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(54) **METHOD AND SYSTEM FOR PERFORMING A TREATMENT BY A HOUSEHOLD APPLIANCE ON A TEXTILE MATERIAL ITEM BASED ON AN AUTOMATIC TREATMENT DETERMINATION**

(57) A method and a corresponding system for performing a treatment on a textile material item by means of a household appliance (5), wherein the method comprises the steps of carrying out, on an area of the textile material item, a first scan by means of electromagnetic radiation (E1) in the near-infrared band, to obtain a first signal (S1) indicative of the nature of the textile material in the scanned area, and a second scan by means of electromagnetic radiation in the visible band (E2) to obtain a second signal (S2) indicative of the color of the textile material in the scanned area, the method then pro-

vides transmitting the aforesaid first signal (S1) and second signal (S2) to electronic processing means (3) to determine a treatment program which can be performed on the textile material item by processing the aforesaid first signal (S1) and second signal (S2), finally the method comprises the steps of providing information about the determined treatment program to a control unit of a household appliance (5), and performing the selected treatment on the textile material item by means of said household appliance (5).

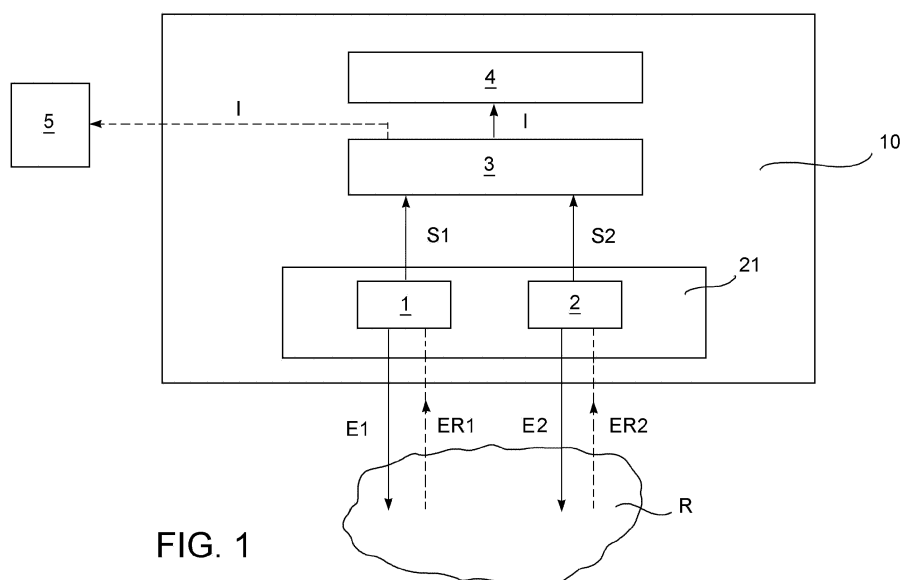


FIG. 1

Description

TECHNOLOGICAL BACKGROUND OF THE INVENTION

5 Field of application.

[0001] The present invention relates, in general, to the technical field of determining, by means of electronic processing, and performing a treatment which can be performed on a textile material item (e.g., by means of a household appliance).

10 [0002] In particular, the invention relates to a method and system for performing a treatment on a textile material item, on the basis of an automatic determination of the treatment to be carried out, based on scans by means of electromagnetic radiations and subsequent processing of the obtained signals.

[0003] Furthermore, the invention further relates to a method and system for recognizing types of fabric and types of stain on fabric, also based on scans by means of electromagnetic radiations and the subsequent processing of the obtained signals.

15 Description of the prior art.

[0004] In the scope of the determination of treatments on fabric items, which can be performed by household appliances, some solutions have been suggested based on the recognition of some properties of the fabric to be treated by means of infrared scanners.

20 [0005] However, such solutions do not appear to provide sufficiently accurate results to be used reliably for the automatic determination of treatment programs (e.g., washing, drying, etc.). Indeed, the information which can be obtained from low/medium-range scanners (compatible with the reasonable costs for this scope of application) allows a rather approximate and not entirely reliable recognition of the fabric to be treated, and consequently a rather approximate and not entirely reliable determination of the treatment to be performed.

[0006] In the considered technical field, the need has therefore arisen to have solutions for the automatic determination of appropriate treatment for fabric item, based on electronic processing, which is more precise and reliable with respect to the known solutions.

30 [0007] Furthermore, for most ordinary treatments (e.g., washing) and even more so for specific treatments or pre-treatments (e.g., stain removal), the need is strongly felt for methods which are able to recognize the type of fabric and also the type of stain automatically by means of electronic processing of data that can be easily acquired. Such a need poses even more complex technical requirements, to be combined with the requirements of simplicity, portability and low cost imposed by the considered applications (which relate, for example, to an enrichment of the functions of existing appliances).

35 [0008] At the moment, the known solutions mentioned above are not able to meet such a need.

[0009] At the same time, similar needs arise with reference to methods and systems for recognizing types of fabric and types of stain, which are desired both as a preparatory step to determining a treatment and in itself, with a view to providing useful information to users.

40 [0010] Also with regard to such needs, the known solutions mentioned above cannot provide a satisfactory response at the moment.

SUMMARY OF THE INVENTION

45 [0011] It is the object of the present invention to provide a method for performing a treatment which can be performed on a textile material item, which allows solving, at least in part, the drawbacks described above with reference to the prior art and to respond to the aforesaid needs particularly felt in the considered technical sector. Such an object is achieved by a method according to claim 1.

[0012] Further embodiments of such a method are defined in claims 2-7.

50 [0013] A further object of the present invention is a method for recognizing a type of textile material and for recognizing and classifying a stain present on said textile material. Such a method is defined in claim 8.

[0014] A further embodiment of such a method is defined in claim 9.

[0015] It is a further object of the present invention to provide a system for performing a treatment on a textile material item by a household appliance, implementing the aforesaid method of performing a treatment. Such a system is defined in claim 10.

55 [0016] Further embodiments of such a system are defined in claims 11-13.

[0017] Finally, an object of the present invention is a household appliance capable of performing a treatment on a textile material by carrying out the aforesaid method for performing a treatment. Such a household appliance is defined in claims 14 and 15.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] Further features and advantages of the methods and systems according to the invention will be apparent from the following description which illustrates preferred embodiments, given by way of indicative, non-limiting examples, with reference to the accompanying figures, in which:

- figure 1 diagrammatically illustrates an embodiment of a system for determining a treatment which can be performed on a textile material item, according to the invention, capable of performing a corresponding embodiment of the method for determining a treatment which can be performed on a textile material item;
- figure 2 illustrates two steps of the method for determining a treatment which can be performed on a textile material item, according to a further embodiment of the invention;
- figures 3-7 represent respective embodiments of the system for determining a treatment which can be performed on a textile material item;
- figure 8 diagrammatically illustrates a system for performing a treatment on a textile material item, according to the invention;
- figure 9 diagrammatically illustrates a household appliance according to the invention, adapted to perform a treatment on a textile material and to perform a method for determining a treatment;
- figure 10 shows spectral curves corresponding to electromagnetic radiations reflected by different types of fabrics, obtained experimentally in response to the exposure to electromagnetic radiations in the near-infrared band; such spectral curves may be used as comparison curves in some embodiments of the method; figures 10A, 10B and 10C show the spectral curves of figure 10, grouped in threes, for the sake of better readability;
- figures 11 and 12 show a "color space" diagram (on the basis of chromatic coordinates x, y), in which the color of an area of the fabric and of a stain are identified, respectively, according to that provided in some embodiments of the method.

DETAILED DESCRIPTION

[0019] With reference to figures 1-12, a method for determining a treatment which can be performed on a textile material item is described.

[0020] The method comprises the steps of carrying out a first scan on an area R of the textile material item by means of electromagnetic radiation E1 in the near-infrared band, NIR, to obtain a first signal indicative of the nature of the textile material in the scanned area, and carrying out a second scan on the aforesaid area R of the textile material item by means of electromagnetic radiation E2 in the visible band to obtain a second signal S2 indicative of the color of the textile material in the scanned area.

[0021] The method then provides transmitting the aforesaid first signal S1 and second signal S2 to electronic processing means 3, and determining, by said electronic processing means 3, a treatment program which can be performed on the textile material item by processing the aforesaid first signal S1 and second signal S2.

[0022] The method finally includes providing information I about the treatment program determined by the electronic processing means 3 to a control unit of a household appliance 5 and/or to a user interface 4.

[0023] It is worth noting that the method thus provides for at least a double scan, on the same area of the fabric, in order to gather the information necessary to determine the treatment to be performed on the textile material item, as shown in figure 1.

[0024] According to several examples of application of the method, the identified treatment, or treatment program, may be performed by a household appliance, or by a user, or may involve a pre-treatment performed by a user and successive treatment performed by a household appliance.

[0025] For example, the treatment program may comprise a washing and/or pre-washing and/or drying program, or the like, which can be performed by a household appliance, such as a washing machine or dryer.

[0026] In such a case, the step of determining a treatment program comprises, for example, selecting a treatment program from a plurality of stored treatment programs.

[0027] According to another example, the treatment or treatment program comprises stain removal or pre-treatment actions, which can be performed by a user (possibly preparatory to a subsequent treatment by a household appliance).

[0028] Details on different embodiments of the aforesaid method will be provided below.

[0029] According to an embodiment, the aforementioned first and second scans are performed on a non-stained area RC of the textile material. Furthermore, the method comprises, in this case, the further step of carrying out a third scan by means of electromagnetic radiation E3 in the near-infrared band on a stained area RS of the textile material item, in which a stain is present, to obtain a third signal S3 indicative of the nature of the textile material in the scanned stained area (as shown in figure 2).

[0030] In such a case, the step of determining the treatment program comprises determining the treatment program for the textile material item, by the electronic processing means 3, by processing the aforesaid first signal S1, second signal S2 and third signal S3.

[0031] According to a further implementation option (also shown in figure 2), the method further provides carrying out a fourth scan on said stained area RS of the textile material item, by means of electromagnetic radiation E4 in the visible band, to obtain a fourth signal S4 indicative of the color of the textile material in the scanned stained area.

[0032] In such a case, the step of determining a treatment program comprises determining a treatment program for the textile material item, by said electronic processing means 3, by processing the aforesaid first signal S1, second signal S2, third signal S3 and fourth signal S4.

[0033] In the example of figure 2, two successive steps of the method are shown in the left and right part of the figure: on the left, performing first and second scan, which can be mutually simultaneous, to generate the first and second signal (S1, S2); on the right, performing the third and fourth scan, which may be mutually simultaneous, to generate the third and fourth signal (S3, S4). After the performing two steps, the electronic processing means 3 have the four signals S1-S4 on the basis of which, in this embodiment, further processing is performed.

[0034] According to an embodiment of the method, the aforesaid steps of carrying out a first scan and of carrying out a third scan are performed by an electromagnetic radiation sensor 1 operating in the near-infrared band, and the aforesaid steps of carrying out a second scan and carrying out a fourth scan are performed by a color sensor 2 operating in the visible band.

[0035] According to a particular implementation option, the step of carrying out a first scan, by means of the electromagnetic radiation sensor 1 operating in the near-infrared band, comprises generating electromagnetic radiation in the near-infrared band E1 and directing the generated electromagnetic radiation in the near-infrared band E1 onto the area to be scanned RC of the textile material; then receiving the electromagnetic radiation in the near-infrared band ER1 reflected by the scanned area of the textile material; finally, generating the aforesaid first signal S1 indicative of the nature of the textile material in the scanned area on the basis of the received reflected electromagnetic radiation ER1.

[0036] According to such an implementation option, the step of carrying out a second scan, by means of the electromagnetic radiation sensor 2 operating in the visible band (i.e. "color sensor" 2) comprises: generating an electromagnetic radiation in the visible band E2 and directing the generated electromagnetic radiation in the visible band E2 onto the area RC to be scanned of the textile material; then receiving the electromagnetic radiation in the visible band ER2 reflected by the scanned area of the textile material; finally, generating the aforesaid second signal S2 indicative of the color of the textile material in the scanned area, on the basis of the received reflected electromagnetic radiation in the visible band ER2.

[0037] According to another implementation option, the step of carrying out a third scan, by means of the electromagnetic radiation sensor 1 operating in the near-infrared band comprises: generating an electromagnetic radiation in the near-infrared band E3 and directing the generated electromagnetic radiation in the near-infrared band E3 onto the stained area to be scanned RS of the textile material; then, receiving the electromagnetic radiation in the near-infrared band ER3 reflected by the scanned stained area of the textile material; finally, generating the aforesaid third signal S3, indicative of the nature of the textile material in the scanned stained area, on the basis of the electromagnetic radiation in the near-infrared band ER3 reflected by the scanned stained area.

[0038] According to such an implementation option, the step of carrying out a fourth scan by the electromagnetic radiation sensor operating in the visible band 2 comprises: generating an electromagnetic radiation in the visible band E4 and directing the generated electromagnetic radiation in the visible band E4 onto the stained area RS to be scanned of the textile material; then receiving the electromagnetic radiation in the visible band ER4 reflected by the scanned area of the stained textile material; finally, generating the aforesaid fourth signal S4 indicative of the color of the textile material in the scanned stained area on the basis of the electromagnetic radiation in the visible band ER4 reflected by the scanned stained area.

[0039] As noted above, various embodiments of the method provide either two detections carried out on the fabric and one processing operation based on two signals, or three detections carried out on the fabric (two in a non-stained area and one in a stained area) and one processing operation based on three signals, or four detections carried out on the fabric (two in a non-stained area and two in a stained area) and one processing operation based on four signals. In any case, at least one of the detections is based on scanning with electromagnetic radiation in the near-infrared band and at least one of the detections is based on scanning with electromagnetic radiation in the visible band.

[0040] According to preferred implementation options, the aforesaid electromagnetic radiation in the near-infrared band (E1, E3) used for the first and third scan are substantially mutually identical, i.e., they have the same nominal spectrum. The respective reflected radiations (ER1, ER3) may be different, since the scanned areas are different.

[0041] Similarly, the aforesaid electromagnetic radiations in the visible band (E2, E4), used for the second scan and the fourth scan, are substantially mutually identical, i.e., they have the same nominal spectrum. The respective reflected radiations (ER2, ER4) may be different, since the scanned areas are different.

[0042] Details will be given below, by way of example, of some processing modes of the signals such as to achieve

the purposes of the method.

[0043] In an implementation option of the method, the aforesaid step of determining comprises: processing the first signal S1 to obtain a first signal spectral curve corresponding to the frequency spectrum of the first signal; then comparing such a first signal spectral curve with each of a first plurality of stored reference spectra representative of the respective known types of textile material; finally, determining the nature of the scanned area of textile material on the basis of such a comparison.

[0044] According to such an implementation option, recognizing the nature and/or type of the textile item to be treated (basic information which is useful to determine the most appropriate treatment) is thus obtained by comparing the spectral curve in the infrared reflected by the fabric with known spectral curves, which are, for example, determined experimentally *a priori*, by performing the aforesaid scans on different types of known fabrics, and appropriately stored.

[0045] Indeed, by carrying out scans with sensors similar to the ones used in the step of experimental characterization, the spectral curve obtained from a given fabric will usually have a high degree of similarity, or will even be substantially identical, to the reference spectrum of the known fabric corresponding to the fabric to be analyzed.

[0046] It is easy to understand that the classes of fabrics which can be recognized by the method can be the most varied and of any number, and can refer both to the material of the fabric (e.g. linen, silk, wool, cotton, man-made, or the most varied mixed compositions, as will be detailed below) and to other characteristics of the fabric. The breadth and the granularity of the fabric classification, which can be obtained with the method, can be expanded simply by increasing the amount of basic experimental data.

[0047] According to different implementation options of the method, the fabrics which can be recognized and classified belong to a group consisting of any combination of the following PURE FABRICS:

acetate (AC), acrylic (PC), cotton (CO), wool (WO), modal (MO), polyamide (PA), polyester (PL), silk (SE), viscose (CI).

[0048] Reference spectra were obtained experimentally and stored (as shown by way of example in figures 10 and 10A - 10C) for each of such fabrics, mentioned by way of example, and this allows recognizing and classifying a fabric as one of these fabrics, or in a further group (fabric other than those indicated). In figures 10 and 10A - 10C, the key shows the same identifiers indicated above in brackets. The obtained spectra represent electromagnetic radiations reflected following the exposure of a clean area of the fabric to standard radiation (E1, E3) in the near-infrared band.

[0049] Typically, according to a preferred example, such standard radiation (E1, E3) in the near-infrared band has a spectrum in the band between 1550 nm and 1850 nm.

[0050] According to further options of implementation of the method, the fabrics which can be recognized and classified belong to a group consisting of any combination of the following MIXED FABRICS:

- fabrics of the "Acrylic - Man-made Fibers" (e.g. Acrylic-Polyester) type;
- fabrics of the "Cotton - Polyester" type;
- fabrics of the "Cotton - Man-made Fibers" type (e.g. Cotton-Acetate, or Cotton-Acrylic);
- fabrics of the "Cotton - Plant-based Fibers" type (e.g. Cotton-Modal, or Cotton-Viscose);
- fabrics of the "Wool-Cotton" type;
- fabrics of the "Wool - Polyester" type;
- fabrics of the "Wool - Man-made Fibers" type (e.g. Wool-Acrylic, or Wool-Polyester);
- fabrics of the "Plant-based Fibers - Polyester" type (e.g. Modal-Polyester, or Viscose-Polyester);
- fabrics of the "Silk-Viscose" type.

[0051] According to a further implementation option of the method, a sub-classification of composition into three subclasses is determined for each of the aforesaid mixed fabrics:

- first component 75% - second component 25%;
- first component 50% - second component 50%;
- first component 25% - second component 75%.

[0052] Such a classification is performed in exactly the same way as above for pure fabrics; reference spectra are experimentally derived for each combination (and for each subclass) and stored, with which the reflected spectra are compared, following the exposure of a clean area of the fabric to a standard radiation in the near-infrared area (E1, E3).

[0053] With reference now to the determinations in the visible band, according to an option of embodiment of the method, the aforesaid electromagnetic radiation in the visible band E2 has known chromatic coordinates. In such a case, the step of determining comprises processing the aforesaid second signal S2 to identify the color coordinates of the reflected radiation ER2, and to determine the color of the scanned area of textile material on the basis of the identified color coordinates of the reflected radiation.

[0054] In such a manner, additional information useful for determining the treatment is obtained, i.e., information about the color of the fabric.

[0055] Therefore, in this case, the step of determining comprises determining the treatment program on the basis of not only on the nature and/or type but also of the color of the scanned area of textile material.

[0056] According to different implementation options, the color coordinates can be detected and color can be identified by means of color sensors 2 (operating with radiations in the visible band) which are known in themselves.

[0057] In several possible options of implementation of the method, the determined chromatic coordinates may be of different types, known in themselves: e.g. RGB coordinates, or x, y coordinates.

[0058] This implies a corresponding selection of the color sensor and a corresponding selection of an RGB or x-y or other "color space".

[0059] According to a particular example of implementation, shown in figure 11, the chosen chromatic coordinates are of type x-y. A fabric area is scanned to determine its x-y color coordinates.

[0060] In the example considered herein, three measurements are made, as shown in the following table:

Chromatic coordinate	Measurement 1	Measurement 2	Measurement 3
x	0.4516	0.4480	0.4476
y	0.4287	0.4239	0.4230

[0061] The averages of such measurements, on x and y, are taken as "chromatic coordinates" of the fabric area, and shown in the "color space" in x, y coordinates, as shown in figure 11. The "color space" is a known diagram in the field of chromatic characterization. Figure 11 shows a "color space" in chromatic coordinates x, y (also called "sailplane diagram"), wherein the axes show the values of x and y, and wherein the parametric values shown in the diagram refer to wavelength values.

[0062] The position of the chromatic coordinates on the diagram allows the color of the scanned area of the fabric to be determined.

[0063] According to a further embodiment of the method, the step of determining further comprises processing the aforesaid third signal S3 to obtain a third signal spectral curve corresponding to the frequency spectrum of the third signal indicative of properties correlated with the type of stain and identifying the type of stain on the basis of such a third signal spectral curve.

[0064] In such a case, the step of determining comprises determining the treatment program on the basis of the nature and color of the scanned non-stained area of textile material, and also on the basis of the identified type of stain.

[0065] The determination is therefore based, in this example, on three measurements, two (near-infrared and visible bands) on a non-stained area and one (near-infrared band) on a stained area.

[0066] Such an implementation example provides the additional advantage of making the decision on the treatment to be performed by availing of additional information on the type of stain.

[0067] In different implementation options, the method can recognize a wide variety of types of stain, comprising, for example, stains belonging to the following groups and subgroups:

- bloodstain;
- sugar stain, which can be classified, in turn, into the subgroups of pudding, chocolate cream, jam;
- fat and/or oil stain, which can be classified, in turn, into the subgroups of butter, olive oil, seed oil, mineral oils (e.g., motor oil);
- pigment stain, which can be classified, in turn, into red wine, grass, earth, fruit (e.g. strawberry), sebum;
- other foods stain, which can be classified, in turn, into tomato sauce, egg.

[0068] According to a further embodiment of the method, in addition to the three scans mentioned above, a fourth scan is carried out on the stained area. In such a case, specifically, the electromagnetic radiation in the visible band E4 has known chromatic coordinates. Furthermore, the step of determining comprises processing the aforesaid fourth signal S4 to identify the chromatic coordinates of the radiation reflected by the scanned stained area; recognizing the color of the scanned stained area of textile material on the basis of the identified chromatic coordinates of said reflected radiation E4; determining the treatment program on the basis of the nature and color of the scanned non-stained area of textile material, and also on the basis of the type of stain identified and of the recognized stain color.

[0069] Even for the color of the stains (as already observed above for the color of the fabric), in different possible embodiments of the method, the chromatic coordinates determined can be of different types, known in themselves: e.g., RGB coordinates, or x, y coordinates.

[0070] This implies a corresponding selection of the color sensor, and a corresponding selection of a "color space" (RGB or x-y or others), which is partitioned into regions corresponding to different types of stain (each with its own range of possible colors), so as to have information for recognizing the stain according to the region in which the detected color

coordinates belong. A "color space" can be partitioned into regions done *a priori*, experimentally, by identifying the most likely colors of different types of recognizable stains.

[0071] The example described above for detecting the color in the fabric illustrates a procedure which can further be applied to a detection of a stain color. A result by way of example (referring to a strawberry stain) is shown in figure 12.

[0072] The position of the chromatic coordinates on the diagram allows determining the type of stain (possibly in cooperation with spectral information).

[0073] According to a particular implementation option of such an embodiment, the step of identifying the type of stain on the basis of the third signal spectral curve firstly provides selecting a set of reference spectra from a plurality of stored spectra sets, on the basis of the determined nature and/or type of the textile material. Each of such sets is associated with a respective nature and/or type of textile material.

[0074] The set of reference spectra comprises a second plurality of reference spectra representative of respective types of stain on the determined specific textile material.

[0075] The method, therefore, provides comparing the aforesaid third signal spectral curve and each of the second plurality of spectra; and determining the type of stain on the basis of such a comparison between the third signal spectral curve and each spectrum of the second plurality of spectra.

[0076] So, in such a case, the identification of the nature and/or type of the fabric (by means of NIR detection on a clean area of the fabric), as well as being the first essential information for determining the treatment, also serves as a basis for the stain type recognition procedure. Indeed, once the fabric has been identified, it is possible to select a particular set of reference spectra (among all the stored ones), each associated with a different type of stain on that particular fabric. Therefore, the comparison of the third spectral curve (derived from the NIR detection on the stain) with the reference spectra belonging to the particular selected set allows recognizing the type of stain from a predefined group of stains for which experimental data are available (i.e., stored spectra).

[0077] According to an implementation option, the information obtained from the aforesaid comparison of the third spectral curve (third signal) is combined with information related to the color of the stain (obtained from the aforesaid fourth signal), to obtain a more precise recognition, suitable to discriminate different stains associated with similar spectra but of different color. Such an option is useful, for example, if the stains contain pigments of staining substances which do not significantly modify the spectrum of the clean fabric and which can be detected with respect to the background color. In particular, such an option is useful for recognizing pigment stains on light-colored fabrics.

[0078] According to a further implementation option, the decision on the appropriate treatment program also takes into account the available information on the color of the fabric which can be derived from the aforesaid second signal.

[0079] According to other different implementation examples, further processing operations are performed on different possible combinations of two or more of the four available pieces of information (NIR spectra on clean fabric and stain, color on clean fabric and stain) in order to obtain useful information for determining the treatment.

[0080] For example, information about spectra detected on clean fabric and stain may be combined to obtain a derived spectrum which takes the background into account; or, information about the colors of clean fabric and stain can be combined with one another, to better estimate the stain color, taking the background color into account.

[0081] According to possible further implementation options, the method can take into account, based on experimental results, how and by what extent the clean spectrum curves are modified, with regard to the stain spectrum curves, according to the type of fabric. Indeed, such deviations may be different and peculiar to different possible situations. A similar observation applies to color and its chromatic coordinates.

[0082] According to an embodiment of the method, the steps of the first and second scan are performed at the same time by detection means 21 comprising both the sensor 1 operating with electromagnetic radiation in the near-infrared and the sensor 2 operating with electromagnetic radiation in the visible band 2; similarly, the third and fourth steps of scanning are performed at the same time by the aforesaid detection means 21 comprising both the sensor 1 operating with electromagnetic radiation in the near-infrared band and the sensor 2 operating with electromagnetic radiation in the visible band.

[0083] According to a further embodiment, the method further comprises the step of providing a user interface 4.

[0084] In various implementation options, the user interface 4 is configured to display information about the identified type of fabric and/or type of stain, and/or to display information about the determined treatment program which is recommended, and/or to allow the user to control the start of the recommended treatment program or to perform the actions provided by the treatment.

[0085] According to a particular embodiment, the method further comprises the step of calibrating the electromagnetic radiation sensor operating in the near-infrared band 1.

[0086] Such a step of calibrating comprises the following sub-steps: providing a sliding cover in front of the sensor, having a bottom such as to generate a reflection with known and predetermined near-infrared spectrum; closing the sliding cover in front of the color sensor; activating the electromagnetic radiation sensor operating in the near-infrared band so that it generates near-infrared electromagnetic radiation and receives the reflected radiation from the bottom of the cover; comparing the obtained spectrum with a reference spectrum; calibrating operating parameters of the

electromagnetic radiation sensor operating in the near-infrared band so that the obtained spectrum coincides with the reference spectrum.

[0087] According to another particular embodiment, the method further comprises the step of calibrating the color sensor 2.

[0088] Such a step of calibrating comprises the following steps: providing a sliding cover in front of the sensor, having a white bottom with the known and predefined chromatic coordinates; closing the sliding cover in front of the color sensor; activating the color sensor so that it generates visible electromagnetic radiation and receives the reflected radiation from the bottom of the cover; comparing the obtained spectrum with a reference spectrum; finally, calibrating operating parameters of the color sensor so that the obtained spectrum coincides with the reference spectrum.

[0089] A method is now described for recognizing a type of textile material and for recognizing and classifying a stain present on such textile material, according to the present invention.

[0090] Such a method comprises the steps of carrying out a first scan on a non-stained area RC of the textile material by means of near-infrared NIR band electromagnetic radiation E1 to obtain a first signal indicative of the nature of the textile material S1 in the scanned non-stained area; furthermore, carrying out a second scan on the aforesaid non-stained area RC of the textile material by means of electromagnetic radiation in the visible band E2 to obtain a second signal indicative of the color of the textile material S2 in the scanned non-stained area; furthermore, carrying out a third scan on a stained area RS of the textile material in which a stain is present, by means of electromagnetic radiation E3 in the near-infrared NIR, band, to obtain a third signal indicative of the nature of the textile material S3 in the scanned stained area.

[0091] The method, then, provides transmitting the aforesaid first signal S1, second signal S2 and third signal S3 to electronic processing means 3, and recognizing and classifying the stain, by the electronic processing means 3, on the basis of processing the aforesaid first signal S1, second signal S2, and third signal S3.

[0092] The method finally includes providing information I' about the type of textile material and type of stain to a control unit of a household appliance 5 and/or a user interface 4 by the electronic processing means 3.

[0093] According to another embodiment of such a method, it further provides carrying out a fourth scan on the aforesaid stained area RS of the textile material item by means of electromagnetic radiation in the visible band E4 to obtain a fourth signal S4 indicative of the color of the textile material in the scanned stained area; and further transmitting such fourth signal S4 to the electronic processing means 3.

[0094] In such a case, the step of recognizing comprises recognizing the type of textile material and recognizing and classifying the stain by the electronic processing means 3, by processing the aforesaid first signal S1, second signal S2, third signal S3 and fourth signal S4.

[0095] The same signal processing operations, previously described with regard to the method to determine a treatment, may also be used in the method to recognize a type of textile material and a stain, described here.

[0096] In this method, a triple scan is necessary (in the near-infrared and in the visible bands on a clean fabric area and in the near-infrared band on a stained area), resulting in the processing of three signals.

[0097] The fourth scan (in the visible band on a stained area) is optional. It may be useful to discriminate against different spots which generate very similar reflective spectra (e.g., different types of pigments) and which can be distinguished and correctly recognized by having information about their color.

[0098] In some cases, it may happen that, although the recognition of stains of the present method is particularly effective, due to the multitude of measurements made and subsequent processing, it is not possible to discriminate a stain, e.g., because it is too small, or because it is an unknown stain (i.e., a stain for which no characterizing information, e.g. the spectra, is recorded).

[0099] To deal with such cases, an implementation option of the method provides that, if the recognition is unsuccessful, the user is asked to make a further scan attempt.

[0100] According to another example of embodiment, if even after a repeated scan the stain cannot be recognized, such information is provided to the user, and a generic treatment suggestion is given.

[0101] A method is now described for performing a treatment on a textile material item by a household appliance, according to the present invention.

[0102] Such a method comprises the steps of performing a method for determining a treatment according to any one of the embodiments described above for selecting a treatment program, such a treatment program being performed by a household appliance 100; then providing information about the selected treatment program to a control unit 5 of a household appliance 100; finally, performing the selected treatment on the textile material item by the household appliance 100.

[0103] A system 10 will now be described, with reference again to figures 1-9, to determine a treatment which can be performed on a textile material item, comprised in the present invention.

[0104] Such a system 10 comprises first detection means 1 operating in the near-infrared band, NIR, second detection means 2 operating in the visible band, and electronic processing means 3.

[0105] The first detection means operating in the near-infrared band, NIR, are configured to carry out a scan on an

area R of the textile material item by means of near-infrared band electromagnetic radiation E1 and to generate, based on such a scan, at least one signal indicative of the nature of the textile material S1 in the scanned area.

[0106] The second detection means 2 operating in the visible band are configured to carry out a scan on an area R of the textile material item by means of visible band electromagnetic radiation E2 to obtain at least one signal indicative of the color of the textile material S2 in the scanned area.

[0107] The electronic processing means 3 are operatively connected to the first detection means 1 to receive the at least one signal indicative of the nature of the textile material S1, and to the second detection means 2 to receive the at least one signal indicative of the color of the textile material S2.

[0108] Furthermore, the electronic processing means 3 are configured to determine a treatment program, which can be performed on the textile material item, based on a processing of the aforesaid received signals (S1, S2) indicative of the nature and color of the textile material, and to provide information I about the determined treatment program to a control unit 5 of a household appliance and/or a user interface 4.

[0109] According to an implementation option, the first detection means 1 are configured to carry out a first scan over an unstained area RC of the textile material item and to generate a respective first signal S1 based on such a first scan; and they are further configured to carry out a third scan over a stained area RS of the textile material item and to generate, based on such third scan, a respective third signal S3.

[0110] The second detection means 2 are configured to carry out a second scan over a non-stained area RC of the textile material item and to generate a respective second signal S2 based on such a second scan.

[0111] The electronic processing means 3 are configured to receive the aforesaid first signal S1, second signal S2 and third signal S3, and to determine the treatment program based on such first signal S1, second signal S2 and third signal S3.

[0112] According to an implementation option of the system, the second detection means 2 are further configured to carry out a fourth scan on a stained area RS of the textile material item and to generate, based on said fourth scan, a respective fourth signal S4. In such a case, the electronic processing means 3 are configured to receive also said fourth signal S4 and to determine the treatment program on the basis of the aforesaid first signal S1, second signal S2, third signal S3 and fourth signal S4.

[0113] According to an implementation option, the aforesaid first detection means 1 comprise at least one electromagnetic radiation sensor 1 operating in the near-infrared band. Such a sensor 1 is configured to generate electromagnetic radiation in the near-infrared band (E1 or E3) and to direct the generated electromagnetic radiation in the near-infrared band to the scanned area of the textile material (RC or RS), to receive the electromagnetic radiation in the near-infrared reflected (ER1 or ER3) from the scanned area of the textile material, and to generate the aforesaid signal (S1 or S3) indicative of the nature of the textile material in the scanned area, based on the received reflected electromagnetic radiation (ER1 or ER3).

[0114] The aforesaid second detection means 2 comprise at least one electromagnetic radiation sensor 2 operating in the visible band. Such a sensor 2 is configured to generate an electromagnetic radiation in the visible band (E2 or E4) and to direct the generated electromagnetic radiation in the visible band to the scanned area of the textile material (RC or RS), to receive the electromagnetic radiation in the visible band (ER2 or ER4) reflected by the scanned area of the textile material, and to generate the aforesaid signal (S2 or S4) indicative of the color of the textile material in the scanned area, on the basis of the received reflected electromagnetic radiation in the visible band (ER2 or ER4).

[0115] In accordance with a further implementation option, the system 10 further comprises a user interface 4, operationally connected to the processing means 3 to receive information I' related to the determined treatment program or to the type of fabric and/or recognized stain. The user interface 4 is configured to display the aforesaid received information and/or to allow the user to send controls to a household appliance to activate the determined treatment program.

[0116] In several possible implementation options of the system, the user interface 4 allows the user to perform a wide range of possible actions, such as, for example, launching the scans, saving the scan results, collecting the scan results in order to create wash baskets, asking for suggestions on the most appropriate groupings of the scanned fabrics, getting suggestions on stain removal methods, launching the indicated washing/drying cycles by transmitting respective controls to one or more connected household appliances.

[0117] According to an implementation option (shown in several variants in figures 3-7), the processing means of the system 3 comprise first processing means 31 and second processing means 32.

[0118] The first processing means 31 are configured to generate the aforesaid first and/or second and/or third and/or fourth signal S1-S4 as digital signals on the basis of the detected analog signals associated with the received reflected electromagnetic radiations.

[0119] The second processing means 32 are configured to receive the aforesaid first S1 and/or third digital signal S3, to obtain respective frequency spectral curves on the basis of such first S1 and/or third digital signal S3, and to compare the derived spectral curves with reference spectra stored in the second processing means 32.

[0120] The second processing means 32 are also configured to receive the second S2 and/or fourth digital signal S4, and obtain the chromatic coordinates, on the basis of such second S2 and/or fourth digital signal S4.

[0121] The second processing means 32 are also configured to determine the treatment program based on the results of the aforesaid step of comparing the spectral curves and/or the aforesaid step of obtaining the chromatic coordinates; and are also configured to provide information I about the determined treatment program to a control unit 5 of a household appliance and/or user interface 4.

[0122] According to an embodiment, the system 10 comprises a portable scanning device 11, which includes the aforesaid first detection means 1 and second detection means 2, and the aforesaid first processing means 31.

[0123] In such a case, the integration of both detection means (i.e., sensors) of the system into the portable scanning device 11 allows advantageously performing both detections at the same time. The user simply needs to approach the portable scanning device 11 closer to the fabric, on a clean area and then possibly on a stain, and to activate it, in order to obtain all the detections and signals necessary to perform the method.

[0124] It is worth noting that the portable scanning device 11, by virtue of the first processing means 31, can provide a digital signal, which can be used for any successive processing.

[0125] According to an implementation option, the first processing means 31 of the portable scanning device 11 are also configured to perform compensation and/or calibration processing of the digital signal generated with respect to temperature or other variables, in order to ensure maximum reliability of the digital signal generated for subsequent processing.

[0126] In an implementation option (shown in figure 3), the portable scanning device further comprises the aforesaid second processing means 32 and user interface 4. Therefore, in such a case, the portable processing device 11 also comprises all the intelligence for signal processing and, thus, is able to provide information I' on the fabric and/or the stain recognition and/or information I' on the recommended treatment program. Therefore, such an implementation option offers a fully integrated solution in a portable device.

[0127] According to another embodiment (shown in figure 4), the system 10 comprises a portable scanning device 11 and a mobile communication device 12.

[0128] The portable scanning device 11 comprises the first detection means 1, the second detection means 2, the first processing means 31, and further comprises scanning device transmission means 110, configured to transmit digital signals from the analog signals generated by the first and second detection means.

[0129] The mobile communication device 12 comprises the user interface 4, the aforesaid second processing means 32 and telecommunications means 120, operationally connected to the scanning device transmission means 110, to receive the aforesaid signals generated by the first and second detection means.

[0130] According to an implementation option, the portable scanning device 11 operates as a scanner, while the mobile communication device 12 comprises a smartphone, or another type of mobile user device, which in itself offers all telecommunication functions and user interface support. In such a case, the second processing means 32 comprise one or more smartphone processors, and one or more applications or software programs, installed on the smartphone and which can be run by the processor of the smartphone and configured to perform the processing and calculation functions mentioned above with regard to the second processing means.

[0131] According to an example, an Android and iOS application (app) is used, loaded on the smartphone. Such an app can also be incorporated into a more general home appliance control application available for smartphones or other mobile devices.

[0132] In an implementation example, libraries containing reference data can be stored on the mobile communication device 12 (e.g., the aforesaid reference spectra and reference chromatic coordinates used for the comparisons required by the processing).

[0133] Such libraries may contain any number of spectra measured during the step of characterization, on the most different types of fabrics and types of stain, and on the most varied fabric and stain combinations (e.g., all the types of fabrics, pure or mixed, and all the types of stain mentioned above).

[0134] Furthermore, such libraries contain not only the reference data but also the algorithms for data analysis and processing.

[0135] According to an implementation option, the aforesaid portable scanning device 11 and mobile communication device 12 are integrated into a single device.

[0136] A further embodiment (shown in figure 5) provides that the system 10 comprises an additional remote processing unit 13, capable of performing, either partially or totally, the functions of the second processing means 32, and in particular the storage of reference data libraries and the running of comparisons.

[0137] According to various implementation options of such an embodiment, the remote processing unit 13 may be either additional or alternative to the mobile communication device 12.

[0138] For example, the remote processing unit 13 may comprise the second processing means 32, and, in such a case, the aforesaid scanning device transmission means 110 are configured to transmit the signals generated by the first and second detection media wirelessly to said remote processing unit 13. In this example, the system does not comprise and does not require a mobile user device.

[0139] In another example (shown in figures 6 and 7), the system 10 comprises both the portable scanning device 11

(provided with scanning device transmission means 110, to transmit digital signals from the analog signals generated by the first and second detection means 1, 2) and the mobile communication device 12 (provided with user interface 4 and with telecommunication means 120, operationally connected to the scanning device transmission means 110, to receive signals generated by the first and second detection means 1, 2), and the remote control unit 13 (provided with the second processing means 32, and therefore adapted to perform the processing functions). In such a case, the mobile communication device telecommunications means 120 are operationally connected to the remote control unit 13 to send the information received from the portable scanning device 11 and to receive the results of processing performed remotely from the second processing means 32.

[0140] Any telecommunication solution, known in itself, can be used to support the aforesaid operational connections.

[0141] According to an implementation option of the system, the remote processing unit 13 is a control unit 5 of a household appliance 100 adapted to perform the treatment program. Such an option is shown in figure 7. Furthermore, in figure 5, such an implementation option is indicated by a dotted connection, indicating that such an option may be alternative or additional to the option which provides a remote-control unit 13 not belonging to the household appliance.

[0142] According to another implementation option of the system (shown in figure 8), the remote processing unit 13 is a remote-control unit which can be accessed via a telecommunications network and/or cloud computing.

[0143] With reference to figure 8, a system 1000 for performing a treatment on a textile material item, according to the present invention, is now described

[0144] Such a system 1000 for performing a treatment on a textile material item comprises a system for determining a treatment on a textile material item 10, according to any one of the embodiments or implementation options illustrated above, in which the treatment can be performed by a household appliance, and further comprises a household appliance 100, comprising a household appliance control unit 5.

[0145] The household appliance control unit 5 is configured to receive information I about a selected treatment program 10 from the system for determining a treatment and to activate such a selected treatment program.

[0146] The household appliance 100 is configured to perform the selected treatment program on the textile material item.

[0147] According to an embodiment of such a system, the home appliance control unit 5 further comprises the second processing means 32 of the system to determine the treatment 10.

[0148] A household appliance 100 will now be described adapted to perform a treatment on a textile material, according to the invention. The household appliance 100 comprises a system 10 for determining a treatment which can be performed on a textile material item according to any of the embodiments described above and is thus able to determine a treatment to be performed on one or more textile material items. The household appliance is also configured to perform the determined treatment.

[0149] According to an embodiment (shown in figure 9), the household appliance 100 comprises a household appliance control unit 5 and further integrates the scanning device or scanner 21 (also referred to as "detection means 21" previously in this description). In such a case, the scanning device is not portable. The user can put the fabric (clean and/or stained area) close to the integrated scanning device and operate such an integrated scanning device 21, in order to activate all the steps of the method for determining a treatment, which are then performed independently by the household appliance. In such a case, the integrated scanning device 21 is operationally connected, inside the household appliance 100, with the control unit of household appliance 5, which is, in turn, configured both to perform the processing functions of the aforementioned second processing means (in order to determine a treatment) and to control the performance of the selected treatment.

[0150] According to an embodiment, the household appliance further provides the functions of the aforesaid user interface 4, e.g., supported by the interface means of the household appliance 40.

[0151] According to possible implementation options, the scanner 21 is mechanically integrated and/or housed on the dashboard of the household appliance or on the ring of the door so that the user can place the fabrics on the sensor before introducing them into the household appliance.

[0152] It is worth noting that the object of the present invention is fully achieved by the method illustrated above by virtue of the functional and structural features thereof.

[0153] Indeed, the method and the system of determination of a treatment described above are based on the detection and processing of a plurality of information (obtained from electromagnetic detections both in the near-infrared band and in the visible band), which, combined, allow discerning the type of a fabric in a more precise and reliable manner.

[0154] Furthermore, the possibility of performing measurements both in the near-infrared region and in the visible region even on stained areas of the fabric, and the articulated processing provided by the method (by appropriately combining several parameters from several measurements) allow recognizing not only the type of fabric but also the type of stain with satisfactory accuracy.

[0155] Similar advantages can be identified for methods and systems for recognizing fabric types and stain types, comprised in the invention, which provide results which can be used both as a basis for a more effective determination of treatment and to provide information which is useful to the user in itself.

[0156] A person skilled in the art may make changes and adaptations to the methods and systems described above or can replace elements with others which are functionally equivalent to satisfy contingent needs without departing from the scope of protection of the appended claims. All the features described above as belonging to one possible embodiment may be implemented independently from the other described embodiments.

Claims

1. A method for performing a treatment on a textile material item by a household appliance, comprising the steps of:

- carrying out a first scan on an area (R) of the textile material item by means of near infrared band, NIR, electromagnetic radiation to obtain a first signal indicative of the nature of the textile material (S1) in the scanned area;
- carrying out a second scan on said area (R) of the textile material item by means of visible band electromagnetic radiation to obtain a second signal indicative of the color of the textile material (S2) in the scanned area;
- transmitting said first signal (S1) and second signal (S2) to electronic processing means (3);
- said electronic processing means (3) determining a treatment program which can be carried out on the textile material item based on a processing of said first signal (S1) and second signal (S2);
- providing a control unit of a household appliance (5) with information about the treatment program determined by the electronic processing means (3);
- performing the selected treatment on the textile material item by the household appliance.

2. A method according to claim 1, wherein said first scan and second scan are performed on an unstained area (RC) of the textile material, and wherein the method further comprises the step of:

- carrying out a third scan by means of near infrared band electromagnetic radiation on a stained area (RS) of the textile material item where there is a stain, to obtain a third signal (S3) indicative of the nature of the textile material in the scanned stained area;

and wherein the determining step comprises:

- determining the treatment program for the textile material item by said electronic processing means (3), based on a processing of said first signal (S1), second signal (S2) and third signal (S3).

3. A method according to claim 2, wherein the method further comprises the step of:

- carrying out a fourth scan on said stained area (RC) of the textile material item by means of visible band electromagnetic radiation to obtain a fourth signal (S4) indicative of the color of the textile material in the scanned stained area;

and wherein the determining step comprises:

- determining the treatment program for the textile material item, by said electronic processing means (3), based on a processing of said first signal (S1), second signal (S2), third signal (S3) and fourth signal (S4).

4. A method according to any one of claims 2 to 3, wherein the determining step further comprises processing said third signal (S3) to obtain a third signal spectral curve corresponding to the frequency spectrum of the third signal, said third signal spectral curve being indicative of properties correlated with the type of stain, and identifying the type of stain on the basis of said third signal spectral curve, and wherein the determining step comprises determining the treatment program on the basis of the nature and color of the scanned unstained area of textile material, and also on the basis of the type of stain identified, and wherein the visible band electromagnetic radiation (E4) has known chromatic coordinates, and wherein the determining step further comprises:

- processing said fourth signal (S4) to identify the chromatic coordinates of the reflected radiation from the scanned stained area;
- recognizing the color of the scanned stained area of textile material on the basis of the identified chromatic coordinates of said reflected radiation (ER4);

- determining the treatment program on the basis of the nature and color of the scanned unstained area of textile material, and also on the basis of the type of stain identified and of the stain color recognized,

wherein the step of identifying the type of stain on the basis of said third signal spectral curve comprises:

- selecting, based on the nature and/or type of the textile material determined, a set of reference spectra, from a plurality of sets of stored spectra, each set being associated with a respective nature and/or type of textile material,
- wherein said set of reference spectra comprises a second plurality of reference spectra representative of respective types of stain on the specific textile material determined;
- comparing said third signal spectral curve with each of said second plurality of spectra;
- determining the type of stain on the basis of said comparison between the third signal spectral curve and each spectrum of said second plurality of spectra.

5. A method according to any one of the preceding claims, wherein the determining step comprises selecting a treatment program from a plurality of stored treatment programs, and/or the treatment program comprises a cleaning and/or pre-cleaning and/or drying program which can be carried out by a household appliance, and/or the treatment program comprises stain removal or pre-treatment actions which can be carried out by a user.

6. A method according to any one of the preceding claims, further comprising the step of calibrating the electromagnetic radiation sensor (1) operating in the near infrared band, through the following steps:

- providing a sliding cover in front of the sensor, having a bottom such as to generate a reflection with known and predetermined near infrared spectrum;
- closing the sliding cover in front of the color sensor;
- activating the electromagnetic radiation sensor operating in the near infrared band so that it generates near infrared electromagnetic radiation and receives the reflected radiation from the bottom of the cover;
- comparing the obtained spectrum with a reference spectrum;
- calibrating operating parameters of the electromagnetic radiation sensor operating in the near infrared band in such a way that the obtained spectrum coincides with the reference spectrum.

7. A method according to any one of the preceding claims, further comprising the step of calibrating the color sensor (2), through the following steps:

- providing a sliding cover in front of the sensor, having a white bottom with the known and predefined chromatic coordinates;
- closing the sliding cover in front of the color sensor;
- activating the color sensor so that it generates visible electromagnetic radiation and receives the reflected radiation from the bottom of the cover;
- comparing the obtained spectrum with a reference spectrum;
- calibrating operating parameters of the color sensor so that the obtained spectrum coincides with the reference spectrum.

8. A method for recognizing a type of textile material and for recognizing and classifying a stain on said textile material, comprising the steps of:

- carrying out a first scan on an unstained area (RC) of the textile material by means of near infrared, NIR, band electromagnetic radiation (E1) to obtain a first signal indicative of the nature of the textile material (S1) in the scanned unstained area;
- carrying out a second scan on said unstained area (RC) of the textile material by means of visible band electromagnetic radiation (E2) to obtain a second signal indicative of the color of the textile material (S2) in the scanned unstained area;
- carrying out a third scan on a stained area (RS) of the textile material where there is a stain, by means of near infrared, NIR, band electromagnetic radiation (E3), to obtain a third signal indicative of the nature of the textile material (S3) in the scanned stained area;
- transmitting said first signal (S1), second signal (S2) and third signal (S3) to electronic processing means (3);
- recognizing the type of textile material and recognizing and classifying the stain by the electronic processing

means (3), on the basis of a processing of said first signal (S1), second signal (S2) and third signal (S3);
 - providing a control unit of a household appliance (5) and/or a user interface (4) with information (I') about the type of textile material and type of stain by the electronic processing means (3).

9. The method according to claim 8, further comprising the step of:

- carrying out a fourth scan on said stained area (RS) of the textile material item by means of visible band electromagnetic radiation (E4) to obtain a fourth signal indicative of the color of the textile material (S4) in the scanned stained area;
- transmitting also said fourth signal (S4) to said electronic processing means (3); and wherein the recognition step comprises:
- recognizing the type of textile material and recognizing and classifying the stain by the electronic processing means (3), on the basis of a processing of said first signal (S1), second signal (S2), third signal (S3) and fourth signal (S4).

10. A system (10) for performing a treatment on a textile material item, comprising:

- first detection means (1) operating in the near infrared band, NIR, configured to carry out a scan on an area (R) of the textile material item by means of near infrared band electromagnetic radiation (E1) and to generate, based on said scan, at least one signal indicative of the nature of the textile material (S1) in the scanned area;
- second detection means (2) operating in the visible band, configured to carry out a scan on an area (R) of the textile material item by means of visible band electromagnetic radiation (E2) to obtain at least one signal indicative of the color of the textile material (S2) in the scanned area;
- electronic processing means (3) operatively connected to the first detection means (1) to receive said at least one signal indicative of the nature of the textile material (S1), and operatively connected to the second detection means (2) to receive said at least one signal indicative of the color of the textile material (S2),
- the electronic processing means (3) being configured to determine a treatment program, which can be carried out on the textile material item, based on a processing of said received signals (S1, S2) indicative of the nature and color of the textile material, and to provide a control unit (5) of a household appliance and/or a user interface (4) with information (I) about the determined treatment program;
- a household appliance (100), comprising a household appliance control unit (5), wherein the household appliance control unit (5) is configured to receive information (I) about a selected treatment program from the system for determining a treatment on a textile material item (10), and to activate said selected treatment program;
- and wherein the household appliance (100) is configured to carry out the selected treatment program on the textile material item.

11. A system (10) according to claim 10, wherein:

- the first detection means (1) are configured to carry out a first scan over an unstained area (RC) of the textile material item and to generate, based on said first scan, a respective first signal (S1); and are also configured to carry out a third scan over a stained area (RS) of the textile material item and to generate, based on said third scan, a respective third signal (S3);
- the second detection means (2) are configured to carry out a second scan over an unstained area (RC) of the textile material item and to generate, based on said second scan, a respective second signal (S2);
- the electronic processing means (3) are configured to receive said first signal (S1), second signal (S2) and third signal (S3), and to determine the treatment program based on said first signal (S1), second signal (S2) and third signal (S3).

12. A system (10) according to claim 10, wherein the second detection means (2) are also configured to carry out a fourth scan over a stained area (RS) of the textile material item and to generate, based on said fourth scan, a respective fourth signal (S4);

- the electronic processing means (3) are also configured to receive said fourth signal (S4) and to determine the treatment program based on said first signal (S1), second signal (S2), third signal (S3) and fourth signal (S4).

13. A system (10) according to any one of claims 10 to 12, wherein the processing means (3) of the system comprise first processing means (31) and second processing means (32), wherein:

- the first processing means (31) are configured to generate said first (S1) and/or second (S2) and/or third (S3) and/or fourth signal (S4) as digital signals on the basis of the detected analog signals associated with the received reflected electromagnetic radiations;
- the second processing means (32) are configured to:

- receive said first (S1) and/or third digital signal (S3);
- obtain respective frequency spectral curves on the basis of said first (S1) and/or third digital signal (S3);
- compare the obtained spectral curves with reference spectra saved in the second processing means (32);
- receive said second (S2) and/or fourth digital signal (S4);
- obtain the chromatic coordinates on the basis of said second (S2) and/or fourth digital signal (S4);
- determine the treatment program based on the results of said step of comparing the spectral curves and/or said step of obtaining the chromatic coordinates;
- provide a control unit (5) on a household appliance and/or user interface (4) with information (I) about the determined treatment program.

14. A household appliance (100) adapted to carry out a treatment on a textile material and to perform a method for performing a treatment according to any one of claims 1 to 9.

15. A household appliance (100) according to claim 14, comprising a household appliance control unit (5) and detection means (21) mechanically accommodated and/or integrated therein, wherein the detection means (21) comprise said first detection means (1) and second detection means (2) and said first processing means (31), and wherein the household appliance control unit (5) comprises said second processing means (32) configured to receive the signals generated by the detection means (21), wherein the household appliance control unit (5) is configured to determine a treatment on the basis of the signals received from the detection means (21) and to control the execution the determined treatment.

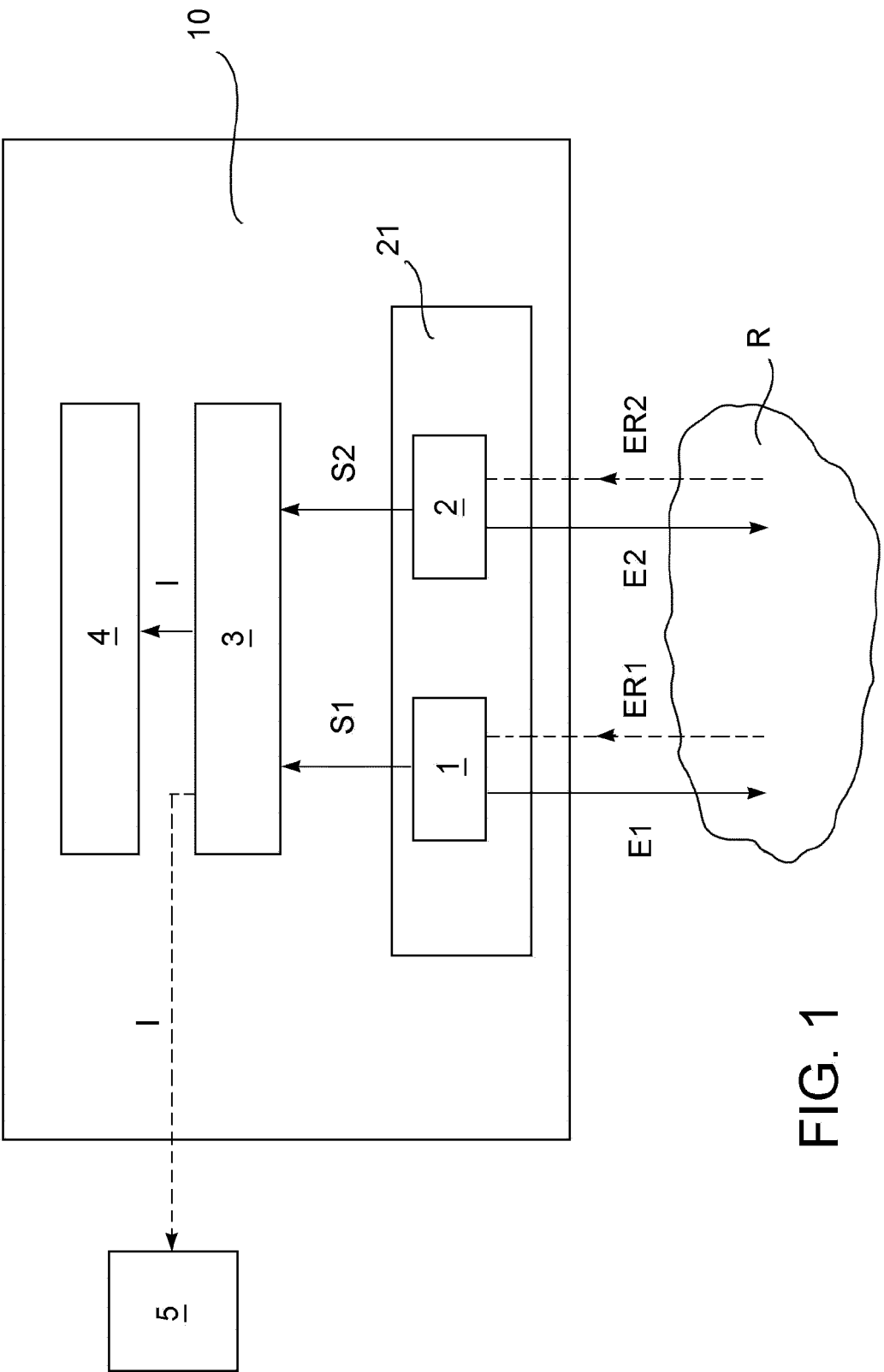


FIG. 1

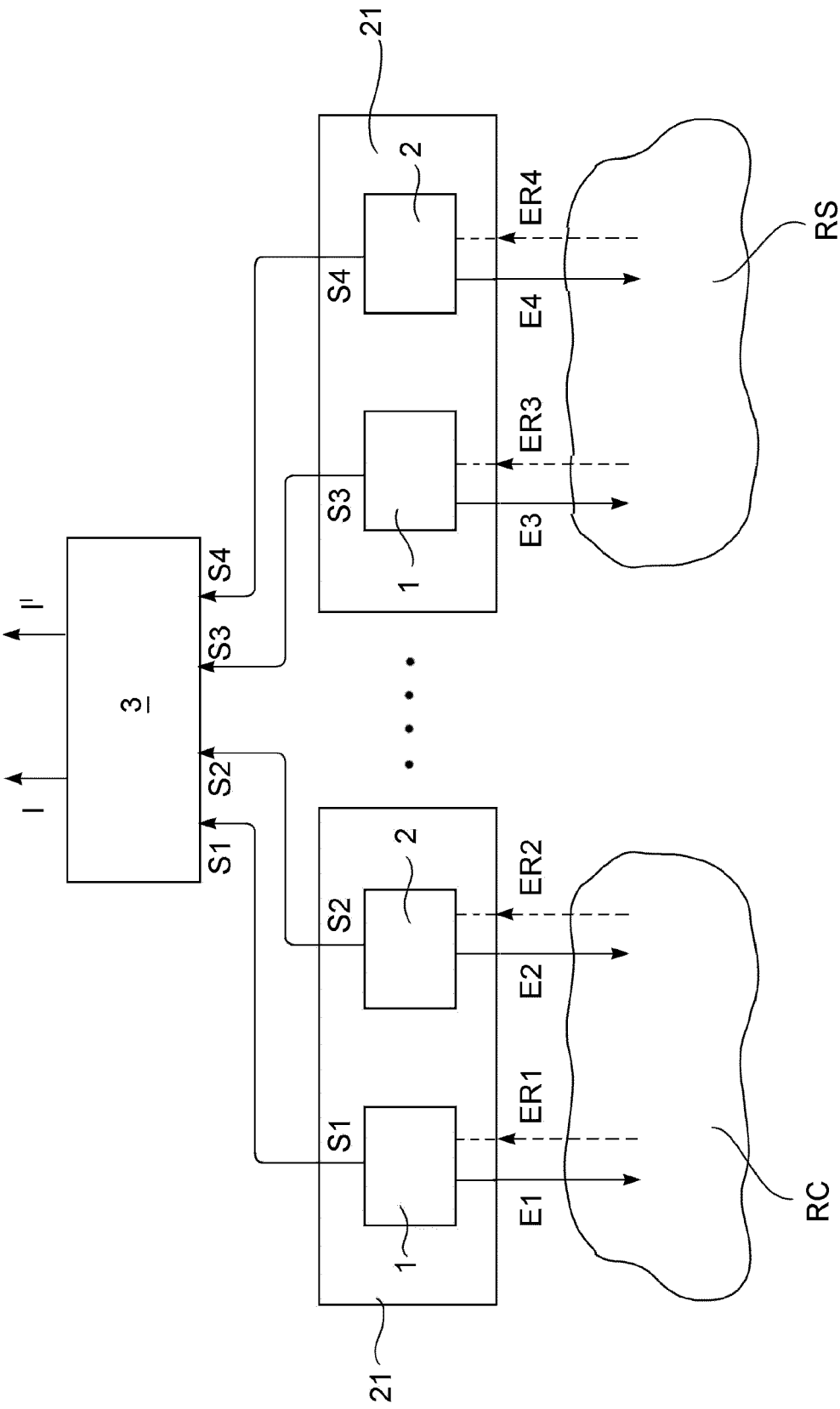


FIG. 2

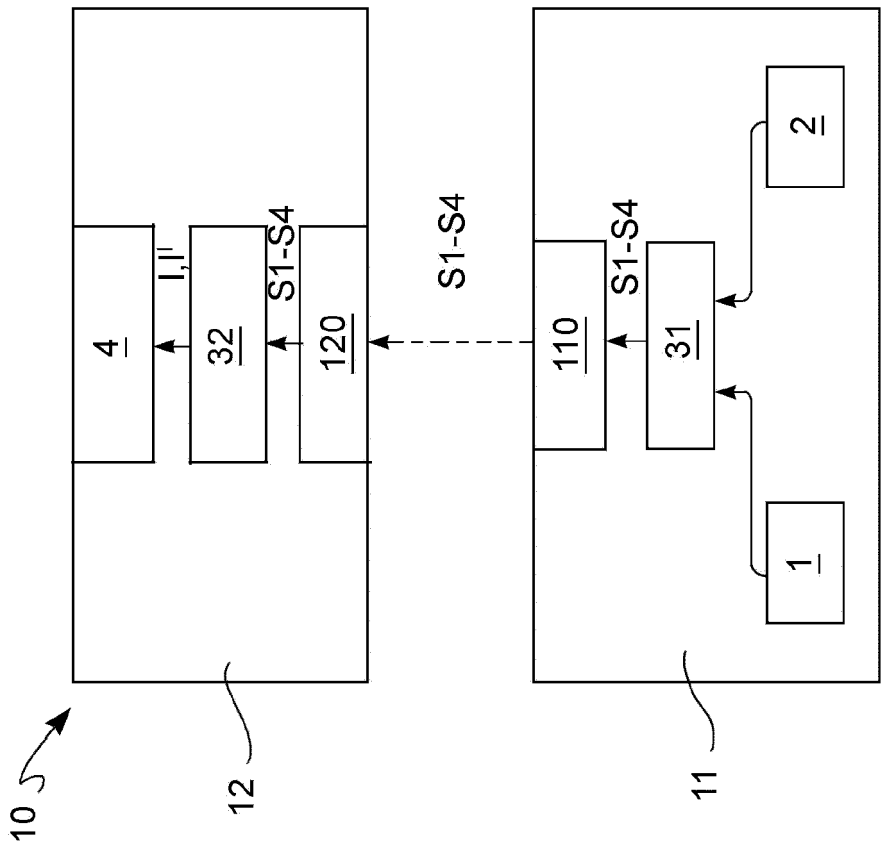


FIG. 4

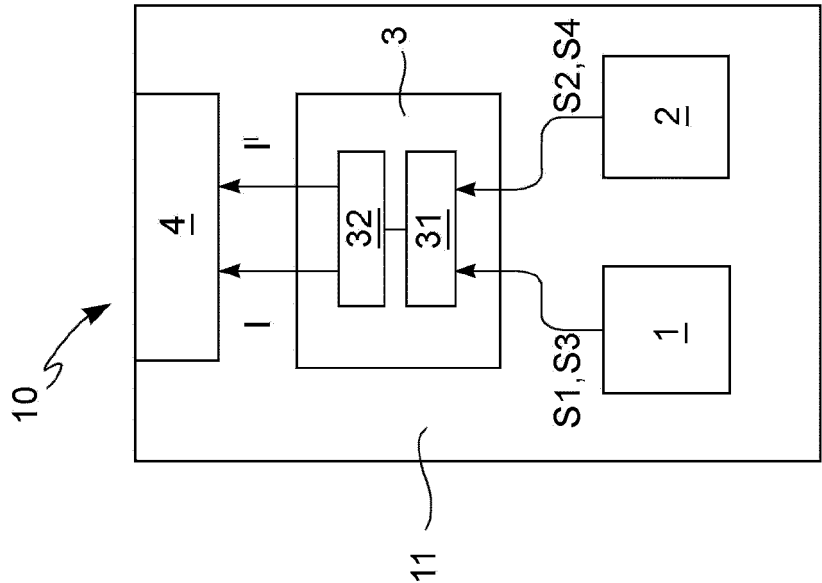


FIG. 3

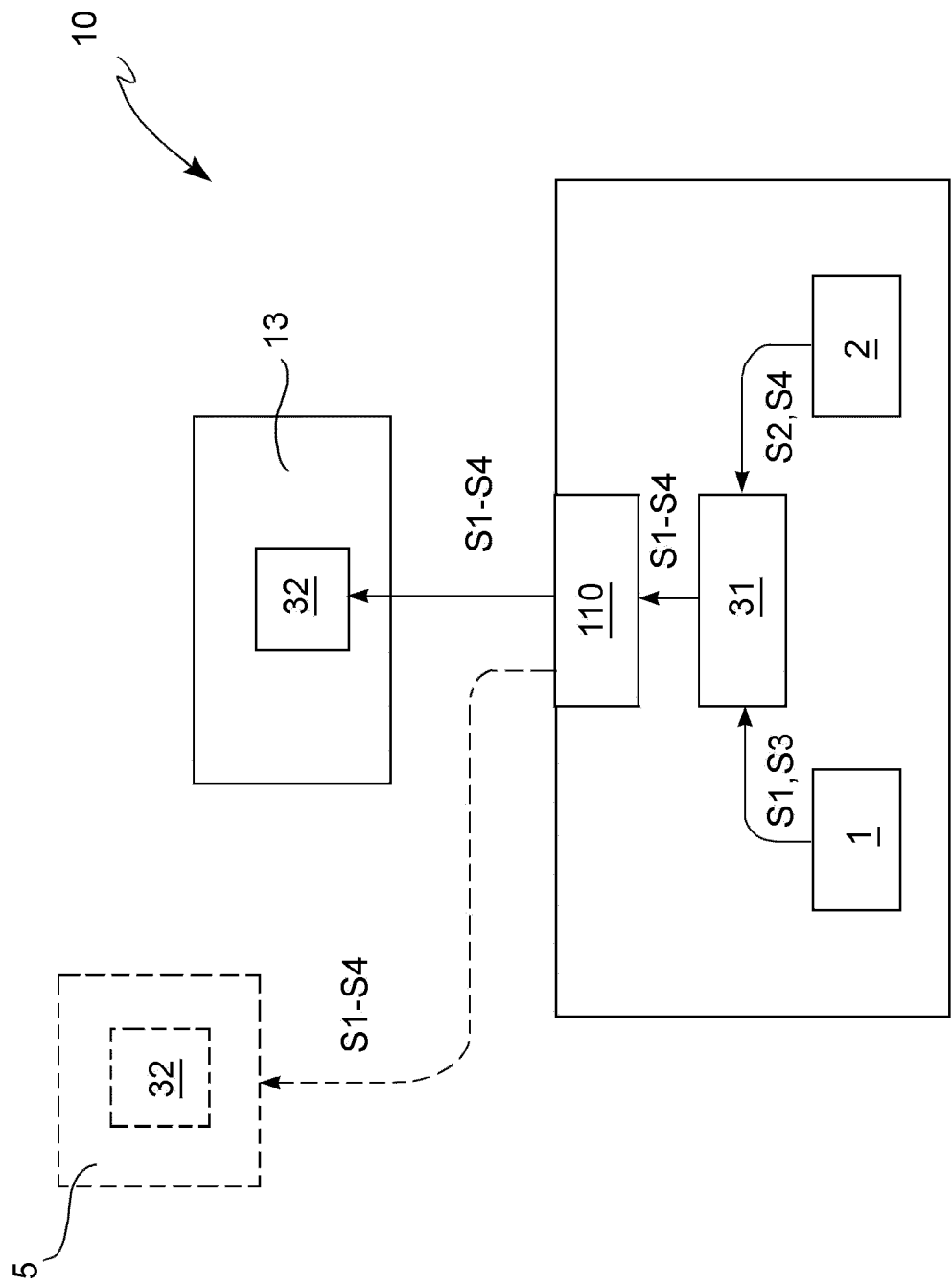
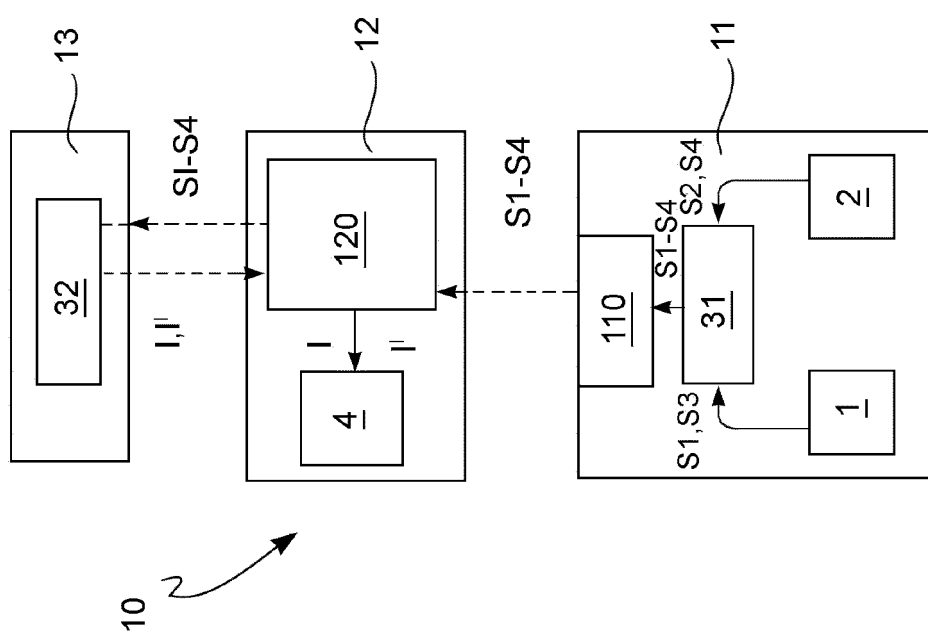
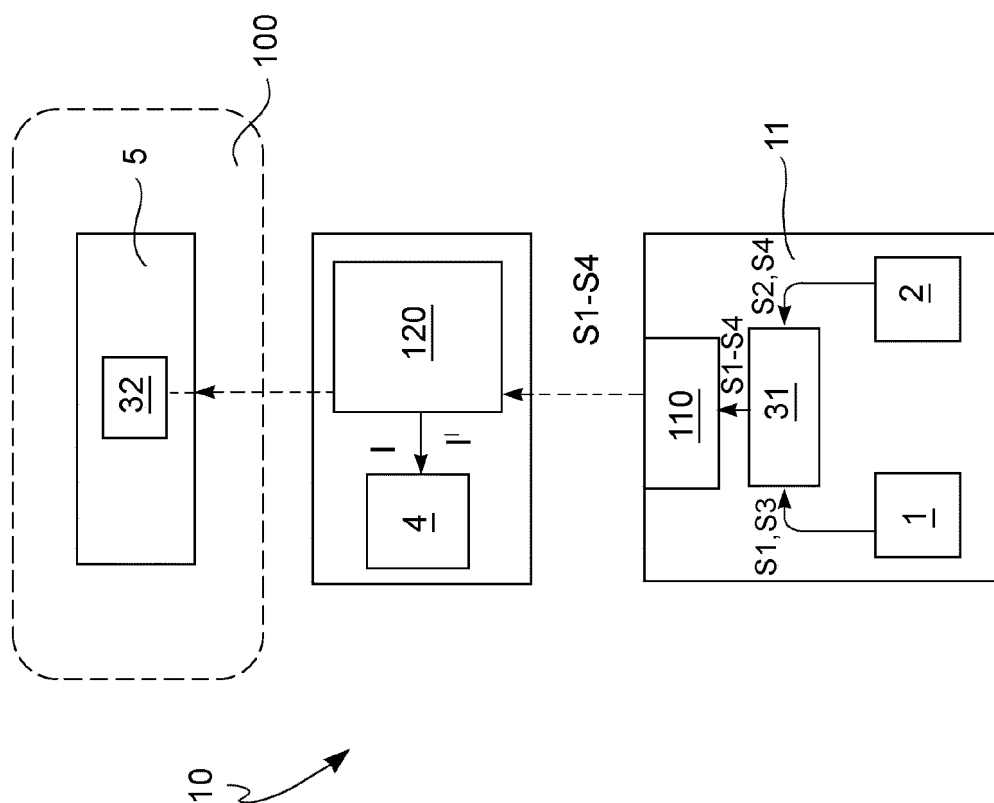


FIG. 5



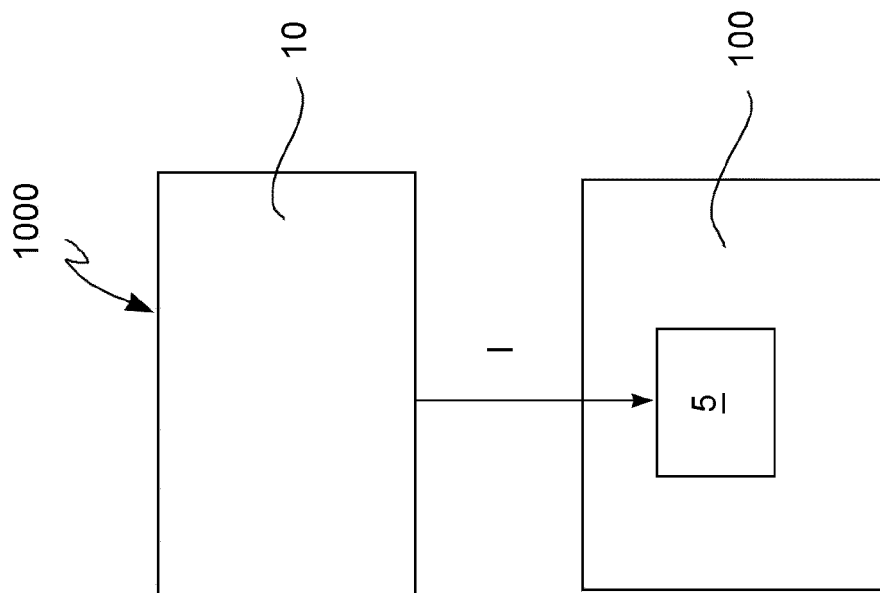


FIG. 8

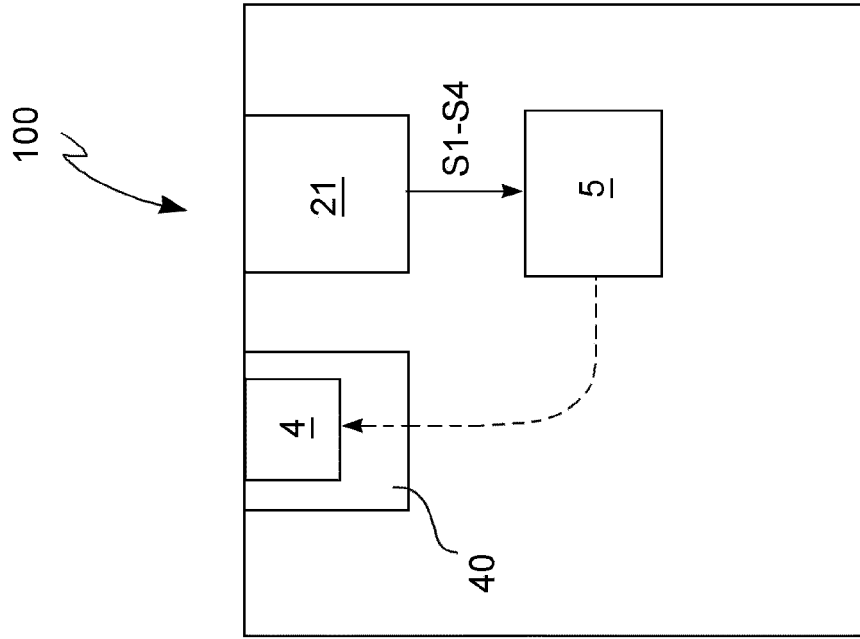


FIG. 9

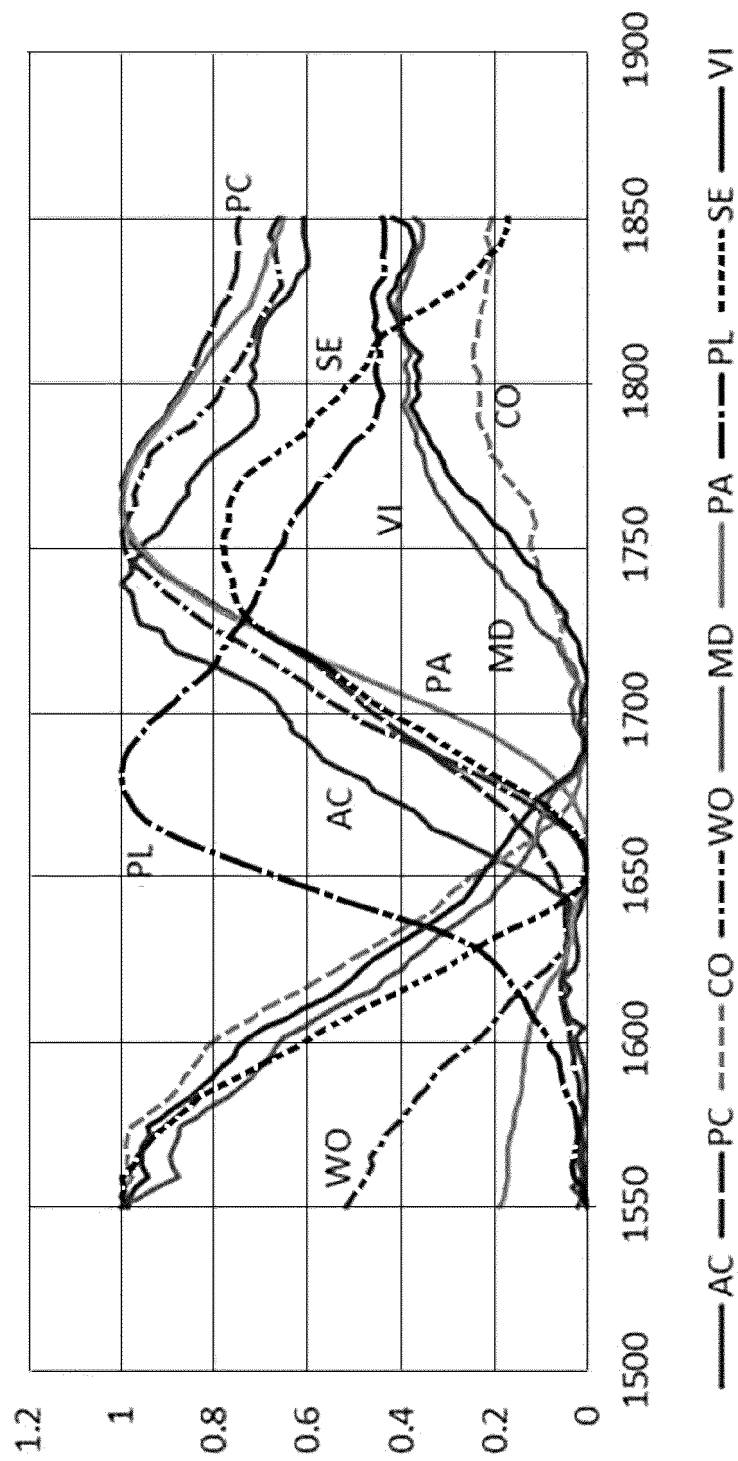


FIG. 10

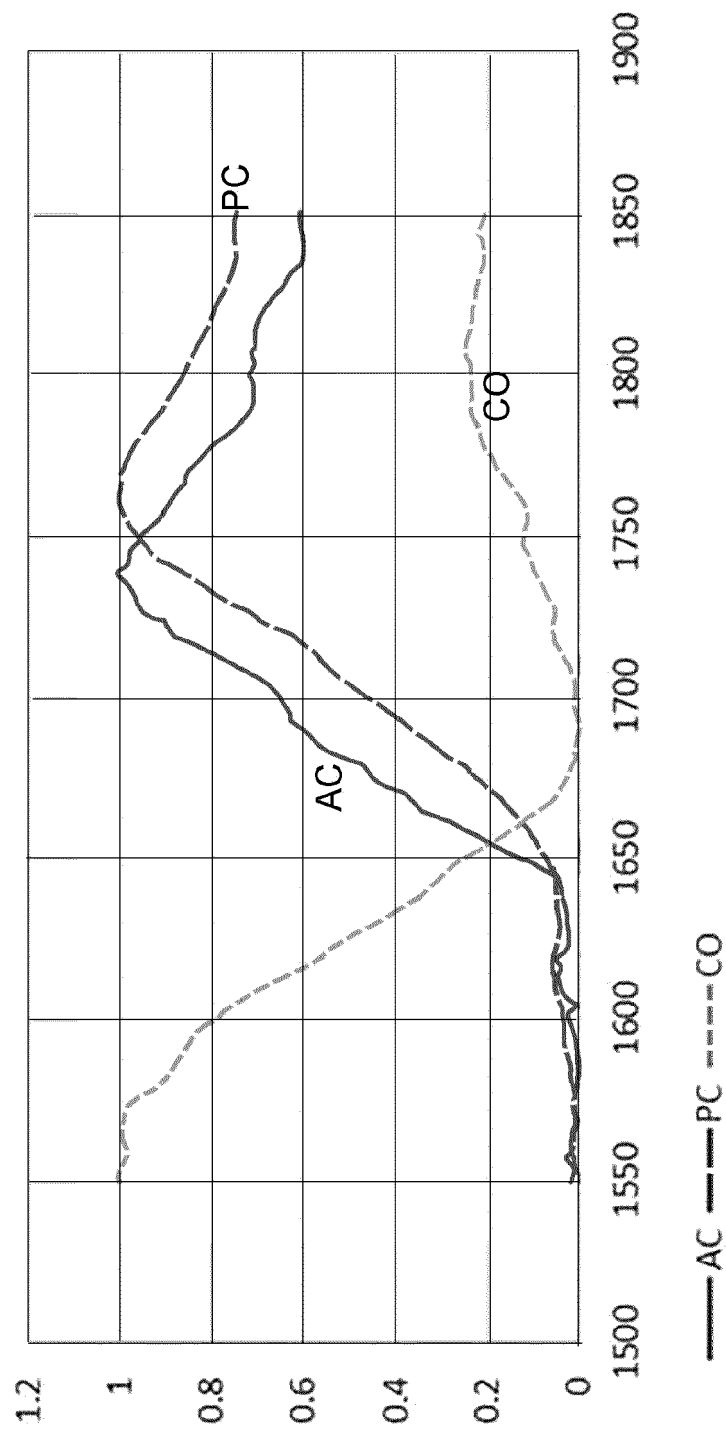


FIG. 10A

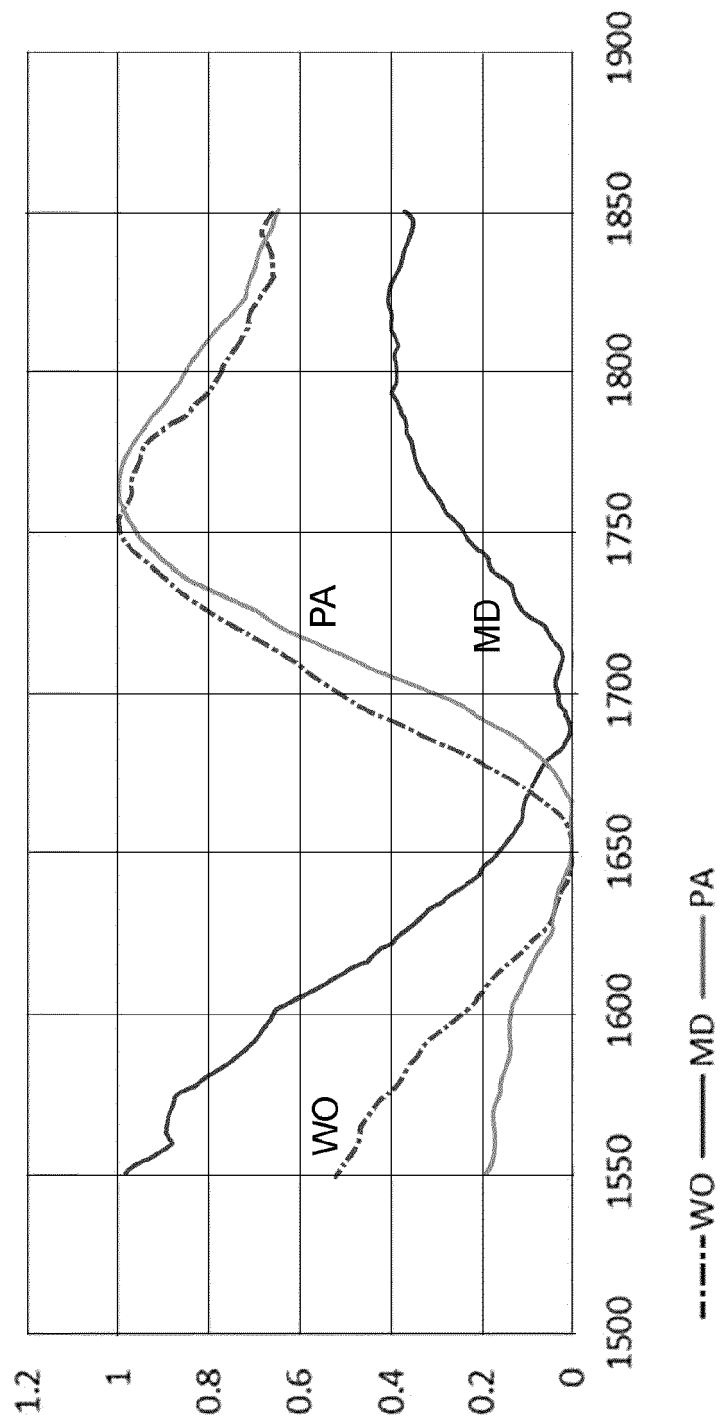


FIG. 10B

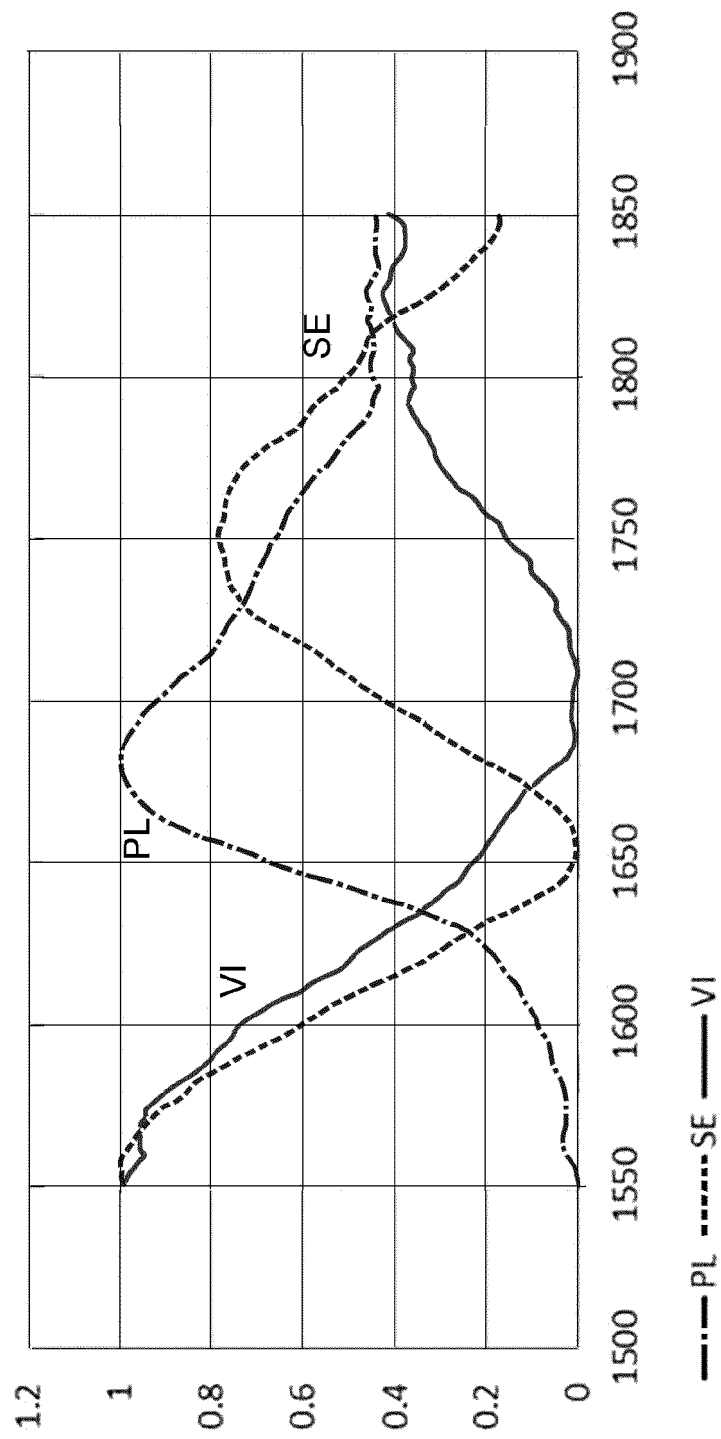


FIG. 10C

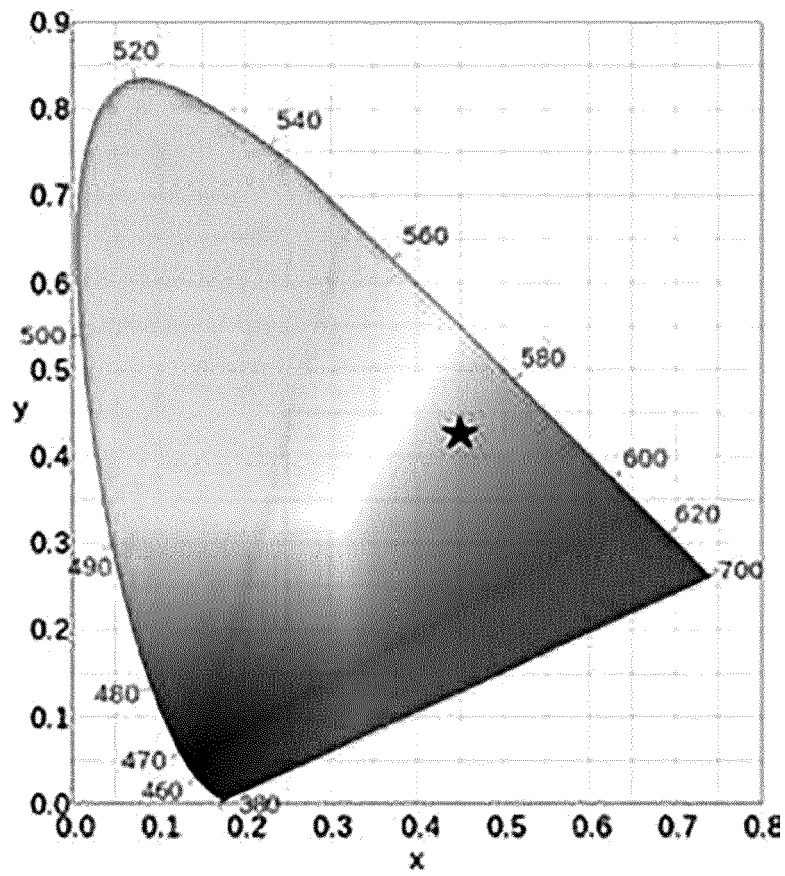


FIG. 11

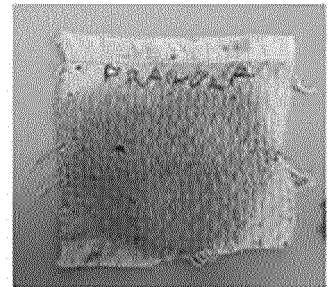
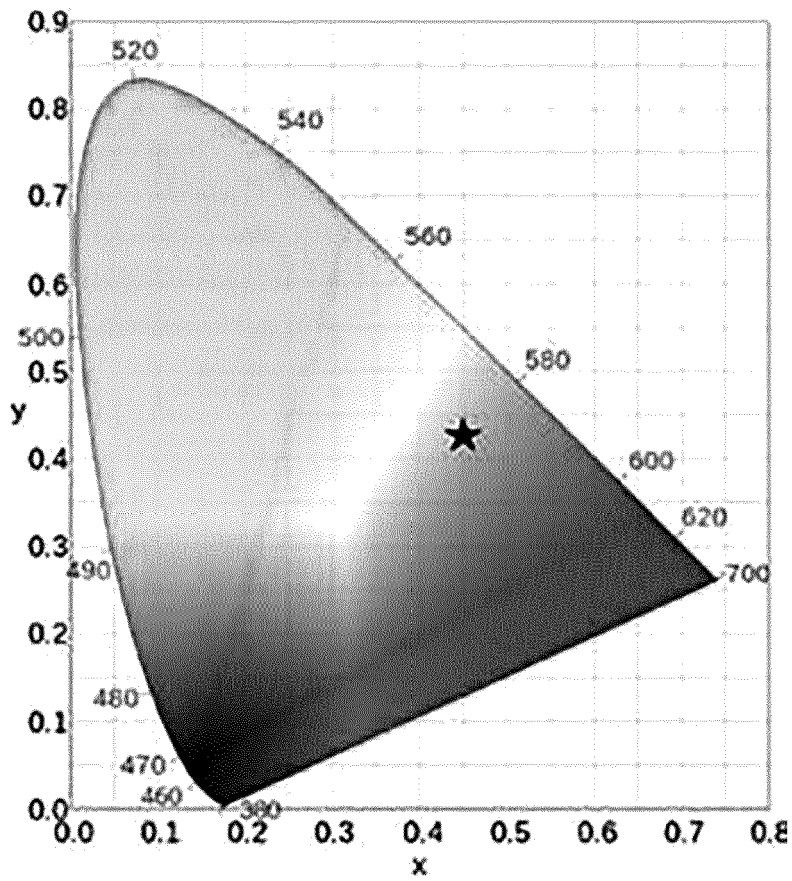


FIG. 12



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