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(71) Applicants: **FRESENIUS MEDICAL CARE DEUTSCHLAND GMBH** [DE/DE]; Else-Kroener-Strasse 1, Bad Homburg, 61352 (DE). **FRESENIUS MEDICAL CARE R&D (SHANGHAI) CO., LTD.** [CN/CN]; Block 4, 1036 Tianlin Road, Shanghai Business Park III, Minhang District, Shanghai 200233 (CN).

(72) Inventor: **FAN, Yuying**; Block 15, 1036 Tianlin Road, Shanghai Business Park III, Minhang District, Shanghai 200233 (CN).

(74) Agent: **NTD PATENT AND TRADEMARK AGENCY LIMITED**; 10th Floor, Tower C, Beijing Global Trade Center, 36 North Third Ring Road East, Dongcheng District, Beijing 100013 (CN).

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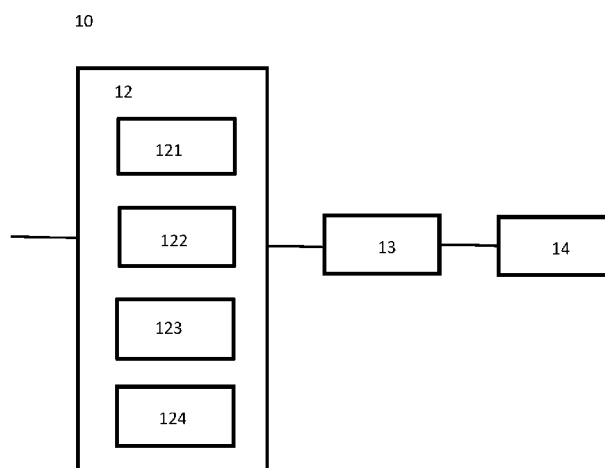


Fig.1

(57) Abstract: A device for recognizing one or more characters is provided. The device comprises an adjusting unit(12) for adjusting color level of a first image of a subject to generate the adjusted image, the first image of the subject being generated from a color image of a subject, the color image of the subject comprising one or more characters to be recognized; a conversion unit(13) for converting the adjusted image into a binary image; and a character recognition unit(14) for recognizing the one or more characters based on the binary image. By the device, one or more characters may be recognized accurately from an image with multiple color information, especially with background color information.



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DEVICE AND METHOD FOR RECOGNIZING ONE OR MORE CHARACTERS

FIELD OF THE INVENTION

The present invention generally relates to optical character recognition, and especially to recognizing one or more characters from a color image.

BACKGROUND OF THE INVENTION

In some cases, parameters are measured and displayed to a user with different foreground colors and background colors. This may be especially common in medical field. For example, for a dialysis machine, the parameters may be shown in different colors, e.g., blue and/or green, in an area with gray background color and for a bedside monitor, the parameters may be shown in different colors, e.g., green and/or red, in an area with black background color.

In some applications, especially in medical applications, a user, e.g., a physician or a care giver, may need to record the parameters. However, some medical devices, such as some relatively cheap medical devices, may only display the measured parameters to the user, but do not have an output interface that may output and record the measured parameters in electronic manner. In this situation, the user may only record the parameters with a pen through hand writing. Such recording of the parameters are error prone and time consuming when the user needs to monitor and record certain parameter(s) of a patient for a long period.

Optical character recognition (OCR) technique may be used to recognize one or more characters from the display of the medical devices, however, due to multiple colors information in the display of the medical devices, especially the background color information in the display of the medical devices, the recognition of the characters may be inaccurate.

SUMMARY OF THE INVENTION

Therefore, it would be desirable to provide method and device which may

recognize one or more characters automatically from an image with multiple color information, especially with background color information, to facilitate a record of parameters shown in a display.

In one aspect, one embodiment of the invention provides a device for recognizing one or more characters. The device comprises an adjusting unit for adjusting color level of a first image of a subject to generate the adjusted image, the first image of the subject being generated from a color image of a subject, the color image of the subject comprising one or more characters to be recognized; a conversion unit for converting the adjusted image into a binary image; and a character recognition unit for recognizing the one or more characters based on the binary image.

Generally, in order to do OCR, the image shall be converted into a binary image first. The multiple color information including background color information and foreground color information of the image may introduce noises in the binary image after the conversion and further adversely affect OCR results. For example, some areas with background color may be converted into black areas in the binary image, just as the characters, so as to interfere the recognition of the characters and thus the characters may not be accurately recognized from a color image with multiple color information.

According to the device of the invention, the color level of a color image is first adjusted before converting the color image into a binary image to do OCR on the characters in the image. By doing so, one or more characters may be recognized from an image with multiple color information, especially with background color information, accurately.

According to one embodiment, the adjusting unit adjusts brightness of the color image of the subject to generate the first image of the subject. Therefore, before adjusting the color level, the brightness of the color image is adjusted first, thereby a portion of background color may be removed.

According to another embodiment, the adjusting unit adjusts contrast of the color image of the subject to generate an intermediate color image of the subject and then adjusts the brightness of the intermediate color image of the subject to generate the

first image of the subject. In this manner, the contrast of the color image is adjusted first, and thus, over exposure and/or under exposure in the color image may be overcome.

According to another embodiment, the adjusting unit sharpens the first image of the subject and then adjusts the color level of the sharpened first image of the subject to generate the adjusted image. In this way, the image is sharpened before being adjusted in view of color level, the noises in the image may be removed.

According to another embodiment, the device further comprises an identifying unit for identifying an region of interest from a preliminary color image as the subject, the region of interest showing the one or more characters to be recognized and determining image data indicative of the region of interest from the preliminary color image to generate the color image of the subject. According to this embodiment, the region of interest is determined from the preliminary color image and all following processes may only performed on only the color image of the region of interest.

According to a further embodiment, the device further comprises a comparing unit for comparing the preliminary color image with one or more predetermined templates, the one or more predetermined templates indicative of the images of interest showing the subject, wherein if the preliminary color image corresponds to the one or more predetermined templates, the identifying unit identifies the region of interest from the preliminary color image as the subject.

According to a further embodiment, the device further comprises a comparing unit for comparing the color image of the subject with one or more predetermined templates, the one or more predetermined templates indicative of the interest images of the subject, wherein if the color image of the subject corresponds to the one or more predetermined templates, the first image of the subject is generated from the color image of the subject.

According to above two embodiments, only the color image or the preliminary color image corresponding to the predetermined templates may be processed according to the embodiments of the invention. Therefore, the validation of the color image may be checked first and invalidated images may be discarded. In this way, the

device of the invention may be designed to process specified kinds of images.

In another aspect, one embodiment of the invention provides a method for recognizing one or more characters. The method comprises adjusting color level of a first image of a subject to generate the adjusted image, the first image of the subject being generated from a color image of a subject and comprising one or more characters to be recognized; converting the adjusted image into a binary image; and recognizing the one or more characters based on the binary image.

In further aspects, the embodiments of the invention provides an image processor configured to perform the method according to the embodiments of the invention; an imaging system comprising the device for recognizing one or more characters or the image processor configured to perform the method according to the embodiments of the invention; and a machine-readable storage medium encoded with instructions for performing the method according to embodiments of the invention when executed.

Various aspects and features of the disclosure are described in further detail below. And other objects and advantages of the present invention will become more apparent and will be easily understood with reference to the description made in combination with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

The present invention will be described and explained hereinafter in more detail in combination with embodiments and with reference to the drawings, wherein:

Fig. 1 shows a system 10 for recognizing one or more characters from a color image according to one embodiment of the invention;

Fig. 2 is a flow chart 100 illustrating adjusting a contrast of a color image according to one embodiment of the invention;

Fig.3 is a flow chart 200 illustrating adjusting a brightness of a color image according to one embodiment of the invention;

Fig.4 is a flow chart 300 illustrating an unsharp masking (USM) sharpening of a color image according to one embodiment of the invention;

Fig.5 is a flow chart 400 illustrating adjusting a color level of a color image according to one embodiment of the invention;

Fig.6 is a flow chart 500 illustrating an optical character recognition procedure based on a binary image including the characters to be recognized according to one embodiment of the invention;

Fig. 7 shows a system 20 for recognizing one or more characters from a color image according to another embodiment of the invention;

Fig.8 is a flow chart illustrating an identification of a region of interest from the preliminary image according to one embodiment of the invention; and

Fig.9 is a flow chart of a method for recognizing one or more characters from a color image according to one embodiment of the invention.

The same reference signs in the figures indicate similar or corresponding feature and/or functionality.

The present invention will be described with respect to particular embodiments and with reference to certain drawings but the invention is not limited thereto but only by the claims. The drawings described are only schematic and are non-limiting. In the drawings, the size of some of the elements may be exaggerated and not drawn on scale for illustrative purposes.

DETAILED DESCRIPTION

Hereinafter the invention will be described with respect to medical applications, especially dialysis machines such as Fresenius' 4008A and advanced dialysis machines. However, it shall be noted that the device and method of the invention may also be used in other fields and for other images, as long as the images have multiple color information, especially background color information, and there is a need to record the parameters automatically but the device may not provide such an interface to record the parameters in electronic way.

In Fresenius' 4008A dialysis machines, during the dialysis, dialysis parameters are shown in a display with multiple color information, e.g., the background color

may be gray while one parameter is shown in blue and another parameter is shown in green. Since such dialysis machines do not provide an interface to record the parameters, in order to record the parameters automatically, the parameters shall be recognized from an image of the display in automated way according to the embodiments of the invention.

Fig.1 shows a device 10 for recognizing one or more characters according to one embodiment of the invention. The device 10 comprises an adjusting unit 12, a conversion unit 13 and a character recognition unit 14. The adjusting unit 12 at least includes a color level adjusting unit 124. In one embodiment, as shown in Fig.1, the adjusting unit 12 also includes a contrast adjusting unit 121, a brightness adjusting unit 122, and a sharpening unit 123. It shall be noted that the contrast adjusting unit 121, the brightness adjusting unit 122, and the sharpening unit 123 are optional in the device. It may be contemplated that the adjusting unit 12 achieves its functions itself but is not divided into further units.

The adjusting unit 12 may receive a color image of a subject. For example, in one embodiment, the adjusting unit 12 receives a color image of a display of a Fresenius' 4008A dialysis machine from an image acquisition unit such as a camera directly, or in another embodiment, a preliminary color image is acquired from the display of the Fresenius' 4008A dialysis machine first, the adjusting unit 12 receives a color image which is obtained by preprocessing a preliminary color image, e.g., the adjusting unit 12 receives a color image of a region of interest identified from the preliminary color image. The preprocessing for the preliminary color image of the display of the dialysis machine will be described below with respect to Figs.7-8.

Once the color image of the subject is received, the contrast adjusting unit 121 determines the contrast of the color image and adjusts the contrast of the color image if necessary. Fig.2 shows a flow chart 100 illustrating adjusting the contrast of the color image according to one embodiment of the invention.

According to blocks 101-105, the contrast adjusting unit 121 scans and determines contrast of the color image, estimates the determined contrast relative to e.g., a threshold or a threshold range, sets an adjusting value Δ_1 if the determined

contrast is higher relative to the threshold or the threshold range, sets an adjusting value Δ_1 if the determined contrast is lower relative to the threshold or the threshold range, and adjusts the color image based on the adjusting values to obtain an intermediate image with contrast adjusted. By adjusting the contrast of the color image, the over exposure and under exposure of the color image may be eliminated.

The intermediate image from the contrast adjusting unit 121 may be further input to the brightness adjusting unit 122 to adjust the brightness of the color image. Fig.3 shows a flow chart 200 illustrating adjusting the brightness of the color image according to one embodiment of the invention.

According to blocks 201-205, for example, the brightness adjusting unit 122 may determine the brightness for the color image and evaluate the brightness relative to e.g., a threshold or a threshold range, set an adjusting value Δ_2 if the determined brightness is higher relative to the threshold or the threshold range, set an adjusting value Δ_2' if the determined brightness is lower relative to the threshold or the threshold range, and then adjust the brightness of the color image based on the adjusting values to obtain a first image with brightness adjusted.

By adjusting the brightness of the color image relative to the threshold or the threshold range, the background color information of the color image may be partly removed and the recognition of the characters is improved. Generally the brightness of the color image may not need to be adjusted if the brightness of the color image is within the threshold range, however, in order to remove the background color information efficiently, it may be preferred to still adjust the brightness of the color image to make the color image a little brighter. In one embodiment, it is also possible to adjust the threshold range according to different requirements to achieve similar effect.

After the brightness of the color image is adjusted, the color image is input to the sharpening unit 123, the sharpening unit 123 performs image sharpening on the first image to remove interference and noise signals in the first image. Various sharpening methods may be adopted by the sharpening unit 123, as one example, Fig.4 shows a flow chart 300 illustrating an unsharp masking (USM) sharpening performed for a

color image according to one embodiment of the invention. The USM sharpening method may be preferred in the embodiment for removing interference and noise signals.

According to blocks 301-304, based on the USM sharpening method, the sharpening unit 123 may obtain the pixel data of the color image and apply a Gaussian blur to the image first, and then a USM formula is used to the blurred image to calculate new pixel values for each pixel of the color image based on an input parameter, finally a new sharpened image is constructed based on the new pixel values, wherein the input parameter may be determined from a user input and the USM formula is well known in the art.

After adjusting the contrast and brightness of the color image and sharpening the color image, the background color information of the color image may be removed partly and the noises may be reduced. Then the sharpened first image from the sharpening unit 123 may be input to the color level adjusting unit 124 for further processing.

The color level adjusting unit 124 may adjust the color level of a color image. Fig.5 shows a flow chart 400 illustrating adjusting a color level of a color image according to one embodiment of the invention. In particular, according to blocks 401-405, it determines color level of the color image, evaluates the color level of the color image relative to e.g. a predetermined color level table, then sets adjusting values Δ_3 if the determined color level is higher than a predetermined value range of the color level table, sets an adjusting value Δ_3' if the determined color level is lower than the predetermined value range of the color level table and then adjust the color level of the color image based on the adjusting values to obtain an adjusted image.

In general, by evaluating the color level of the color image relative to the color level table and then adjusting the color level of the color image, the color information in the color image corresponding to the characters may be maintained or enhanced while the background color information may be removed, thus reducing potential noises introduced by the background color information during a following optical

character recognition procedure.

Although the contrast adjusting unit 121, the brightness adjusting unit 122, the sharpening unit 123 and the color level adjusting unit 124 are described as above with reference to Figs. 2-5, processes mentioned above and shown in Figs.2-5 are not limiting but illustrative, other processes and algorithm for achieving similar effects may also be contemplated.

Furthermore, although the processes of the adjusting unit 12 are described as above in view of adjusting contrast and brightness first, then sharpening and finally adjusting color level, other sequences of above processes may also be contemplated, or one or more processes as above may be omitted and/or combined to meet different requirements. For example, one or more of the contrast adjusting unit 121, the brightness adjusting unit 122 and the sharpening unit 123 may be omitted; or even all of them may be omitted, in this case, the received color image of the subject is determined as the first image to be adjusted by the color level adjusting unit 124.

The adjusted image may be input to a conversion unit 13 to be converted into a binary image. Since the background color information has been almost removed, the noises and interferences may be reduced and the characters may be identified in the binary image clearly.

The binary image obtained after the conversion is input to the character recognition unit 14 for use in an optical character recognition procedure. Fig.6 shows a flow chart 500 illustrating an optical character recognition procedure based on a binary image including the characters to be recognized. According to the embodiment as shown in Fig.6, at block 501, if the binary image has black foreground and white background, it is converted to inverse binary image first, this step may be omitted in some cases; at block 502, projection value sum in horizontal direction of the binary image is calculated for each row of pixels; at block 503, the projection value sum for each row of pixels is compared with a horizontal projection value threshold and then based on a determination that a projection value sum for a row of pixels is lower than the horizontal projection value threshold to split the binary image into one or more row images, each of which comprises a row of characters; at block 504, for each row

image, erosion and dilation algorithm are performed to make neighboring characters as one text unit; at block 505, projection value sum in vertical direction of each row image is calculated for each column of pixels; at block 506, the projection value sum for each column of pixels is compared with a vertical projection value threshold and then based on a determination that a projection value sum for a column of pixels is lower than the vertical projection value threshold to split the row image into each text unit; finally at block 507, characters in each text unit may be recognized by any known optical character recognition techniques. Above flow chart performed by the character recognition unit 14 is illustrative but not limiting, the steps may be adjusted according to the binary image to be processed and different requirements.

From above, with reference to Fig.1, a device 10 for recognizing one or more characters is described according to one embodiment of the invention. Fig.7 shows a device 20 for recognizing one or more characters according to another embodiment of the invention. According to this embodiment, the device 20 comprises an identifying unit 25, a comparing unit 26, an adjusting unit 22, a conversion unit 23 and a character recognition unit 24, wherein the adjusting unit 22, the conversion unit 23 and the character recognition unit 24 have similar functions to the adjusting unit 12, the conversion unit 13 and the character recognition unit 14 as shown in Fig.1, the main difference of the device 20 from the device 10 relates to the identifying unit 25, and the comparing unit 26. In one example, as shown in Fig.7, the identifying unit 25 and the comparing unit 26 may be referred as a pre-processing unit 21.

According to the embodiment as shown in Fig.7, a preliminary color image received from an image acquisition unit (not shown) may be input to the pre-processing unit 21 to obtain the color image of the subject to be processed in the adjusting unit 22.

The identifying unit 25 of the pre-processing unit 21 may receive the preliminary color image to identify a region of interest from the preliminary color image. For medical devices such as dialysis machines that do not provide an interface to record the parameters, in order to recognize and record the parameters shown in the display of the medical devices in automated way, a physician or a care giver may capture an

image of the display of the medical devices by the image acquisition unit such as a camera, the captured image may be the preliminary color image to be processed.

Sometimes, the captured image may include some information unrelated to the display of the medical devices, e.g., a person standing nearby the display of the medical devices, or unrelated to the region of interest including the characters to be recognized, by using the identifying unit 25, only the region of interest such as the region relating to the display or the region including the characters to be recognized is identified from the preliminary image, and thus the corresponding image data is determined from the captured image to obtain the color image of the subject, which is in turn adjusted in the adjusting unit 22, other information from the preliminary image may be removed.

Fig.8 is a flow chart 600 illustrating an identification of a region of interest from the preliminary image according to one embodiment of the invention. The region of interest may be a region showing the display of the medical devices. According to the embodiment as shown in Fig.8, at blocks 601 and 602, determine and adjust the size of the preliminary color image first; at block 603, the adjusted preliminary color image is converted into a gray image; at blocks 604-606, perform dilation on the gray image and detect image borders e.g., with Canny algorithm for the dilated image to find out a border with a largest area; at blocks 607 and 608, four vertexes of the found border are calculated and a color image of a region of interest is obtained by determining image data indicative of the region of interest from the preliminary color image based on the four vertexes, the color image of the region of interest may be used as the color image of a subject to be further processed in the adjusting unit 22. The processes shown in Fig.8 are illustrative, they may be modified, and other processes for identifying the region of interest may be contemplated.

In one embodiment, after identifying and generating the color image of the region of interest as the color image of the subject, the color image may be further input to the comparing unit 26 for further processing. The comparing unit 26 may compare the color image of the subject with the one or more predetermined templates, the one or more predetermined templates may be pre-stored and indicative of the

interest images of the subject, wherein if the color image of the subject corresponds to the one or more predetermined templates, the color image of the subject is further processed in the adjusting unit 22, otherwise, the color image of the subject may be deemed as invalidated and no process is performed on it. By doing so, the validation of the color image to be processed may be checked.

Although as shown in Fig.7 and explained above, preprocessing the preliminary color image is described with reference to identifying the image data of a region of interest, such as a display region, to obtain the color image of the subject and then checking the validation of the obtained color image of the subject by comparing the color image with the predetermined templates, it shall be understood that this is not limiting, other process(es) may be included in the preprocessing procedure, for example, image trapezoidal correction; and one or more processes of the identifying unit 25 and the comparing unit 26 may be omitted. For example, the identifying unit 25 may be omitted if the preliminary color image shows only the region of interest.

In another embodiment, the comparing unit 26 receives and compares the preliminary color image with the one or more predetermined templates first, the one or more predetermined templates indicative of the images of interest showing the subject, wherein if the preliminary color image corresponds to the one or more predetermined templates, the identifying unit 25 identifies the region of interest from the preliminary color image as the subject to obtain the color image of the subject to be further processed.

Although Fig.7 shows only above processes for preprocessing the preliminary color image, it may be contemplated that one or two processes in the adjusting unit 12 may be performed in the preprocessing unit 21.

From above, the device of the invention for recognizing one or more characters is described with respect to different embodiments, different flow charts and different units, it shall be understood that all the flow charts are illustrative and one or more processes according to individual flow charts may be deleted, modified, combined and/or divided to achieve and/or omit its corresponding functions. It shall also be understood that the sequence of the processes may be altered if necessary. For

example, the contrast of the preliminary color image may be adjusted first and then the color image of the subject is generated from the adjusted preliminary color image for further processing. Furthermore, individual units of the device of the invention may be deleted, modified, combined and/or divided to achieve and/or omit its corresponding functions.

Fig.9 is a flow chart of a method 700 for recognizing one or more characters from a preliminary color image according to one embodiment of the invention. According to the method 700, a preliminary color image acquired by e.g., a camera is received at 701; a region of interest is identified from the preliminary color image as a subject and image data indicative of the region of interest are determined from the preliminary color image to generate the color image of the subject at 702, the region of interest showing the one or more characters to be recognized. At 703, the color image of the subject may be compared with one or more predetermined templates indicative of the images of interest and showing the subject, if the color image of the subject corresponds to the one or more predetermined templates, the color image of the subject is further processed at 704; otherwise, the process returns to 701 to receive a new preliminary color image.

At 704, the contrast of the color image is determined and adjusted based on e.g. a threshold range to obtain an intermediate image; and then at 705 the brightness of the color image is determined and adjusted based on e.g. another threshold range to generate a first image. At 706, the first image is sharpened. At 707, the color level of the color image is determined and adjusted to generate an adjusted image and then at 708 the adjusted image is converted into a binary image. Based on the binary image, one or more characters may be recognized at 709.

The method 700 is illustrative but not limiting; various steps may be omitted, combined and/or amended to omit/amend corresponding functions. For example, in one embodiment, any one or more steps of identifying the region of interest, validating the image, adjusting contrast and brightness of the image and sharpening the image may be omitted. The sequence of the steps may be altered also. In one embodiment, the preliminary color image may be compared with predetermined

template(s) first, after it is determined that the preliminary color image corresponds to a template, the region of interest is identified from the preliminary color image.

In one embodiment, the device of the invention may be embodied as an application that may run in e.g., a mobile phone. Or, the device of the invention may be realized as an image processor configured to perform the method of the invention which has been described above. The device of the invention may be included in an imaging system, the imaging system may further comprise an image acquisition unit for acquiring a preliminary image.

It may be contemplated that the individual units of the device of the invention may be achieved by any one of software, hardware or firmware. Furthermore, a machine readable storage medium may store instructions for performing the method of the invention.

Please note that, the device and the method according to the present invention should not be limited to that mentioned above only. They will be apparent to those skilled in the art that the various aspects of the invention claimed may be practiced in other examples that depart from these specific details.

Furthermore, the mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

It should be noted that the above-mentioned embodiments illustrate rather than limit the invention and that those skilled in the art would be able to design alternative embodiments without departing from the scope of the appended claims. In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. The word “comprising” does not exclude the presence of elements or steps not listed in a claim or in the description. The word “a” or “an” preceding an element does not exclude the presence of a plurality of such elements. In the product claims enumerating several units, several of these units can be embodied by one and the same item of software and/or hardware. The usage of the words first, second and third, et cetera, does not indicate any ordering. These words are to be interpreted as names.

CLAIMS:

1. A device for recognizing one or more characters comprising
an adjusting unit for adjusting color level of a first image of a subject to generate the adjusted image, the first image of the subject being generated from a color image of a subject, the color image of the subject comprising one or more characters to be recognized;

a conversion unit for converting the adjusted image into a binary image; and

a character recognition unit for recognizing the one or more characters based on the binary image.

2. The device according to claim 1 wherein

the adjusting unit adjusts brightness of the color image of the subject to generate the first image of the subject.

3. The device according to claim 1, wherein

the adjusting unit adjusts contrast of the color image of the subject to generate an intermediate color image of the subject and then adjusts the brightness of the intermediate color image of the subject to generate the first image of the subject.

4. The device according to claim 1 wherein the adjusting unit sharpens the first image of the subject and then adjusts the color level of the sharpened first image of the subject to generate the adjusted image.

5. The device according to any one of claims 1-4 further comprising

an identifying unit for identifying an region of interest from a preliminary color image as the subject, the region of interest showing the one or more characters to be recognized; and determining image data indicative of the region of interest from the preliminary color image to generate the color image of the subject.

6. The device according to any one of claims 1-5 further comprising

a comparing unit for comparing the color image of the subject with one or more predetermined templates, the one or more predetermined templates indicative of the interest images of the subject, wherein if the color image of the subject corresponds to the one or more predetermined templates, the first image of the subject is generated from the color image of the subject.

7. The device according to claim 5 further comprising

a comparing unit for comparing the preliminary color image with one or more predetermined templates, the one or more predetermined templates indicative of the images of interest showing the subject, wherein if the preliminary color image corresponds to the one or more predetermined templates, the identifying unit identifies the region of interest from the preliminary color image as the subject.

8. A method for recognizing one or more characters comprising

adjusting color level of a first image of a subject to generate the adjusted image, the first image of the subject being generated from a color image of a subject and comprising one or more characters to be recognized;

converting the adjusted image into a binary image; and

recognizing the one or more characters based on the binary image.

9. The method according to claim 8 further comprising

adjusting brightness of the color image of the subject to generate the first image of the subject.

10. The method according to claim 8 further comprising

adjusting contrast of the color image of the subject to generate an intermediate color image of the subject; and

adjusting the brightness of the intermediate color image of the subject to generate the first image of the subject.

11. The method according to claim 8 further comprising sharpening the first image of the subject; and adjusting the color level of the sharpened second image of the subject to generate the adjusted image.

12. The method according to any one of claims 8-11 further comprising identifying an region of interest from a preliminary color image as the subject, the region of interest showing the one or more characters to be recognized; and determining image data indicative of the region of interest from the preliminary color image to generate the color image of the subject.

13. The method according to any one of claims 8-12 further comprising comparing the color image of the subject with the one or more predetermined templates, the one or more predetermined templates indicative of the interest images of the subject; and if the color image of the subject corresponds to the one or more predetermined templates, generating the first image of the subject from the color image of the subject.

14. The method according to claim 12 further comprising comparing the preliminary color image with the one or more predetermined templates, the one or more predetermined templates indicative of the images of interest showing the subject; and if the preliminary color image corresponds to the one or more predetermined templates, identifying the region of interest from the preliminary color image as the subject.

15. An image processor configured to perform the method according to any one of claims 8-14.

16. An imaging system comprising the device for recognizing one or more characters according to any one of claims 1-8 or the image processor according to claim 15.

17. The imaging system according to claim 16 further comprising an image acquisition unit for acquiring a preliminary image, and wherein the one or more characters are recognized from the preliminary image.

18. A machine-readable storage medium encoded with instructions for performing the method according to any one of claims 8-14 when executed.

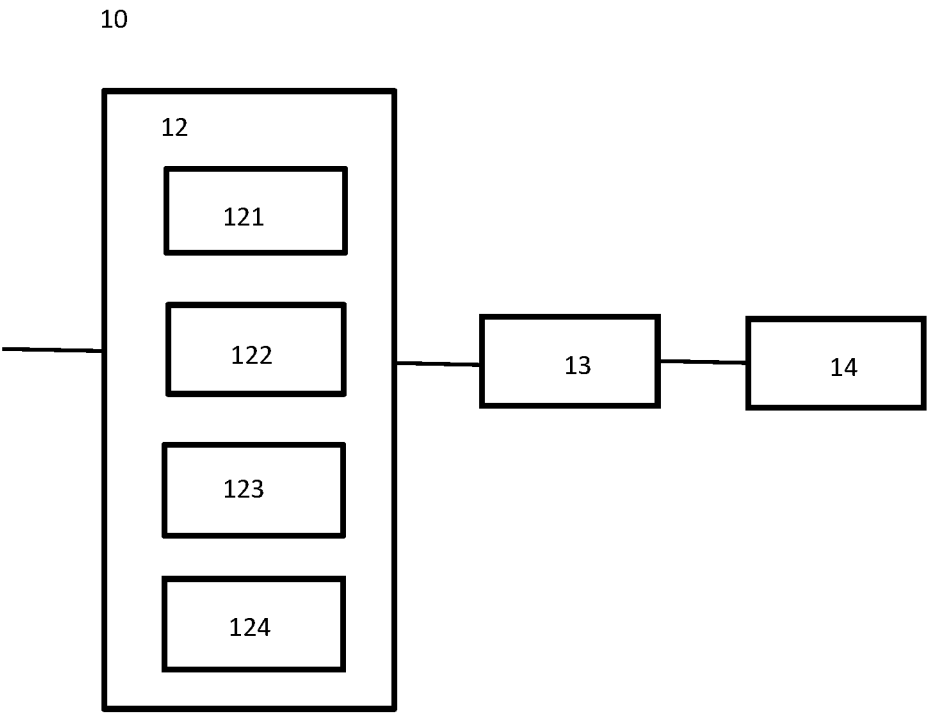
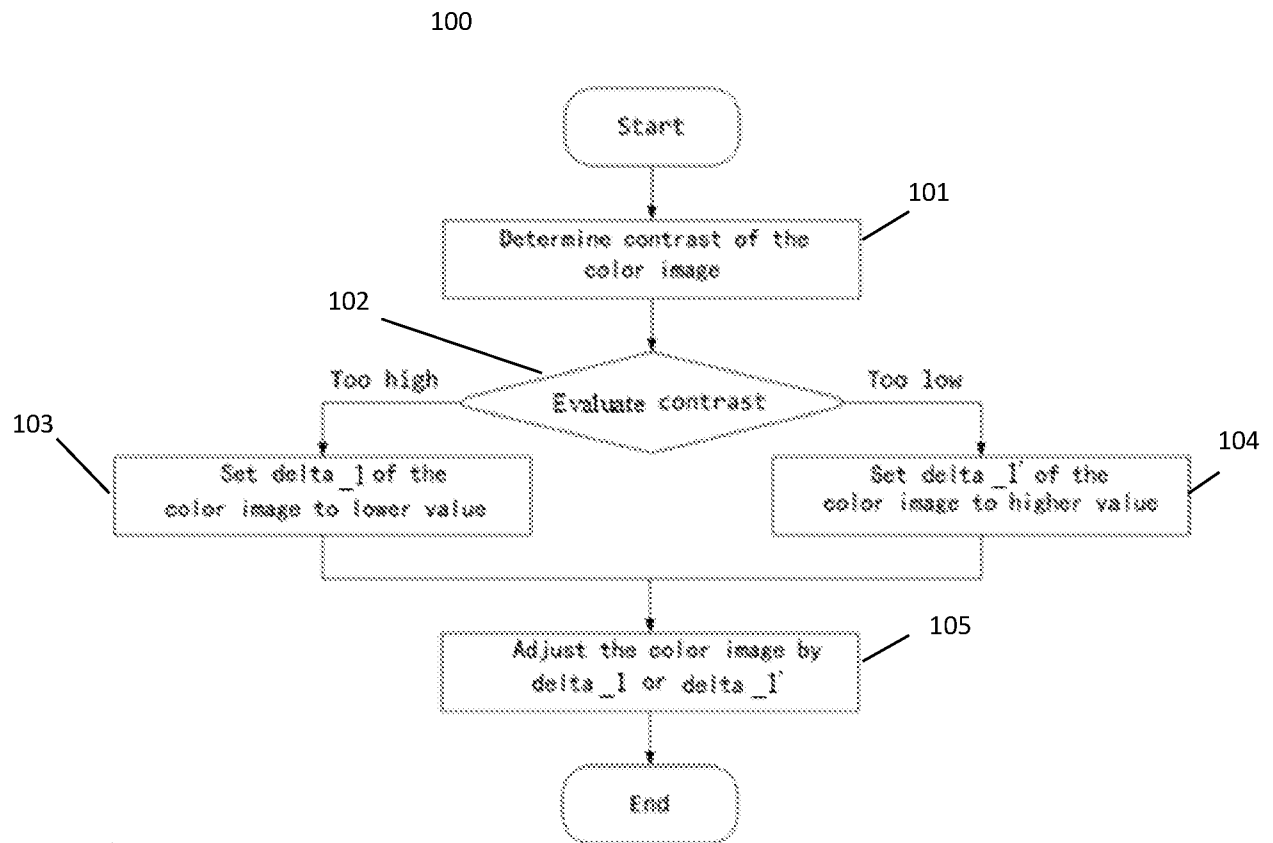
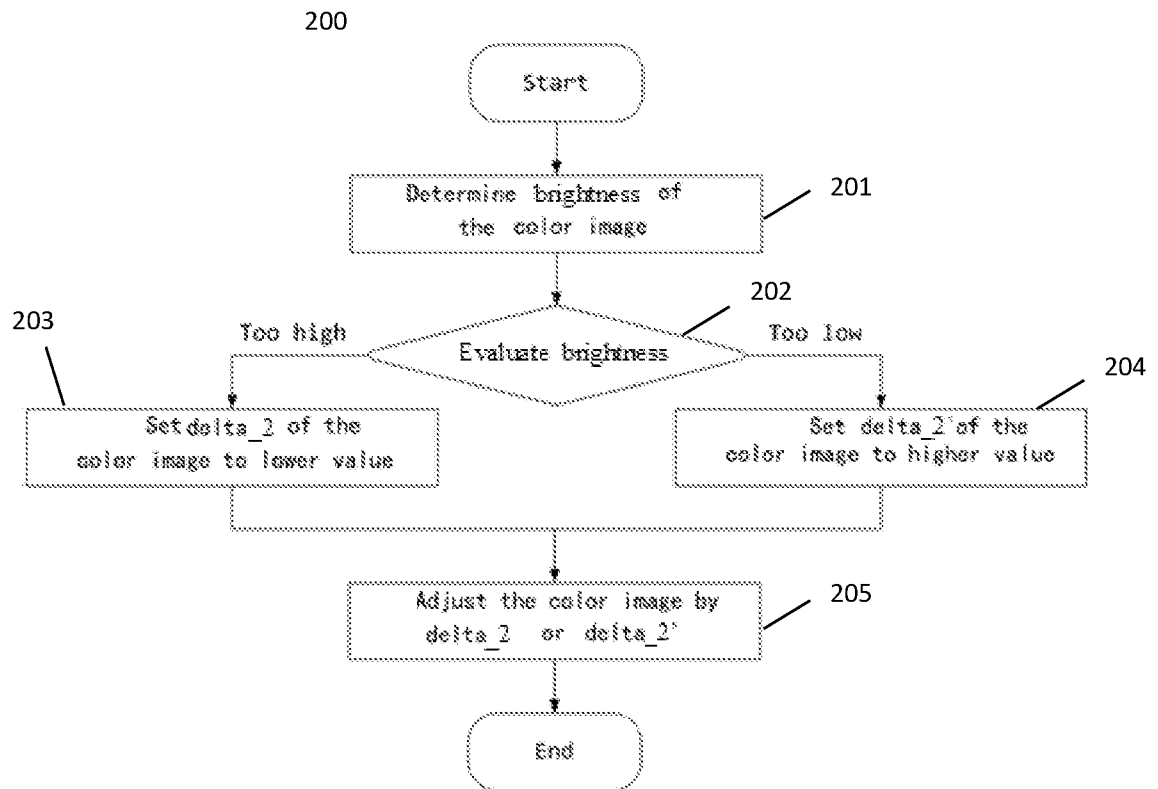
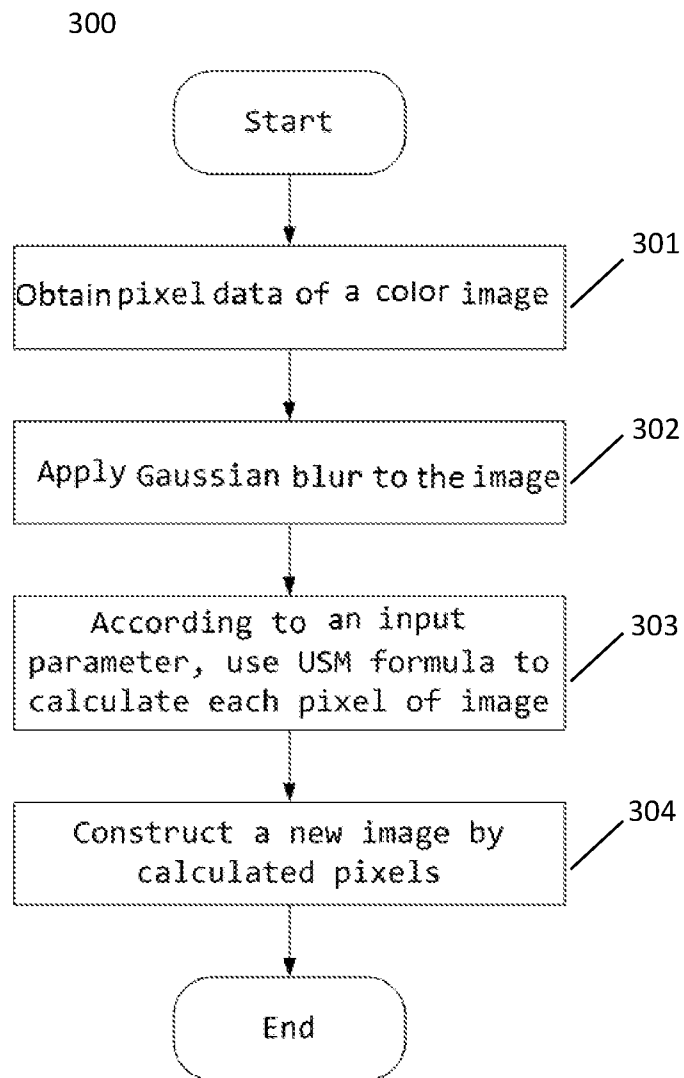


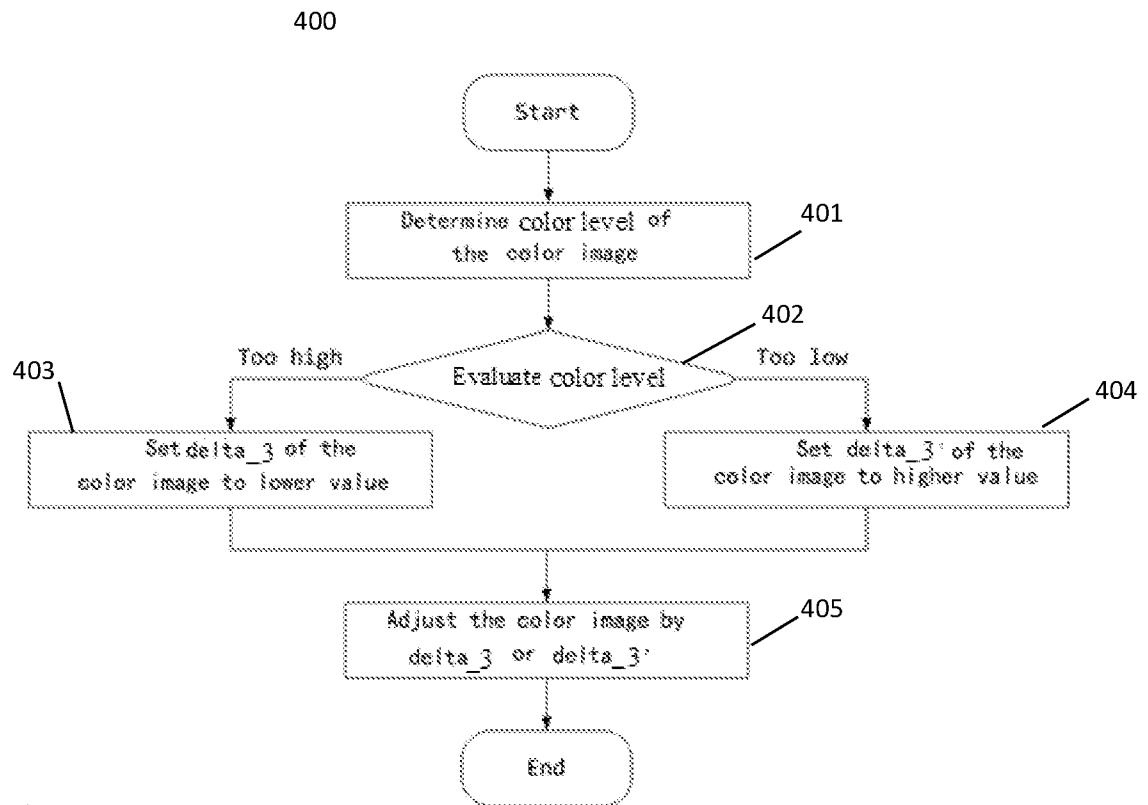
Fig.1

**Fig.2**

**Fig.3**

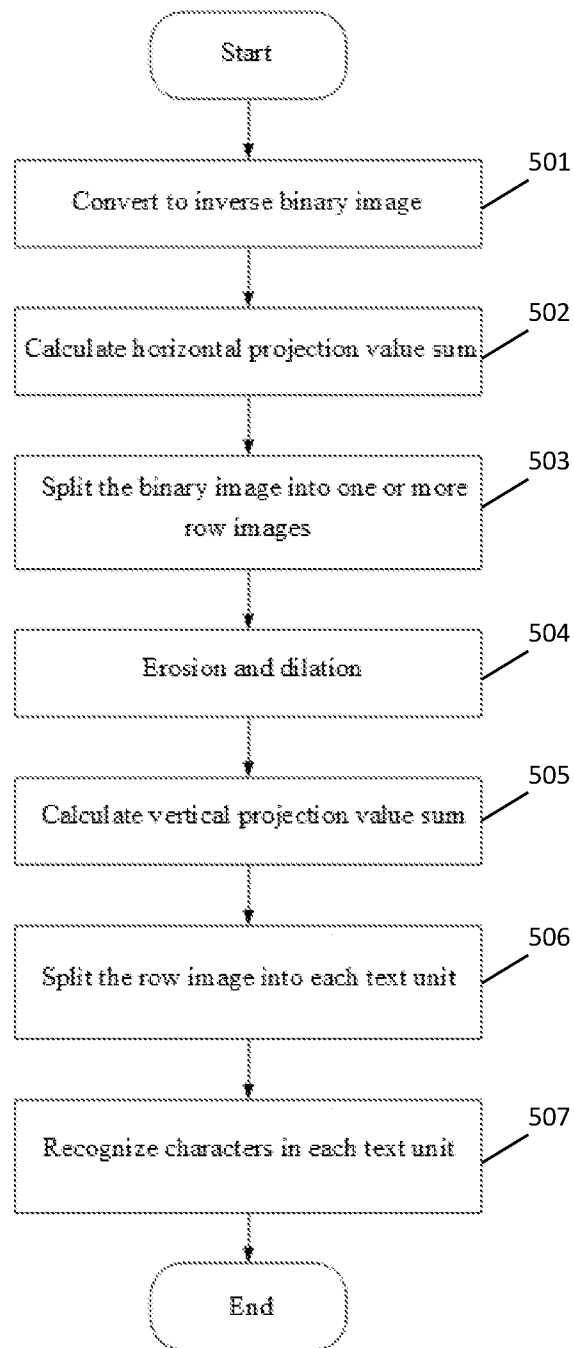
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**Fig.4**

**Fig.5**

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**Fig.6**

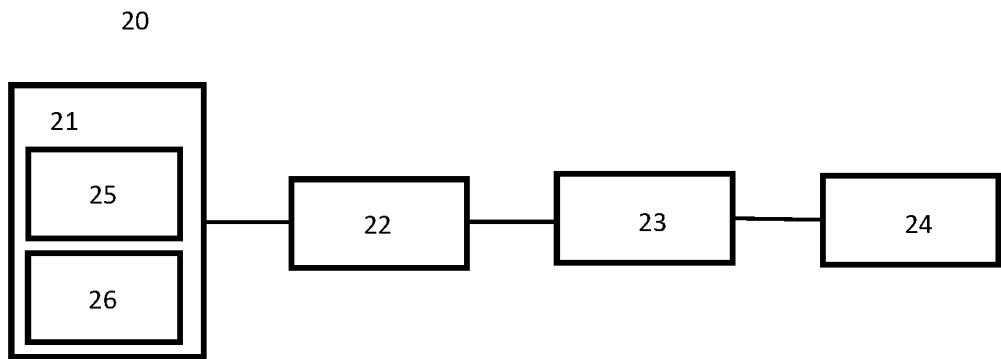
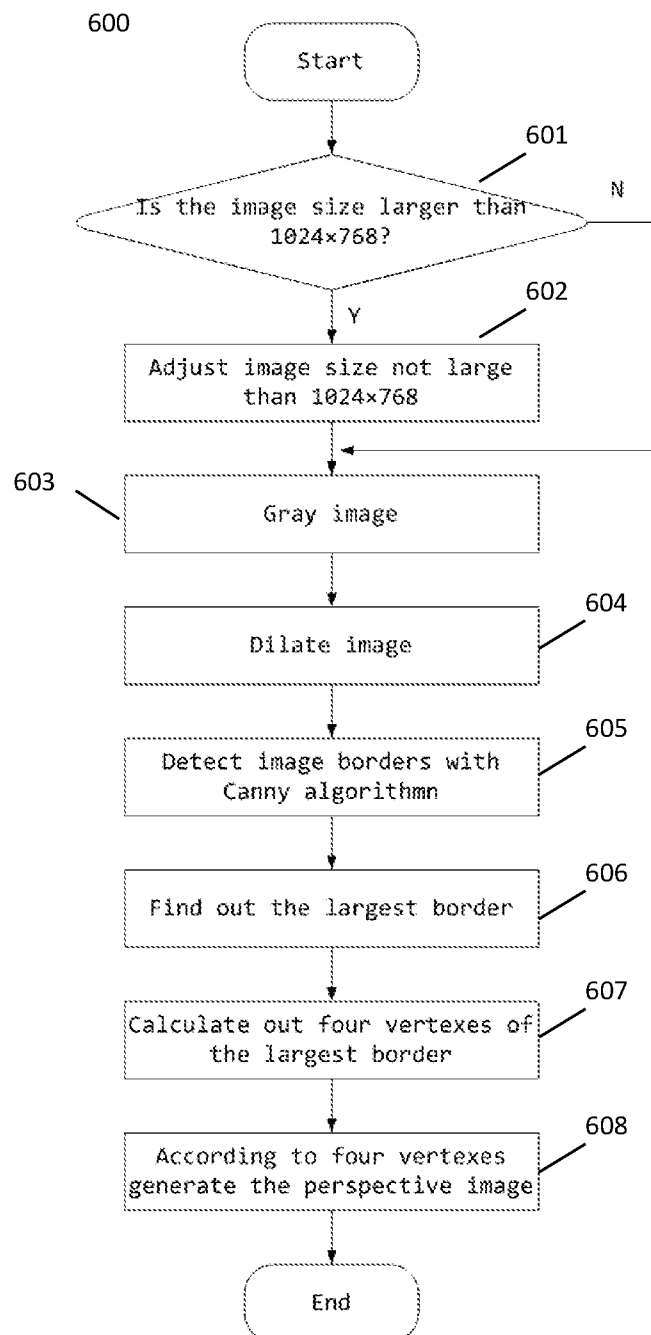
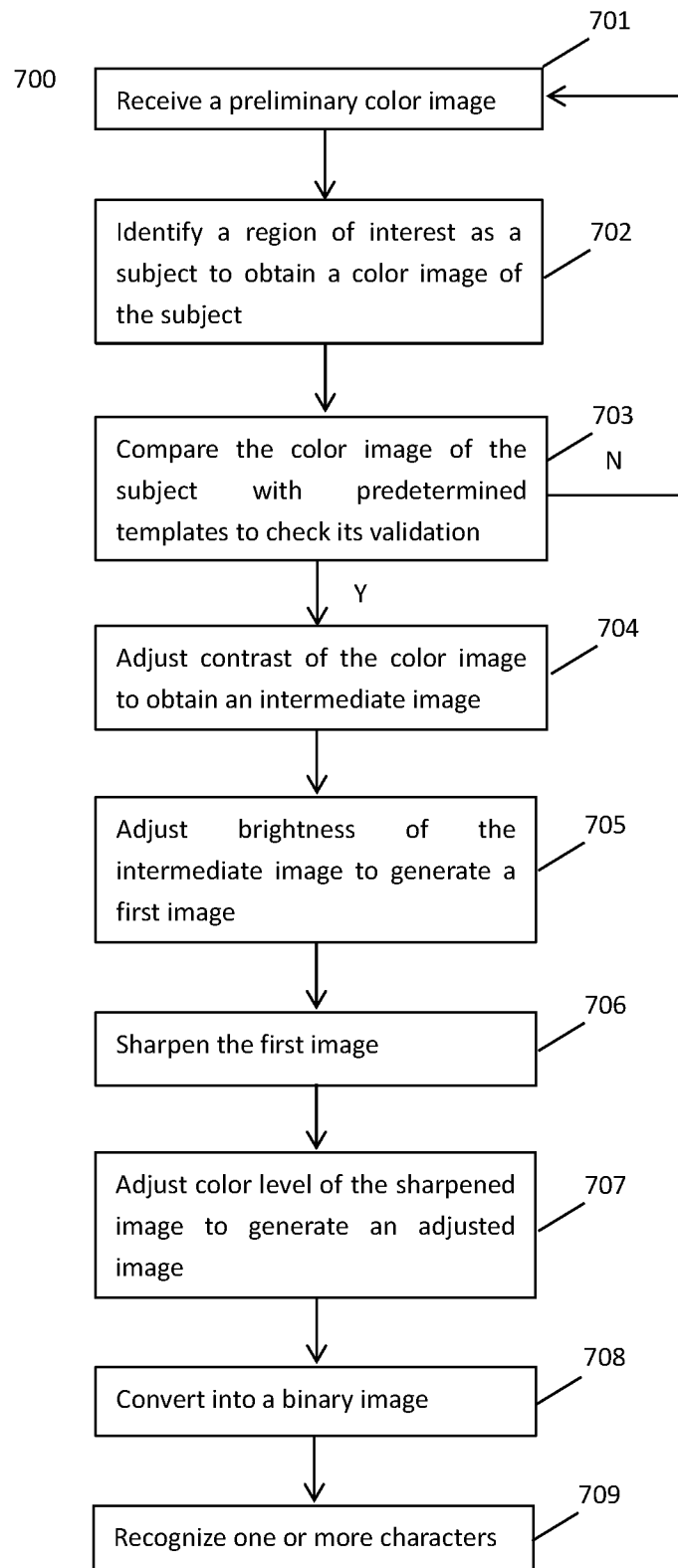


Fig.7

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**Fig.8**

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**Fig.9**

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2018/110423

A. CLASSIFICATION OF SUBJECT MATTER

G06K 9/20(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G06K; G06T

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT,CNKI,WPI,EPODOC,IEEE:recognize,character,optical,OCR,adjust,color,level,binary,brightness,sharpen,template, interest

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 103530625 A (BEIJING JINHER SOFTWARE CO., LTD.) 22 January 2014 (2014-01-22) description, paragraphs 0024-0041, figure 1	1-4, 6, 8-11, 13, 15-18
Y	CN 103530625 A (BEIJING JINHER SOFTWARE CO., LTD.) 22 January 2014 (2014-01-22) description, paragraphs 0024-0041, figure 1	5, 7, 12, 14
Y	CN 103198311 A (SAMSUNG ELECTRONICS CO., LTD.) 10 July 2013 (2013-07-10) description, paragraph 0023	5, 7, 12, 14
X	LUO, Jian Feng et al. "A new way to improve the effectiveness of character" <i>Image Processing and Multimedia Technology</i> , No. 11, 09 July 2009 (2009-07-09), pages 28-30	1-4, 6, 8-11, 13, 15-18
Y	LUO, Jian Feng et al. "A new way to improve the effectiveness of character" <i>Image Processing and Multimedia Technology</i> , No. 11, 09 July 2009 (2009-07-09), pages 28-30	5, 7, 12, 14
A	CN 105374015 A (HUBEI UNIVERSITY OF TECHNOLOGY) 02 March 2016 (2016-03-02) the whole document	1-18



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

02 July 2019

Date of mailing of the international search report

24 July 2019

Name and mailing address of the ISA/CN

National Intellectual Property Administration, PRC
6, Xitucheng Rd., Jimen Bridge, Haidian District, Beijing
100088
China

Facsimile No. (86-10)62019451

Authorized officer

LIU, Changyong

Telephone No. 86-(10)-53961368

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2018/110423

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 107123093 A (CHONGQING MICROID TECHNOLOGY CO., LTD.) 01 September 2017 (2017-09-01) the whole document	1-18

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2018/110423

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	103530625	A	22 January 2014	None			
CN	103198311	A	10 July 2013	EP	2605186	A2	19 June 2013
				KR	20130066819	A	21 June 2013
				US	2015278630	A1	01 October 2015
				US	2013148899	A1	13 June 2013
CN	105374015	A	02 March 2016	None			
CN	107123093	A	01 September 2017	None			