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Data Processing Apparatus and Method
and Storage Medium

BACKGROUND OF THE INVENTION



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Field of the Invention

5 The present invention relates to a data processing apparatus and method of embedding or padding electronic water-mark information in moving image data and a storage medium storing the method.

Related Background Art

10 As techniques of embedding electronic water-mark information in moving image data, a method of embedding electronic water-mark information in movement vectors between frames, a method of embedding electronic water-mark information by combining two types of moving
15 images obtained by two cameras for photographing the same object at slightly different angles, and the like are known.

 The principle of moving image compression in a moving image compression scheme including an intraframe
20 encoding means and an interframe encoding means, e.g., MPEG moving image compression, will be described first. A method of embedding electronic water-mark information in movement vectors between a plurality of frames of moving image data will be described next.

25 In MPEG moving image compression, the redundancy in the time axis direction is reduced by calculating

the difference between a plurality of frames, and the obtained difference data is subjected to the DCT (Discrete Cosine Transform) and variable-length encoding processing to reduce the redundancy in the spatial direction, thereby realizing efficient encoding as a whole. Consider the redundancy in the time axis direction. Since the correlation between consecutive frames of a moving image is high, the redundancy can be reduced by calculating the difference between a target frame to be encoded and a frame temporally preceding or succeeding the target frame.

According to this compression scheme, one of the following pictures is assigned to each frame: an intra-coded picture (I-picture) obtained by the intra-encoding mode of encoding a frame based on only the image data in the frame to be encoded; a forward predictive-coded picture (P-picture) obtained by encoding the difference value between a target frame and a frame one frame ahead of the target frame; and a bidirectional predictive-coded picture (B-picture) obtained by the difference value between a target frame and a frame temporally preceding or succeeding the target frame or the difference value between interpolated frames generated from these two frames. Each frame is encoded in accordance with this assignment result, and three types of encoded data obtained in this manner are combined with each other in

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a predetermined sequence. The resultant data is then output.

In MPEG, it is recommended that 1 I-picture, 4 P-picture, and 10 B-picture constitute one unit (GOP) with the I-picture being assigned at the beginning of the 15 frames, and 2 B-pictures and 1 P-picture being repeatedly assigned afterward. By assigning I-pictures to a plurality of frames in a predetermined cycle, special reproduction such as reverse reproduction or partial reproduction in units of GOPs can be performed, and error propagation can be prevented.

Assume that a given target frame to be encoded is a new image that is not related to a temporally preceding frame. In this case, the difference value between the target frame and a succeeding frame may become smaller than that between the target frame and the preceding frame. For this reason, in MPEG, bidirectional predictive encoding is performed to realize more efficient compression.

In MPEG, so-called movement compensation is performed. In this operation, the differences between macroblocks at/near the same positions in a target frame and a temporally preceding or succeeding frame in units of a predetermined number of blocks (macroblocks) consisting of 4 luminance data blocks and 2 color difference data blocks, each block serving as a processing unit in the above DCT and consisting of 8

pixels $\times$ 8 pixels. By discriminating a macroblock exhibiting the minimum difference, a movement vector is detected, and the detected movement vector is output as part of encoded data.

5 A given macroblock is decoded as follows.

Macroblock data at the same position in a temporally preceding or succeeding frame is extracted by using this movement vector, and the macroblock encoded in the above manner is decoded on the basis of this extracted
10 data. In the above movement compensation, after a frame temporally preceding the target frame is temporarily encoded on the encoding side, a preceding frame that can be obtained by decoding the encoded frame is generated in advance on the decoding side.
15 Then, movement compensation is performed by using macroblocks in this preceding frame and the target frame. With this operation, the target frame can be properly encoded by referring to the actual reproduced image on the decoding side.

20 According to the scheme of embedding electronic water-mark information in movement vectors, 1 bit of water-mark information can be embedded by changing one movement vector. When, for example, the value of 1 bit is to be set to "1", this movement vector is moved to a
25 visually unrecognizable degree. When the above value is to be set to "0", the movement vector is not moved. This changing/unchanging processing is performed for

movement vectors equal in number to the bits of water-mark information, thereby embedding one piece of water-mark information.

When electronic water-mark information is to be embedded in image data by using this method, movement vectors must always exist. It is therefore difficult to embed electronic water-mark information in a frame having an image without any movement vector, i.e., a frame having an image without any movement of the object.

The method of embedding water-mark information by combining two types of moving image data obtained by two cameras for photographing the same object at slightly different angles will be described next.

According to this method, two cameras are installed to photograph one object at slightly different angles. Since the angle defined by the two cameras with the object serving as a vertex is very small, the difference between the images obtained by the two cameras cannot be identified by the human eye.

In the following description, the two cameras will be referred to as cameras A and B. Each of the moving images obtained by the cameras A and B is divided into frames. The respective frames are represented by $(a_1, a_2, \dots, a_n)$ and $(b_1, b_2, \dots, b_n)$. Frames are randomly selected from the respective moving images obtained by the cameras A and B and are combined with each other to

generate an original moving image. With this operation, for example, the original moving image can be generated in the form of (a1, a2, b3, a4, b5,..., bn).

5 Subsequently, several bits constituting water-mark information are sequentially embedded one by one in each frame. More specifically, when 1 bit to be embedded in 1 frame of the original moving image, i.e., "a1", is "1", the frame "a1" of the original moving
10 image is replaced with another frame "b1" of the moving image. When the value of this 1 bit is "0", the frame is not be replaced. By performing this processing for frames equal in number to the bits of the water-mark information, one piece of water-mark information can be
15 embedded in the moving image data.

When the water-mark information embedded by this processing is to be extracted and decoded, the respective images (a1, a2,..., an) and (b1, b2,..., bn) obtained by the two cameras A and B are required in
20 addition to the original moving image. Therefore, a large storage area is required. In addition, since moving images obtained by the two cameras for photographing the same object at slightly different angles are required, this method cannot be applied to
25 an existing moving image.

As described above, according to the method of embedding electronic water-mark information in movement

vectors, no electronic water-mark information can be embedded in a moving image constituted by a plurality of frames whose contents hardly change. The method of embedding electronic water-mark information by combining two types of moving images obtained by photographing the same object at different angles cannot be applied to a general moving image.

SUMMARY OF THE INVENTION

The present invention has been made to solve the above problems, and has as its object to provide a new electronic water-mark information padding scheme capable of padding electronic water-mark information in a moving image formed by a plurality of frames having little change and of padding electronic water-mark information in a general moving image obtained by photographing at a single angle.

In order to achieve the above object, according to a preferred embodiment of the present invention, there is provided an image processing apparatus using a scheme of selectively using intraframe encoding or interframe encoding as a moving image compression scheme, wherein electronic water-mark information is padded in only intraframe-encoded data.

It is another object of the present invention to provide a scheme of extracting electronic water-mark information padded by the new padding scheme.

In order to achieve the above object, according to a preferred embodiment of the present invention, there is provided an image processing apparatus using a scheme of selectively using intraframe encoding or
5 interframe encoding as a moving image compression scheme, wherein electronic water-mark information is extracted from only intraframe-encoded data.

The above and other objects, features, and advantages of the present invention will be apparent
10 from the following detailed description in conjunction with the accompanying drawings and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing an electronic
15 water-mark information padding apparatus according to the first embodiment of the present invention;

Fig. 2 is a block diagram showing an electronic water-mark information padding apparatus according to the second embodiment of the present invention;

20 Fig. 3 is a block diagram showing the electronic water-mark information padding apparatus according to the second embodiment;

Fig. 4 is a block diagram showing the electronic water-mark information padding apparatus according to
25 the second embodiment;

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Fig. 5 is a block diagram showing an apparatus applied to the third embodiment of the present invention; and

Fig. 6 is a block diagram showing an apparatus applied to the fourth embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The preferred embodiments of the present invention will be sequentially described below.

(First Embodiment)

The first embodiment of the present invention will be described below with reference to the accompanying drawings.

Fig. 1 is a block diagram showing an image processing apparatus according to an embodiment of the present invention (an apparatus for embedding electronic water-mark information in compressed moving image information).

Referring to Fig. 1, this apparatus includes a difference circuit 1 for calculating the difference between image data of a present frame and image data a preceding frame having undergone movement compensation, a DCT circuit 2 for performing the discrete cosine transform for the difference value calculated by the difference circuit 1, a quantization coefficient encoding circuit 3 for reducing the data amount by

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quantizing the data with a variable quantization width,
an inverse quantization coefficient encoding circuit 4
for inversely quantizing the output from the
quantization coefficient encoding circuit 3, and an
5 inverse DCT circuit 5 for performing transform
processing inverse to that performed by the DCT circuit
2.

This apparatus also includes an adder 6 for adding
the image data of the preceding frame having undergone
10 movement compensation to the image data having
undergone inverse DCT, a frame memory 7 for storing
image data corresponding to the preceding frame, a
movement vector detecting circuit 8 for detecting
movement vector by comparing the image data of the
15 preceding frame with the image data of the present
image data, and a movement compensation circuit 9 for
performing movement compensation based on the image
data of the preceding frame and the movement vector.

This apparatus further includes a variable length
20 encoding circuit 10 for assigning quantized image data
to short bit codes in descending order of occurrence
frequency. Since the arrangement of this moving image
information encoding circuit is known, a detailed
description thereof will be omitted. The apparatus
25 further includes a switch (selection means) 11 for
selectively inputting only intraframe encoded data to
the padding circuit, a buffer 12 for storing the

intraframe encoded data in which electronic water-mark information is to be embedded, a padding circuit 13 for padding electronic water-mark information in the intraframe encoded data, and a writing buffer 14 for
5 changing the sequence of transmission data to attain a constant output bit rate.

According to the basic principle of compression of moving image information, only the predicted error between a target frame to be presently compressed and
10 sent and a frame that has been compressed and sent (preceding frame) is sent upon performing the DCT and quantization by so-called movement detection and movement compensation frame prediction instead of directly compressing and sending the image data in the
15 target frame itself. Note that the image data of some frames of a moving image (a plurality of frames) to be intraframe-encoded are subjected to the DCT and quantization without calculation of the predicted error between the target frame and the preceding frame. In
20 this embodiment, only image data corresponding to such frames are encoded by variable length encoding or the like, and the resultant data is input to the buffer 12 (the B side is selected) located before the padding circuit 13 through the switch 11, and the padding
25 circuit 13 pads electronic water-mark information in the data.

After the movement of the preceding frame is detected, the difference between the image data of each of other frames encoded on the basis of interframe differences and the preceding frame is calculated on the basis of this movement detection result, and the predicted error is subjected to the DCT and quantization. The image data quantized in this manner is encoded by variable length encoding or the like, and the resultant data is input to the writing buffer 14 through the switch 11 without the mediacy of the padding circuit 13 (the A side is selected).

With the above processing, electronic water-mark information is embedded in only the image data of some frames, of the image data of all the frames representing the moving image, which are intraframe-encoded. This reduces the load on the padding circuit 13. In addition, the processing speed of the padding circuit 13 need not be very high because it suffices if embedding of electronic water-mark information in intraframe-encoded data corresponding to a given frame in the padding circuit 13 is complete before intraframe encoded data corresponding to a frame to be intraframe-encoded several frames after the given frame is input. In this case, however, in consideration of the reproduction of the moving image, final output operation or a write of data in the memory must be complete before interframe encoded data

corresponding to several frames that are
interframe-encoded with reference to the intraframe
encoded data. For this reason, the writing buffer 14
is required to adjust the final output or write
5 sequence of the encoded data.

According to the electronic water-mark information
padding method described above, the switch 11 is used
to embed electronic water-mark information in only
intraframe-encoded image data after each frame is
10 intraframe-/interframe-encoded. However, the present
invention is not limited to this. If, for example, it
is known in advance that given image data is subjected
to intraframe encoding, electronic water-mark
information may be embedded in the image data before it
15 is input to the difference circuit 1, and the resultant
image data may be encoded afterward. In this case, the
function of the difference circuit 1 is preferably
inserted before the difference circuit 1. In addition,
the function of the switch 11 may be inserted
20 immediately after the DCT circuit 2. With this
arrangement, after only the DCT coefficients of
intraframe-encoded frame are processed by the padding
circuit, the resultant data is returned to the
quantization coefficient encoding circuit 3, thereby
25 embedding electronic water-mark information in the
image data in the same manner as described above.

Fig. 2 is a block diagram showing an image processing apparatus according to an embodiment of the present invention (an apparatus for extracting electronic water-mark information from compressed moving image information). Fig. 2 shows procedures for decoding moving image information in which electronic water-mark information is embedded by the arrangement shown in Fig. 1 and extracting the electronic water-mark information.

Referring to Fig. 2, this apparatus includes a switch (selection means) 21 for selectively inputting only intraframe-encoded data to an extraction circuit, a buffer 22 for storing intraframe-encoded data from which electronic water-mark information is to be extracted, an extraction circuit 23 for extracting the electronic water-mark information from the intraframe-encoded data, a buffer 24 for adjusting the sequence of compressed image data variable-length-encoded by the arrangement shown in Fig. 1, and a variable length decoding circuit 25 for decoding the compressed image data.

This apparatus also includes an inverse DCT circuit 26 for performing transform processing inverse to the DCT, an inverse quantization coefficient encoding circuit 27 for inversely quantizing the output from the inverse DCT circuit 26, an adder 28 for adding the image data of a preceding frame having undergone

movement compensation to the inversely quantized image data, a movement compensation circuit 29 for performing movement compensation on the basis of the image data of the preceding frame, and a frame memory 30 for storing
5 the image data corresponding to the preceding frame.

Assume that moving image information having electronic water-mark information embedded in only intraframe-encoded data by the arrangement in Fig. 1 is to be decoded. In this case, only when
10 intraframe-encoded data is input, the image data is input to the buffer 22 provided for the extraction circuit 23 through the switch 21 (the B side is selected), and electronic water-mark information is extracted. In contrast to this, when
15 interframe-encoded data is input, the image data is input to the buffer 24 through the switch 21 without the mediacy of the extraction circuit 23 (the A side is selected). With the above processing reverse to that on the electronic water-mark information embedding
20 side, since electronic water-mark information is extracted from only image data corresponding to some frames, of the image data of all the frames representing the moving image, which are intraframe-encoded, the load on the extraction circuit
25 23 can be reduced.

In addition, the processing speed of the extraction circuit 23 need not be very high because it

suffices if extraction of electronic water-mark information from one intraframe-encoded data in the extraction circuit 23 is complete before the next intraframe-encoded data is input as in the case of the embedding side. Similar to the embedding side, the buffer 24 is used to adjust the sequence of encoded data such that a given frame to be intraframe-encoded is output before a frame to be interframe-encoded with reference to this given frame.

As described above, according to the image processing apparatus of this embodiment, electronic water-mark information is embedded in only intraframe-encoded data unlike the scheme of embedding electronic water-mark information in movement vectors and the scheme of combining moving images from two cameras. This apparatus can therefore be applied to a moving image that moves little and produces no moving vector and an existing moving image that does not use two moving images. In addition, many storage areas need not be prepared to store two moving images.

(Second Embodiment)

Figs. 3 and 4 are block diagrams showing an image processing apparatus according to the second embodiment of the present invention. Fig. 3 is a block diagram showing an apparatus for encrypting data after electronic water-mark information is embedded in it. Fig. 4 is a block diagram showing an apparatus that

receives output data from the apparatus in Fig. 3,
decodes the data, and extracts electronic water-mark
information from the data. Since the same reference
numerals in Figs. 3 and 4 denote parts having the same
5 functions as those in Figs. 1 and 2, a detailed
description thereof will be omitted.

As shown in Fig. 3, in this embodiment, a buffer
31 and a coding circuit 32 are arranged on the
subsequent stage of a buffer 12 and a padding circuit
10 13, and the image data decoded by the coding circuit 32
is supplied to a writing buffer 14. That is, only
intraframe-encoded data in which electronic water-mark
information is embedded is input to the coding circuit
32 and encrypted, thereby allowing even a coding
15 circuit with a relatively low processing speed to keep
data private without jeopardizing security in practice.
This provides highly robust copyright protection.

As shown in Fig. 4, in this embodiment, a buffer
41 and a decoding circuit 42 are arranged on the front
20 stage of a buffer 22 and an extraction circuit 23, and
the intraframe-encoded data output from the switch 21
is supplied to the extraction circuit 23 through the
decoding circuit 42. That is, only intraframe-encoded
data is input to the decoding circuit 42 and decoded so
25 as to allow even a decoding circuit with a relatively
low processing speed to decode data.

As an encrypting scheme that can be applied to this embodiment, a secret key cryptosystem such as DES (data encryption standard) or FEAL (fast data encipherment algorithm) or a public key cryptosystem such as RSA (for further information about each encryption scheme, see Eiji Okamoto, "Introduction to Encryption Theory", Kyoritsu Shuppan K.K) is available.

The embodiment shown in Fig. 3 has exemplified the apparatus for encrypting data after electronic water-mark information is embedded in the data. However, the coding circuit 32 may be arranged before the electronic water-mark information padding circuit 13 to embed electronic water-mark information in encrypted moving image data. The embodiment shown in Fig. 4 has exemplified the apparatus for extracting electronic water-mark information from data after the data is decoded. However, data may be decoded after electronic water-mark information is extracted therefrom. It is easy to infer that the same effect as that described above can be obtained in this case as well.

In addition, the coding circuit 32 may be connected to the output stage of the writing buffer 14 in Fig. 3. In this case, a high-speed coding circuit is required because data other than intraframe-encoded must be encrypted. However, data can be kept private

without jeopardizing security in practice as in the case described above.

(Third Embodiment)

In the third embodiment shown in Fig. 5, the moving image compression circuit and electronic water-mark information padding circuit (and coding circuit) in the first and second embodiments are replaced with media processors, respectively. The same reference numerals in Fig. 5 denote the same blocks as those in Figs. 1 and 3.

Prior to a description of the arrangement of the apparatus of this embodiment, a media processor will be described. The media processor is a programmable digital signal processor having its internal structure optimized for image processing and signal processing. The operation speed of this processor is as high as 3 to 4 BOPS (billion operations per second), and is mainly used for home information devices for image processing, e.g., MPEG compression/decoding devices, DVD players, printers, and car navigation systems at present.

The design techniques used for the media processor are roughly classified into three types of techniques:

1) Parallel processing techniques that improve the processing performance in performing the same operation. Many of these techniques use an SIMD (single instruction stream-multiple data stream)

architecture to allow many arithmetic units to simultaneously operate. The same operation is executed by using a plurality of arithmetic units to improve the performance.

5 2) Parallel processing techniques that improve the processing performance in performing a plurality of different operations. Many of these techniques use a VLIW (very long instruction word) architecture to increase the number of instructions that can be
10 simultaneously executed, thereby improving the performance.

 3) Specifying techniques that improve the efficiency of specific operation. Some of these techniques incorporate special instructions or special
15 arithmetic units and special circuits.

 In image processing for electronic water-mark information and the like, arithmetic operation and frequency conversion such as the DCT transform are performed each pixel data, and hence the processing
20 amount is very large. In addition, concurrent arithmetic operations must be repeatedly executed. As a processor for performing such image processing, an SIMD type media processor designed to concurrently execute the same instruction for each data is
25 especially effective.

 Although the SIMD type media processor is especially effective in this case, this does not deny

the effectiveness of other two types of media processors, and the same effect can be expected with the other types of media processors. The use of a media processor for encryption and decryption processing is effective as in the case of image processing because the contents of the processing are mainly associated with the same operation and inversion for each bit.

The arrangement shown in the block diagram of Fig. 5 will be described next. Referring to Fig. 5, a media processor 51 inserted on the input stage of a switch 11 compresses moving image data. A media processor 52 inserted on the subsequent stage of a buffer 12 serving as the output stage of the switch 11 performs electronic water-mark information embedding (and encryption processing). The media processor for performing moving image compression processing is currently available (for further information about this processor, see NIKKEI ELECTRONICS No. 694, 1997. 7. 14, pp. 83 - 102).

As described above, the media processor is programmable, and hence can easily cope with changes in moving image compression scheme, encryption, electronic water-mark information embedding method, and the like. In addition, the high-speed processing performance of this media leads to an increase in the overall processing speed of the apparatus. Furthermore, if the

processing speed is sufficiently high, the buffer 12 on the input stage of the media processor 52 in Fig. 5 can be omitted. Moreover, since the components for moving image compression processing in the second embodiment are integrated into one circuit (media processor 51), and the components for electronic water-mark information embedding and encryption processing are integrated into one circuit (media processor 52), the apparatus can be simplified and reduced in cost.

10 (Fourth Embodiment)

In the fourth embodiment shown in Fig. 6, a media processor is used in place of both the moving image compression circuit and the electronic water-mark padding circuit (and the coding circuit) in the first and second embodiments. The same reference numerals in Fig. 6 denote the same blocks as in Figs. 1 and 3.

Referring to Fig. 6, the processing performed by the media processors 51 and 52 in Fig. 5 is performed by one media processor 62. A buffer 12 also serves as a delay circuit for correcting any time offset. A switch 61 selects the image data input to the A side or the image data input from the buffer 12 to the B side, and supplies it to the media processor 62. More specifically, the switch 61 selects the A side when moving image compression is to be performed by the media processor 62, and selects the B side when electronic water-mark information embedding (and

encryption) is to be performed with respect to
intraframe-encoded image data.

If an arrangement for moving image compression
processing, electronic water-mark information embedding
5 processing, and encryption processing is integrated
into one circuit (media processor 62) as in this
embodiment, further reductions in the size and cost of
the apparatus can be attained. In addition, if a
plurality of media processors are connected in parallel
10 and controlled integrally, a further increase in
operation speed can be attained.

Although the third and fourth embodiments have
exemplified only the arrangements for performing moving
image compression processing, electronic water-mark
15 information embedding processing, and encryption
processing, at least one or all of moving image
decoding processing, electronic water-mark information
extraction processing, and decryption processing can be
performed by a media processor.

20 (Other Embodiments)

An electronic water-mark padding circuit that can
be applied to the present invention will be described
below. A typical example of this circuit is a circuit
for performing frequency conversion of an input image
25 by the fast Fourier transform, discrete cosine
transform, wavelet transform, or the like, adding
water-mark information to the information in the

frequency domain, and embedding the information by
inverse frequency conversion.

For example, in the method based on the fast
Fourier transform, PN sequence information is added to
5 an input image, the image is divided into blocks, the
Fourier transform is performed in units of blocks, and
1-bit water-mark information is embedded in one block.
The block in which the water-mark information is
embedded is subjected to the inverse Fourier transform,
10 and PN sequence information identical to the first PN
sequence information is added to the resultant data,
thereby obtaining a synthetic image. This method is
described in Onishi, Oka, & Matsui, "Water-mark
Signature Method for Image with PN Sequences",
15 Proceedings of 1997 Encryption and Information Security
Symposium, SCIS97-26B.

In the method based on the discrete cosine
transform, after PN sequence information is added to an
input image, the image is divided into blocks, and the
20 discrete cosine transform is executed in units of
blocks. After 1-bit information is embedded in one
block, the resultant data is inversely transformed, and
PN sequence information is added again to the data,
thereby generating a synthetic image. This method is
25 described in Cox, Kilian, Leighton, & Shamoon, "A
Secure, Robust Watermark for Multimedia", Information
Hiding, pp. 185 - 206, 1996.

According to the method based on the wavelet transform, an input image need not be divided into blocks. This method is described in Ishizuka, Sakai, & Sakurai, "Experimental Study on Security and

5 Reliability of Electronic Watermarking Technique Using Wavelet Transform", Proceedings of 1997 Encryption and Information Security Symposium, SCIS97-26D. In addition, a method of embedding electronic water-mark information in data by arithmetic processing for the

10 hue, brightness, or the like of pixels (U.S. Patent No. 5,636,292 to Digimarc, and the like).

Actual implementation means of the present invention will be described next. As described in each embodiment, according to the present invention, the

15 apparatus for electronic water-mark information embedding (and encryption) and the apparatus for electronic water-mark information extraction (and decoding) may be independently formed or may be integrated into one apparatus. That is, the present

20 invention may be applied to either a system constituted by a plurality of devices (e.g., a host computer, an interface device, a reader, a printer, and the like), or an apparatus consisting of a single device (e.g., a DVD player or car navigation system).

25 The objects of the present invention are also achieved by supplying a program code of software that can realize the functions of the above embodiments to

the computer (CPU or MPU) in the system or apparatus, and making the computer in the system or apparatus connected to the respective devices operate the devices in accordance with the program code.

5 In this case, since the program code itself realizes the functions of the above embodiments, the program code itself and a means for supplying the program code to the computer, and more specifically, a storage medium storing the program code constitute the
10 present invention. As the storage medium for supplying the program code, for example, a floppy disk, hard disk, optical disk, magneto-optical disk, CD-ROM, CD-R, magnetic tape, nonvolatile memory card, ROM, and the like may be used.

15 This program code constitutes the present invention not only in a case in which the functions of the above embodiments are realized by making the computer control the respective devices in accordance with only the supplied program code but also in a case
20 in which the functions are realized by the program code in cooperation with an OS (operating system) running on the computer, another application software, or the like.

 Furthermore, the present invention includes a case
25 in which this supplied program code is stored in a memory in a function extension board of the computer or a function extension unit connected to the computer,

and some or all of actual processing operations are executed by a CPU or the like arranged in the function extension board or function extension unit on the basis of the instructions of the program code, thereby
5 realizing the functions of the above embodiments.

According to the present invention, as described above, in the image processing apparatus for compressing the frames representing a moving image by selectively using intraframe encoding and interframe
10 encoding, electronic water-mark information is embedded in only image data (encoded data) representing a frame to be intraframe-encoded. This apparatus can therefore be applied to a moving image exhibiting a small difference between frames or an existing moving image
15 to embed electronic water-mark information in image data. Since image data (encoded data) representing frames to be intraframe-encoded are discretely present in a plurality of frames representing a moving image, the speed at which electronic water-mark information is
20 embedded in these frames while they are encoded need not be very high. This apparatus can therefore be provided at a low cost.

The present invention can be variously modified within the scope of the following claims.

WHAT IS CLAIMED IS:

1. An image processing apparatus using a scheme of selectively using intraframe encoding or interframe encoding as a moving image compression scheme,
5 wherein electronic water-mark information is padded in only intraframe-encoded data.

2. An image processing apparatus using a scheme of selectively using intraframe encoding or interframe
10 encoding as a moving image compression scheme,
wherein electronic water-mark information is padded in only intraframe-encoded data,
wherein said apparatus comprises at least one of storage means for changing a data sequence of the
15 intraframe-encoded data and interframe-encoded data and storage means for temporarily storing only the intraframe-encoded data.

3. An image processing apparatus using a scheme
20 of selectively using intraframe encoding or interframe encoding as a moving image compression scheme,
wherein electronic water-mark information is padded in only intraframe-encoded data, and
wherein after or before the electronic water-mark
25 information is padded, only the intraframe-encoded data is encrypted.

4. An apparatus according to claim 2 or 3,
wherein said apparatus comprises selection means for
selectively inputting only the intraframe-encoded data
to a padding circuit to pad the electronic water-mark
5 information.

5. An apparatus according to claim 3, wherein a
media processor is used for at least one of the moving
image compression, the electronic water-mark
10 information padding processing, and the encryption
processing.

6. An apparatus according to claim 3, wherein all
the moving image compression, the electronic water-mark
15 information padding processing, and the encryption
processing are executed by one media processor.

7. An image processing apparatus using a scheme
of selectively using intraframe encoding or interframe
20 encoding as a moving image compression scheme,
wherein electronic water-mark information is
extracted from only intraframe-encoded data.

8. An image processing apparatus using a scheme
25 of selectively using intraframe encoding or interframe
encoding as a moving image compression scheme,

wherein electronic water-mark information is
extracted from only intraframe-encoded data,

wherein said apparatus comprises at least one of
storage means for changing a data sequence of the
5 intraframe-encoded data and interframe-encoded data and
storage means for temporarily storing only the
intraframe-encoded data.

9. An image processing apparatus using a scheme
10 of selectively using intraframe encoding or interframe
encoding as a moving image compression scheme,

wherein electronic water-mark information is
extracted from only intraframe-encoded data, and

wherein after or before the electronic water-mark
15 information is extracted, only the intraframe-encoded
data is decrypted.

10. An apparatus according to claim 8 or 9,
wherein said apparatus comprises selection means for
20 selectively inputting only the intraframe-encoded data
to a padding circuit to pad the electronic water-mark
information.

11. An apparatus according to claim 9, wherein a
25 media processor is used for at least one of the moving
image decoding, the electronic water-mark information
extraction processing, and the decryption processing.

12. An apparatus according to claim 9, wherein
all the moving image decoding, the electronic
water-mark information extraction processing, and the
decryption processing are executed by one media
5 processor.

13. An image processing method selectively using
intraframe encoding or interframe encoding as a moving
image compression scheme, comprising a step of
10 padding electronic water-mark information in only
intraframe-encoded data.

14. A method according to claim 13, further
comprising a step of changing a data sequence of the
15 intraframe-encoded data and interframe-encoded data and
temporarily storing only the intraframe-encoded data.

15. A method according to claim 13, further
comprising a step of encrypting only the
20 intraframe-encoded data after or before padding the
electronic water-mark information.

16. An image processing method selectively using
intraframe encoding or interframe encoding as a moving
25 image compression scheme, comprising a step of
extracting electronic water-mark information from
only intraframe-encoded data.

17. A method according to claim 16, further comprising a step of changing a data sequence of the intraframe-encoded data and interframe-encoded data and temporarily storing only the intraframe-encoded data.

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18. A method according to claim 16, further comprising a step of extracting the electronic water-mark information after only the intraframe-encoded data is decrypted.

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19. A computer-readable recording medium which records a program for causing a computer to be functioned as selection means for selectively extracting only intraframe-encoded data, and padding means for padding electronic water-mark information in only the intraframe-encoded data extracted by said selection means in an image processing apparatus using a scheme of selectively using intraframe encoding or interframe encoding as a moving image compression scheme.

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20. A medium according to claim 19, wherein said medium further records a program for causing said computer to be functioned as storage means for changing a data sequence of the intraframe-encoded data and interframe-encoded data and temporarily storing only the intraframe-encoded data.

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21. A medium according to claim 19, wherein said medium further records a program for causing said computer to be functioned as encrypting means for encrypting only the intraframe-encoded data before or after the electronic water-mark information is padded.

22. A computer-readable recording medium recording a program for causing a computer to be functioned as selection means for selectively extracting only intraframe-encoded data, and extraction means for extracting electronic water-mark information from only the intraframe-encoded data extracted by said selection means in an image processing apparatus using a scheme of selectively using intraframe encoding or interframe encoding as a moving image compression scheme.

23. A medium according to claim 22, wherein said medium further records a program for causing said computer to be functioned as storage means for changing a data sequence of the intraframe-encoded data and interframe-encoded data and temporarily storing only the intraframe-encoded data.

24. A medium according to claim 22, wherein said medium further records a program for causing said computer to implement decrypting means for decrypting

only the intraframe-encoded data before or after the electronic water-mark information is extracted.