(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
12 April 2001 (12.04.2001)

PCT

(10) International Publication Number
WO 01/26054 A3

(51) International Patent Classification[7]: G06T 5/40

(21) International Application Number: PCT/US00/27194

(22) International Filing Date: 2 October 2000 (02.10.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/411,619 1 October 1999 (01.10.1999) US

(71) Applicant: MICROSOFT CORPORATION [US/US]; Patent Group, One Microsoft Way, Redmond, WA 98052 (US).

(72) Inventor: SZELISKI, Richard; 2602 131st Place SE, Bellevue, WA 98005 (US).

(74) Agents: LYON, Richard et al.; Lyon, Harr, & DeFrank, 300 Esplanade Drive, Suite 800, Oxnard, CA 93030 (US).

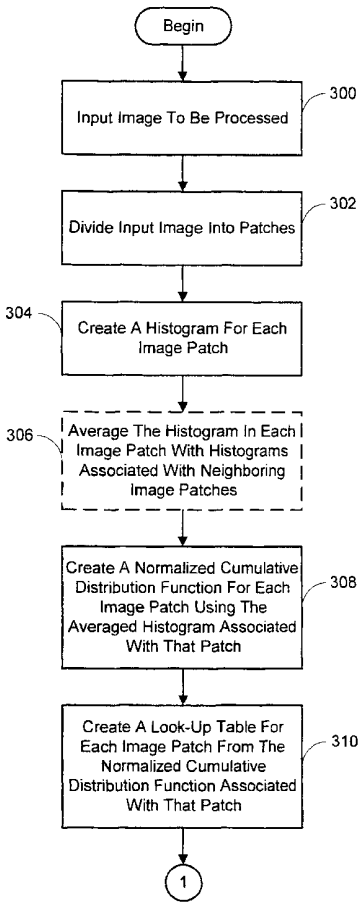
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

[Continued on next page]

(54) Title: LOCALLY ADAPTED HISTOGRAM EQUALIZATION



(57) Abstract: This invention relates to a system and method for improving the uniformity in exposure and tone of a digital image using a locally adapted histogram equalization approach. This approach involves first segmenting the digital image into a plurality of image patches (302). For each of these patches, a pixel brightness level histogram is created (304). The histogram for each patch is then optionally averaged with the histograms associated with a prescribed number of neighboring image patches (306). A normalized cumulative distribution function is generated for each patch based on the associated averaged histogram (308). This normalized cumulative distribution function identifies a respective new pixel brightness level for each of the original pixel brightness levels. For each of the original pixel brightness levels, the associated new pixel brightness levels from one or more of the image patches are blended (314). Preferably, this blending is accomplished using either a bilinear or biquadratic interpolator function. Finally, for each image patch, the original pixel brightness level of each pixel in the image patch is replaced with the blended pixel brightness level corresponding to that original brightness level (316). A further refinement can also be implemented to mitigate the effects of noise caused by areas of a single color in the scene depicted in patch. In one embodiment, this refinement entails employing a partial equalization approach. In another embodiment, the refinement entails limiting the gain exhibited by any of the blended pixel brightness levels associated with an image patch, in comparison to its associated original pixel brightness level, to a prescribed level.

WO 01/26054 A3

(88) Date of publication of the international search report:
27 December 2001

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

	International Application No PCT/US 00/27194

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G06T5/40

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 7 G06T

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 practical, search terms used)
EPO-Internal, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	VOSSEPOEL A M ET AL: "ADAPTIVE HISTOGRAM EQUALIZATION USING VARIABLE REGIONS" PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON PATTERN RECOGNITION. (ICPR),US,WASHINGTON, IEEE COMP. SOC. PRESS, vol. CONF. 9, 14 November 1988 (1988-11-14), pages 351-353, XP000093898 ISBN: 0-8186-0878-1	1,2,8, 14,16, 17,23, 28,29,35
Y		3-6,15, 18-21, 30-33
A	page 351, left-hand column, line 25 -right-hand column, line 4	7,9, 11-13, 22, 24-27, 34,36-39
	page 352, left-hand column, line 32 - line -/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
6 July 2001	20/07/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Kröner, S

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Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
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X	JOUNG-YOUN KIM ET AL: "An advanced contrast enhancement using partially overlapped sub-block histogram equalization" 2000 IEEE INTERNATIONAL SYMPOSIUM ON CIRCUITS AND SYSTEMS. EMERGING TECHNOLOGIES FOR THE 21ST CENTURY. PROCEEDINGS (IEEE CAT NO.00CH36353), ISCAS 2000 GENEVA, pages 537-540 vol.4, XP002170456 2000, Lausanne, Switzerland, Presses Polytech. Univ. Romandes, Switzerland ISBN: 0-7803-5482-6	40
Y	page 537, left-hand column, line 34 - line 41	3-6, 18-21, 30-33
A	page 537, right-hand column, line 40 -page 538, left-hand column, line 29; figure 2	1,16,28, 41
Y	CASELLES V ET AL: "SHAPE PRESERVING LOCAL CONTRAST ENHANCEMENT" PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON IMAGE PROCESSING,US,LOS ALAMITOS, CA: IEEE, 26 October 1997 (1997-10-26), pages 314-317, XP000792774 ISBN: 0-8186-8184-5 abstract page 317, left-hand column, line 23 - line 28	15
A	KIM T K ET AL: "CONTRAST ENHANCEMENT SYSTEM USING SPATIALLY ADAPTIVE HISTOGRAM EQUALIZATION WITH TEMPORAL FILTERING" IEEE TRANSACTIONS ON CONSUMER ELECTRONICS,US,IEEE INC. NEW YORK, vol. 44, no. 1, 1 February 1998 (1998-02-01), pages 82-87, XP000779253 ISSN: 0098-3063 section 4	10,25, 37,41
A	WO 97 49064 A (PARK YUNG JUN ;SAMSUNG ELECTRONICS CO LTD (KR)) 24 December 1997 (1997-12-24) page 3, line 30 -page 4, line 21	41

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 00/27194

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	PIZER S M ET AL: "Adaptive histogram equalization and its variations" COMPUTER VISION, GRAPHICS, AND IMAGE PROCESSING, SEPT. 1987, USA, vol. 39, no. 3, pages 355-368, XP001002914 ISSN: 0734-189X figure 3A section 2.1, 2.2, first paragraph of section 3.1 -----	1,16,28

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Information on patent family members

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PCT/US 00/27194

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