Literature 1 and Non-patent Literature 2).

[0004] The data compression processes in the H.264/AVC Standard is roughly divided into prediction, transform, quantization, and entropy coding. The entropy coding is intended to reduce redundant information in information to be used for the prediction and quantized information. Representatives of entropy coding include variable-length coding, adaptive coding, and fixed-length coding. Representatives of variable-length coding include Huffman coding, run-length coding, and arithmetic coding. Among these, the arithmetic coding is known as a scheme which is intended to determine output codes using contexts for identifying symbol occurrence probabilities and which provides a high coding efficiency by switching contexts according to the features of image data, compared to Huffman coding which uses a fixed coding table.

[Citation List]

[Non Patent Literature]

[0005]

[NPL 1]

"MPEG-4 Part 10 Advanced Video Coding", ISO/IEC 14496 - 10,

[NPL 2]

"Overview of the H. 264/AVC Video Coding Standard", Thomas Wiegand et al, IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, JULY 2003, PP. 560-576

[Summary of Invention]

[Technical Problem]

[0006] However, the conventional arithmetic coding has a problem of not providing a sufficient coding efficiency.

[0007] Embodiments of t~~T~~he present invention ~~has been made to solve the aforementioned problem, with an aim to~~ provide an image coding method, an image coding apparatus, an image decoding method, an image decoding apparatus, and an image coding and decoding apparatus which make it possible to increase coding efficiency.

[Solution to Problem]

[0007a] According to a first aspect, there is provided an image decoding method of reconstructing a coded image including a plurality of processing units having mutually different sizes by decoding the coded image, said image decoding method comprising: obtaining current signals to be decoded of each of the processing units of the coded image; selecting a context of each of the current signals to be decoded from among a plurality of contexts; generating a binary signal by performing arithmetic decoding of the current signal to be decoded by using decoded probability information associated with the context selected in said selecting; reconstructing the coded image by performing multi-value conversion on the binary signal; and updating the decoded probability information associated with the context selected in said selecting, based on the binary signal, wherein a first shared context is set in advance, wherein, in said selecting, the first shared context is selected as the context for the current signal to be decoded in the case where a size of the processing unit which includes the current signal to be decoded is a block size of 16 x 16, and in the case where the size of the processing unit which includes the current signal to be decoded is a block size of 32 x 32, and wherein, in said selecting, a dedicated context is selected as the context for the current signal to be decoded in the case where the size of the processing unit which includes the current signal to be decoded is smaller than the block size of 16 x 16.

[0007b] According to a second aspect, there is provided an image decoding apparatus which reconstructs a coded image including a plurality of processing units having mutually different sizes by decoding the coded image, said image decoding apparatus comprising: a storage unit configured to store a plurality of contexts; a context selection control unit configured to select, from among a plurality of contexts, a context for each of current signals to be decoded included in the plurality of processing units of the coded image; a context control unit configured to execute a decoded probability information identification process for identifying decoded probability information associated with the context selected by said context selection control unit; an arithmetic decoding unit configured to obtain the current signals to be decoded and perform arithmetic decoding of the current signals to be decoded by said context control

unit by using the decoded probability information; and a multi-value conversion unit configured to reconstruct the image data by performing multi-value conversion on the binary signal, wherein said context control unit is configured to execute an update process for updating the decoded probability information identified by said context control unit based on the binary signal, wherein a shared context is set in advance, wherein said context selection control unit is configured to select the shared context as the context for the current signal to be decoded in the case where a size of the processing unit which includes the current signal to be decoded is a block size of 16 x 16, and in the case where the size of the processing unit which includes the current signal to be decoded is a block size of 32 x 32, and wherein said context selection control unit is configured to select a dedicated context as the context for the current signal to be decoded in the case where the size of the processing unit which includes the current signal to be decoded is smaller than the block size of 16 x 16.

[0008] Disclosed herein is~~In order to achieve the aforementioned problem,~~ an image coding method of~~according to the present invention is for~~ compression-coding image data including a plurality of processing units having mutually different sizes, the image coding method comprising: obtaining current signals to be coded of each of the processing units of the image data (S401); generating a binary signal by performing binarization on each of the current signals to be coded (S402); selecting a context for each of the current signals to be coded from among a plurality of contexts (S403); performing arithmetic coding of the binary signal by using coded probability information associated with the context selected in the selecting (S404); and updating the coded probability information associated with the context selected in the selecting, based on the binary signal generated in the generating (S405), wherein, in the selecting, the context for the current signal to be coded is selected for a signal which is included in one of a plurality of processing units and has a size different from a size of the processing unit including the current signal to be coded.

[0009] For example, it is possible to apply the same context for the signals to be coded having the same statistical properties. For this reason, the image coding method according to an embodiment of the present invention is intended to select the shared context for the signals having the same statistical properties even when the processing unit sizes are different. In this way, it is possible to reduce the number of contexts to be used. This reduction in the number of the contexts makes it possible to reduce the size of memory for storing the contexts. Here, it is unnecessary that the image coding method according to an embodiment of the present invention is configured to use all of the contexts for different processing units. In other words, the image coding method according to an embodiment of the present invention may be configured to partly use the contexts exclusively for a particular processing unit.

[0010] Conventionally, the number of contexts is large because a different context is set based on a processing unit size and on a coefficient position or a surrounding condition. In the case where a large number of contexts is used, there is a possibility that the

numbers of updates of coded probability information for some of the contexts are small and the accuracies of the coded probability information are not assured. In contrast, as described above, the image coding method according to an embodiment of the present invention makes it possible to reduce the number of contexts, to increase the numbers of updates for the contexts to be selected and shared, and to increase the prediction accuracy of the coded probability information. This increase in the accuracy of the coded probability information makes it possible to increase the coding efficiency.

[0011] According to an embodiment of the image coding method of the present invention, the context which is set as a shared context in advance may be selected in the case where the size of the processing unit including the current signal to be coded obtained in the obtaining is larger than a predetermined size.

[0012] Here, generally, a context is selected according to a surrounding condition. When the processing unit size is comparatively large, the statistical properties become approximately the same, and thus, the same shared context can be used. An ~~aspect~~embodiment of the image coding method of~~according to~~ the present invention makes it possible to reduce the number of contexts by using a shared context in the case where the processing unit size is larger than the predetermined size. In this way, it is possible to increase the prediction accuracy of the coded probability information and to thereby increase the coding efficiency in the case where the processing unit size is larger than the predetermined size.

[0013] The image coding method of an embodiment of the present invention may further comprise performing frequency transform on the image data to generate transform coefficients of frequency components and to generate the current signals to be coded which respectively indicate the transform coefficients of the frequency components, wherein in the selecting, the context which is set as a dedicated context for a processing unit which is included in the processing units may be selected in the case where the frequency component corresponding to the current signal to be coded is lower than a predetermined frequency. The image coding method of an embodiment of the present invention may

further comprise performing frequency transform on the image data to generate transform coefficients of frequency components and to generate the current signals to be coded which respectively indicate the transform coefficients of the frequency components, wherein in the selecting, the context which is set for a processing unit which is included in the processing units may be selected in the case where the frequency component corresponding to the current signal to be coded is lower than a predetermined frequency.

[0014] In this way, it is possible to select a context adapted to the features of the image data.

[0015] The image coding method according to an embodiment of the present invention may further comprise segmenting the image data into a plurality of sub blocks each having the same sub processing unit size, wherein in the generating, the binary signal may be generated by performing binarization on the current signals to be coded of each of the sub blocks, and in the selecting, the context which may be set for the sub processing unit size in advance is selected. It is possible to apply the same context by setting the context based on the sub block size, irrespective of whether the block size is large or small.

[0016] Disclosed herein is ~~In order to achieve the aforementioned problem,~~ an image decoding method of ~~according to the present invention is for~~ reconstructing coded image data including a plurality of processing units having mutually different sizes by decoding the coded image data, the image decoding method comprising: obtaining current signals to be decoded of each of the processing units of the coded image data (S501); selecting a context of each of the current signals to be decoded from among a plurality of contexts (S502); generating a binary signal by performing arithmetic decoding of the current signal to be decoded by using decoded probability information associated with the context selected in the selecting (S503); reconstructing the coded image data by performing multi-value conversion on the binary signal (S504); and updating the decoded probability information associated with the context selected in the selecting, based on the binary signal (S505), wherein, in the selecting, the context for the current signal to be decoded is selected,

as a shared context, for a signal which is included in a plurality of processing units and has a size different from a size of the processing unit including the current image data to be decoded.

[0017] In this way, it is possible to appropriately decode the coded image data coded using the image coding method according to an embodiment of the present invention. As in the image coding method according to an embodiment of the present invention, it is possible to reduce the number of contexts. Furthermore, it is possible to increase the numbers of updates for the contexts, and to thereby increase the prediction accuracy of decoded probability information.

[0018] According to an embodiment of the image decoding method of the present invention, in the selecting, the context which is set as a shared context in advance may be selected in the case where the processing unit size including the current signals to be coded obtained in the obtaining is larger than a predetermined size.

[0019] In this way, it is possible to reduce the number of contexts because the shared context is used when the processing unit size is larger than the predetermined size. In this way, it is possible to increase the prediction accuracy of the coded probability information and to thereby increase the coding efficiency in the case where the processing unit size is larger than the predetermined size.

[0020] According to an embodiment of the image decoding method of the present invention, in the selecting, the context which is set as a dedicated context in advance for a processing unit included in the processing units may be selected when the frequency component corresponding to the current signal to be decoded is lower than a predetermined frequency in the case where the current signal to be decoded is a signal indicating one of transform coefficients of frequency components generated through frequency transform in the generation of the coded image data. According to an embodiment of the image decoding method of the present invention, in the selecting, the context which is set as a shared context in advance for processing units which are included in the processing units and have high frequencies which are higher than the predetermined frequency may be selected when the frequency component corresponding to the

current signal to be decoded is higher than the predetermined frequency in the case where the current signal to be decoded is a signal indicating one of transform coefficients of frequency components generated through frequency transform in the generation of the coded image data.

[0021] In this way, it is possible to select a context adapted to the features of the image data.

[0022] According to an embodiment of the image decoding method of the present invention, in the case where the coded image data is coded image data generated by segmenting the image data into a plurality of sub blocks each having the same sub processing unit size, and performing binarization and arithmetic coding of each of the sub blocks, in the selecting, the context which is set as a context for each of the sub blocks having the sub processing unit size may be selected.

[0023] It is possible to apply the same context by setting the context based on the sub block size, irrespective of whether the block size is large or small.

[0024] It is to be noted that an embodiment of the present invention can be realized or implemented not only as image coding methods, but also as image coding apparatuses which include processing units for performing the processing steps included in the image coding methods. Likewise, an embodiment of the present invention can be realized or implemented not only as image decoding methods, but also as image decoding apparatuses which include processing units for performing the processing steps included in the image decoding methods. Furthermore, an embodiment of the present invention can be realized or implemented as image coding and decoding apparatuses which include processing units for performing the processing steps included in both the image coding methods and the image decoding methods.

[0025] Furthermore, these steps may be realized as a program for causing a computer to execute these steps. Furthermore, an embodiment of the present invention may be implemented as recording media such as computer-readable Compact Disc-Read Only Memories (CD-ROMs) including the programs recorded thereon, and information, data,

and/or signals representing the programs. Naturally, the program, information, data, and signals may be distributed through communication networks such as the Internet.

[0026] Some or all of the structural elements which make up any one of the image coding apparatuses and the image decoding apparatuses may be configured in the form of a single system Large Scale Integration (LSI). Such a system LSI is a super multifunctional LSI manufactured by integrating plural structural element units on a single chip. For example, the system LSI is a computer system configured to include a macro processor, a ROM, a Random Access Memory (RAM), and the like.

[Advantageous Effects of Invention]

[0027]

Embodiments of t~~T~~he present invention make~~s~~ it possible to perform predictions of symbol occurrence probabilities with high accuracy, and to thereby increase the image coding efficiency.

[Brief Description of Drawings]

[0028]

FIG. 1 is a block diagram showing a structure of an arithmetic coding apparatus according to conventional art.

FIG. 2 is a flowchart indicating an arithmetic coding method according to conventional art.

FIG. 3 is a block diagram showing an example of a structure of an arithmetic coding unit of an image coding apparatus according to the present invention.

FIG. 4 is a diagram showing an example of a signal information table for use in an image coding method and an/the image coding apparatus according to the present invention.

FIG. 5A is a block diagram showing an example of a context table for use in an/the image coding method and an/the image coding apparatus according to the present invention.

FIG. 5B is a block diagram showing an example of a context table for use in an/the image coding method and an/the image coding