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(54) Title: METHOD AND APPARATUS FOR CONTEXT-ADAPTIVE BINARY ARITHMETIC CODING OF SYNTAX ELEMENTS

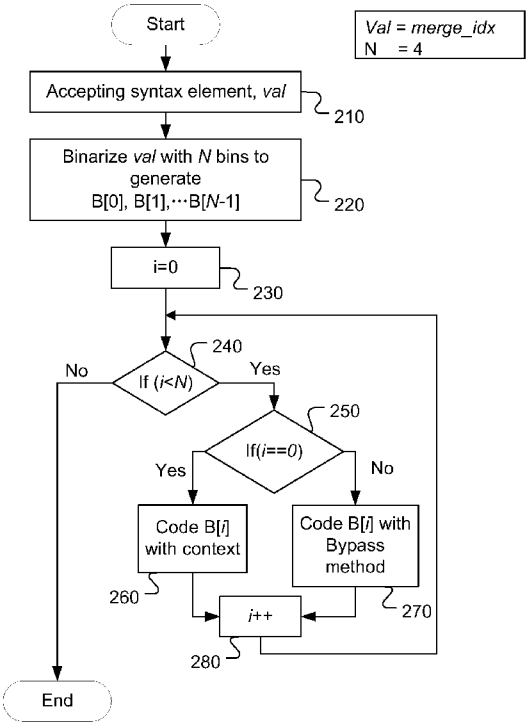

Fig. 2

(57) Abstract: A method and apparatus for context-adaptive arithmetic coding (CABAC) of a syntax element are disclosed. The bin string corresponding to a syntax element is processed by context- adaptive arithmetic coding with a reduced number of contexts using the bin-level bypass mode, bin-level context sharing, or both. The syntax element belongs to a group comprising merge_idx, ref_idx_lc/ref_idx_10/ref_idx_11, pred_type, and cu_qp_delta. In one embodiment, the syntax element corresponds to merge_idx and three bins of the bin string with bin indices corresponding to 1, 2 and 3 are coded in the bin bypass mode. In another embodiment, the syntax element corresponds to ref_idx_lc/ref_idx_10/ref_idx_11 and one or more bins of the bin string with bin indices larger than 1or larger than 2 are coded in the bin bypass mode.

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METHOD AND APPARATUS FOR CONTEXT-ADAPTIVE BINARY ARITHMETIC CODING OF SYNTAX ELEMENTS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present invention claims priority to PCT Patent Application, Serial No. PCT/CN2012/070428, filed January 16, 2012, entitled "CABAC Simplification for Some Syntax Elements". The PCT Patent Application is hereby incorporated by reference in its entirety.

TECHNICAL FIELD

[0002] The present invention relates to video coding or video processing. In particular, the present invention relates to CABAC coding of syntax elements with reduced complexity in High Efficiency Video Coding (HEVC).

BACKGROUND

[0003] The arithmetic coding is known as an efficient data compressing method and is widely used in coding standards, such as JBIG, JPEG2000, H.264/AVC, and High-Efficiency Video Coding (HEVC). In H.264/AVC JVT Test Model (JM) and HEVC Test Model (HM), Context-Based Adaptive Binary Arithmetic Coding (CABAC) is adopted as the entropy coding tool for various syntax elements in the video coding system.

[0004] Fig. 1 illustrates an example of CABAC encoder 100 which includes three parts: Binarization 110, Context Modeling 120, and Binary Arithmetic Coding (BAC) 130. In the binarization step, each syntax element is uniquely mapped into a binary string (also called bin or bins in this disclosure). In the context modeling step, a probability model is selected for each bin. The corresponding probability model may depend on previously encoded syntax elements, bin indices, side information, or any combination of the above. After the binarization and the context model assignment, a bin value along with its associated context model is provided to the binary arithmetic

coding engine, i.e., the BAC 130 block in Fig. 1. The bin value can be coded in two coding modes depending on the syntax element and bin indices, where one is the regular coding mode, and the other is the bypass mode. The bins corresponding to regular coding mode are referred to as *regular bins* and the bins corresponding to bypass coding mode are referred to as *bypass bins* in this disclosure. In the regular coding mode, the probability of the Most Probable Symbol (MPS) and the probability of the Least Probable Symbol (LPS) for BAC are derived from the associated context model. In the bypass coding mode, the probability of the MPS and the LPS are equal. In CABAC, the bypass mode is introduced to speed up the encoding process.

[0005] In HEVC Test Model Version 5.0 (HM-5.0), syntax elements such as merge_flag (related to the merge flag for a coding unit, i.e., CU), merge_idx (related to the merge index), ref_idx_lc/ ref_idx_l0/ref_idx_l1 (related to the reference picture index), pred_type (related to the prediction type), and cu_qp_delta (related to delta of quantization parameter QP for a CU) are coded using CABAC. Syntax element merge_flag, which has a value equal to either 0 or 1, has only one bin and is coded using one context. The bin strings of merge_idx, ref_idx_lc/ref_idx_l0/ref_idx/l1, and pred_type are shown in Table 1, Table 2 and Table 3 respectively. For merge_idx, pred_type and ref_idx_lc/ref_idx_l0/ref_idx_l1, one context is used for each bin. For ref_idx_lc/ref_idx_l0/ref_idx_l1, if the maximum value of ref_idx_lc/ref_idx_l0/ref_idx_l1 is larger than 3, the additional bins share the same context as the bin with binIdx equal to 2. For cu_qp_delta, the bin string is specified by a process equivalent to the following pseudo-code. The value of cu_qp_delta is denoted as synVal. For bin 0 (i.e., binIdx=0), the bin value is associated with the condition regarding whether abs(synVal) is equal to 0 or greater than 0 as shown in the pseudo code. When bin 0 has a value of 1, one or more additional bins are used to represent the value of delta QP. In the pseudo code, parameter QpBdOffsetY is recited due to specific data representation of delta QP used in HM-5.0 and QpBdOffsetY is related to bit depth of underlying video data.

Table 1. Bin string of merge_idx in HM5.0

Value	Bin string			
0	0			
1	1	0		
2	1	1	0	
3	1	1	1	0

4	1	1	1	1
binIdx	0	1	2	3

Table 2. Bin string of ref_idx_lc/ref_idx_l0/ref_idx_l1 in HM5.0

Value	Bin string						
0	0						
1	1	0					
2	1	1	0				
3	1	1	1	0			
…	.	.	.	.	…		
N-1	1	1	1	1		1	0
N	1	1	1	1	…	1	1
binIdx	0	1	2	3	…	N-2	N-1

Table 3. Bin string of pred_type for inter blocks in HM5.0

Slice type	Value of pred_type	PredMode	PartMode	Bin string											
				cLog2CUSize > Log2MinCUSize					cLog2CUSize = = Log2MinCUSize						
									cLog2CUSize = = 3 && !inter_4x4_enabled_flag			cLog2CUSize > 3 || inter_4x4_enabled_flag			
I	0	MODE_INTRA	PART_2Nx2N	-					1			1			
	1	MODE_INTRA	PART_NxN	-					0			0			
P/B	0	MODE_INTER	PART_2Nx2N	0	1				0	1		0	1		
	1	MODE_INTER	PART_2NxN	0	0	1	1		0	0	1	0	0	1	
	2	MODE_INTER	PART_Nx2N	0	0	0	1		0	0	0	0	0	0	1
	4	MODE_INTER	PART_2NxnU	0	0	1	0	0	-			-			
	5	MODE_INTER	PART_2NxnD	0	0	1	0	1	-			-			
	6	MODE_INTER	PART_nLx2N	0	0	0	0	0	-			-			
	7	MODE_INTER	PART_nRx2N	0	0	0	0	1	-			-			
	3	MODE_INTER	PART_NxN	-					-			0	0	0	0
	4	MODE_INTRA	PART_2Nx2N	1					1	1		1	1		
	5	MODE_INTRA	PART_NxN	-					1	0		1	0		
binIdx				0	1	2	3	4	0	1	2	0	1	2	3

Pseudo code for bin string generation of cu_qp_delta:

```
absV = abs( synVal )
if( absV = = 0 ){
        put( 0 ) ----------------------------------------------------binIdx = 0
} else {
```

```
            put( 1 ) ----------------------------------------------------binIdx = 0
            signV = ( synVal > 0 ) ? 0 : 1
            put( signV )
            cMax = 24 + ( QpBdOffsetY >> 1 ) + signV
            cNum = absV − 1
            absVGreaterThan1Flag = ( absV = = 1 ) ? 0 : 1
            put( absVGreaterThan1Flag ) --------------------------binIdx = 1
            if( absVGreaterThan1Flag ){
                while( cNum−− )
                        put( 1 ) ------------------------------------binIdx = 2……
                if( cMax > absV − 1 )
                        put( 0 )
            }
}
```

[0006] The contexts used for the bin string are also indicated in the above pseudo code. The first two bins of cu_qp_delta (i.e., binIdx = 0 and 1) use two separate contexts for each bin, while other bins (i.e., binIdx ≥ 2) share one common context. When a bin is coded using contexts, it requires additional memory and also results in higher complexity at both encoder and decoder sides. Therefore, it is desirable to reduce the number of contexts required.

SUMMARY

[0007] A method and apparatus for context-adaptive arithmetic coding (CABAC) of a syntax element are disclosed. The method comprises receiving a syntax element and converting the syntax element into a bin string. The context-adaptive arithmetic coding is then applied to the bin string with a reduced number of contexts using a bin-level bypass mode, bin-level context sharing, or a combination of the bin-level bypass mode and said bin-level context sharing. The syntax element belongs to a group comprising merge_idx, ref_idx_lc/ref_idx_l0/ref_idx_l1, pred_type, and cu_qp_delta. In one embodiment, the syntax element corresponds to merge_idx and at least one bin of the bin string is coded in the bin-level bypass mode. For example, three bins of the bin string with bin indices corresponding to 1, 2 and 3 are coded in the bin bypass

mode and the bin index starts with 0. Alternatively, at least two bins of the bin string of merge_idx share a common context. For example, three bins of the bin string with bin indices corresponding to 1, 2 and 3 share a common context. In another embodiment, the syntax element corresponds to ref_idx_lc/ref_idx_l0/ref_idx_l1 and at least one bin of the bin string is coded in the bin-level bypass mode. For example, one or more bins of the bin string with bin indices larger than 1or larger than 2 are coded in the bin bypass mode. Alternatively, one or more bins of the bin string with bin indices larger than 1 share a common context.

[0008] Using the bin-level bypass mode and bin-level context sharing for reducing the number of contexts can be applied in multiple instances or applied jointly. For example, at least one bin of the bin string can be coded in the bin-level bypass mode and at least two bins of the bin string may share a common context. In another example, at least two first bins of the bin string share a first common context and at least two second bins of the bin string share a second common context.

BRIEF DESCRIPTION OF DRAWINGS

[0009] Fig. 1 illustrates exemplary architecture of CABAC encoding system with the bypass mode.

[0010] Fig. 2 illustrates an exemplary flow chart for context-adaptive arithmetic coding of merge_idx according to an embodiment of the present invention, where bins with binIdx equal to 1, 2 and 3 are coded in the bypass mode.

[0011] Fig. 3 illustrates an exemplary flow chart for context-adaptive arithmetic coding of ref_idx_lc/ref_idx_l0/ref_idx_l1 according to an embodiment of the present invention, where bins with binIdx equal to 2 or larger are coded in the bypass mode.

DETAILED DESCRIPTION

[0012] As described earlier, the use of contexts for syntax element coding requires additional memory and results in higher complexity. Embodiments of the present invention reduce the number of contexts by using the bypass mode for at least one bin, by sharing a context by more than one bin, or both.

[0013] For example, when the syntax element merge_idx is coded, the bins for merge_idx shown in Table 1 will be processed using contexts. The bin location is

indicated by binIdx, where binIdx is from 0 to 3 for merge_idx. In conventional CABAC for merge_idx, one context is used for each bin. Embodiments according to the present invention can use the bypass mode for at least one bin, share a context by more than one bin to reduce the total number of contexts, or do both. When the bypass mode is used, the bypass mode can be applied to a bin or bins with binIdx belonging to a set, where the set consists of 1, 2, or 3 alone, or any combination of them. In other words, the set may be {1}, {2}, {3}, {1,2}, {1,3}, {2,3} or {1,2,3}. For example, the bypass mode can be applied to a bin or bins with binIdx belonging to {3}, {2,3} or {1,2,3} in various embodiments. When the context sharing mode is used, a context may be shared by 2 or more bins. For example, a common context may be shared by bins with binIdx belonging to {2,3} or {1,2,3} in various embodiments.

[0014] The context simplification method described above for the syntax element merge_idx reduces the number of contexts and consequently reduces storage and complexity. The impact on system performance in terms of BD-rate is negligible, where BD-rate is a coding quality measure widely used in the field of video coding.

[0015] In another example, the context simplification method according to the present invention is applied to the syntax element ref_idx_lc/ref_idx_l0/ref_idx_l1. The binarization of the syntax element ref_idx_lc/ref_idx_l0/ref_idx_l1 is shown in Table 2. The bin location is indicated by binIdx, where binIdx can be 0, 1, 2, …, *N-1* for ref_idx_lc/ref_idx_l0/ref_idx_l1, where *(N+1)* is an integer related to the maximum number of reference pictures allowed in a list. In the conventional CABAC for ref_idx_lc/ref_idx_l0/ref_idx_l1, one context is used for each bin. Embodiments according to the present invention use the bypass mode for at least one bin or share a context by more than one bin to reduce the total number of contexts. When the bypass mode is used, the bypass mode can be applied to a bin or bins with binIdx belonging to a set, where the set consists of 1, 2,…, *N*-2, or *N*-1 alone, or any combination of them. For example, the bypass mode can be applied to a bin or bins with binIdx belonging to {*i*; $2 \le i \le (N-1)$} or { *i*; $1 \le i \le (N-1)$}in various embodiments. When the context sharing mode is used, a common context may be shared by 2 or more bins. For example, a common context may be shared by bins with binIdx belonging to {2,3,…,*N*-1} or {3,…,*N*-1} in various embodiments.

[0016] The context simplification method described above for the syntax element

ref_idex_lc/ref_idx_l0/ref_idx_l1 can reduce the number of contexts and consequently reduce storage and complexity. The impact on system performance in terms of BD-rate is negligible.

[0017] In yet another example, the context simplification method according to the present invention is applied to the syntax element pred_type. The binarization of the syntax element pred_type is shown in Table 3. The bin location is indicated by binIdx, where binIdx is from 0 to 4 for pred_type. In the conventional CABAC for pred_type, one context is used for each bin. Embodiments according to the present invention can use the bypass mode for at least one bin or share a context by more than one bin to reduce the total number of contexts. When the bypass mode is used, the bypass mode can be applied to a bin or bins with binIdx belonging to a set, where the set consists of 1, 2, 3, or 4 alone, or any combination of them. For example, the bypass mode can be applied to a bin or bins with binIdx belongs to {4}, {3,4} or {2,3,4} in various embodiments. When the context sharing mode is used, a common context may be shared by 2 or more bins. For example, a context may be shared by bins with binIdx belonging to {2,3}, {3,4} or {2,3,4} in various embodiments.

[0018] The context simplification method described above for the syntax element pred_type can reduce the number of contexts and consequently reduce storage and complexity. The impact on system performance in terms of BD-rate is negligible.

[0019] In HEVC, the syntax element merge_flag is also encoded using CABAC. The syntax element merge_flag has one bin. An embodiment according to the present invention may use the bypass mode for the bin instead of using a context.

[0020] In a further example, the context simplification method according to the present invention is applied to the syntax element cu_qp_delta. The binarization of the syntax element cu_qp_delta is shown in the exemplary pseudo code described earlier. Bin 0 corresponds to the information associated with “whether abs(deltaQP) is greater than 0”, where deltaQP is the difference between a current QP value and a previous QP value and abs() is the absolution value function. Bin 1 corresponds to the information associated with “whether abs(deltaQP) is greater than 1”. Bins with binIdx equal to 2 and larger are related to “abs(deltaQP)-1”. The largest binIdx value (N-1) depends on the largest allowed abs(deltaQP)-1. In the conventional CABAC for cu_qp_delta, the first two bins of cu_qp_delta (i.e., binIdx = 0 and 1) use two separate contexts for each bin, while other bins (i.e., binIdx ≥ 2) share one common

context. Embodiments according to the present invention can use the bypass mode for at least one bin or share a context by more than one bin to reduce the total number of contexts. When the bypass mode is used, the bypass mode can be applied to a bin or bins with binIdx belonging to a set, where the set consists of 1, 2,..., *N*-1 or any combination of them. For example, the bypass mode can be applied to bins with binIdx equal to 2 or larger according to one embodiment. The bypass mode can be applied to bins with binIdx equal to 1 or larger according to another embodiment. When the context sharing mode is used, a context may be shared by 2 or more bins. For example, a context may be shared by the bin with binIdx equal to 1 and bins with binIdx equal to 2 or larger according to one embodiment. In other words, bins with binIdx equal to 1 or larger share a common context. A context may be shared by bins with binIdx equal to n+1, n+2,... according to another embodiment, where n is an integer greater than 0. Bypass mode and context sharing may also be used jointly according to an embodiment of the present invention. For example, bins with binIdx in the range $\{m,\ldots,n\text{-}1\}$ can share the same context while bins with binIdx in the set $\{n,n+1,\ldots\}$ use the bypass mode, where m and n are integers, and $(n\text{-}1)>m$. Furthermore, multiple bin groups can share respective common contexts. For example, bins with binIdx in the range $\{m1,\ldots,m2\text{-}1\}$ share a first common context and bins with binIdx in the range $\{m2,\ldots,m3\text{-}1\}$ share a second common context, where *m1*, *m2* and *m3* are integers and $m3>m2>m1$.

[0021] Fig. 2 illustrates an exemplary flowchart for a system incorporating context simplification according to an embodiment of the present invention. In this example, the bypass mode is applied to bins of the syntax element, merge_idx, where merge_idx is binarized into 4 bits. In step 210, the syntax element merge_idx is read into variable *val*. The variable *val* is then binarized into *N* bins: B[0], B[1],...B[*N*-1] in step 220. The counter *i* is initialized to 0 in step 230. The counter *i* is checked in step 240 to determine whether all bins have been processed. If all bins have been processed, the procedure is terminated (i.e., the "No" path). Otherwise, the counter *i* is checked (i.e., the "Yes" path) to see whether it is equal to 0 in step 250. If *i* is equal to 0, the bin is coded using context as shown in step 260; otherwise the bin is coded in the bypass mode as shown in step 270. The counter *i* is then incremented in step 280 and the process goes back to step 240 to process the next bin. Accordingly, the flowchart in Fig. 2 will cause the bin with binIdx equal to 0 to be coded using context and bins with binIdx in {1,2,3} to be coded in the bypass mode.

[0022] Fig. 3 illustrates another exemplary flowchart for a system incorporating context simplification according to an embodiment of the present invention. In this example, the bypass mode is applied to bins of the syntax element, ref_idx_lc/ref_idx_l0/ref_idx_l1, where ref_idx_lc/ref_idx_l0/ref_idx_l1 is binarized into 5 bits. The flowchart is substantially the same as the flowchart of Fig. 2 and the same steps are labeled with the same reference numbers. The syntax element ref_idx_lc/ref_idx_l0/ref_idx_l1 is read into the variable *val* as shown in step 210 and the variable *val* is binarized into *N* bins: B[0], B[1],...B[*N*-1] in step 220, where *N* is 5. In step 350, the counter *i* is compared with an integer *m* (*m*=2). For *i*=0 and 1, B[*i*] is coded using the context mode. For bins with binIdx in {2,3,4}, the bins are coded in the bypass mode.

[0023] Fig. 2 and Fig. 3 illustrate context coding simplification for syntax elements merge_idx and ref_idx_lc/ref_idx_l0/ref_idx_l1 respectively according to embodiments of the present invention. While specific syntax elements and parameters (such as number of bins, the bins selected for coding using the bypass mode) are used in the examples, a person skilled in the art may practice the present invention on other syntax elements and/or parameters. Furthermore, the steps shown in Fig. 2 and Fig. 3 may be re-arranged and some steps may be combined or split to practice the present invention.

[0024] The above description is presented to enable a person of ordinary skill in the art to practice the present invention as provided in the context of a particular application and its requirement. Various modifications to the described embodiments will be apparent to those with skill in the art, and the general principles defined herein may be applied to other embodiments. Therefore, the present invention is not intended to be limited to the particular embodiments shown and described, but is to be accorded the widest scope consistent with the principles and novel features herein disclosed. In the above detailed description, various specific details are illustrated in order to provide a thorough understanding of the present invention. Nevertheless, it will be understood by those skilled in the art that the present invention may be practiced.

[0025] Embodiment of the present invention as described above may be implemented in various hardware, software codes, or a combination of both. For example, an embodiment of the present invention can be a circuit integrated into a video compression chip or program code integrated into video compression software

to perform the processing described herein. An embodiment of the present invention may also be program code to be executed on a Digital Signal Processor (DSP) to perform the processing described herein. The invention may also involve a number of functions to be performed by a computer processor, a digital signal processor, a microprocessor, or field programmable gate array (FPGA). These processors can be configured to perform particular tasks according to the invention, by executing machine-readable software code or firmware code that defines the particular methods embodied by the invention. The software code or firmware code may be developed in different programming languages and different formats or styles. The software code may also be compiled for different target platforms. However, different code formats, styles and languages of software codes and other means of configuring code to perform the tasks in accordance with the invention will not depart from the spirit and scope of the invention.

[0026] The invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described examples are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

CLAIMS

1. A method of context-based adaptive binary arithmetic coding (CABAC) of a syntax element, the method comprising:

receiving the syntax element, wherein the syntax element belongs to a group comprising merge index, reference picture index, prediction type, and quantization parameter delta for a coding unit;

converting the syntax element into a bin string, wherein the bin string consists of two or more bins and each bin is associated with a bin index; and

applying context-based adaptive binary arithmetic coding to said two or more bins of the bin string with a reduced number of contexts using a bin-level bypass mode, bin-level context sharing, or a combination of the bin-level bypass mode and said bin-level context sharing.

2. The method of Claim 1, wherein the syntax element corresponds to the merge index and at least one bin of the bin string is coded in the bin-level bypass mode.

3. The method of Claim 2, wherein three bins of the bin string with bin indices corresponding to 1, 2 and 3 are coded in the bin bypass mode and the bin index starts with 0.

4. The method of Claim 1, wherein the syntax element corresponds to the merge index, and at least two bins of the bin string share a common context.

5. The method of Claim 4, wherein three bins of the bin string with bin indices corresponding to 1, 2 and 3 share the common context and the bin index starts with 0.

6. The method of Claim 4, wherein two bins of the bin string with bin indices corresponding to 2 and 3 share the common context and the bin index starts with 0.

7. The method of Claim 1, wherein the syntax element corresponds to the reference picture index and at least one bin of the bin string is coded in the bin-level bypass mode.

8. The method of Claim 7, wherein one or more bins of the bin string with bin indices larger than 1are coded in the bin bypass mode and the bin index starts with 0.

9. The method of Claim 7, wherein one or more bins of the bin string with bin indices larger than 2 are coded in the bin bypass mode and the bin index starts with 0.

10. The method of Claim 1, wherein the syntax element corresponds to the reference picture index, and wherein one or more bins of the bin string with bin indices larger than 1 share a common context and the bin index starts with 0.

11. The method of Claim 1, wherein at least one bin of the bin string is coded in the bin-level bypass mode and at least two bins of the bin string share a common context.

12. The method of Claim 1, wherein at least two first bins of the bin string share a first common context and at least two second bins of the bin string share a second common context.

13. An apparatus of context-based adaptive binary arithmetic coding (CABAC) of a syntax element, the apparatus comprising:

means for receiving the syntax element, wherein the syntax element belongs to a group comprising merge index, reference picture index, prediction type, and quantization parameter delta for a coding unit;

means for converting the syntax element into a bin string, wherein the bin string consists of two or more bins and each bin is associated with a bin index; and

means for applying context-based adaptive binary arithmetic coding to said two or more bins of the bin string with a reduced number of contexts using a bin-level bypass mode, bin-level context sharing, or a combination of the bin-level bypass mode and said bin-level context sharing.

14. The apparatus of Claim 13, wherein the syntax element corresponds to the merge index and at least one bin of the bin string is coded in the bin-level bypass mode.

15. The apparatus of Claim 14, wherein three bins of the bin string with bin indices corresponding to 1, 2 and 3 are coded in the bin bypass mode and the bin index starts with 0.

16. The apparatus of Claim 13, wherein the syntax element corresponds to merge_idx, and at least two bins of the bin string share a common context.

17. The apparatus of Claim 13, wherein the syntax element corresponds to the reference picture index and at least one bin of the bin string is coded in the bin-level bypass mode.

18. The apparatus of Claim 17, wherein one or more bins of the bin string with bin indices larger than 2 are coded in the bin bypass mode and the bin index starts with 0.

19. The apparatus of Claim 13, wherein at least one bin of the bin string is coded in the bin-level bypass mode and at least two bins of the bin string share a common context.

20. The apparatus of Claim 13, wherein at least two first bins of the bin string share a first common context and at least two second bins of the bin string share a second common context.

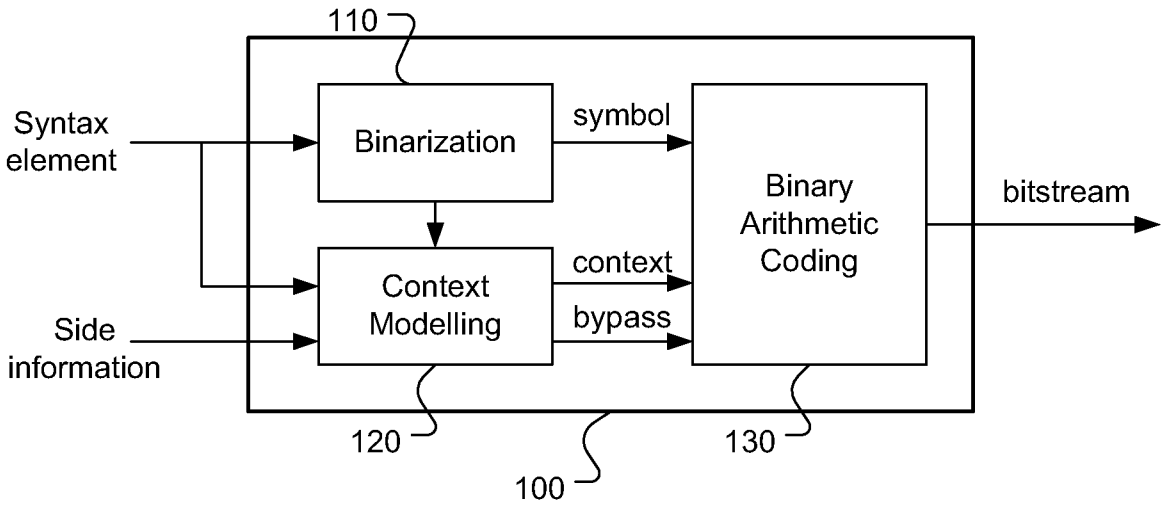
110
Syntax element
Binarization
symbol
Binary Arithmetic Coding
bitstream
Context Modelling
context
bypass
Side information
120
130
100

Fig. 1

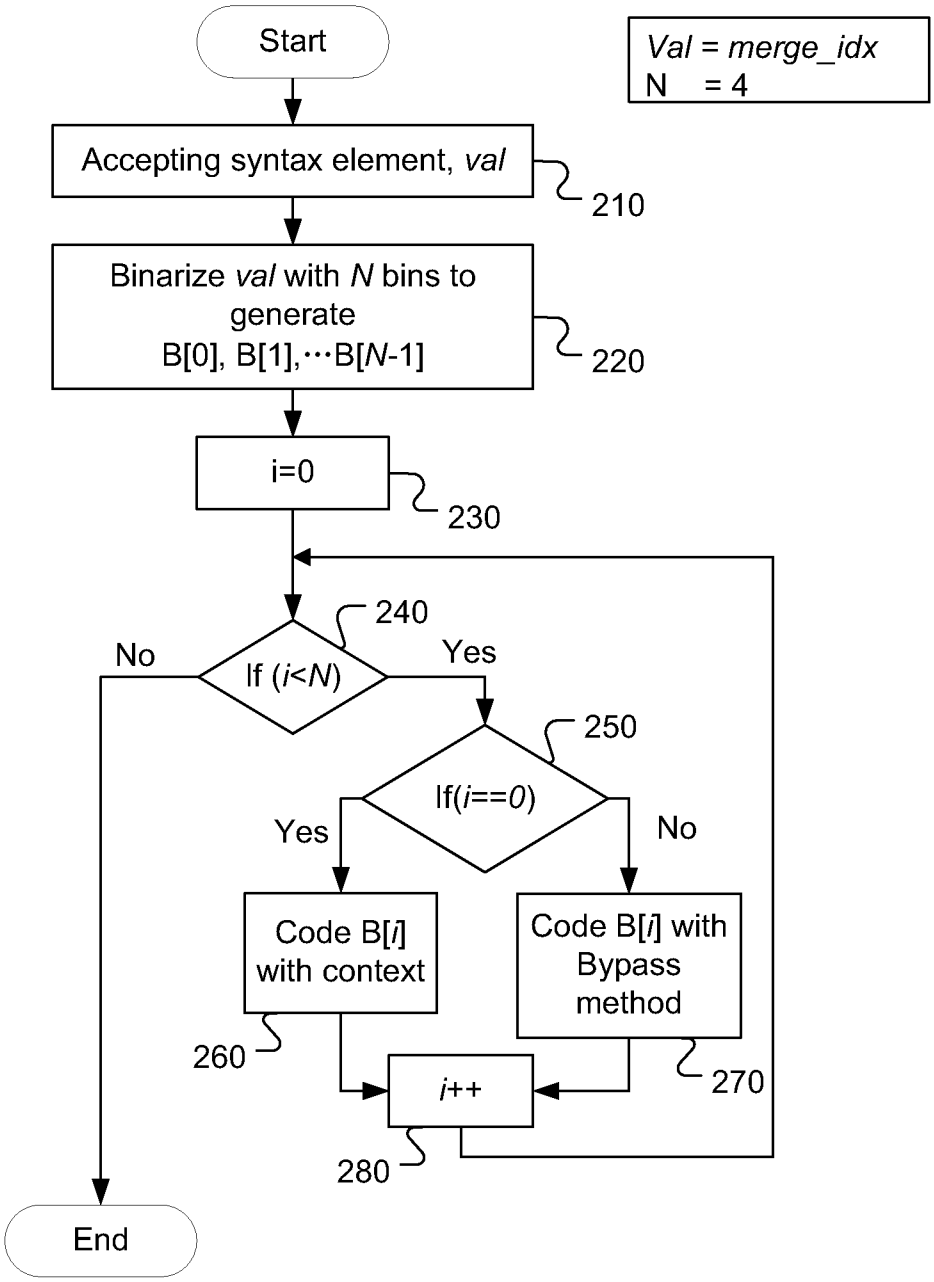
Start
Val = merge_idx
N = 4
Accepting syntax element, val
210
Binarize val with N bins to generate
B[0], B[1],···B[N-1]
220
i=0
230
240
No
If (i<N)
Yes
250
If(i==0)
Yes
No
Code B[i] with context
260
Code B[i] with Bypass method
270
i++
280
End

Fig. 2

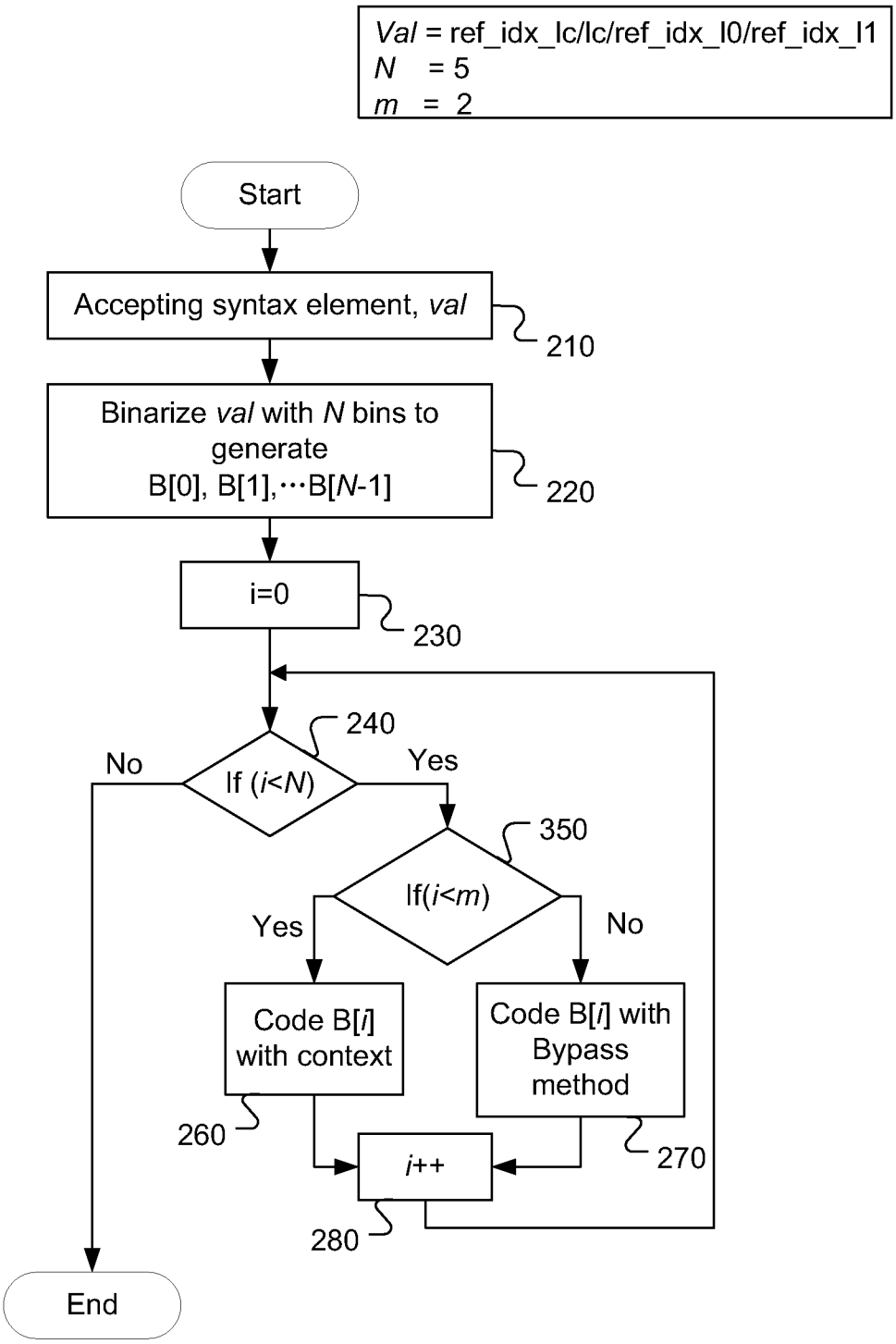
Val = ref_idx_lc/lc/ref_idx_l0/ref_idx_l1
N = 5
m = 2
Start
Accepting syntax element, val
210
Binarize val with N bins to generate B[0], B[1],…B[N-1]
220
i=0
230
240
If (i<N)
No
Yes
350
If(i<m)
Yes
No
Code B[i] with context
260
Code B[i] with Bypass method
270
i++
280
End

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2012/086536

A. CLASSIFICATION OF SUBJECT MATTER

H04N 7/26(2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS, CNTXT, CNKI, VEN: CABAC, bin?, syntax, bypass, context?, shar???, reduce???, sav???

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN101771879A (UNIV. QINGHUA) 07 July 2010(07.07.2010) description page 1 paragraph 2	1-20
Y	CN101771879A (UNIV. QINGHUA) 07 July 2010(07.07.2010) description page 1 paragraph 2	1-20
Y	CN102256125A(UNIV. BEIJING TECHNOLOGY) 23 Nov.2011(23.11.2011) claims 1 and 2	1-20
A	CN101951516A(UNIV. QINGHUA) 19 Jan. 2011(19.01.2011) the whole document	1-20
A	US2009168868A1(JAHANGHIR, M.) 02 July 2009(02.07.2009) the whole document	1-20

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 Mar. 2013(01.03.2013)	**21 Mar. 2013 (21.03.2013)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer LUO, Xinyao Telephone No. (86-10)62412039

Form PCT/ISA /210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2012/086536

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN101771879A	07.07.2010	CN101771879B	17.08.2011
CN102256125A	23.11.2011	None	
CN101951516A	19.01.2011	None	
US2009168868A1	02.07.2009	None	