal by suppressing the obtained stationary signal comprises; application of an exponential filter on the stationary signal.

15 In a preferred embodiment of the invention the step of evaluating (S6) the smoothed signal in order to predict whether there is an upcoming fire ignition comprises; a step of obtaining (S7) the absolute value of smoothed signal obtained by applying an exponential filter on the stationary signal; a step of (S8) applying a Hilbert filter on the absolute value of the smoothed signal and a step of applying (S9) a predetermined threshold (TH_{current}) to the signal amplitude. If it is determined after the step of applying (S9) a predetermined threshold (TH_{current}) to the signal amplitude that the value of the amplitude of the signal is greater than
20 the value of the threshold (TH_{current}), the step of informing (S3) the user is performed.

25 In an embodiment of the invention in order to process the electrical signals (f[n]) indicating infrared radiation of at least one electrical and/or electronic component the method further comprises; a step of applying both a high exponential filter (S10) and low exponential filter (S11) independently on the signal (f[n]) received from second sensor (4) and obtain a higher smoothed signal (f_h[n]) and lower smoothed signal (f_l[n]); a step of calculating (S12) the difference (df[n]) between higher smoothed signal (f_h[n]) and lower smoothed signal (f_l[n]); a step of
30 counting (S13) the number of incidents (#df(n)) in which the calculated difference

(df[n]) crosses a predetermined threshold (TH_infrared) consecutively and a step of comparing (S14) the counted value (#df(n)) with a predetermined threshold value (TH_value). If it is determined after the step of comparing (S14) the counted value with a predetermined threshold value (TH_value) that the counted value is greater than the predetermined threshold value, the step of informing (S3) the user is performed. By this way, it is possible to predict existence of a fire, or at least a flame, inside the domestic appliance (1) by detecting that the intensity of the infrared radiation emitted by at least one electrical and/or electronics component exceeds a predetermined threshold (TH_infrared) consecutively more than a predetermined threshold value (TH_value).

The present invention also relates to a computer readable program which comprises codes for causing a domestic appliance (1) to execute the method steps of the present invention.

The present invention also relates to a computer readable recording medium which stores the computer readable program of the present invention.

According to present invention, by employing at least one first sensor (3) and at least one second sensor (4) which generate the electrical signals indicating the electrical current taken from the mains supply and radiation of at least one electrical and/or electronics component of the domestic appliance (1) respectively, it is possible to predict an upcoming fire inside the domestic appliance (1) by appropriately processing the electrical signals received from the first sensor (3) and existence of a fire, or at least a flame, by appropriately processing the electrical signals received from the from the second sensor (4).

CLAIMS

1. A domestic appliance (1) comprises a body (2) in which the electrical and/or electronics components for performing the operations of the domestic appliance (1) are housed, at least a first sensor (3) which is located inside the body (2) and configured to continuously determine the electrical current received from a mains supply and at least a second sensor (4) which is located inside the body (2) and configured to continuously determine infrared radiations emitted from at least one electrical and/or electronics component and **characterized by** a controller (5) which is capable of communicating with at least one first sensor (3) and at least one second sensor (4) in order to receive electrical signals generated by these sensors (3, 4) wherein the controller (5) is configured to;
- receive the electrical signals indicating the current taken from the mains supply from the first sensor (3) and the electrical signals indicating infrared radiation of at least one electrical and/or electronics component from the second sensor (4);
- process the received electrical signals independent of each other in order to determine whether there is an upcoming fire or fire existence inside the domestic appliance (1) and
- if it is determined that there is an upcoming fire or fire existence inside the domestic appliance (1) inform the user accordingly.
2. The domestic appliance (1) according to claim 1, **characterized in that** in order to process the electrical signals taken from the first sensor (3), the controller (5) is further configured to;
- make the signal stationary;
- obtain a smoothed signal by suppressing the stationary signal;
- calculate the amplitude of the smoothed signal and

apply a predetermined threshold (TH_{current}) in order to predict whether there is an upcoming fire.

- 5 3. The domestic appliance (1) according to claim 2, **characterized in that** the controller (5) is further configured to apply 3rd order difference on the signal received from first sensor (3) in order to make the signal stationary.
- 10 4. The domestic appliance (1) according to claim 2 or 3, **characterized in that** the controller (5) is further configured to apply an exponential filter on the stationary signal to obtain a smoothed signal.
- 15 5. The domestic appliance (1) according to any of the claims 2 to 4, **characterized in that** the controller (5) is further configured apply a Hilbert filter on the positive part of the smoothed signal in order to calculate the amplitude of the signal.
- 20 6. The domestic appliance (1) according to any of the claims 2 to 5, **characterized in that** controller (5) is further configured to apply a predetermined threshold (TH_{current}) to the obtained signal amplitude and detect that there is an upcoming fire ignition if the value of the signal amplitude is greater than the value of the threshold (TH_{current}).
- 25 7. The domestic appliance (1) according to any one of the above claims, **characterized in that** in order to process the electrical signals (f[n]) taken from the second sensor (4), the controller (5) is configured to;
smooth the signal (f[n]) by applying both a high and low exponential filters independently on the signal (f[n]) received from second sensor (4) and obtain a higher smoothed signal (f_h[n]) and lower smoothed signal (f_l[n]);

calculate the difference ($df[n]$) between higher smoothed signal ($f_h[n]$) and lower smoothed signal ($f_l[n]$);

count the number of incidents ($\#df(n)$) in which the calculated difference ($df[n]$) crosses a predetermined infrared threshold consecutively and

5 compare the counted value ($\#df(n)$) with a predetermined threshold value (TH_value) in order to determine whether there is a fire existence inside the domestic appliance (1).

8. A method for predicting and detecting a fire inside a domestic appliance
10 (1) which comprises a body (2) in which the electrical and/or electronics components for performing the operations of the domestic appliance (1) are housed, at least a first sensor (3) which is located inside the body (2) and configured to continuously determine the electrical current received from the mains supply and at least a second sensor (4) which is located
15 inside the body (2) and configured to continuously determine the infrared radiations emitted from at least one electrical and/or electronics component and a controller (5) which is capable of communicating with at least one first sensor (3) and at least one second sensor (4) in order to take electrical signals generated by these sensors (3, 4) wherein the method
20 comprises;

a step of generating (S1) the electrical signals indicating the current taken from the mains supply and the electrical signals indicating infrared radiation of at least one electrical and/or electronic component;

a step of processing (S2) the received electrical signals independently in
25 order to determine whether there is a risk of fire inside the domestic appliance (1) or there is a fire existence inside the domestic appliance (1) and

a step of informing (S3) the user if it is determined that there is a fire or a risk of fire inside the domestic appliance (1).

30

9. The method according to claim 8, **characterized in that** in order to process the electrical signals indicating the electric current taken from the mains supply the method further comprises;
a step of making (S4) the signal stationary;
5 a step of obtaining (S5) a smoothed signal by suppressing the obtained stationary signal and
a step of evaluating (S6) the smoothed signal in order to predict whether there is an upcoming fire ignition.
- 10 10. The method according to claim 9, **characterized in that** the step of making (S4) the signal stationary comprises an application of 3rd order difference on the signal in order to make the signal stationary.
11. The method according to claim 9 or 10, **characterized in that** the step of
15 obtaining (S5) a smoothed signal by suppressing the obtained stationary signal comprises an application of an exponential filter on the stationary signal.
12. The method according to any of the claims 9 to 11, **characterized in that**
20 the step of evaluating (S6) the smoothed signal in order to predict whether there is an upcoming fire ignition comprises;
a step of obtaining (S7) the absolute value of the smoothed signal;
a step of (S8) applying a Hilbert filter on the absolute value of the smoothed signal to find the amplitude of the signal and
25 a step of applying (S9) a predetermined threshold (TH_{current}) to the signal amplitude in order to predict whether there is an upcoming fire.
13. The method according to any of the claims 8 to 12, **characterized in that** in order to process the electrical signals (f[n]) indicating infrared radiation

of at least one electrical and/or electronic component the method further comprises;

a step of applying both a high exponential filter (S10) and low exponential filter (S11) independently on the signal ($f[n]$) received from second sensor (4) and obtain a higher smoothed signal ($f_h[n]$) and lower smoothed signal ($f_l[n]$);

a step of calculating (S12) the difference ($df[n]$) between higher smoothed signal ($f_h[n]$) and lower smoothed signal ($f_l[n]$);

a step of counting (S13) the number of incidents ($\#df(n)$) in which the calculated difference ($df[n]$) crosses a predetermined threshold ($TH_{infrared}$) consecutively and

a step of comparing (S14) the counted value ($\#df(n)$) with a predetermined threshold value (TH_value).

14. A computer readable program which comprises codes for causing a domestic appliance (1) to execute the method steps according to any of the claims 8 to 13.

15. A computer readable recording medium which stores the computer readable program according to claim 14.

Figure 1

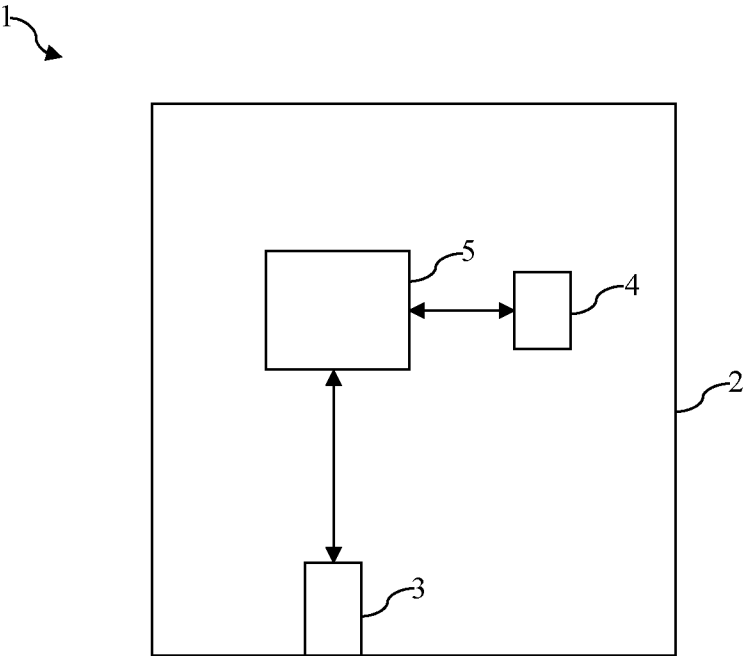


Figure 2

