17 MAY 2002

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APPARATUS AND METHOD FOR DETECTING ENLARGING RATIO OR REDUCING RATIO OF IMAGE DATA

BACKGROUND OF THE INVENTION

The present invention relates to a technology for detecting an enlarging ratio or a reducing ratio of a digital image data in which the enlarging ratio or reducing ratio of an image is unknown.

Conventionally, in such a kind of an image enlarging or reducing ratio detecting circuit, it is necessary to previously provide an enlarging or reducing ratio of an image which will be an objective, as an additional data of the image in a some data form, like technology described in JP-A-51294/1992, JP-A-295545/1995 and JP-A-129356/1996.

However, in the above-described technology, there is a task that the additional data is easily destroyed by a disturbance and the reducing or enlarging ratio of an original image is lost.

Accordingly, in order to solve this task, it is required to add a circuit to an apparatus, which has means for restoring the additional data by adding a complicated error correcting circuit or by attaching the additional data over several times together with the image data, and so forth.

However, there is still a defect that the apparatus

becomes to be complicated and large-sized.

Also, in the conventional technology, the reducing or enlarging ratio is detected by putting a reference signal (referred to as a synchronizing signal) in the image itself, and repeating it until the image itself is reduced or enlarged and the synchronizing signal can be detected with the largest amplitude.

However, to put the synchronizing signal in the image itself is to insert a data or noise which has some influence on the image itself, and thereby, quality of the image itself is lost. Moreover, since the reduction and enlargement is repeatedly conducted over an entire image plane, an amount of processing and memories for storing the image are needed a great deal, and accordingly, there is a defect that the circuit becomes to be large-sized.

SUMMARY OF THE INVENTION

Therefore, the objective of the present invention is to solve the above-described tasks.

Also, the objective of the present invention is to provide a detection apparatus and a detection method for detecting an appropriate image reducing or enlarging ratio with simple circuit size without affecting quality of an image.

The above-described objective of the present invention is achieved by an enlarging ratio detecting apparatus for

detecting an enlarging ratio of a digital image data in which the enlarging ratio of an image is unknown. The enlarging ratio detecting apparatus includes a section unit for sectioning the digital image data, in which the enlarging ratio of an image is unknown, by predetermined horizontal or perpendicular block sizes, a conversion unit for frequency-converting sectioned blocks into a two-dimension, an addition unit for adding frequencies of the blocks every the same frequency over an entire block and obtaining a sum of the frequencies every the same frequency, a retrieval unit for retrieving frequencies at which energy is collecting using an added result, a calculation unit for calculating an enlarging ratio based on a retrieved result, and a restoration unit for restoring an image of an image data to an image having the calculated enlarging ratio.

Also, the above-described objective of the present invention is achieved by a reducing ratio detecting apparatus for detecting a reducing ratio of a digital image data in which the reducing ratio of an image is unknown. The reducing ratio detecting apparatus includes a section unit for sectioning the digital image data, in which the reducing ratio of an image is unknown, by predetermined horizontal or perpendicular block sizes, a conversion unit for frequency-converting sectioned blocks

into a two-dimension, an addition unit for adding frequencies of the blocks every the same frequency over an entire block and obtaining a sum of the frequencies every the same frequency, a retrieval unit for retrieving frequencies at which energy is collecting using an added result, a calculation unit for calculating a reducing ratio based on a retrieved result, and a restoration means for restoring an image of an image data to an image having the calculated reducing ratio.

It is preferable that the above-described retrieval unit is constructed so as to select n signals which have frequencies in order of the highest energy, and to obtain a frequency-energy distribution in which energy is collecting.

Moreover, the above-described calculation unit determines a set of frequencies from the frequency-energy distribution obtained by the retrieval unit, at which energy is collecting, and calculates an enlarging ratio or reducing ratio that corresponds to this set.

Also, if a loop circuit for returning an output from the above-described restoration unit to the above-described section unit again, even though a correct enlarging ratio or reducing ratio cannot be obtained one time, processing can be conducted again based on a rough enlarging ratio or reducing ratio obtained at the first time.

In addition, of course, it is possible to construct one apparatus, an enlarging ratio or reducing detecting apparatus, by combining the above-described enlarging ratio detecting apparatus and the above-described reducing ratio detecting apparatus.

Also, the above-described objective of the present invention is achieved by an image data enlarging ratio detecting method of detecting an enlarging ratio of a digital image data in which the enlarging ratio of an image is unknown. The image data enlarging ratio detecting method includes steps of:

(a) sectioning the digital image data, in which the enlarging ratio of an image is unknown, by predetermined horizontal or perpendicular block sizes;

(b) frequency-converting sectioned blocks into a two-dimension;

(c) adding frequencies of the above-described blocks every the same frequency over an entire block and obtaining a sum of the frequencies every the same frequency;

(d) obtaining a set of frequencies at which energy is collecting using a result of the above-described sum; and

(e) calculating an enlarging ratio of an image based on the above-described set of frequencies at which energy is collecting.

Furthermore, the above-described objective of the present invention is achieved by an image data reducing ratio detecting method of detecting a reducing ratio of a digital image data in which the reducing ratio of an image is unknown. The image data reducing ratio detecting method includes steps of:

(a) sectioning the digital image data, in which the reducing ratio of an image is unknown, by predetermined horizontal or perpendicular block sizes;

(b) frequency-converting sectioned blocks into a two-dimension;

(c) adding frequencies of the above-described blocks every the same frequency over an entire block and obtaining a sum of the frequencies every the same frequency;

(d) obtaining a set of frequencies at which energy is collecting using a result of the above-described sum; and

(e) calculating a reducing ratio of an image based on the above-described set of frequencies at which energy is collecting.

In the above-described step (d), n frequencies in order of the highest energy are selected, and a frequency-energy distribution in which energy is collecting is obtained, and in the above-described step (e), a set of frequencies at which energy is collecting is determined based on the

obtained frequency-energy distribution, and an enlarging ratio or reducing ratio that corresponds to this set is calculated.

In addition, even though a correct enlarging ratio or reducing ratio cannot be obtained one time, it is possible to obtain a more correct enlarging ratio or reducing ratio by repeating the above-described steps again.

In accordance with the present invention as constructed above, an enlarging ratio or reducing ratio of an image is not affected by a disturbance. The reason thereof is that it is not necessary to attach the reducing or enlarging ratio to the image as a data in a form of adding the ratio to the image, and that the data of the enlarging ratio or reducing ratio is not lost.

Also, in accordance with the present invention, it is possible to prevent deterioration of an image. The reason thereof is that it is not necessary to insert an image reference signal for finding original size of an image into the image.

BRIEF DESCRIPTION OF THE DRAWINGS

This and other objects, features and advantages of the present invention will become more apparent upon a reading of the following detailed description and drawings, in which:

Fig. 1 is a block diagram showing construction of an

embodiment of an image reducing or enlarging ratio detecting circuit of the present invention;

Fig. 2 is an energy distribution of an original image;

Fig. 3 is an energy distribution in case of being enlarged twofold; and

Fig. 4 is an energy distribution in case that a reducing ratio is 1/2.

DESCRIPTION OF THE EMBODIMENTS

Embodiments of the present invention will be explained by referring to drawings.

Fig. 1 is a block diagram of an enlarging ratio or reducing ratio detecting apparatus in this embodiment.

In Fig. 1, a reference numeral 100 is a block sectioning device. This block sectioning device 100 sections an image data, in which an enlarging ratio or reducing ratio of an image is unknown, by predetermined horizontal or perpendicular block size (horizontal n pixels × perpendicular n lines). In this embodiment, an image data 700 is to be sectioned by horizontal eight pixels and perpendicular eight lines as one block. In addition, the case in which the block size is not 8 × 8 is handled in the same manner, and basically, it can be realized by having a memory corresponding to the number of perpendicular lines to be sectioned.

A reference numeral 200 is a pixel frequency converter.

This pixel frequency converter 200 converts a sectioned block with respect to pixel frequency into a two-dimension. In this embodiment, a pixel data 110 formed of blocks is DCT-converted, and one set of frequencies is obtained for one block. In addition, with regard to a method of the frequency conversion, general frequency conversion, such as FFT, can be adopted.

A reference numeral 300 is an adder. This adder 300 calculates a sum of the same frequency components every the same frequency component for the frequency components of the block over an entire image plane. For example, for a frequency f_1, the adder 300 calculates a sum of the frequency f_1 over the entire image plane by adding the frequency f_1 of each block. The calculation for all frequencies, such as a frequency f_2, a frequency f_3, ……, is conducted in the same manner.

A reference numeral 400 is an energy retrieving device. This energy retrieving device 400 retrieves frequency components in which energy is collecting, using an added result. In this embodiment, n signals of frequency summing signals 310, which have frequencies in order of the highest energy, are selected. In other words, a set of frequencies at which energy is collecting is obtained.

A reference numeral 500 is an enlarging ratio or reducing ratio calculator. This enlarging ratio or

reducing ratio calculator 500 calculates an enlarging ratio or a reducing ratio based on a retrieved result. Particularly, the enlarging ratio or reducing ratio calculator 500 previously stores sets of frequencies at which high energy corresponding to several kinds of enlarging ratios or reducing ratios is collecting, determines from energy retrieving signals 410 a set of frequencies at which energy is collecting, and calculates the enlarging ratio or reducing ratio by making the determined set correspond to the previously stored sets.

A reference numeral 600 is an image memory, and stores the image data 700 and restores an image to an image having the obtained enlarging ratio or reducing ratio.

Moreover, the apparatus has a loop circuit 800 for returning an image, which is restored to an image having an obtained rough enlarging ratio or reducing ratio, to the block sectioning device again, in case that a correct enlarging ratio or reducing ratio cannot be obtained at one processing.

In accordance with this apparatus constructed above, it is possible to detect the enlarging ratio or reducing ratio without depending on an additional data indicating an enlarging ratio or reducing ratio.

Next, operation of this apparatus will be explained.

The block size sectioning device 100 sections the image

data 700 by blocks of predetermined horizontal or perpendicular sizes. Here, for simplicity of the explanation, the explanation will be made under an assumption of horizontal eight pixels and perpendicular eight lines. In case of 8 × 8 sizes, the block size sectioning circuit generally has a memory corresponding to eight lines, re-conducts addressing every line and every pixel, and sequentially stores pixel data in a memory 102. When data corresponding to 8 × 8 pixels is stored in the memory, the data is transferred to the pixel frequency converter 200.

The pixel frequency converter 200 receives the image data 110 formed of blocks and frequency-converts data pixels of 8 × 8 sizes. For simplicity of the explanation, DCT conversion is used here. The data to which the frequency conversion is applied shows a frequency energy distribution that represents characteristic of the sectioned block. This distribution is output as two-dimensional frequency signals 210.

The adder 300 obtains a sum of energies of the same frequency every the same frequency over an entire image plane from the two-dimensional frequency signals 210. While the frequency energy distribution of each sectioned block shows individual characteristic thereof, the distribution obtained by the sum over the entire image

plane becomes to describe an energy distribution over the entire image plane. This is input to the energy retrieving device 400 as frequency summing signals 310.

The energy retrieving device 400 can determine unbalance of the entire image plane by selecting n signals of the frequency summing signals 310, which have frequencies in order of the highest energy. For example, in case that the image plane is enlarged two times, in the frequency summing signals 310, energy of the highest frequency is extremely low, and energy of a frequency that is a next high frequency is high. Accordingly, a group of frequencies that have high energy is retrieved by the energy retrieving device 400, and a result of the retrieval is output as energy retrieving signals 410.

The enlarging ratio or reducing ratio calculator 500 finds a set of frequencies from an energy distribution of a frequency having high energy, which is shown by the energy retrieving signals 410. And, the calculator 500 calculates an enlarging ratio or a reducing ratio from the sets of frequencies of an energy distribution corresponding to the previously stored enlarging ratio or reducing ratio and the set of frequencies of an energy distribution determined from the energy retrieving signals 410.

For example, in case of the DCT conversion, in a

distribution of an original image, energy usually collects at highest frequencies as shown in Fig. 2. On the other hand, in case that an image enlarging ratio is twofold, as shown in Fig. 3, an energy distribution (a set of frequencies having high energy) causes offset by one frequency. Also, in case of a reducing ratio of 1/2, as shown in Fig. 4, energy collects at high frequencies. Such information is previously stored in the enlarging ratio or reducing ratio calculator 500, and the enlarging ratio or reducing ratio is calculated from the set of frequencies having high energy that was output from the energy retrieving signals 410.

For example, if an energy distribution (a set of frequencies having high energy) that was output from the energy retrieving signals 410 is a distribution shown in Fig. 3, the enlarging ratio or reducing ratio calculator 500 can determined that an enlarging ratio of an image data is two, and if an energy distribution (a set of frequencies having high energy) that was output from the energy retrieving signals 410 is a distribution shown in Fig. 4, the enlarging ratio or reducing ratio calculator 500 can determined that a reducing ratio of an image data is 1/2.

The reducing or enlarging ratio of an image is calculated in this manner and the enlarging ratio is

output to the image memory 600, and it is possible to restore the image to an image having an original image ratio.

In addition, in case that a correct enlarging ratio or reducing ratio cannot be obtained at one processing, an image, which is restored to an image having an obtained rough enlarging ratio or reducing ratio, is returned to the block sectioning device 100 again by the loop circuit 800, and the same operation mentioned above is repeated.

CLAIMS

1 An enlarging ratio detecting apparatus for detecting an enlarging ratio of a digital image data in which said enlarging ratio of an image is unknown, comprising:

section means for sectioning said digital image data, in which said enlarging ratio of an image is unknown, by predetermined horizontal or perpendicular block sizes;

conversion means for frequency-converting sectioned blocks into a two-dimension;

addition means for adding frequencies of said blocks every the same frequency over an entire block and obtaining a sum of said frequencies every the same frequency;

retrieval means for retrieving frequencies at which energy is collecting using an added result;

calculation means for calculating an enlarging ratio based on a retrieved result; and

restoration means for restoring an image of an image data to an image having said calculated enlarging ratio.

2 An enlarging ratio detecting apparatus according to claim 1, wherein said conversion means includes means for applying DCT conversion to a data of said sectioned blocks.

3 An enlarging ratio detecting apparatus according to

claim 1, wherein said retrieval means includes means for selecting n signals out of said added result, which have frequencies in order of the highest energy, and obtaining an energy distribution.

4 An enlarging ratio detecting apparatus according to claim 1, wherein said calculation means determines a set of frequencies from an energy distribution retrieved by said retrieval means, at which energy is collecting, and calculates an enlarging ratio of an image.

5 An enlarging ratio detecting apparatus according to claim 1, having a loop circuit for returning an output from said restoration means to said section means again.

6 A reducing ratio detecting apparatus for detecting a reducing ratio of a digital image data in which said reducing ratio of an image is unknown, comprising:

section means for sectioning said digital image data, in which said reducing ratio of an image is unknown, by predetermined horizontal or perpendicular block sizes;

conversion means for frequency-converting sectioned blocks into a two-dimension;

addition means for adding frequencies of said blocks every the same frequency over an entire block and obtaining a sum of said frequencies every the same frequency;

retrieval means for retrieving frequencies at which energy is collecting using an added result;

calculation means for calculating a reducing ratio based on a retrieved result; and

restoration means for restoring an image of an image data to an image having said calculated reducing ratio.

7 A reducing ratio detecting apparatus according to claim 6, wherein said conversion means includes means for applying DCT conversion to a data of said sectioned blocks.

8 A reducing ratio detecting apparatus according to claim 6, wherein said retrieval means includes means for selecting n signals out of said added result, which have frequencies in order of the highest energy, and obtaining an energy distribution.

9 A reducing ratio detecting apparatus according to claim 6, wherein said calculation means determines a set of frequencies from an energy distribution retrieved by said retrieval means, at which energy is collecting, and calculates a reducing ratio of an image.

10 A reducing ratio detecting apparatus according to claim 6, having a loop circuit for returning an output from said restoration means to said section means again.

11 An enlarging ratio detecting apparatus for detecting an enlarging ratio of a digital image data in which said

enlarging ratio of an image is unknown, comprising:

section means for sectioning said digital image data, in which said enlarging ratio of an image is unknown, by predetermined horizontal or perpendicular block sizes;

conversion means for frequency-converting sectioned blocks into a two-dimension by means of DCT conversion;

addition means for obtaining a sum of frequencies of all of said frequency-converted blocks every the same frequency of all blocks;

retrieval means for selecting n signals out of an added result, which have frequencies in order of the highest energy, and outputting an energy distribution of frequencies at which energy is collecting;

calculation means for determining a set of frequencies based on said energy distribution, at which energy is collecting, and calculating an enlarging ratio of an image, which corresponds to said set; and

restoration means for restoring an image of an image data to an image having said calculated enlarging ratio.

12 An enlarging ratio detecting apparatus according to claim 11, having a loop circuit for returning an output from said restoration means to said section means again.

13 A reducing ratio detecting apparatus for detecting a reducing ratio of a digital image data in which said reducing ratio of an image is unknown, comprising:

section means for sectioning said digital image data, in which said reducing ratio of an image is unknown, by predetermined horizontal or perpendicular block sizes;

conversion means for frequency-converting sectioned blocks into a two-dimension by means of DCT conversion;

addition means for obtaining a sum of frequencies of all of said frequency-converted blocks every the same frequency of all blocks;

retrieval means for selecting n signals out of an added result, which have frequencies in order of the highest energy, and outputting an energy distribution of frequencies at which energy is collecting;

calculation means for determining a set of frequencies based on said energy distribution of said frequencies, at which energy is collecting, and calculating a reducing ratio of an image, which corresponds to said set; and

restoration means for restoring an image of an image data to an image having said calculated reducing ratio.

14 A reducing ratio detecting apparatus according to claim 13, having a loop circuit for returning an output from said restoration means to said section means again.

15 An image data enlarging ratio detecting method of detecting an enlarging ratio of a digital image data in which said enlarging ratio of an image is unknown, said method comprises steps of:

(a) sectioning said digital image data, in which said enlarging ratio of an image is unknown, by predetermined horizontal or perpendicular block sizes;

(b) frequency-converting sectioned blocks into a two-dimension;

(c) adding frequencies of said blocks every the same frequency over an entire block and obtaining a sum of said frequencies every the same frequency;

(d) obtaining a set of frequencies at which energy is collecting using a result of said sum; and

(e) calculating an enlarging ratio of an image based on said set of frequencies at which energy is collecting.

16 An image data enlarging ratio detecting method according to claim 15, further comprising a step of (f) restoring an image data to said calculated enlarging ratio of an image.

17 An image data enlarging ratio detecting method

according to claim 16, wherein said method has a step of applying said steps (a) to (f) to said image data again, which is restored to said calculated enlarging ratio of an image.

18 An image data enlarging ratio detecting method according to claim 15, wherein, in said step (b), frequency-conversion is DCT conversion.

19 An image data reducing ratio detecting method of detecting a reducing ratio of a digital image data in which said reducing ratio of an image is unknown, said method comprises steps of:

(a) sectioning said digital image data, in which said reducing ratio of an image is unknown, by predetermined horizontal or perpendicular block sizes;

(b) frequency-converting sectioned blocks into a two-dimension;

(c) adding frequencies of said blocks every the same frequency over an entire block and obtaining a sum of said frequencies every the same frequency;

(d) obtaining a set of frequencies at which energy is collecting using a result of said sum; and

(e) calculating a reducing ratio of an image based on said set of frequencies at which energy is collecting.

20 An image data reducing ratio detecting method

according to claim 19, further comprising a step of (f) restoring an image data to said calculated reducing ratio of an image.

21 An image data reducing ratio detecting method according to claim 20, wherein said method has a step of applying said steps (a) to (f) to said image data again, which is restored to said calculated reducing ratio of an image.

22 An image data reducing ratio detecting method according to claim 19, wherein, in said step (b), frequency-conversion is DCT conversion.