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Date: October 8, 2021

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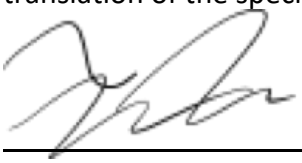
“To the best of my knowledge, the aforementioned documents are a true, full and accurate translation of the specified documents.”



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(54) [TITLE OF THE INVENTION]

Human Face Region Detecting Device

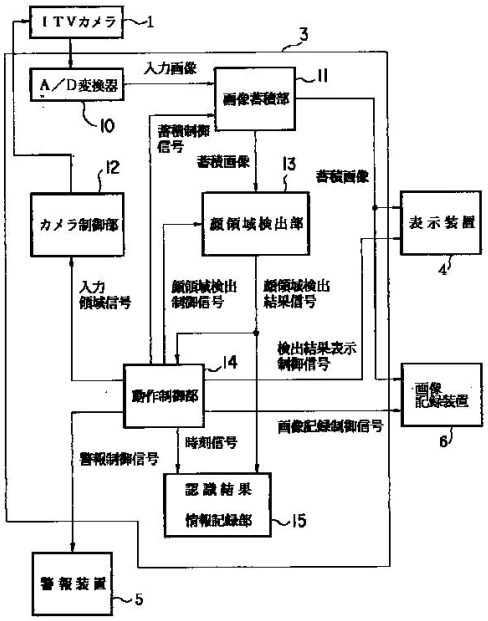
(57) [ABSTRACT]

[OBJECT]

To provide a human face region detecting device able to detect, accurately and quickly, the face region of a person.

[STRUCTURE]

In a face region detecting portion 13 for a gradation image of a person captured by an image accumulating portion 11, a y-direction projection is measured, and at intervals of given numbers of pixels the projections are compared sequentially to detect maximum points, and, simultaneously, the projection differentiation values at those maximum points are calculated to detect a plurality of face region dividing position candidates from the state of distribution of the maximum points, to divide an image of a person into a plurality of regions, where a statistic for the projection differentiation values for the maximum points is compared with projection differentiation values for the maximum points within each of the regions to detect a head top position and a face bottom position, where, additionally, x-direction projections of the gradation image are measured within a projection measurement range on the x axis, and the first differentiation values of those projections are compared to a statistic value thereof to detect left and right edges of the face, and these information are outputted as a face region detection controlling signal to an operation controlling portion.



1: ITV Camera
10: A/D Converter
[RIGHT OF 10] Input Image
11: Image Accumulating Portion
[LOWER LEFT OF 11] Accumulation Controlling Signal
[UNDER 11] Accumulated Image
[RIGHT OF 13] Accumulated Image
12: Camera Controlling Portion
13: Face Region Detecting Portion
4: Displaying Device
[UNDER 12] Input Region Signal
[LOWER LEFT OF 13] Face Region Detection Controlling Signal
[LOWER RIGHT OF 13] Face Region Detection Result Signal
[RIGHT OF 14] Detection Result Display Controlling Signal
14: Operation Controlling Portion
6: Image Recording Portion
[LOWER LEFT OF 14] Warning Controlling Signal
[LOWER RIGHT OF 14] Time Signal
[LOWER LEFT OF 6] Image Recording Controlling Signal
15: Identification Result Information Recording Portion
5: Warning Device

[PATENT CLAIMS]
[CLAIM 1]
A human face region detecting device for detecting a face region from a gradation image that includes a face region of a person, comprising:
imaging inputting means for inputting a gradation image that includes a face region of a person;
first projection measuring means for measuring y-direction projections of the gradation image inputted by the image inputting means;
dividing means for dividing, into a plurality of regions, the gradation image inputted by the image inputting means, based on the projections measured by the first projection measuring means;
first detecting means for detecting a y-direction face region dividing position through evaluating a distinctive feature within each region divided by the dividing means;
second projection measuring means for measuring x-direction projections of the image inputted by the image inputting means; and
second detecting means for detecting an x-direction face region dividing position based on the projections measured by the second projection measuring means.
[CLAIM 2]
A human face region detecting device for detecting a face region from a gradation image that includes a face region of a person, comprising:
imaging inputting means for inputting a gradation image that includes a face region of a person;
first projection measuring means for measuring y-direction projections of the gradation image inputted by the image inputting means;
maximum point detecting means for detecting maximum points of the projections measured by the first projection measuring means;
dividing means for dividing, into a plurality of regions, the gradation image inputted by the image inputting means, based on the maximum points detected by the maximum point detecting means;
first detecting means for detecting a head top position by comparing a statistic of differentiation value at maximum points detected by the maximum point detecting means and a maximum point of the boundary vicinity at the top of a region divided by the dividing means, among the maximum points detected by the maximum points detecting means;
second projection measuring means for measuring x-direction projections of the gradation image inputted by the image inputting stage; and
second detecting means for detecting an x-direction face region dividing position based on a differentiation value of the projections measured by the second projection measuring means.
[CLAIM 3]
A human face region detecting device for detecting a face region from a gradation image that includes a face region of a person, comprising:
imaging inputting means for inputting a gradation image that includes a face region of a person;
first projection measuring means for measuring y-direction projections of the gradation image inputted by the image inputting means;
maximum point detecting means for detecting maximum points from the projections measured by the first projection measuring means;
dividing means for dividing, into a plurality of regions, the gradation image inputted by the image inputting means, based on the maximum points detected by the maximum point detecting means;
first detecting means for detecting a face bottom position based on projections of the maximum points in the vicinity of a boundary region at the bottom of a region divided by the dividing means, of the maximum points detected by the maximum point detecting means;
second projection measuring means for measuring x-direction projections of the gradation image inputted by the image inputting means; and
second detecting means for detecting a face region dividing position based on a differentiation value of the projections measured by the second projection measuring means.
[CLAIM 4]
A human face region detecting device for detecting a face region from a gradation image that includes a face region of a person, comprising:
imaging inputting means for inputting a gradation image that includes a face region of a person;
first projection measuring means for measuring y-direction projections of the image inputted by the image inputting means;
maximum point detecting means for detecting maximum points from the projections measured by the first projection measuring means;
dividing means for dividing, into a plurality of regions, the gradation image inputted by the image inputting means, based on the maximum points detected by the maximum point detecting means;
first detecting means for detecting a y-direction face region dividing position through evaluating a distinctive feature within each region divided by the dividing means;
second detecting means for estimating a position of eyes wherein a change feature is strong, based on a y-direction face region dividing position, detected by the first detecting means, to detect, in that region, an x-direction projection measuring region;
second projection measuring means for measuring x-direction projections of the image inputted by the image inputting means, in the x-direction projection measuring region detected by the second detecting means; and
third detecting means for detecting an x-direction face region dividing position based on a differentiation value of the projections measured by the second projection measuring means.
[CLAIM 5]
A human face region detecting device that uses a system wherein a distribution of maximum point spacing of projections on an axis is used in order to carry out division of regions of that wherein there is a different period of gradation change, by region, such as in a face part and a non-face part, in the y-direction, and performing threshold value processing thereon.
[CLAIM 6]

A human face region detecting device for detecting a face region from a gradation image that includes a face region of a person, comprising:

imaging inputting means for inputting a gradation image that includes a face region of a person;

first projection measuring means for measuring y-direction projections of the gradation image inputted by the image inputting means;

maximum point detecting means for performing a plurality of samplings of projections while changing the sampling spacing on projections measured by the first projection measuring means to detect maximum points in each case;

dividing means for selecting maximum points of an optimal sampling spacing, based on a state of distribution of the maximum points in each case, detected by the maximum point detecting means, to divide, based on that maximum point, the gradation image inputted by the image inputting means into a plurality of regions;

first detecting means for detecting a y-direction face region dividing position through evaluating a distinctive feature within each region divided by the dividing means;

second projection measuring means for measuring x-direction projections of the image inputted by the image inputting means; and

second detecting means for detecting an x-direction face region dividing position based on a differentiation value of the projections measured by the second projection measuring means.

[DETAILED EXPLANATION OF THE INVENTION]

[0001]

[FIELD OF APPLICATION IN INDUSTRY]

The present invention relates to a human face region detecting device for detecting a face region from an image of a person that, for example, enters into a monitoring region.

[0002]

[PRIOR ART]

Face regions are detected through, for example, the following method in this type of human face region detecting device. Specifically, there is a method wherein, after a person who has entered into a monitoring region has been imaged by an ITV camera, for example, and the image that has been captured has been subjected to binarization by gradations, the face region is detected by detecting connecting regions.

[0003]

Moreover, as another face region detecting method there is a method wherein an image captured by an ITV camera is binarized, by the gradations thereof, and projections for the vertical and horizontal directions are calculated and division into regions in the pattern thereof is carried out through threshold values of the pattern values. As yet another face region detecting method there is a method wherein a color image captured by an ITV camera is used and region division is carried out after performing binarization.

[0004]

[PROBLEM SOLVED BY THE PRESENT INVENTION]

In the three methods set forth above, after an image that has been captured is binarized it is, for example, stored in a frame buffer, and the frame buffer is accessed and the binarized image is handled as a two-dimensional array to carry out the process of dividing into regions, so there is a problem in that it is difficult to carry out, by simple processing means, reliable and high-speed detection of the desired region. Given this, the object of the present invention is to provide a human face region detecting device able to detect, reliably and quickly, the face region of a person.

[0005]

[MEANS FOR SOLVING THE PROBLEM]

A human face region detecting device according to the present invention, for detecting a face region from a gradation image that includes a face region of a person, comprises: imaging inputting means for inputting a gradation image that includes a face region of a person; first projection measuring means for measuring y-direction projections of the gradation image inputted by the image inputting means; dividing means for dividing, into a plurality of regions, the gradation image inputted by the image inputting means, based on the projections measured by the first projection measuring means; first detecting means for detecting a y-direction face region dividing position through evaluating a distinctive feature within each region divided by the dividing means; second projection measuring means for measuring x-direction projections of the image inputted by the image inputting means; and second detecting means for detecting an x-direction face region dividing position based on the projections measured by the second projection measuring means.

[0006]

A human face region detecting device according to the present invention, for detecting a face region from a gradation image that includes a face region of a person, comprises: imaging inputting means for inputting a gradation image that includes a face region of a person; first projection measuring means for measuring y-direction projections of the gradation image inputted by the image inputting means; maximum point detecting means for detecting maximum points of the projections measured by the first projection measuring means; dividing means for dividing, into a plurality of regions, the gradation image inputted by the image inputting means, based on the maximum points detected by the maximum point detecting means; first detecting means for detecting a head top position by comparing a statistic of differentiation value at maximum points detected by the maximum point detecting means and a maximum point of the boundary vicinity at the top of a region divided by the dividing means, among the maximum points detected by the maximum points detecting means; second projection measuring means for measuring x-direction projections of the gradation image inputted by the image inputting stage; and second detecting means for detecting an x-direction face region dividing position based on a differentiation value of the projections measured by the second projection measuring means.

[0007]

A human face region detecting device according to the present invention, for detecting a face region from a gradation image that includes a face region of a person, comprises: imaging inputting means for inputting a gradation image that includes a face region of a person;

first projection measuring means for measuring y-direction projections of the gradation image inputted by the image inputting means; maximum point detecting means for detecting maximum points from the projections measured by the first projection measuring means; dividing means for dividing, into a plurality of regions, the gradation image inputted by the image inputting means, based on the maximum points detected by the maximum point detecting means; first detecting means for detecting a face bottom position based on projections of the maximum points in the vicinity of a boundary region at the bottom of a region divided by the dividing means, of the maximum points detected by the maximum point detecting means; second projection measuring means for measuring x-direction projections of the gradation image inputted by the image inputting means; and second detecting means for detecting a face region dividing position based on a differentiation value of the projections measured by the second projection measuring means.

[0008]

A human face region detecting device according to the present invention, for detecting a face region from a gradation image that includes a face region of a person, comprises: imaging inputting means for inputting a gradation image that includes a face region of a person; first projection measuring means for measuring y-direction projections of the image inputted by the image inputting means; maximum point detecting means for detecting maximum points from the projections measured by the first projection measuring means; dividing means for dividing, into a plurality of regions, the gradation image inputted by the image inputting means, based on the maximum points detected by the maximum point detecting means; first detecting means for detecting a y-direction face region dividing position through evaluating a distinctive feature within each region divided by the dividing means; second detecting means for estimating a position of eyes wherein a change feature is strong, based on a y-direction face region dividing position, detected by the first detecting means, to detect, in that region, an x-direction projection measuring region; second projection measuring means for measuring x-direction projections of the image inputted by the image inputting means, in the x-direction projection measuring region detected by the second detecting means; and third detecting means for detecting an x-direction face region dividing position based on a differentiation value of the projections measured by the second projection measuring means.

[0009]

A human face region detecting device according to the present invention uses a system wherein a distribution of maximum point spacing of projections on an axis is used in order to carry out division of regions of that wherein there is a different period of gradation change, by region, such as in a face part and a non-face part, in the y-direction, and performing threshold value processing thereon.

[0010]

A human face region detecting device according to the present invention, for detecting a face region from a gradation image that includes a face region of a person, comprises: imaging inputting means for inputting a gradation image that includes a face region of a person; first projection measuring means for measuring y-direction projections of the gradation image inputted by the image inputting means; maximum point detecting means for performing a plurality of samplings of projections while changing the sampling spacing on projections measured by the first projection measuring means to detect maximum points in each case; dividing means for selecting maximum points of an optimal sampling spacing, based on a state of distribution of the maximum points in each case, detected by the maximum point detecting means, to divide, based on that maximum point, the gradation image inputted by the image inputting means into a plurality of regions; first detecting means for detecting a y-direction face region dividing position through evaluating a distinctive feature within each region divided by the dividing means; second projection measuring means for measuring x-direction projections of the image inputted by the image inputting means; and second detecting means for detecting an x-direction face region dividing position based on a differentiation value of the projections measured by the second projection measuring means.

[0011]

[OPERATION]

A face region of a person can be detected accurately and quickly through measuring y-direction projections of a gradation image of a person; detecting maximum points of those projections; dividing into a plurality of regions from the state of distribution of the maximum points; comparing a statistic of the differential values of the maximum points with differential values of projections at the maximum points in the vicinities of the boundaries at the tops of the regions to detect a head top position; using the shapes of the projections at the maximum points in the vicinities of the boundaries of the bottoms of the regions to detect a face bottom position; detecting a x-direction projection measuring region based on the detected head top position and face bottom position and measuring the x-direction projections of the gradation image within this region; and detecting x-direction face region dividing positions based on the differentiation values of the projections and on a statistic value thereof.

[0012]

[EMBODIMENT]

An embodiment according to the present invention will be explained below in reference to the drawings. FIG. 1 depicts schematically a human face region processing device according to the present embodiment. That is, an ITV 1 camera captures, in black and white, an image within a monitoring region 7, to convert it into an electric signal. The image signal captured by the ITV camera 1 is sent, by a transmission path 2, to a processing device 3 and a displaying device 4. The displaying device 4 displays the image that was captured by the ITV camera 1, and the processing device 3 continuously reads in the image captured by the ITV camera 1 to carry out image processing and evaluations, etc., in order to detect the region of a face of a person from an image that includes a person. When the result is that a face region is detected, a face region detected indicator is shown on the screen of the displaying device 4, or an alarm tone is emitted by a warning device 5, and the image at that time is recorded

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