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(54) Title: EYE DETECTING METHOD AND EYE DETECTING DEVICE

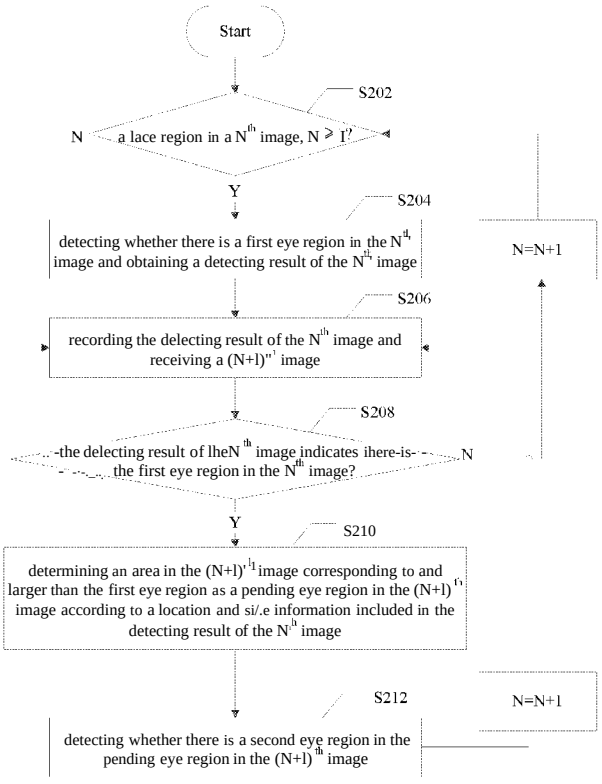

Fig. 2

(57) Abstract: An eye detecting method is provided. The method comprises: detecting whether there is a face region in a N th image (S202); if yes, detecting whether there is a first eye region in the N th image and obtaining a detecting result of the N th image (S204); recording the detecting result of the N th image and receiving a (N+l) th image (S206); if the detecting result of the N th image indicates there is the first eye region in the N th image (S208, yes), determining an area in the (N+l) th image corresponding to and larger than the first eye region as a pending eye region in the (N+l) th image (S210), otherwise (S208, no) making N=N+1 and returning to step S202; and detecting whether there is a second eye region in the pending eye region in the (N+l) th image (S212), making N=N+1 and returning to step S206.

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EYE DETECTING METHOD AND EYE DETECTING DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to, and benefits of Chinese Patent Application Serial No. 201010218870.8, filed with the State Intellectual Property Office of P. R. C. on June 29, 2010, the entire contents of which are incorporated herein by reference.

FIELD

The present disclosure relates to an object detecting field, and more particularly, to an eye detecting method and eye detecting device.

BACKGROUND

A research proves that an eye status may reflect a fatigue of a driver reliably, and an eye detection is a premise for judging the eye status. Therefore how to detect the eye correctly and quickly is key to achieve fatigue monitoring in a driving process.

Many researches have been done in a field of eye detection, and a detecting technology includes a method based on study, template matching or characteristics. The method based on study includes, for example, AdaBoost (Adaptive Boosting) algorithm, neural network, and principal component analysis. The algorithms are with high accuracy, but a computation is complicated, which limits an application in a real-time system. The method based on the template matching firstly obtains a template of a right eye and a left eye and then searches in a whole image for matching. Because of an influence of light changing, angle rotation etc., this method has low accuracy and the computation for this method is complicated. The method based on the characteristics includes HIS (Hue Saturation Intensity, representing tone, color saturation and brightness) iris detection, gray projection etc.. The iris detection is fast in speed, but this method should be performed in a color space and is not suitable for an infrared imaging system. The gray projection method will be invalid when a face is deflected. There is also an eye detecting method

based on a whole face characteristic, eye gradient etc., but this method is with low accuracy.

In a real image detection, a size of an image to be detected and an amount of matched target objects are unknown in advance. A target image classifier used by the AdaBoost algorithm may scale up or down. Referring to Fig. 1, the AdaBoost algorithm comprises: judging whether a size of a scaled up target image classifier is larger than the size of the target image, if yes, terminating the detection, otherwise scaling up the target image classifier to detect the target image until finding a match between the target image classifier and the target image. According to the AdaBoost algorithm, the target images with different sizes are detected by scaling up the target image classifier continuously until the size of the target image classifier is larger than the size of the target image. Therefore, the larger the size of the image is, the larger the amount of the target image classifier is, and the longer the time taken in reviewing the image each time is. Therefore the computation of the AdaBoost algorithm is complex.

SUMMARY

The present disclosure is directed to solve at least one of the above mentioned problems and to provide an eye detecting method and an eye detecting device.

According to an aspect of the present disclosure, an eye detecting method is provided, comprising the steps of: A) detecting whether there is a face region in a N^{th} image, in which $N \geqslant 1$; B) if there is the face region in the N^{th} image, detecting whether there is a first eye region in the N^{th} image and obtaining a detecting result of the N^{th} image; C) recording the detecting result of the N^{th} image and receiving a $(N+l)^{th}$ image, otherwise making N=N+1 and returning to step A); D) if the detecting result of the N^{th} image indicates there is the first eye region in the N^{th} image, determining an area in the $(N+l)^{th}$ image corresponding to and larger than the first eye region as a pending eye region in the $(N+l)^{th}$ image according to a location and size information included in the detecting result of the N^{th} image; and E) detecting whether there is a second eye region in the pending eye region in the $(N+l)^{th}$ image making N=N+1 and returning to step C) .

According to another aspect of the present disclosure, an eye detecting device is provided. The eye detecting device comprises: a face detecting unit, configured to detect whether there is a face region in an image; an eye detecting unit, configured to detect whether there is an eye region in an image and recording a detecting result of the image; a controlling unit, connected with the face detecting unit and the eye detecting unit, and configured to control the eye detecting unit to

detect whether there is a first eye region in a face region in a N^{th} image and record a detecting result of the N^{th} image if the face detecting unit detects that there is the face region in the N^{th} image; and an area determining unit, connected with the controlling unit and configured to determine an area in a $(N+l)^{th}$ image corresponding to and larger than the first eye region as a pending eye region in the $(N+l)^{th}$ image according to a location and size information included in the detecting result of the N^{th} image, wherein the controlling unit is further configured to control the eye detecting unit to detect whether there is a second eye region in the pending eye region in the $(N+l)^{th}$ image.

According to the present disclosure, when there is the eye region in the N^{th} image, it is not necessary to search the whole $(N+l)^{th}$ image but only to search the area in the $(N+l)^{th}$ image corresponding to the eye region in the N^{th} image. Therefore, a time needed for detecting the eye region is decreased and the eye detecting may be performed quickly, which is suitable for a real-time image system.

Additional aspects and advantages of the embodiments of present disclosure will be given in part in the following descriptions, become apparent in part from the following descriptions, or be learned from the practice of the embodiments of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other aspects and advantages of the disclosure will become apparent and more readily appreciated from the following detailed descriptions taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a flow chart showing an eye detecting method according to a conventional AdaBoost algorithm;

Fig. 2 is a flow chart showing an eye detecting method according to an embodiment of the present disclosure;

Fig. 3A is a flow chart showing a face region detecting method according to an embodiment of the present disclosure;

Fig. 3B is a flow chart showing a face region detecting method according to an embodiment of the present disclosure;

Fig. 4A is a flow chart showing an eye region detecting method according to an embodiment of the present disclosure;

Fig. 4B is a flow chart showing an eye region detecting method according to an embodiment of the present disclosure;

Fig. 4C is a flow chart showing an eye region detecting method according to an embodiment of the present disclosure;

Fig. 4D is a flow chart showing an eye region detecting method according to an embodiment of the present disclosure;

Fig. 5A is a schematic block diagram of showing an eye detecting device according to one an embodiment of the present disclosure;

Fig. 5B is a schematic block diagram of showing an eye detecting device according to one an embodiment of the present disclosure;

Fig. 5C is a schematic block diagram of showing an eye detecting device according to one an embodiment of the present disclosure;

Fig. 6 is a schematic block diagram showing a face detecting unit according to an embodiment of the present disclosure; and

Fig. 7 is a schematic block diagram showing an eye detecting unit according to an embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Reference will be made in detail to embodiments of the present disclosure. The embodiments described herein with reference to drawings are explanatory, illustrative, and used to generally understand the present disclosure. The embodiments shall not be construed to limit the present disclosure.

Referring to Fig. 2, an eye detecting method is provided. The method comprises the following steps.

Step S202), a N^{th} image is detected to find whether there is a face region in the N^{th} image, in which $N > 1$.

Step S204), if there is the face region in the N^{th} image, it is detected whether there is a first eye region in the N^{th} image and a detecting result of the N^{th} image is obtained.

Step S206), the detecting result of the N^{th} image is recorded and a $(N+l)^{th}$ image is received.

Step S208), if the detecting result of the N^{th} image indicates there is the first eye region in the N^{th} image, going to S210, an area in the $(N+l)^{th}$ image corresponding to and larger than the first

eye region is determined as an pending eye region in the (N+l) th image according to a location and size information included in the detecting result of the Nth image, otherwise the method makes N=N+1 and returns to step S202.

Step S212), detecting whether there is a second eye region in the pending eye region in the (N+l) th image, and the method makes N=N+1 and returns to step S206.

In some embodiment of the present disclosure, face samples and eye samples are obtained by sampling the image of objects at different angles and by putting an infrared camera in a different light environment. The different light environment comprises but not limited to the environment illuminated by a fluorescent light, an environment without a visible light, at a side of an instrument in a vehicle under different lights. The objects sampled are people with different heights, wearing or not wearing glasses and with different skin colors. Therefore, a sufficient face database is obtained. An eye database is obtained by extracting an eye part from each image in the face database. The face database, the eye database and a database without the face sample and eye sample are established. The face classifier and the eye classifier are obtained by calculating a characteristic value of all the samples in the database and performing selection on the characteristic values. A procedure of obtaining the face classifier comprises the following steps: selecting in the face database and the database without the face sample and eye sample according to a selected group of characteristic values to obtain a first selecting result; adding one or more characteristic values and selecting the image in the first selecting result according the characteristic values with the one or more characteristic values added to obtain the second selecting result; repeating adding and selecting until a selecting error for the images including the face and the images not including the face meets a requirement; obtaining the face classifier including the characteristic value and a parameter. A procedure of obtaining the eye classifier is similar with the procedure of obtaining the face classifier, which will not be described in detail here.

In an embodiment of the present disclosure, if there is no face region in the Nth image, the detecting result of the Nth image is recorded and the (N+l) th image is received.

In an embodiment of the present disclosure, Step S204) comprises extracting the face region and detecting the first eye region in the face region.

Fig. 3A is a flow chart showing a face region detecting method according to an embodiment of the present disclosure.

In an embodiment of the present disclosure, step S202) comprises the following steps:

Step S302), detecting whether there is the face region in the N^{th} image by using a face classifier of a preset size;

Step S304), terminating detecting whether there is the face region in the N^{th} image if the face region in the N^{th} image is detected;

Step S306), if the face region in the N^{th} image is not detected, enlarging a size of the face classifier and detecting the face region in the N^{th} image;

Step S308), if the face region in the N^{th} image is detected, going to step S304, otherwise going to step S310; and

Step S310), comparing the size of the face classifier with the size ofthe N^{th} image, if the size of the face classifier is the same as or larger than the size of the N^{th} image, going to step S304, otherwise going to step S306.

In an embodiment of the present disclosure, the preset size of the face classifier is 40*40.

In an embodiment of the present disclosure, as shown in Fig. 3, step S202) comprises the following steps:

Step S312), detecting whether there is the face region in the N^{th} image by using a face classifier of a preset size;

Step S314), terminating detecting whether there is the face region in the N^{th} image if the face region in the N^{th} image is detected;

Step S316), if the face region in the N^{th} image is not detected, decreasing a size of the face classifier and detecting whether there is the face region in the N^{th} image.

Step S318), if the face region in the N^{th} image is detected, going to step S304, otherwise going to step S320.

Step S320), comparing the size of the face classifier with the size of 40*40, if the size of the face classifier is the same as or small than the size of 40*40, going to step S314, else going to step S316.

In an embodiment of the present disclosure, the preset size of the face classifier is the same as the size ofthe N^{th} image.

Fig. 4A-4D is a flow chart showing an eye region detecting method according to an embodiment of the present disclosure.

In an embodiment of the present disclosure, as shown in Fig. 4A, the step S204 comprises

the following steps:

Step S402), detecting whether there is the first eye region in the N^{th} image;

Step S404), terminating detecting whether there is the first eye region in the N^{th} image if the first eye region in the N^{th} image is detected;

Step S406), if the first eye region in the N^{th} image is not detected, enlarging a size of the eye classifier and detecting whether there is the first eye region in the N^{th} image;

Step S408), if the first eye region in the N^{th} image is not detected, going to step S404, otherwise going to step S410; and

Step S410), comparing the size of the eye classifier with the size ofthe N^{th} image, if the size of the eye classifier is the same as or larger than the size of the N^{th} image, going to step S404, else going to step S406.

In an embodiment of the present disclosure, the preset size of the eye classifier is 40*40.

In an embodiment of the present disclosure, as shown in Fig. 4B, the step S204 comprises the following steps:

Step 412), detecting whether there is the first eye region in the N^{th} image;

Step 414), terminating detecting whether there is the first eye region in the N^{th} image if the first eye region in the N^{th} image is detected;

Step S416), if the first eye region in the N^{th} image is not detected, decreasing a size of the eye classifier and detecting whether there is the first eye region in the N^{th} image;

Step S418), if the first eye region in the N^{th} image is not detected, going to step S414, else going to step S420; and

Step S420), comparing the size of the eye classifier with the size of 40*40, if the size of the eye classifier is the same as or smaller than the size of 40*40, going to step S414, else going to step S416.

In an embodiment of the present disclosure, the preset size of the eye classifier is the same as the size of the first eye region.

In an embodiment of the present disclosure, as shown in Fig. 4C, the step S212 comprises the following steps:

Step S422), detecting whether there is the second eye region is detected in the $(N+l)^{th}$ image;

Step S424), terminating detecting whether there is the second eye region in the $(N+l)^{th}$ image if the second eye region in the $(N+l)^{th}$ image is detected;

Step S426), if the second eye region in the (N+l) th image is not detected, enlarging a size of the eye classifier and detecting whether there is the second eye region in the (N+l) th image;

Step S428), if the second eye region in the (N+l) th image is not detected, going to step S404, otherwise going to step S430; and

Step S430), comparing the size of the eye classifier with the size of the (N+l) th image, if the size of the eye classifier is the same as or larger than the size of the (N+l) th image, going to step S424, otherwise going to step S426.

In an embodiment of the present disclosure, the preset size of the eye classifier is 40*40.

In an embodiment of the present disclosure, as shown in Fig. 4D, the step S212 comprises the following steps:

Step 432), detecting whether there is the second eye region in the (N+l) th image;

Step 434), terminating detecting whether there is the second eye region in the (N+l) th image if the second eye region in the (N+l) th image is detected;

Step S436), if the second eye region in the (N+l) th image is not detected, decreasing a size of the eye classifier and detecting whether there is the second eye region in the (N+l) th image;

Step S438), if the second eye region in the (N+l) th image is not detected, going to step S414, otherwise going to step S440; and

Step S440), comparing the size of the eye classifier with the size of 40*40, if the size of the eye classifier is the same as or smaller than the size of 40*40, going to step S434, otherwise going to step S436.

In an embodiment of the present disclosure, the preset size of the eye classifier is the same as the size of the second eye region.

According to the method of the present disclosure, when there is the eye region in the Nth image, it is not necessary to search the whole (N+l) th image but only to search the pending eye region in the (N+l) th image corresponding to and larger than the first eye region in the Nth image. Therefore, a time needed for detecting the eye region is reduced and the eye detecting may be performed quickly, which is suitable for a real-time image system.

In an embodiment of the present disclosure, an eye detection device is provided. Referring to Fig. 5A, the eye detecting device 500 comprises a face detecting unit 501, an eye detecting unit 502, a controlling unit 503 and an area determining unit 504. The face detecting unit 501 is configured to detect whether there is a face region in an image. The eye detecting unit 502 is

configured to detect whether there is an eye region in an image and recording a detecting result of the image. The controlling unit 503 is connected with the face detecting unit 501 and the eye detecting unit 502, and is configured to control the eye detecting unit 502 to detect whether there is a first eye region in a face region in a N^{th} image and record a detecting result of the N^{th} image. The area determining unit 504 is connected with the controlling unit 503 and is configured to determine an area in a $(N+l)^{th}$ image corresponding to and larger than the first eye region as an pending eye region in the $(N+l)^{th}$ image according to a location and size information included in the detecting result of the N^{th} image. In an embodiment of the present disclosure, the controlling unit 503 is further configured to control the eye detecting unit 502 to detect whether there is a second eye region in the pending eye region in the $(N+l)^{th}$ image. In an embodiment of the present disclosure, the first eye region and the second eye region are a rectangular region.

In an embodiment of the present disclosure, the eye detecting device 500 may further comprise a face extracting unit. Referring to Fig. 5B, the face extracting unit is connected with the face detecting unit 501 and the eye detecting unit 502 and is configured to extract the face region in the image. The eye detecting unit 502 detects the first eye region in the face region.

In an embodiment of the present disclosure, the eye detecting unit 502 may further comprise a first eye detecting unit 510 and a second eye detecting unit 508. Referring to Fig. 5C, the first eye detecting unit 510 is connected with the face extracting unit 506 and configured to detect whether there is the first eye region in the face region. The second eye detecting unit 508 is connected with the area determining unit 504 and is configured to detect whether there is the second eye region in the pending eye region.

Fig. 6 is a schematic block diagram showing a face detecting unit according to an embodiment of the present disclosure.

In an embodiment of the present disclosure, as shown in Fig. 6, the face detecting unit 501 comprises a detecting module 5011, a face classifier size changing module 5012 and a first sub-controlling module 5013. The detecting module 5011 is configured to detect the face region in the N^{th} image. The face classifier size change module 5012 is configured to enlarge or decrease the size of the face classifier. The first sub-controlling module 5013 is connected with the detecting module 5011. In an embodiment, the face classifier size changing module 5012, and is configured to control to enlarge a size of the face classifier until the size of the face classifier is the same as or larger than a size of the N^{th} image if the face region in the N^{th} image is not detected.

And the face classifier is with a preset size of 40*40. In an embodiment, the face classifier size changing module 5012 is configured to control to decrease a size of the face classifier until the size of the face classifier is the same as or smaller than a size of 40*40 if the face region in the N^{th} image is not detected. And the face classifier is with a preset size that is the same as the size of the N^{th} image.

Fig. 7 is a schematic block diagram showing an eye detecting unit according to an embodiment of the present disclosure.

In an embodiment of the present disclosure, as shown in Fig. 7, the eye detecting unit 502 comprises a detecting module 5021, an eye classifier size changing module 5022 and a second sub-controlling module 5023. The detecting module 5021 is configured to detect the eye region in an image. The eye classifier size changing module 5022 is configured to enlarge or decreases the eye classifier. The second sub-controlling module 5023 is connected with the detecting module 5021. In an embodiment, the eye classifier size changing module 5022, and is configured to control to enlarge a size of the eye classifier until the size of the eye classifier is the same as a size of the image if the eye region in the image is not detected. And the face classifier is with a preset size of 40*40. In an embodiment, the eye classifier size changing module 5012, and is configured to control to decrease a size of the eye classifier until the size of the eye classifier is the same as or smaller than a size of 40*40 if the eye region in the N^{th} image is not detected. And the eye classifier is with a preset size that is the same as the size ofthe N^{th} image.

According to the device of the present disclosure, when there is the eye region in the N^{th} image, it is not necessary to search the whole (N+l) th image but only to search the pending eye region in the (N+l) th image corresponding to or larger than the eye region in the N^{th} image. Therefore, a time needed for detecting the eye region is decreased and the eye detecting may be performed quickly, which is suitable for a real-time image system.

Although explanatory embodiments have been shown and described, it would be appreciated by those skilled in the art that changes, alternatives, and modifications can be made in the embodiments without departing from spirit and principles of the disclosure. Such changes, alternatives, and modifications all fall into the scope of the claims and their equivalents.

WHAT IS CLAIMED IS:

1. An eye detecting method, comprising the steps of:

A) detecting whether there is a face region in a N^{th} image, in which $N \geqslant 1$;

B) if there is the face region in the N^{th} image, detecting whether there is a first eye region in the N^{th} image and obtaining a detecting result of the N^{th} image;

C) recording the detecting result of the N^{th} image and receiving a $(N+l)^{th}$ image;

D) if the detecting result of the N^{th} image indicates there is the first eye region in the N^{th} image, determining an area in the $(N+l)^{th}$ image corresponding to and larger than the first eye region as a pending eye region in the $(N+l)^{th}$ image according to a location and size information included in the detecting result of the N^{th} image, otherwise making N=N+1 and returning to step A); and

E) detecting whether there is a second eye region in the pending eye region in the $(N+l)^{th}$ image, making N=N+1 and returning to step C).

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

if there is no face region in the N^{th} image, proceeding to step (C).

3. The eye detecting method of claim 1, wherein step B) comprises:

extracting the face region and detecting whether there is the first eye region in the face region.

4. The eye detecting method of claim 1, wherein step A) comprises the steps of:

al) detecting whether there is the face region in the Nth image by using a face classifier of a preset size;

a2) terminating detecting whether there is the face region in the N^{th} image if the face region in the N^{th} image is detected;

a3) if the face region in the N^{th} image is not detected, enlarging a size of the face classifier and detecting whether there is the face region in the N^{th} image; and

a4) if the face region in the N^{th} image is not detected, repeating step a3) until the size of the face classifier is the same as or larger than a size of the N^{th} image, otherwise terminating detecting whether there is the face region in the N^{th} image.

5. The eye detecting method of claim 1, wherein step A) comprises the steps of:

a1) detecting whether there is the face region in the N^{th} image by using a face classifier of a preset size;

a2) terminating detecting whether there is the face region in the N^{th} image if the face region in the N^{th} image is detected;

a3) if the face region in the N^{th} image is not detected, decreasing a size of the face classifier and detecting whether there is the face region in the N^{th} image; and

a4) if the face region in the N^{th} image is not detected, repeating step a3) until the size of the face classifier is or is smaller than 40*40 pixels, otherwise terminating detecting whether there is the face region in the Nth image.

6. The eye detecting method of claim 1, wherein detecting whether there is the first eye region comprises the steps of:

a1) detecting whether there is the first eye region in the N^{th} image by using an eye classifier of a preset size;

a2) terminating detecting whether there is the first eye region in the N^{th} image if the first eye region in the N^{th} image is detected;

a3) if the first eye region in the N^{th} image is not detected, enlarging a size of the eye classifier and detecting whether there is the first eye region in the N^{th} image; and

a4) if the first eye region in the N^{th} image is not detected, repeating step a3) until the size of the eye classifier is the same as or larger than a size ofthe N^{th} image, otherwise terminating detecting whether there is the first eye region in the N^{th} image.

7. The eye detecting method of claim 1, wherein detecting whether there is the first eye region comprises the steps of:

a1) detecting whether there is the first eye region in the N^{th} image by using an eye classifier of a preset size;

a2) terminating detecting whether there is the first eye region in the N^{th} image if the first eye region in the N^{th} image is detected;

a3) if the first eye region in the N^{th} image is not detected, decreasing a size of the eye

classifier and detecting whether there is the first eye region in the N^{th} image; and

a4) if the first eye region in the N^{th} image is not detected, repeating step a3) until the size of the eye classifier is or is smaller than 40*40 pixels, otherwise terminating detecting whether there is the first eye region in the N^{th} image.

8. The eye detecting method of claim 1, wherein the second eye region comprises the steps of:

al) detecting whether there is the second eye region in the $(N+l)^{th}$ image by using an eye classifier of a preset size;

a2) terminating detecting whether there is the second eye region in the $(N+l)^{th}$ image if the second eye region in the $(N+l)^{th}$ image is detected;

a3) if the second eye region in the $(N+l)^{th}$ image is not detected, enlarging a size of the eye classifier and detecting whether there is the second eye region in the $(N+l)^{th}$ image; and

a4) if the second eye region in the $(N+l)^{th}$ image is not detected, repeating step a3) until the size of the eye classifier is the same as or larger than a size of the $(N+l)^{th}$ image, otherwise terminating detecting whether there is the second eye region in the $(N+l)^{th}$ image.

9. The eye detecting method of claim 1, wherein detecting the second eye region comprises the steps of:

al) detecting whether there is the second eye region in the $(N+l)^{th}$ image by using an eye classifier of a preset size;

a2) terminating detecting whether there is the second eye region in the $(N+l)^{th}$ image if the second eye region in the $(N+l)^{th}$ image is detected;

a3) if the second eye region in the $(N+l)^{th}$ image is not detected, decreasing a size of the eye classifier and detecting whether there is the second eye region in the $(N+l)^{th}$ image; and

a4) if the second eye region in the $(N+l)^{th}$ image is not detected, repeating step a3) until the size of the eye classifier is or is smaller than 40*40 pixels, otherwise terminating detecting whether there is the second eye region in the $(N+l)^{th}$ image.

10. An eye detecting device, comprising:

a face detecting unit, configured to detect whether there is a face region in an image;

an eye detecting unit, configured to detect whether there is an eye region in an image and

recording a detecting result of the image;

a controlling unit, connected with the face detecting unit and the eye detecting unit, and configured to control the eye detecting unit to detect whether there is a first eye region in a face region in a N^{th} image and record a detecting result of the N^{th} image if the face detecting unit detects that there is the face region in the N^{th} image; and

an area determining unit, connected with the controlling unit and the eye detecting unit and configured to determine an area in a $(N+l)^{th}$ image corresponding to and larger than the first eye region as a pending eye region in the $(N+l)^{th}$ image according to a location and size information included in the detecting result of the N^{th} image,

wherein the controlling unit is further configured to control the eye detecting unit to detect whether there is a second eye region in the pending eye region in the $(N+l)^{th}$ image.

11. The eye detecting device of claim 8 further comprising a face extracting unit, connected with the face detecting unit and the eye detecting unit and configured to extract the face region in the image.

12. The eye detecting device of claim 11, wherein the eye detecting comprises:

a first eye detecting unit, connected with the face extracting unit and configured to detect whether there is the first eye region in the face region; and

a second eye detecting unit, connected with the area determining unit and configured to detect whether there is the second region in the pending eye region.

13. The eye detecting device of claim 8, wherein the face detecting unit comprises:

a detecting module, configured to detect whether there is the face region in the N^{th} image by using the face classifier of a preset size;

a face classifier enlarging module, configured to enlarge the face classifier of a preset size; and

a first sub-controlling module, connected with the detecting module and the face classifier enlarging module, and configured to control to enlarging a size of the face classifier and to detect whether there is the face region in the N^{th} image until the size of the face classifier is the same as or larger than a size of the N^{th} image if the face region in the N^{th}

image is not detected.

14. The eye detecting device of claim 8, wherein the face detecting unit comprises:

a detecting module, configured to detect whether there is the face region in the N^{th} image by using the face classifier of a preset size;

a face classifier decreasing module, configured to decrease the face classifier of a preset size; and

a first sub-controlling module, connected with the detecting module and the face classifier decreasing module, and configured to control to decrease a size of the face classifier and to detect whether there is the face region in the N^{th} image until the size of the face classifier is or smaller than 40*40 pixels if the face region in the N^{th} image is not detected.

15. The eye detecting device of claim 8, wherein the eye detecting unit comprises:

a detecting module, configured to detect whether there is the eye region in an image by using the eye classifier of a preset size;

an eye classifier enlarging module, configured to enlarge the eye classifier of a preset size; and

a second sub-controlling module, connected with the detecting module and the eye classifier enlarging module, and configured to control to enlarging a size of the eye classifier and to detect whether there is the eye region in the image until the size of the eye classifier is the same as or larger than a size of the image if the eye region in the image is not detected.

16. The eye detecting device of claim 8, wherein the eye detecting unit comprises:

a detecting module, configured to detect whether there is the eye region in an image by using the eye classifier of a preset size;

an eye classifier decreasing module, configured to decrease the eye classifier of a preset size; and

a second sub-controlling module, connected with the detecting module and the eye classifier decreasing module, and configured to control to decrease a size of the eye classifier and to detect whether there is the eye region in the image until the size of the eye classifier is or less than 40*40 pixels if the eye region in the image is not detected.

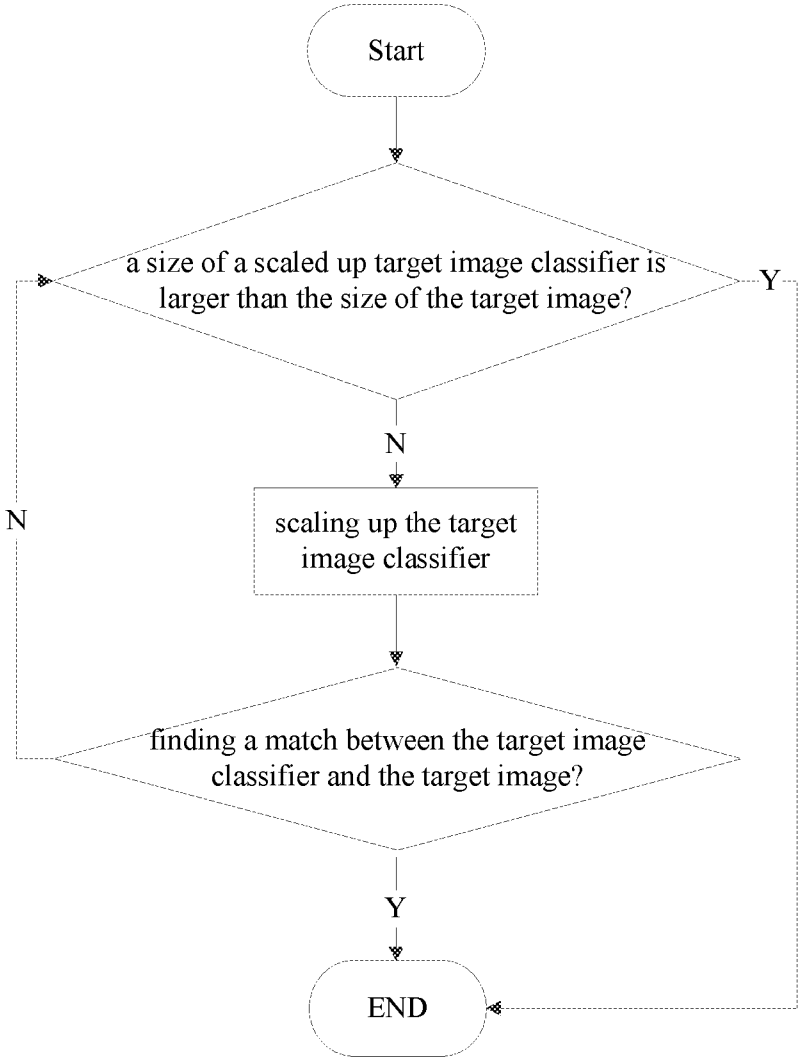
Start
a size of a scaled up target image classifier is larger than the size of the target image?
Y
N
N
scaling up the target image classifier
finding a match between the target image classifier and the target image?
Y
END

Fig. 1

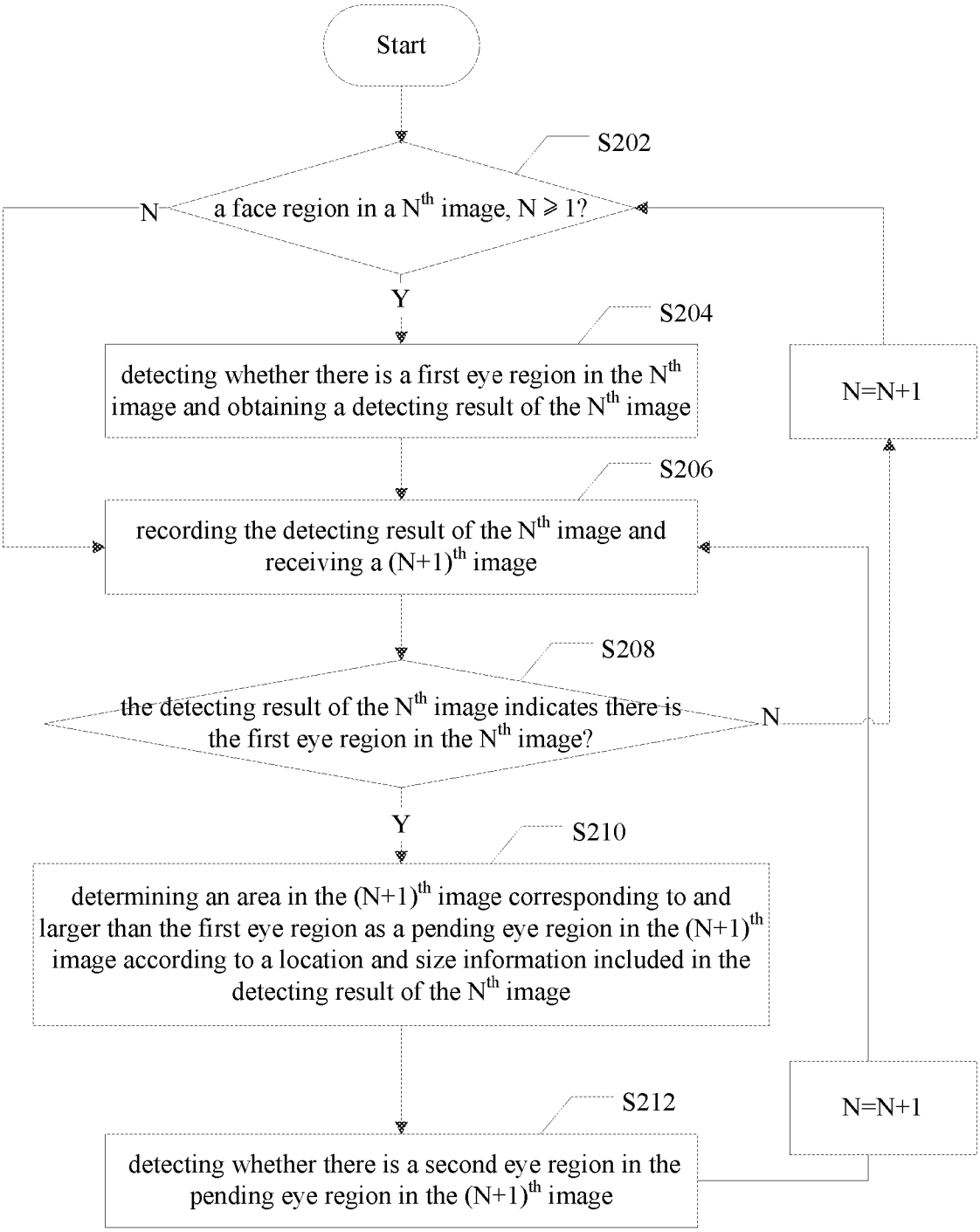
Start
S202
a face region in a N^th image, N ⩾ 1?
N
Y
S204
detecting whether there is a first eye region in the N^th image and obtaining a detecting result of the N^th image
N=N+1
S206
recording the detecting result of the N^th image and receiving a (N+1)^th image
S208
the detecting result of the N^th image indicates there is the first eye region in the N^th image?
N
Y
S210
determining an area in the (N+1)^th image corresponding to and larger than the first eye region as a pending eye region in the (N+1)^th image according to a location and size information included in the detecting result of the N^th image
S212
N=N+1
detecting whether there is a second eye region in the pending eye region in the (N+1)^th image

Fig. 2

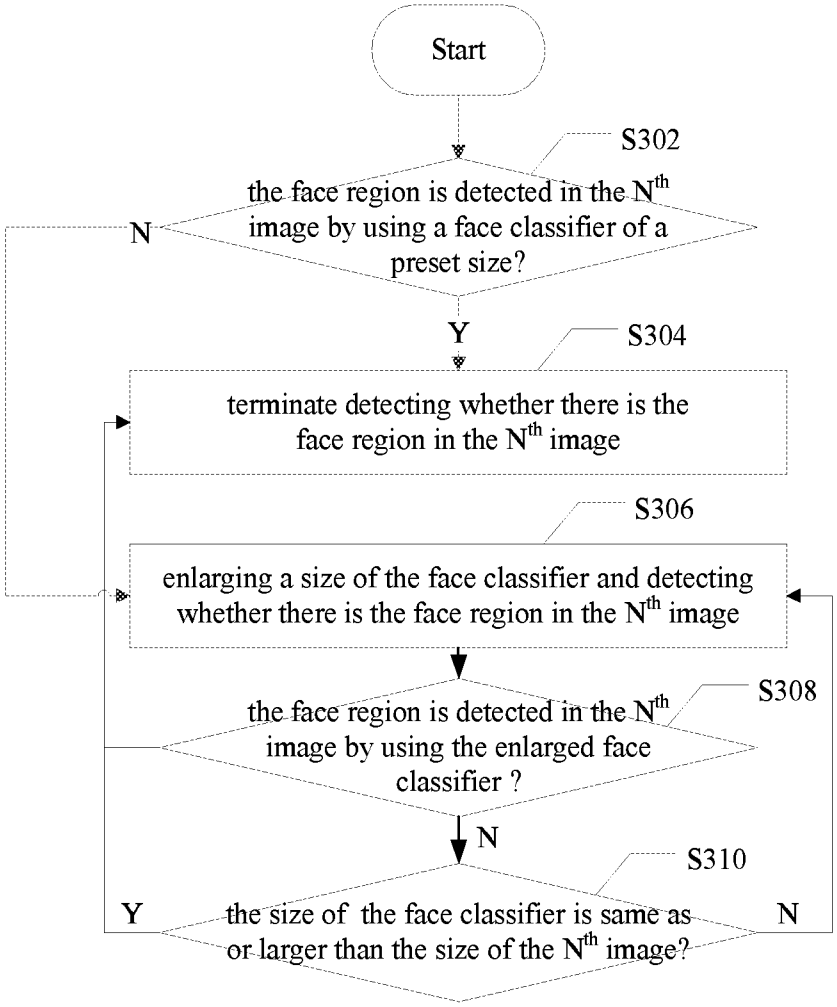
Start
S302
the face region is detected in the Nth image by using a face classifier of a preset size?
N
Y
S304
terminate detecting whether there is the face region in the Nth image
S306
enlarging a size of the face classifier and detecting whether there is the face region in the Nth image
S308
the face region is detected in the Nth image by using the enlarged face classifier ?
N
S310
Y
the size of the face classifier is same as or larger than the size of the Nth image?
N

Fig. 3A

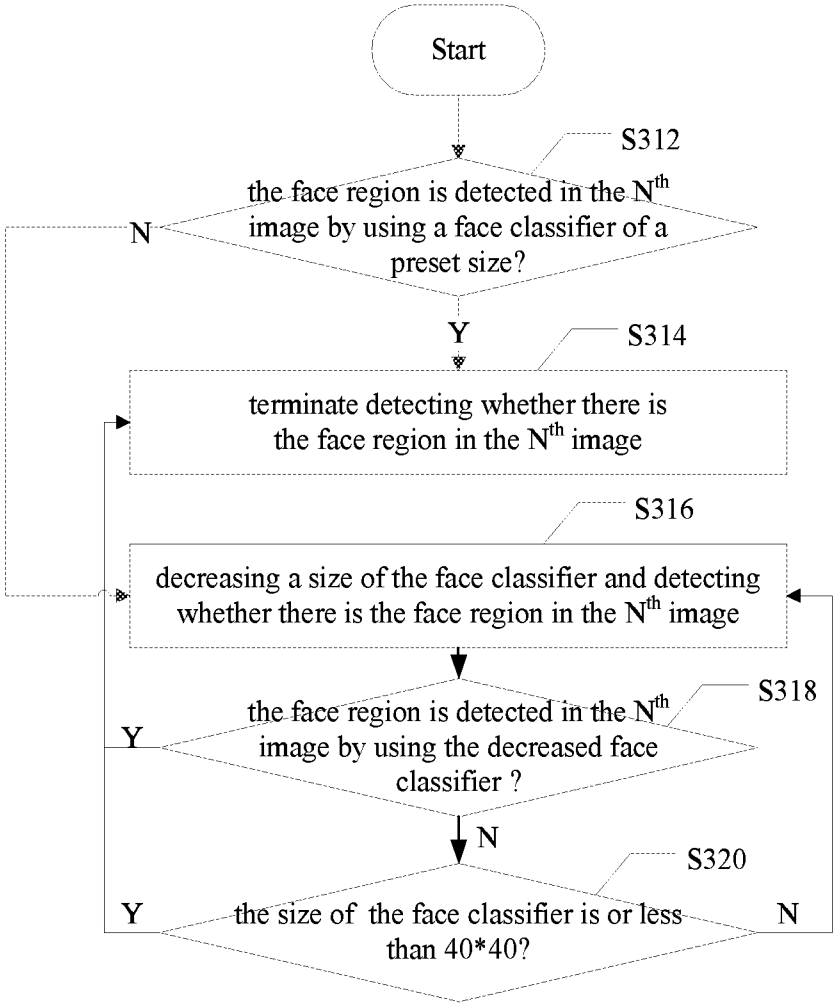
Start
S312
the face region is detected in the Nth image by using a face classifier of a preset size?
N
Y
S314
terminate detecting whether there is the face region in the Nth image
S316
decreasing a size of the face classifier and detecting whether there is the face region in the Nth image
S318
the face region is detected in the Nth image by using the decreased face classifier ?
Y
N
S320
the size of the face classifier is or less than 40*40?
Y
N

Fig. 3B

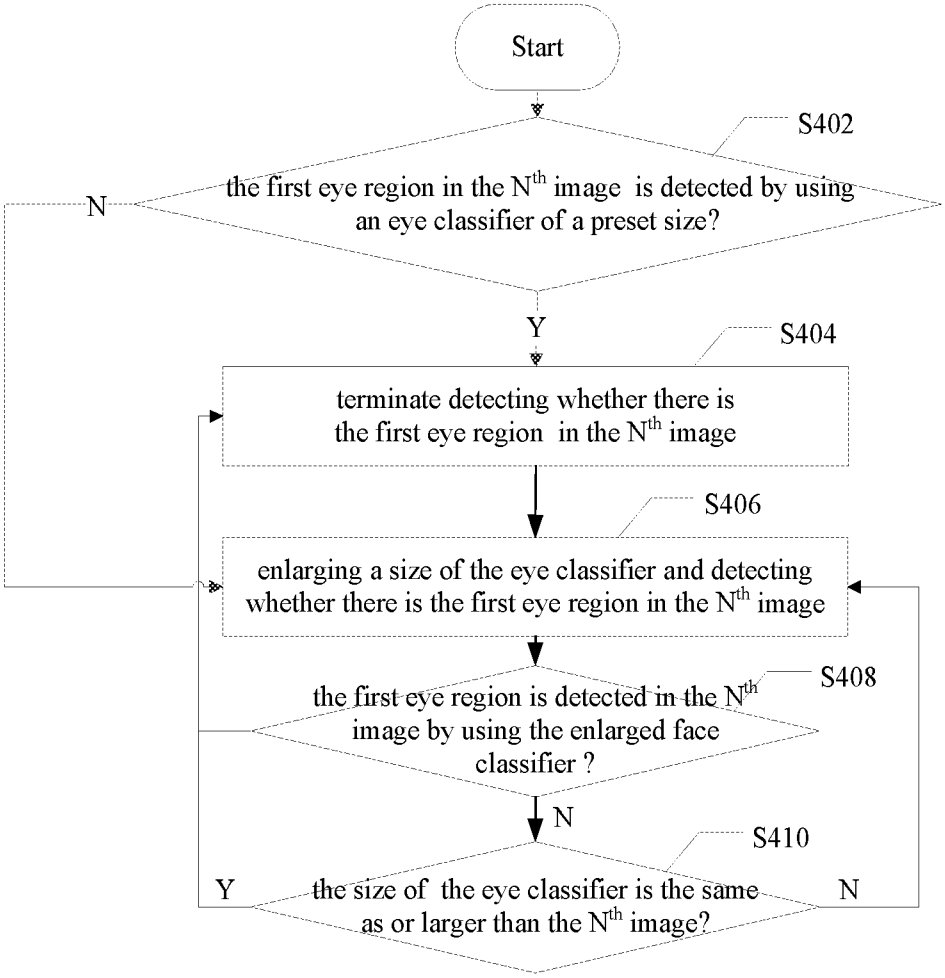
Start
S402
the first eye region in the Nth image is detected by using an eye classifier of a preset size?
N
Y
S404
terminate detecting whether there is the first eye region in the Nth image
S406
enlarging a size of the eye classifier and detecting whether there is the first eye region in the Nth image
S408
the first eye region is detected in the Nth image by using the enlarged face classifier ?
N
S410
Y
the size of the eye classifier is the same as or larger than the Nth image?
N

Fig. 4A

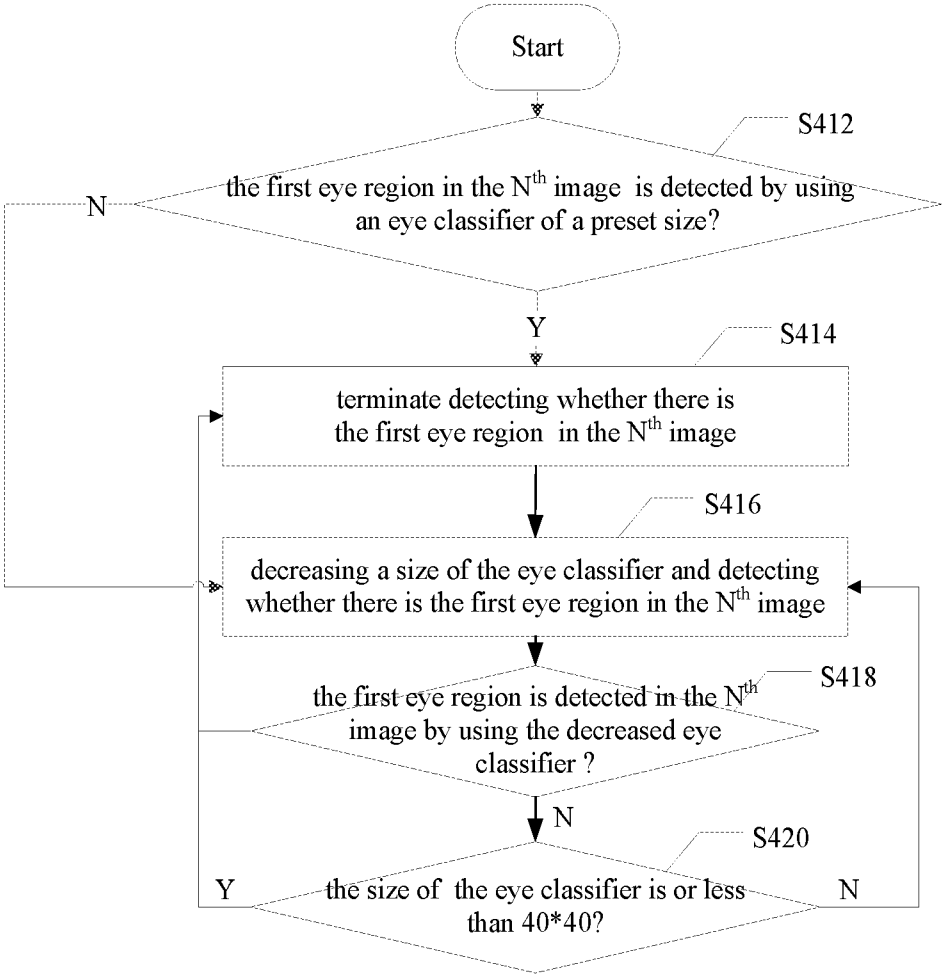
Start
S412
the first eye region in the Nth image is detected by using an eye classifier of a preset size?
N
Y
S414
terminate detecting whether there is the first eye region in the Nth image
S416
decreasing a size of the eye classifier and detecting whether there is the first eye region in the Nth image
S418
the first eye region is detected in the Nth image by using the decreased eye classifier ?
N
S420
Y
the size of the eye classifier is or less than 40*40?
N

Fig. 4B

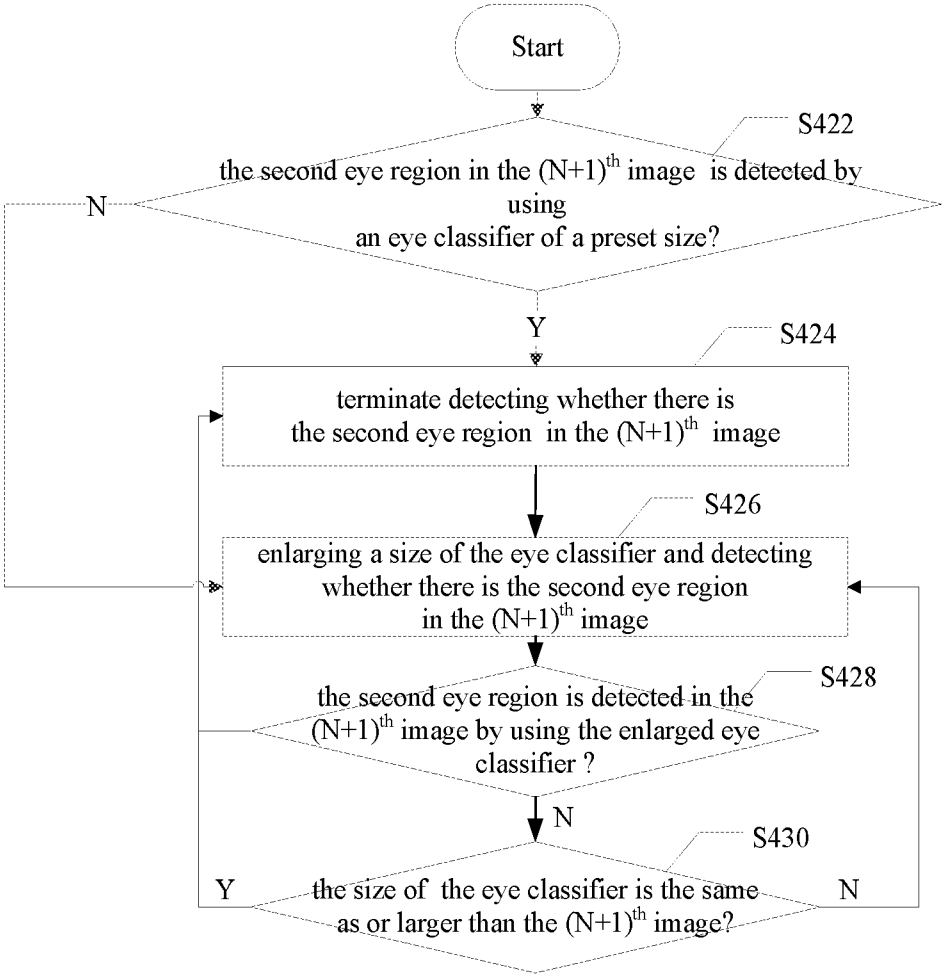
Start
S422
the second eye region in the (N+1)th image is detected by using an eye classifier of a preset size?
N
Y
S424
terminate detecting whether there is the second eye region in the (N+1)th image
S426
enlarging a size of the eye classifier and detecting whether there is the second eye region in the (N+1)th image
S428
the second eye region is detected in the (N+1)th image by using the enlarged eye classifier ?
N
S430
Y
the size of the eye classifier is the same as or larger than the (N+1)th image?
N

Fig. 4C

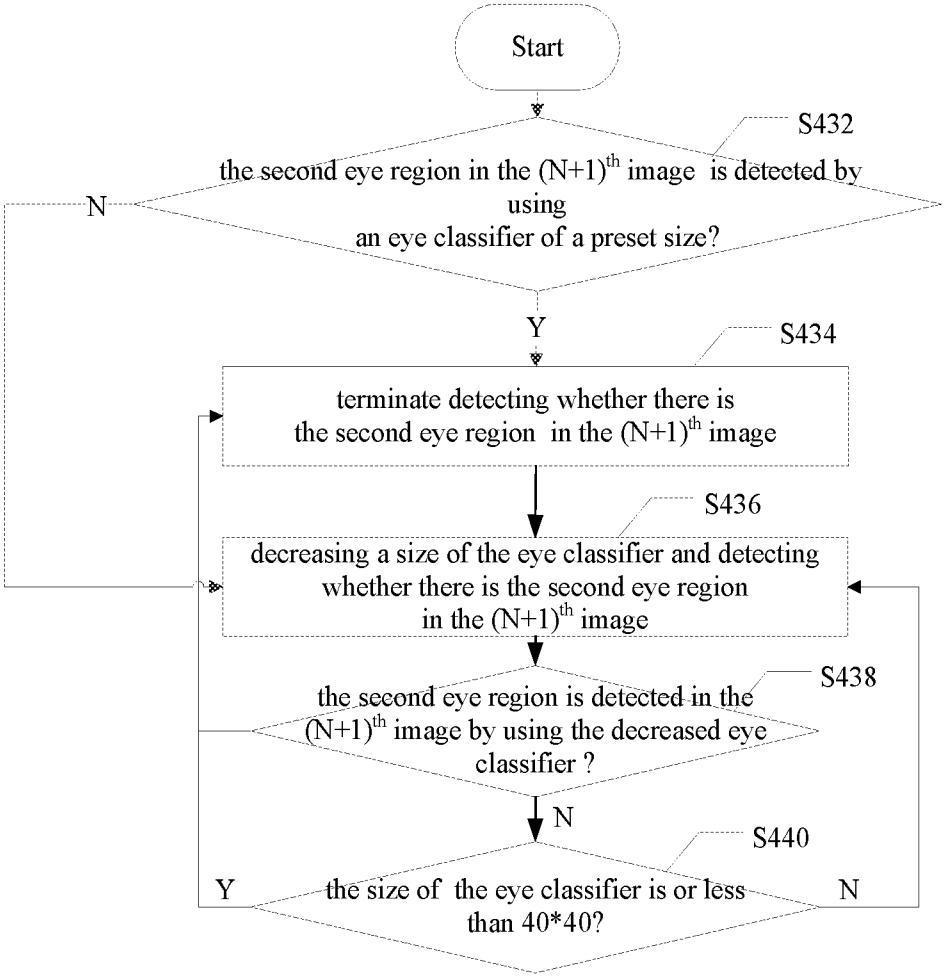
Start
S432
the second eye region in the (N+1)th image is detected by using an eye classifier of a preset size?
N
Y
S434
terminate detecting whether there is the second eye region in the (N+1)th image
S436
decreasing a size of the eye classifier and detecting whether there is the second eye region in the (N+1)th image
S438
the second eye region is detected in the (N+1)th image by using the decreased eye classifier ?
N
S440
Y
the size of the eye classifier is or less than 40*40?
N

Fig. 4D

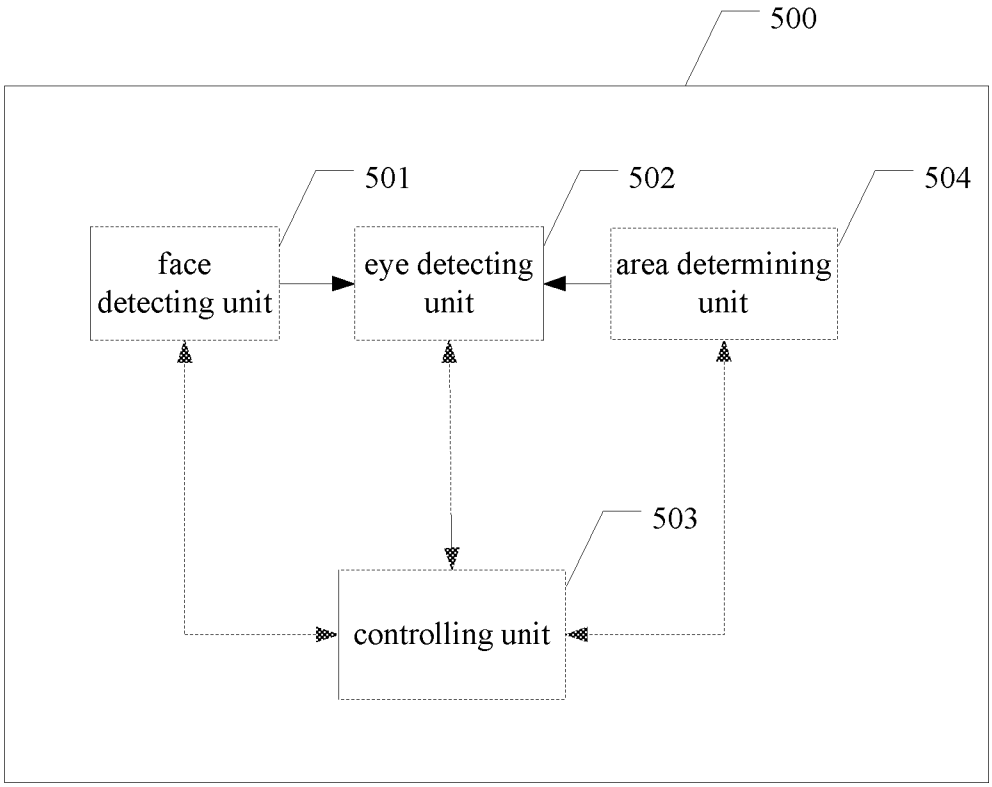
500
501
502
504
face detecting unit
eye detecting unit
area determining unit
503
controlling unit

Fig. 5A

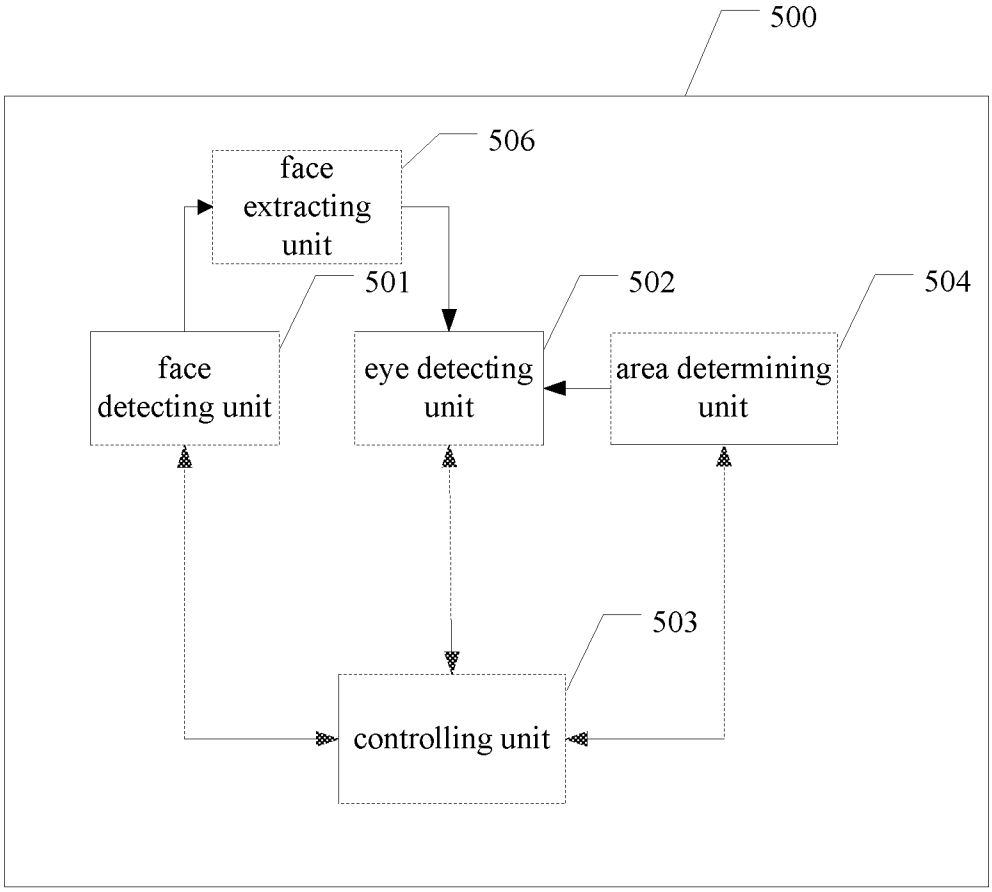
500
506
face extracting unit
501
502
504
face detecting unit
eye detecting unit
area determining unit
503
controlling unit

Fig. 5B

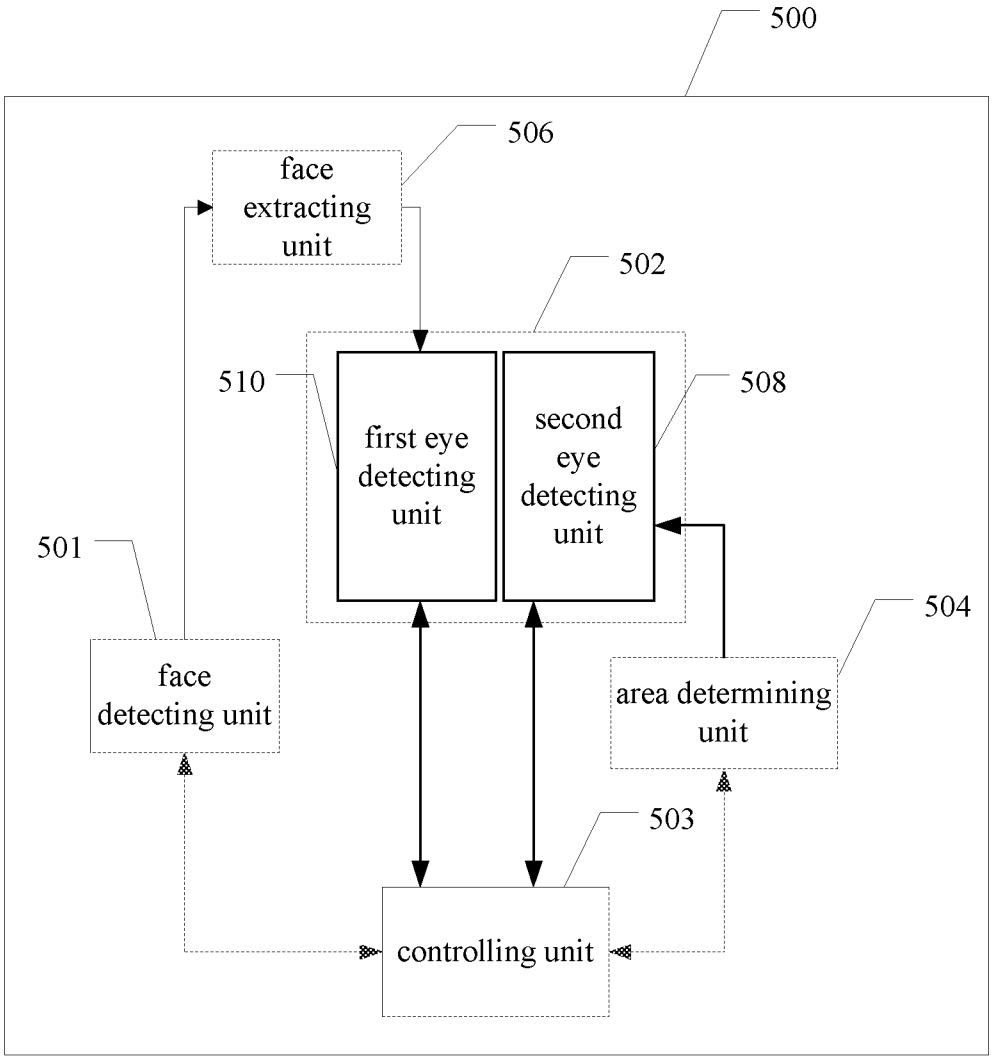
500
506
face extracting unit
502
510
first eye detecting unit
second eye detecting unit
508
501
face detecting unit
504
area determining unit
503
controlling unit

Fig. 5C

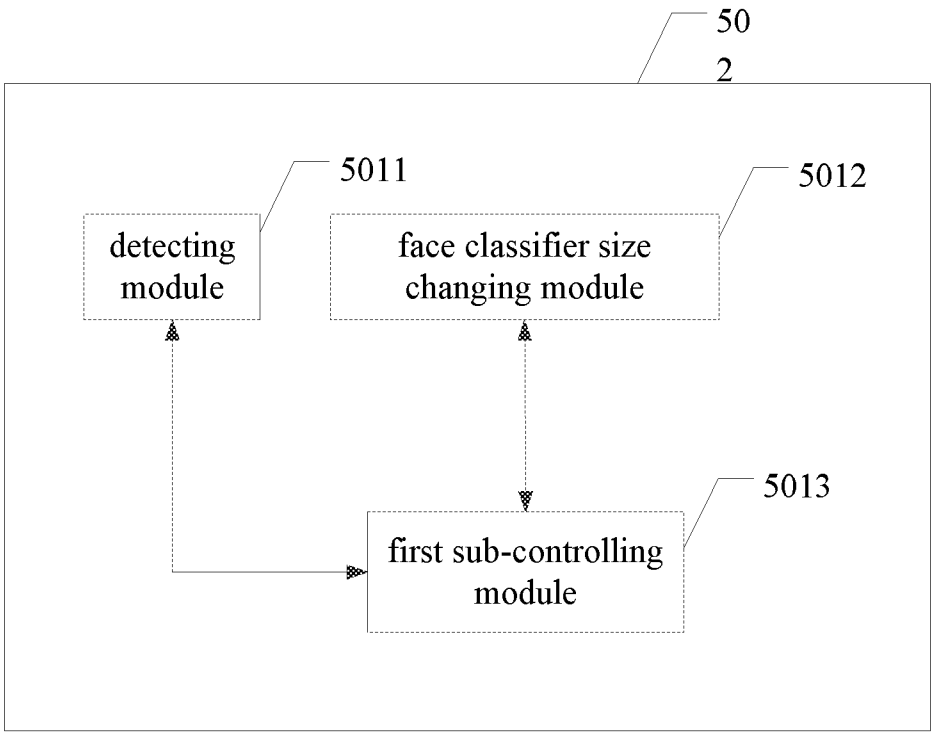
50
2
5011
detecting module
5012
face classifier size changing module
5013
first sub-controlling module

Fig. 6

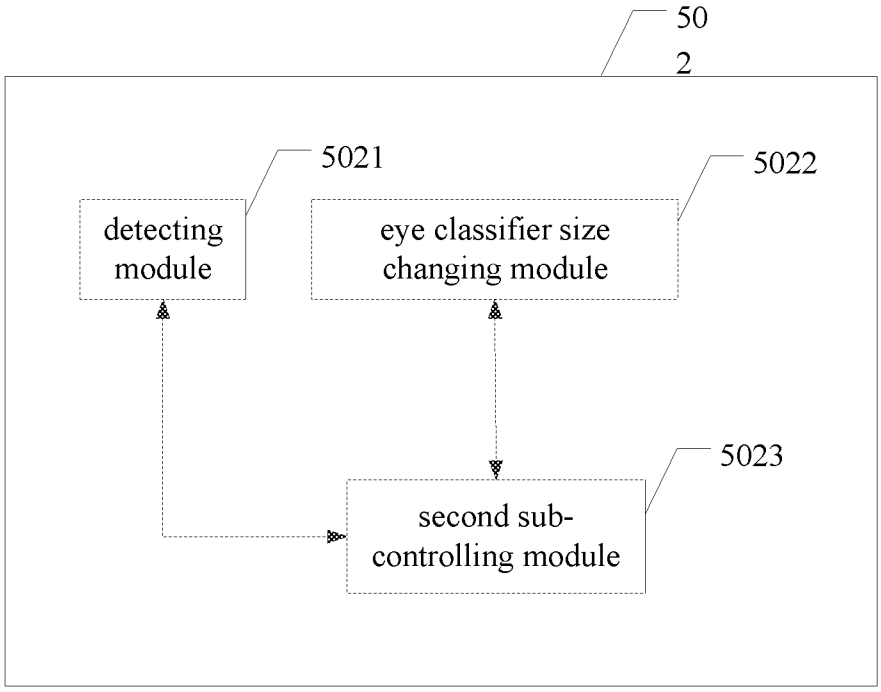
50
2
5021
detecting module
5022
eye classifier size changing module
5023
second sub-controlling module

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2011/076339

A. CLASSIFICATION OF SUBJECT MATTER

G06K 9/00(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)

IPC: G06K *91-*

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)

WPI,EPODOC, CNPAT,CNKI: eye detecting; face region; first eye region; second eye region; pending eye region; face classifier; preset size; location and size information;

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 101216887 A (UNIV ZHEJIANG) 09 Jul.2008(09.07.2008) see the whole document	1-16
A	CN 1940967 A (FUJI PHOTO FILM CO LTD) 04 Apr.2007(04.04.2007) see the whole document	1-16
A	CN 1475961 A (INST OF COMP TECHNOLOGY CHINESE) 18 Feb.2004(18.02.2004) see the whole document	1-16

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 Jul.2011(15.07.2011)	**04 Aug. 2011 (04.08.2011)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer LI,Qinghui Telephone No. (86-10)62411768

Form PCT/ISA /210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN201 1/076339

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 101216887 A	09.07.2008	CN 100592322 C	24.02.2010
CN 1940967 A	04.04.2007	US 20070713 19 A l	29.03.2007
		JP 2007087262 A	05.04.2007
		KR 20070034973 A	29.03.2007
		KR 100823967 B l	22.04.2008
		JP 4386447 B2	16.12.2009
		CN 100521727 C	29.07.2009
CN 1475961 A	18.02.2004	CN 1204531 C	0 1.06.2005