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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, 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, IS, JP, KE, KG, KM, 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, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, 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.

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Declarations under Rule 4.17:

— as to the identity of the inventor (Rule 4.17(i))

[Continued on next page]

(54) Title: ENCODING, DECODING, AND REPRESENTING HIGH DYNAMIC RANGE IMAGES

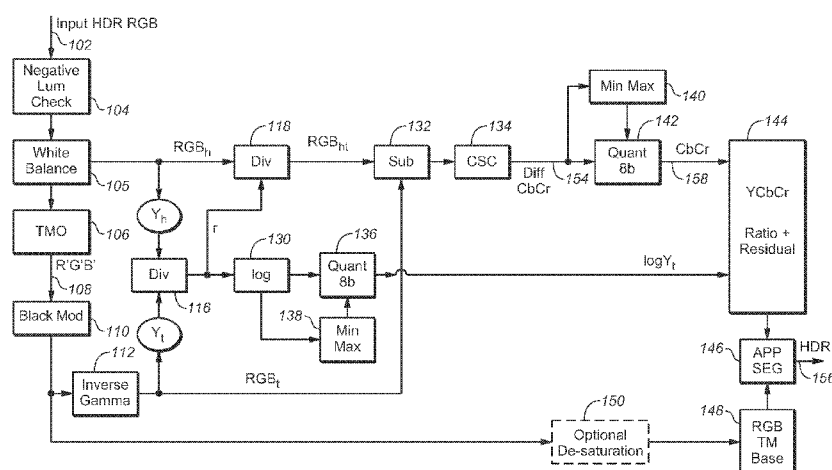


FIG. 1

(57) Abstract: Techniques are provided to encode and decode image data comprising a tone mapped (TM) image with HDR reconstruction data in the form of luminance ratios and color residual values. In an example embodiment, luminance ratio values and residual values in color channels of a color space are generated on an individual pixel basis based on a high dynamic range (HDR) image and a derivative tone-mapped (TM) image that comprises one or more color alterations that would not be recoverable from the TM image with a luminance ratio image. The TM image with HDR reconstruction data derived from the luminance ratio values and the color-channel residual values may be outputted in an image file to a downstream device, for example, for decoding, rendering, and/or storing. The image file may be decoded to generate a restored HDR image free of the color alterations.



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| — as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) | — before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h)) |
| — as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) | |
| — of inventorship (Rule 4.17(iv)) | |
- (88) Date of publication of the international search report:**
10 January 2013

Published:

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

A. CLASSIFICATION OF SUBJECT MATTER***H04N 1/41(2006.01)i, H04N 1/40(2006.01)i, H04N 1/46(2006.01)i, H04N 9/04(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)

H04N 1/41; H04N 5/20; G06K 9/36; H04N 5/225; H04N 7/26; G06K 9/00

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: "high dynamic range (HDR), tone-mapped (TM) image, color alteration, luminance ratio image, HDR reconstruction data, residual data, balance correction"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2010-0226547 A1 (ANTONIO CRIMINISI et al.) 09 September 2010 See abstract, figures 3,7, paragraphs [0032]-[0036], [0042]-[0043], and claims 1,4-5.	1-31,41-44
A	KR 10-1007101 B1 (IUCF-HYU (INDUSTRY-UNIVERSITY COOPERATION FOUNDATION HANYANG UNIVERSITY)) 10 January 2011 See abstract, figures 1,6, paragraphs [0027]-[0031], [0098]-[0103], and claims 1,15.	1-31,41-44
A	JP 2010-213360 A (SHARP CORP) 24 September 2010 See abstract, figure 2, paragraphs [0022]-[0024], and claim 1.	1-31,41-44
A	US 2009-0022421 A1 (MATTHEW T. UYTENDAELE et al.) 22 January 2009 See abstract, figures 8-9, paragraphs [0053]-[0058], and claims 1-3,6,16-18.	32-40



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 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

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Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2012/033795**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

- I. Claims 1-31,41-44 relate to a method or apparatus for encoding or decoding a TM image and HDR reconstruction data.
- II. Claims 32-40 relate to a method for performing white balance correction on initial image data.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2012/033795

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010-0226547 A1	09.09.2010	CN 102341825 A EP 2404279 A2 US 8290295 B2 WO 2010-101789 A2 WO 2010-101789 A3	01.02.2012 11.01.2012 16.10.2012 10.09.2010 13.01.2011
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