



(51) International Patent Classification:  
*G06F 9/45* (2006.01)

(21) International Application Number:  
PCT/CN2013/090761

(22) International Filing Date:  
27 December 2013 (27.12.2013)

(25) Filing Language: English

(26) Publication Language: English

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: PATTERNS OF MAJOR COLOR INDEX MAP IN PALETTE CODING

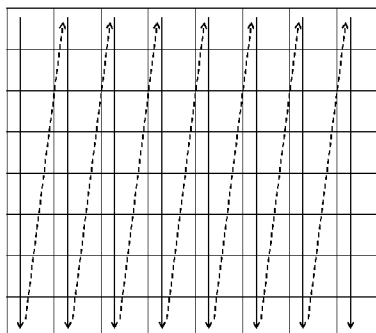


Fig. 2

(57) Abstract: Methods of major color coding (palette coding) are disclosed. Several scanning patterns other than horizontal one could be used for coding the palette index (major color index). Additional coding method to predict the palette index are also disclosed to improve the coding efficiency of palette coding.

## PATTERNS OF MAJOR COLOR INDEX MAP IN PALETTE CODING

### FIELD OF INVENTION

The invention relates generally to screen content video processing. In particular, the present invention relates to methods for the major color –based coding (palette coding) method in HEVC range extensions (RExt) or screen content video codec.

### BACKGROUND OF THE INVENTION

The first version of High Efficiency Video Coding (HEVC) standard was finalized in January, 2013, which can achieve 40%~50% bitrate savings as compared to H.264/AVC for high-resolution applications. Currently, extensions of HEVC are being developed, including range extensions (RExt) which target on non-4:2:0 color formats, such as 4:2:2 and 4:4:4, and higher bit-depths video such as 12, 14 and 16 bit-per-sample.

One of the mostly likely applications utilizing RExt is screen sharing, over wired-connection or wireless. Due to specific characteristics of screen-content, coding tools have been developed that demonstrated significant gains in coding efficiency. Among them, the palette coding (a.k.a. major color based coding) techniques represent block of pixels using indices to the palette (major colors), and encode the palette and the indices by exploiting spatial redundancy.

#### **Palette coding [1][2] [3]**

In this first method, proposed by Qualcomm, palette is utilized to represent a given video block (e.g. CU). In the original version of the work [1], palette of each component are constructed and transmitted. All pixels within the given block are then coded using their palette indices.

Later on Qualcomm proposed a second version of their palette coding technique [2], in which each element in the palette is a triplet, representing a specific combination of the three color components. The palette index is shared by all the color components to reduce overhead.

The following describes the procedure to code the palette indices in qualcomm's method.

- Scan the CU in horizontal scan order (or so called raster scan order, horizontal direction in each line, from top line to bottom line, see figure 1 for reference)
- Signal palette index using one of the following 2 modes
  - o Run mode: signal "palette\_index" followed by "run"
  - In "run mode", a palette index is first signaled followed by "palette\_run" (e.g., M). No

further information needs to be transmitted for the current position and the following M positions as they have the same palette index as signaled.

- Copy top mode: Signal a “copy run”

- In “copy above mode”, a value “copy\_run” (e.g., N) is transmitted to indicate that for the following N positions (including the current one), the palette index is equal to the palette index of the one that is at the same location in the row above.

Another major color-base coding (palette coding) method was proposed by Microsoft. Similar to [1], palette of each component are constructed and transmitted. However, the method of coding the palette index is different from the one proposed by Qualcomm. The following describes the procedure to code the palette indices in Microsoft’s method.

- Scan the CU in horizontal scan order (or so called raster scan order, horizontal direction in each line, from top line to bottom line, see figure 1 for reference)

- Signal one line of palette index using one of the following 3 modes

- horizontal mode

- In horizontal mode, all the pixels in the same line have the same value. If the value is the same as the first pixel of the above pixel line, only line mode signalling bits are transmitted. Otherwise, the index value is also transmitted.

- vertical mode

- In vertical mode, the current pixel line is the same with the above pixel line. Therefore, only line mode signalling bits are transmitted.

- normal mode

- In normal mode, pixels in a line are predicted individually. For each pixel, the left or above neighbours is used as predictor, and the prediction symbol is transmitted to the decoder.

- 

In this invention, we invent several methods to improve the major color based coding (palette coding).

## SUMMARY OF THE INVENTION

In view of the previously described major color based coding scheme, we propose several methods for major color coding improvement.

Other aspects and features of the invention will become apparent to those with ordinary skill in the art upon review of the following descriptions of specific embodiments.

## BRIEF DESCRIPTION OF THE DRAWINGS

The invention can be more fully understood by reading the subsequent detailed description and examples with references made to the accompanying drawings, wherein:

Fig. 1 is a diagram illustrating horizontal scanning order to code the palette index;

Fig. 2 is a diagram illustrating vertical scanning order to code the palette index;

Fig. 3 is a diagram illustrating diagonal scanning order to code the palette index;

Fig. 4 is a diagram illustrating inverse diagonal scanning order to code the palette index;

Fig. 5 is a diagram illustrating the invented prediction mode of L shape.

## DETAILED DESCRIPTION

The following description is of the best-contemplated mode of carrying out the invention. This description is made for the purpose of illustrating the general principles of the invention and should not be taken in a limiting sense. The scope of the invention is best determined by reference to the appended claims.

### **Additional Coding Modes (Prediction Modes)**

In addition to the “run” mode, “copy top” mode, “horizontal” mode and “vertical” mode, we propose additional palette index coding mode (prediction mode) to improve the performance. Note that, when the neighboring palette index value which is used to predict current palette index is not available, a default value (e.g. zero) or a derived value based on the pixel value of the neighboring reconstructed pixels are used.

#### **“copy left” mode**

In “copy left” mode, a value “copy\_run” (e.g., N) is transmitted or derived to indicate that for the following N positions (including the current one), the palette index is equal to the palette index of the one that is at the same location in the column left. In one example, N could be 1. In another one example of deriving N, the N could be the number of the remaining palette index which are not coded yet within the same line.

#### **“copy left column” mode**

In “copy left” mode, all the pixels in the same line have the same value. If the value is the same as the first pixel of the left pixel column, only line mode signalling bits are transmitted. Otherwise, the index value is also transmitted.

#### **“Column filling” mode**

In “column filling” mode, all the pixels in the same column (vertical line) have the same value. If the value is the same as the first pixel of the left pixel column, the first pixel of the above pixel row, or any other derived location, only line mode signalling bits are transmitted.

Otherwise, the index value is also transmitted.

**“copy irregular shape” mode**

In “copy irregular shape” mode, a shape description is transmitted or derived to indicate following N positions (including the current one) in the shape are the palette index of the one that is at the transmitted or derived location.

**“fill irregular shape” mode**

In “copy irregular shape” mode, a shape description is transmitted or derived to indicate following N positions (including the current one) in the shape are the same value. If the value is the same as the first pixel of the left pixel column, the first pixel of the above pixel row, or any other derived location, only prediction shape description bits (and prediction description bits) are transmitted. Otherwise, the index value is also transmitted.

**“copy L shape” mode**

In “copy L shape” mode, following N positions (including the current one) in the L shape, as figure 5, are the palette index of the one that is at the transmitted or derived location.

**“fill L shape” mode**

In “copy L shape” mode, following N positions (including the current one) in the L shape, as figure 5, are the same value. If the value is the same as the first pixel of the left pixel column, the first pixel of the above pixel row, or any other derived location, only prediction shape description bits (and prediction description bits) are transmitted. Otherwise, the index value is also transmitted.

**Adaptive prediction mode signaling**

To signal the prediction mode, the signaling method can be adaptively determined. The adaptive signalling method can be use different VLC code to signal mode according to the position of the current pixel. Another adaptive signalling method can be turn off some modes according to the position of the current pixel.

**Different Scanning Order for Coding Palette Index**

In this invention, we propose to use scanning orders different from horizontal scanning order for coding the palette index.

**Vertical scanning order:**

As shown in figure 2, the palette index of each pixel is scanned column by column vertically from top pixel to bottom pixel within one column. Besides, the scanning is started from the left most column to the right most column.

In one example of palette coding using vertical scanning order, the “run” mode in Qualcomm’s method can still be used and the “copy top” mode is modified as “copy left” mode

accordingly. The “normal” mode in Macrosoft’s method can still be the same and the “horizontal” and “vertical” are modified as ” copy left column” and “column filling” modes, respectively.

Other scanning such as **Zig-Zag, Hilbert scanning, diagonal scanning (figure 3),**  
5 **inverse diagonal scanning (figure 4)** could also be used.

#### **Signaling of Scanning order (Coding Method)**

In this invention, we have proposed several scanning orders for coding the palette index along with different coding methods. If a codec only allows one specific scanning order be used for coding the palette index, any invented scanning order along with the associated  
10 coding method could be used. If multiple scanning orders could be used for coding the palette index, additional syntax could be signaled to indicate which one is used for coding the palette index among the different scanning orders (horizontal scanning, vertical scanning, zig-zag scanning, Hilbert scanning and so on) and the associated coding method. The selection of scanning order and the associated coding methods could also be implicitly derived at encoder  
15 and decoder sides through an identical derivation process without signaling any additional syntax. Note that, both explicit singaling and implicit deriving of the used scanning order could be done in PU level, CU level, slice level, picture level or sequence level.

#### **REFERENCE**

- 20 [1] L. Guo, M. Karczewicz, and J. Sole, “RCE3: Results of Test 3.1 on Palette Mode for Screen Content Coding”, JCTVC-N0247, Vienna, AT, July 2013.
- [2] L. Guo, M. Karczewicz, J. Sole, and R. Joshi, “Non-RCE3: Modified Palette Mode for Screen Content Coding”, JCTVC-N0249, Vienna, AT, July 2013.
- [3] X. Guo, B. Li, J. Xu, Y. Lu, S. Li, and F. Wu, “AHG8: Major-color-based screen  
25 content coding”, JCTVC-O0182, Geneva, CH, October 2013.

## CLAIMS

1. A method of major color based (palette ) coding method, comprising:

Transmission of the palette;

5 Scanning the palette indices;

Prediction of palette indices;

Transmission of palette indices.

10 2. The method as claimed in claim 1, wherein the palette indices within a block are coded using a scanning pattern.

15 3. The method as claimed in claim 1, wherein the invented prediction modes of palette indices include “copy left”, “copy left column”, “column filling ”, **“copy irregular shape”**, **“fill irregular shape”**, **“fill L shape”**, and **“fill L shape”**.

4. The method as claimed in claim 2, wherein the scanning pattern could be vertical, diagonal, zig-zag, Hilbert, or inverse-diagonal scanning patterns.

20 5. The method as claimed in claim 2, wherein the scanning pattern for each block is explicitly signaled or implicitly derived to indicate which scanning pattern is used among multiple predefined scanning patterns.

25 6. The method as claimed in claim 5, wherein the signaling or deriving of the scanning pattern for each block could be at TU level, PU level, CU level, LCU level, slice level, picture level, PPS, SPS or VPS.

7. The method as claimed in claim 5, wherein the multiple scanning patterns include “horizontal”, “vertical”, “Zig-Zag”, “Hilbert”, “diagonal”, “inverse diagonal” scanning patterns.

30 8. A method of position dependent prediction mode signaling.

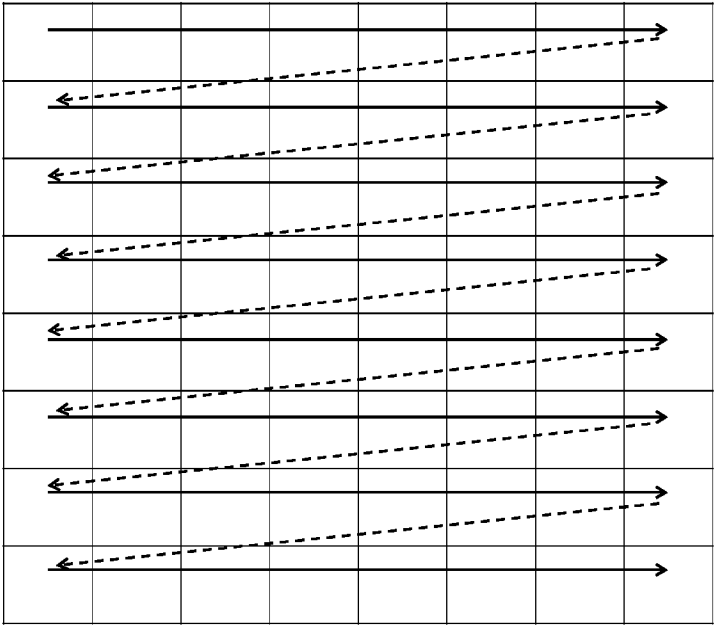


Fig. 1

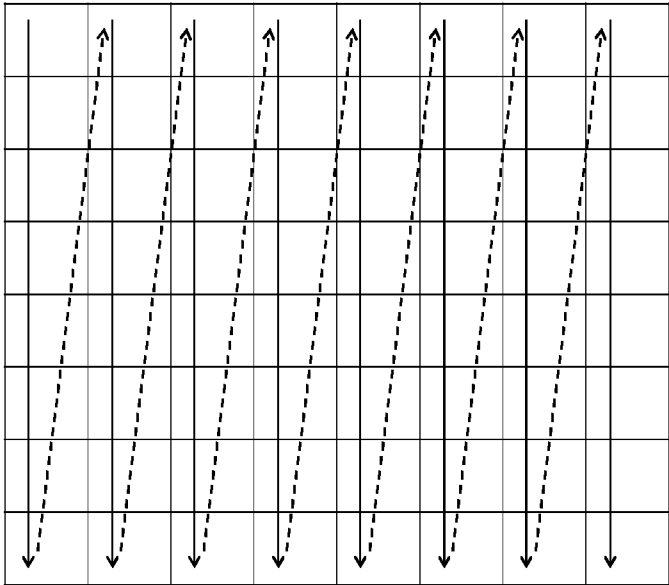


Fig. 2

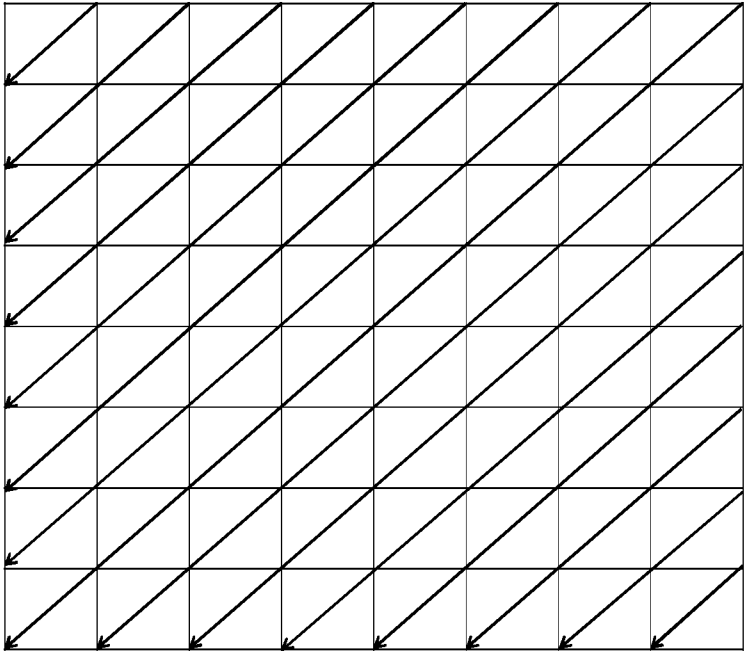


Fig. 3

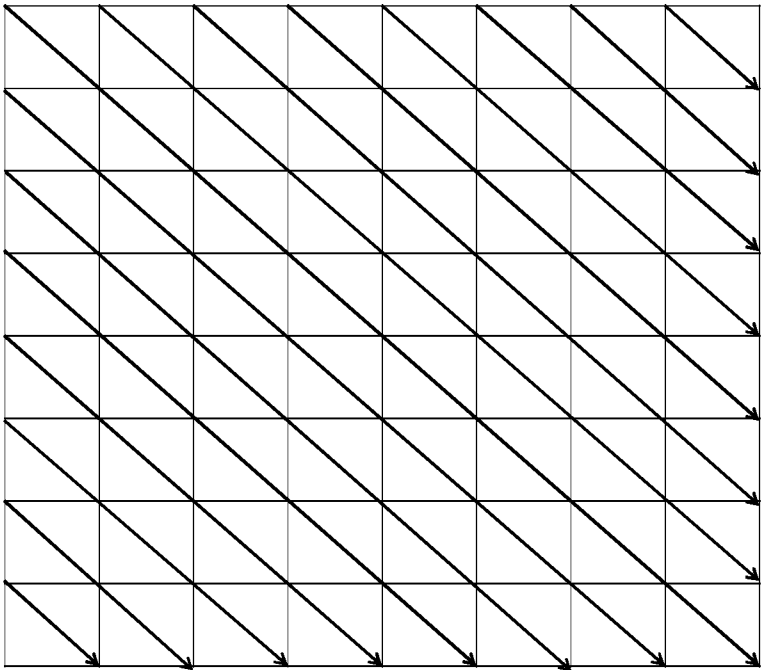


Fig. 4


Fig.5

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2013/090761

**A. CLASSIFICATION OF SUBJECT MATTER**

G06F 9/45 (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)

G06F

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)

CPRSABS, CNKI, DWPI, SIPOABS: palette, color, index, scan, scanning, sweep, predict, prediction, forecast, anticipate, anticipation, transmission, transmit, transfer, convey, transport, code, coding, encode, encipher, encrypt, compile, codify, codification

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 102523367 A (BEIJING CHUANGXIANG SPACE BUSINESS COMMUNICATION SERVICE CO.) 27 June 2012 (2012-06-27) claim 3	1-7
Y	CN 103209326 A (UNIV HUIZHOU) 17 July 2013 (2013-07-17) claim 1	1-7
X	CN 101884219 A (LG ELECTRONICS INC. ET AL.) 10 November 2010 (2010-11-10) claim 1	8
A	US 2011197117 A1 (WILLIAMSON, C.) 11 August 2011 (2011-08-11) the whole document	1-8
A	US 2008273804 A1 (MOTOROLA INC.) 06 November 2008 (2008-11-06) the whole document	1-8



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	“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
“E”	earlier application or patent but published on or after the international filing date	“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
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“O”	document referring to an oral disclosure, use, exhibition or other means	“&”	document member of the same patent family
“P”	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search

05 September 2014

Date of mailing of the international search report

09 October 2014

Name and mailing address of the ISA/

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**INTERNATIONAL SEARCH REPORT**  
**Information on patent family members**

International application No.

**PCT/CN2013/090761**

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