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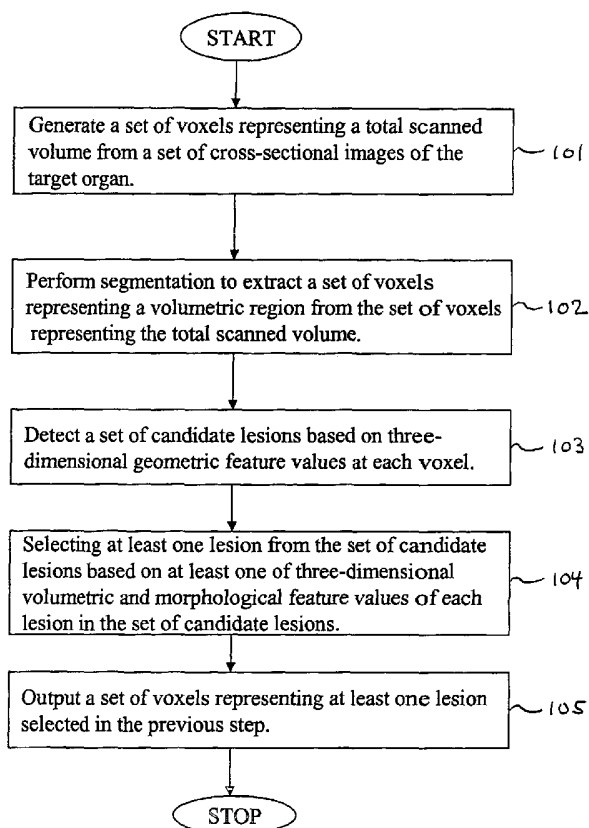
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[Continued on next page]

(54) Title: COMPUTER-AIDED DETECTION OF THREE-DIMENSIONAL LESIONS



(57) Abstract: A method, system, and computer program product for identifying at least one three-dimensionally extended lesion within a volumetric region encompassing an inner surface, an outer surface, and intervening tissue of a target organ. The method includes: (1) generating a set of voxels representing a total scanned volume from a set of cross-sectional images of the target organ (101); (2) performing segmentation to extract a set of voxels representing the volumetric region from the set of voxels representing the total scanned volume (102); (3) detecting a set of candidate lesions based on geometric feature values of each voxel in the set of voxels representing the volumetric region (103); and (4) selecting the at least one three-dimensionally extended lesion from the set of candidate lesions based on at least one of volumetric, morphologic, and texture feature values of each lesion in the set of candidate lesions (104).

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Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),  
European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,  
ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK,  
TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,  
GW, ML, MR, NE, SN, TD, TG).

*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.*

**Published:**

— *with international search report*

**(88) Date of publication of the international search report:**

11 December 2003

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US02/31578

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(7) : G06K 9/00

US CL : 382/131

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)

U.S. : 382/131, 154, 203

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)  
Please See Continuation Sheet**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y --- A	US 6,138,045 A (KUPINSKI et al) 24 October 2000 (24.10.2000), column 5, line 25 to column 12, line 60.	1-10, 15, 21-25, 30, 36-38 ----- 11-14, 16-20, 26-29, 31-35
Y --- A	US 6,246,784 B1 (SUMMERS et al) 12 June 2001 (12.06.2001), column 7, line 16 to column 8, line 57.	1-10, 15, 21-25, 30, 36-38 ----- 11-14, 16-20, 26-29, 31-35
Y --- A	JUSTICE et al. 3-D Segmentation of MR Brain Images Using Seeded Region Growing. Proc. of the 18th Annual Int. Conf. of the IEEE Eng. in Medicine and Biology Society. October 31, 1996, vol.3, pages 1083-1084, especially page 1083.	1-10, 15, 21-25, 30, 36-38 ----- 11-14, 16-20, 26-29, 31-35



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 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

"&amp;"

document member of the same patent family

Date of the actual completion of the international search

03 April 2003 (03.04.2003)

Date of mailing of the international search report

17 APR 2003

Name and mailing address of the ISA/US

Commissioner of Patents and Trademarks

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# INTERNATIONAL SEARCH REPORT

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## C. (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y --- A	LIANG et al. Inclusion of A Priori Information in Segmentation of Colon Lumen for 3D Virtual Colonoscopy. IEEE Nuclear Science Symposium. November 9, 1997, vol.2, pages 1423-1427, especially pages 1423-1424.	1-10, 15, 21-25, 30, 36-38 ----- 11-14, 16-20, 26-29, 31-35
Y --- A	CHEN et al. A Novel Approach to Extract Colon Lumen from CT Images for Virtual Colonoscopy. IEEE Trans. on Medical Imaging. December 2000, vol.19, no.12, pages 1220-1226, especially pages 1220-1223.	1-10, 15, 21-25, 30, 36-38 ----- 11-14, 16-20, 26-29, 31-35

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US02/31578

## Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

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

1. ☒ Claim Nos.: 39-43  
because they relate to subject matter not required to be searched by this Authority, namely:  
Claims 39-43 are drawn to "signals." Signals are physical phenomena or mere data.
2. ☐ Claim 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. ☐ Claim Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

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

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.

No protest accompanied the payment of additional search fees.

## INTERNATIONAL SEARCH REPORT

PCT/US02/31578

### **Continuation of Item 4 of the first sheet:**

The title is not two to seven words, as required by PCT Rule 4.3.

#### **NEW TITLE:**

COMPUTER-AIDED DETECTION OF THREE-DIMENSIONAL LESIONS

### **Continuation of B. FIELDS SEARCHED Item 3:**

EAST, IEEE Xplore

search terms; voxels, segmentation, lesions, colon