【Disclosure】

【Technical Problem】

The present invention is directed to an apparatus for encoding a moving picture, and more particularly, to an apparatus for effectively encoding transformed residual signals of a moving picture having a predetermined size or more.

【Technical Solution】

One aspect of the present invention provides an apparatus for encoding a moving picture, including: a coding mode determiner configured to divide an input image into a plurality of coding units each of which size is predetermined and determine a prediction mode of eachthe coding unit ~~and a size of a predictive coding block of the coding unit~~; a transform/quantization unit configured to transform and quantize a residual block ~~between the predictive coding block and a prediction block~~ generated according to the prediction mode to generate a quantized block ~~through intra prediction or inter prediction~~; an inverse quantization/transform unit configured to inversely quantize and inversely transform the quantized ~~transform~~ block into a frequency domain; a deblocking filter configured to performapply a de-blocking filtering process to image data received from the inverse quantization/transform ~~decoding~~ unit; ~~a prediction block generator configured to generate the predictive coding block;~~ and an entropy coder configured to encode ~~the quantized transform~~ coefficients of the quantized block ~~from the transform coding/quantization unit~~, wherein, when a size of a transform block is equal to 8x8 in intra prediction ~~or larger than a predetermined size~~, the entropy coder divides the ~~quantized transform~~ coefficients of the quantized block into a plurality of subsets, and scans ~~and entropy codes~~ non-zero ~~quantized transform~~ coefficients of the each subset according to a scan pattern determined by an intra prediction mode to entropy-code the scanned non-zero coefficients.

Preferably, the entropy coder scans the non-zero coefficients of each subset in a reverse direction using one of a plurality of scan patterns.

Preferably, the scan pattern for scanning the non-zero coefficients of each subset is equal to a scan pattern for scanning the plurality of subsets.

Preferably, the entropy coder encodes positions of the non-zero coefficients and information for identifying the non-zero coefficients of each subset.

【Advantageous Effects】

the size of the predictive coding block should be included in the bit stream of coding unit. The prediction mode varies according to a type of the slice.

When the type of the slice is intra (I), all predictive coding blocks in the slice are intra predicted, and a prediction type of a predictive coding block can be determined according to a size of the predictive coding block. However, when the slice type is unidirectional prediction (P) or bidirectional prediction (B), a prediction type of a predictive coding block may be determined according to prediction mode information and a size of the predictive coding block. Thus, it is preferable to generate the prediction type of the predictive coding block on the basis of the slice type, the prediction mode information and the information indicating the size of the predictive coding block, and insert the generated prediction type in a header of the coding unit.

When the predictive coding block is intra-coded, intra prediction mode information used for intra prediction as well as the prediction type needs to be transmitted to a decoder.

When the predictive coding block is inter predictive -coded, the predictive coding block is encoded by any one of unidirectional prediction and bidirectional prediction. In the case of unidirectional prediction, a bit stream should include information on a reference picture and motion vector information used for prediction as well as a prediction type of the predictive coding block for unidirectional prediction. In the case of bidirectional prediction, a header of the predictive coding block should include information on two reference pictures and motion vector information used for bidirectional prediction as well as a prediction type of the block for bidirectional prediction. The motion vector information may include information indicating a residual motion vector and a motion vector predictor.

Also, the transform/quantization unit 120 determines a quantization step size used for quantizing the transform coefficients, and quantizes the transform coefficients using a quantization matrix determined according to the determined quantization step size and a coding mode.

The inverse quantization/transform unit 160 inversely quantizes and inversely transforms the quantization coefficients quantized by the transform ~~coding~~/quantization unit 120, thereby restoring a residual block in the spatial domain from a residual block transformed into the frequency domain.

The de-blocking filter 170 receives image data that is inversely quantized and inversely transformed from the inverse quantization/transform unit 160 and performs a filtering process for removing a blocking effect. The de-blocking filtering process may be applied to a boundary between predictive coding blocks and between transform blocks. The boundary is an edge of a grid having a predetermined size or more and the predetermined size may be 8x8. The de-blocking filtering process includes a step of determining a boundary to be filtered, a step of determining a boundary filtering strength to be applied to the boundary, a step of determining whether or not to apply a de-blocking filter, and a step of selecting a filter to be applied to the boundary when it is determined to apply the de-blocking filter.

Whether or not to apply the de-blocking filter is determined according to i) whether or not the boundary filtering strength is greater than 0 and ii) whether or not a value indicating the difference between boundary pixels of P block and Q block is less than a first reference value determined according to a quantization parameter.

Two or more filters may exist. When an absolute value of a difference between two pixels adjacent to the block boundary is equal to or greater than a

First, the intra predictor 140 receives position and size information on a coding block to be encoded from the coding mode determiner 110.

Next, the intra predictor 140 receives valid reference pixels for determining an intra prediction mode of the current predictive coding block from the picture storage 180. The reference pixels have already been encoded and restored, and are adjacent to the current ~~predictive coding~~ block ~~(hereafter, referred to as current block)~~. When the current block is positioned at an upper boundary of the current picture, pixels adjacent to the upper side of the current block are not defined. When the current block is positioned at a left boundary of the current picture, pixels adjacent to the left side of the current block are not defined. Also, when the current block is positioned at the upper or left boundary of the slice, pixels adjacent to the upper or left side are not defined.

When there are no pixels adjacent to the left or upper side of the current block or there are no pixels that have been previously encoded and restored as mentioned above, an intra prediction mode of the current block can be determined using only available~~valid~~ pixels.

However, the invalid reference pixels may be generated using pixels adjacent to the current block or available pixel. For example, when pixels of an upper block are not available~~valid~~, pixels on the upper side may be generated using one or more available reference pixels on the left side.

Meanwhile, even when there are pixels on the upper or left side of the current block, the pixels may be determined as unavailable~~invalid~~ pixels according to a coding mode of a block to which the pixels belongs. For example, when a block to which pixels adjacent to the upper side of the current block belong has been inter predictive -coded and

restored, the pixels may be determined as unavailable~~invalid~~ pixels. In this case, reference pixels corresponding to positions of unavailable reference pixels may be generated using ~~reference~~ pixels of a block restored in intra prediction and adjacent to the current block ~~having intra mode~~.

Next, the intra predictor 140 determines the intra prediction mode of the current block using the reference pixels. The number of intra prediction modes depends on a size of the block.

According to the size of the block, 33, 16 or 2 directional modes and at least one non-directional mode are allowed. The non-directional mode may be a direct current (DC) mode or a planar mode.

Different numbers of valid intra prediction modes can be assigned to blocks having the same size. To indicate that different numbers of intra prediction modes are allowed, information indicating the number of intra prediction modes can be inserted in at least one of a sequence header, picture header, slice header and a coding unit header. It is preferable to insert the information in a sequence header or a picture header.

Next, when the intra prediction mode of the current block is determined, a prediction block of the current block is generated. The prediction block is generated using available reference pixels including generated pixel or using a linear combination of the reference pixels on the basis of the intra prediction mode of the current block. For example, in a directional mode of a specific direction, a prediction mode can be generated using available reference pixels on the upper side of the current block and those on the left side of the current block.

The available~~valid~~ reference pixels used to generate the prediction block may be filtered reference pixels. A filter to be applied to the available~~valid~~ reference pixels may be plural in number. Also, the plurality of filters may be adaptively applied according to a size of the current block and the intra prediction mode.

Next, the final intra prediction mode of the current block is encoded. Using different coding tables according to whether or not the upper block of the current block has the same intra prediction mode as the left block of the current block, the final intra prediction mode of the current block is encoded. The intra prediction mode of the upper block or the left block of the current block may be a modified intra prediction mode. In other words, the intra prediction mode of the upper block or the left block of the current block may be an intra prediction mode modified by a table for mapping intra prediction modes allowable for the upper block and the left block to a predetermined number of intra prediction modes. The predetermined number may be 9 or 3.

A quantized transform coefficient coding process of the entropy coder 130 of FIG. 3 will be described below.

The quantized transform coefficients are entropy-coded using context-adaptive variable length coding (CAVLC) or context-adaptive binary arithmetic coding (CABAC). When a size of transform block becomes large, there is a high possibility that a large number of bits will be required to scan and entropy-code coefficients other than 0. Thus, it is preferable to introduce new scan method for reducing the number of bits for a transform block having a size equal to or larger than a predetermined size.

First, it is determined whether or not to divide quantized transform coefficients into a plurality of subsets. It depends on a size of transform coding block. In other words, when the size of a transform coding block is equal to or larger than a predetermined size, the quantized transform coefficients are divided into a plurality of subsets. The predetermined size may be 8×8 or 16×16. The plurality of subsets consist of one main subset and one or more residual subsets. The main subset is

positioned at an upper left side including a DC coefficient, and the one or more residual subsets cover area other than area that the main subset covers.

Next, when the size of the transform coding block is equal to or larger than the predetermined size, the quantized transform coefficients are divided into a main subset and one or more residual subsets, and quantized transform coefficients included in each subset are scanned and encoded. The quantized transform coefficients in the subset may be scanned using one of a plurality of scan patterns. A scan pattern in which the number of bits to be encoded becomes the minimum may be selected according to distribution of non-zero pixels of the quantized transform coefficients in the subset. The plurality of scan patterns may include zigzag scan, vertical scan and horizontal scan. Also, vertical scan or horizontal scan of Motion Picture Experts Group (MPEG)-4 may be included. When a scan pattern is transmitted for each subset, a large number of bits are required. Therefore one scan pattern may be applied to a plurality of subsets.

Meanwhile, the scan pattern may be adaptively selected according to the prediction mode and the intra prediction direction. For example, in the inter prediction mode, it is possible to apply only one predetermined scan pattern (e.g., zigzag scan) or one of the plurality of scan patterns. In the former case, scan pattern information does not need to be transmitted to the decoder, but in the latter case, scan pattern information needs to be transmitted to the decoder. In the intra prediction mode, a scan pattern can be selected according to the intra-prediction direction. For example, it is possible to apply horizontal scan in a vertical intra prediction mode, vertical scan in a horizontal intra prediction mode, and zigzag scan in a DC mode.

A scan pattern to be applied to the main subset and the one or more residual subsets may be a predetermined pattern. The predetermined pattern may be zigzag

scan. In addition to zigzag scan, horizontal scan or vertical scan may be applied to the subsets. The scan pattern applied to the subsets may also be adaptively determined according to the prediction mode and the intra prediction direction. In other words, in the inter prediction mode, a predetermined scan pattern may be applied to the subsets. In the intra prediction, a scan pattern selected by the intra prediction direction may be applied to the subsets.

It may be effective to scan the quantized transform coefficients in the subset in a reverse direction. In other words, the quantized transform coefficients can be scanned from the last non-zero coefficient of the subset in a reverse direction according to a scan pattern. Likewise, the plurality of subsets are scanned from a subset including the last non-zero coefficient of the transform coding block to a main subset in a reverse direction

Meanwhile, for correct entropy decoding of the decoder, an encoder encodes information capable of indicating a position of the last non-zero coefficient in the transform coding block and information capable of indicating a position of the last non-zero coefficient in each subset, and transmits the encoded information to the decoder. The information may indicate a position of the last non-zero coefficient in each subset. Also, the information may be map information consisting of flags indicating whether each transform coefficients is 0 or not and flags indicating whether the non-zero coefficient is the last non-zero coefficient or not in the transform coding block. A scan pattern for generating the map information may be the same as the scan pattern in the subsets.

In another example for scanning quantized transform coefficients of the transform coding block, the quantized transform coefficients of a transform coding block may be

[CLAIMS]

【Claim 1】

An apparatus for encoding a moving picture, comprising:

a coding mode determiner configured to divide an input image into coding units and determine a prediction mode of the coding unit and a size of a predictive coding block of the coding unit;

an intra predictor configured to generate a prediction block using intra prediction;

a transform/quantization unit configured to transform and quantize a transform block of residual signals obtained using the predictive coding block and a prediction block; and

an entropy coder configured to entropy-code the quantized transform block,

wherein, if the size of the quantized transform block is equal to or larger than a predetermined size, the quantized transform block is divided into a plurality of subsets and quantized transform coefficients of each subset are scanned using a scan pattern and entropy-coded.

【Claim 2】

The apparatus of claim 1, wherein the quantized transform coefficients of each subset are scanned in a reverse direction.

【Claim 3】

The apparatus of claim 1, wherein the scan pattern for scanning the plurality of subsets is the same as the scan pattern for scanning the quantized transform coefficients of each subset.

【Claim 4】

The apparatus of claim 1, wherein a scan pattern for scanning the quantized transform coefficients is selected according to an intra prediction mode of the predictive coding block.

【Claim 5】

The apparatus of claim 1, wherein the entropy coder encodes a position of a last non-zero coefficient of the transform block.

【Claim 6】

The apparatus of claim 1, wherein the predetermined size is 8x8.

【CLAIMS】

【Claim 1】

An apparatus for encoding a moving picture, comprising:

a coding mode determiner configured to divide an input image into a plurality of coding units each of which size is predetermined and determine a prediction mode of each coding unit;

a transform/quantization unit configured to transform and quantize a residual block generated according to the prediction mode to generate a quantized block;

an inverse quantization/transform unit configured to inversely quantize and inversely transform the quantized block into a frequency domain;

a deblocking filter configured to perform a deblocking filtering process to image data received from the inverse quantization/transform unit; and

an entropy coder configured to entropy-code coefficients of the quantized block,

wherein, when a size of the quantized block is equal to 8x8 in intra prediction, the entropy coder divides the coefficients of the quantized block into a plurality of subsets, and scans non-zero coefficients of each subset according to a scan pattern determined by an intra prediction mode to entropy-code the scanned non-zero coefficients.

【Claim 2】

The apparatus of claim 1, wherein the entropy coder scans the non-zero coefficients of each subset in a reverse direction using one of a plurality of scan patterns.

【Claim 3】

The apparatus of claim 1, wherein the scan pattern for scanning the non-zero coefficients is equal to the scan pattern for scanning the plurality of subsets.

【Claim 4】

The apparatus of claim 1, wherein the entropy coder encodes positions of the non-zero coefficients and information for identifying the non-zero coefficients in each subset.