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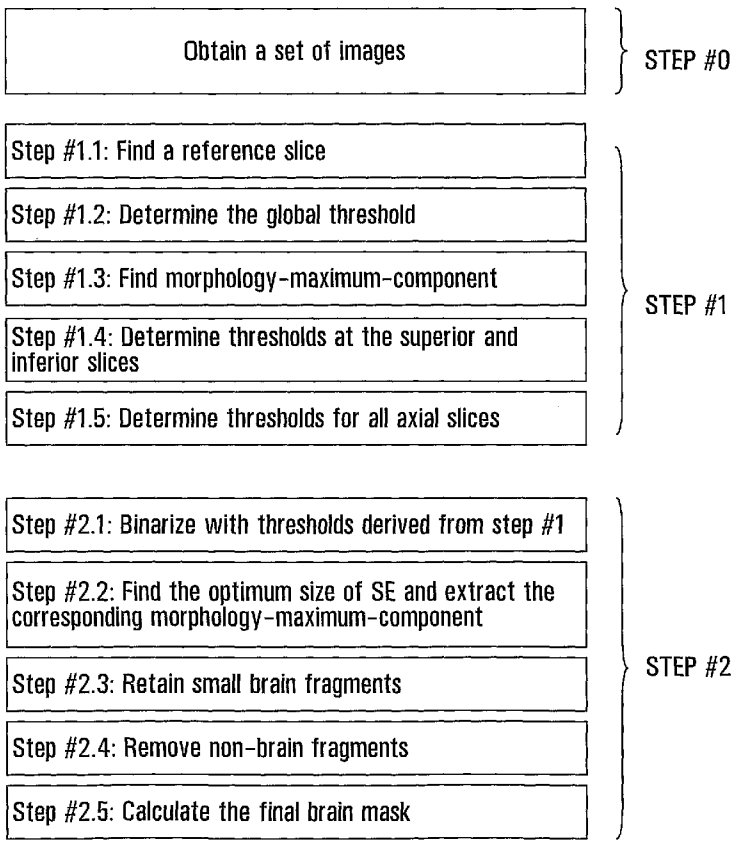
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[Continued on next page]

(54) Title: METHODS, APPARATUS AND COMPUTER-READABLE MEDIA FOR IMAGE SEGMENTATION



(57) Abstract: A method of thresholding a set of images of an object of interest taken at different relative axial positions, each image in the set of images comprising a plurality of pixels each pixel having an intensity. The method comprises determining based on the intensities of the pixels in plural images from the set of images a global intensity value for the set of images; determinging based on the intensities of the pixels in a first image from the set of images a local intensity value for the first image; establishing for at least one image intermediate the first and second images, a respective lower threshold that is dependent on at least the global intensity value and the local intensity value for the first image; and binarizing the at least one intermedite image according to the respective lower threshold to create a corresponding at least one mask for segmentation of the object of interest.

WO 2007/105107 A3

FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(88) Date of publication of the international search report:
24 January 2008

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/IB2007/001215

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

G06T 5/00 (2006.01)

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)

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)
DWPI, ESPACE, USPTO, FreePatentsOnline, IEEE (G06T+, threshold+, intensity+)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2000/004497 A1 (THE PERKIN-ELMER CORPORATION) 27 January 2000	1-35
A	US 5,982,916 A (KUHN) 9 November 1999	1-35
A	ARDEKANI et al. 'Region Based Fuzzy Clustering for Automated Brain Segmentation' In: Engineering in Medicine and Biology, 2002. 24th Annual Conference and the Annual Meeting of the Biomedical Engineering Society - IEEE, 2002, Vol.2, pages 1041-1042	1-35

☐ 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 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
28 September 2007	16 NOV 2007
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **TIM GILLETT** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : (02) 6222 3671

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2007/001215

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:
Please see continuation box III

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 additional fees, this Authority did not invite payment of additional fees.
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.:
1-35

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.

Supplemental Box
(To be used when the space in any of Boxes I to VIII is not sufficient)

Continuation of Box No: III

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

In assessing whether there is more than one invention claimed, I have given consideration to those features which can be considered to potentially distinguish the claimed combination of features from the prior art. Where different claims have different distinguishing features they define different inventions.

This International Searching Authority has found that there are different inventions as follows:

- Claims 1, 34 and 35: I consider that a method of finding a lower threshold for an image which is part of a set of images using both a global intensity derived from the set and a local intensity derived from the image constitutes a first distinguishing feature.

- Claims 36, 49, 50 and 67: I consider that a recursive method of segmenting a pixelated image whereby smaller structuring elements are used to erode and dilate a pixelated image until a certain criteria is reached constitutes a second distinguishing feature.

- Claims 68, 84, and 85: I consider that a method of processing a set of axial images whereby a first function is used to process those images taken at axial positions superior to a reference image and a second function is used to process those images taken at axial positions inferior to the reference image comprises a third distinguishing feature.

- Claims 86, 103 and 104: I consider that a method of restoring foreground components of an image whereby the foreground pixels of the image when eroded and dilated are taken as the foreground and the forground pixels of the image meeting certain criteria when binarised are taken as the background constitutes a fourth distinguishing feature.

- Claims 105, 112, 113 and 114: I consider that a method of removing non-brain fragments from an image whereby isolated components are removed one at a time dependant on a set of criteria for the components constitutes a fifth distinguishing feature.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

Each of the abovementioned groups of claims has a different distinguishing feature and they do not share any feature which could satisfy the requirement for being a special technical feature. Because there is no common special technical feature it follows that there is no technical relationship between the identified inventions. Therefore the claims do not satisfy the requirement of unity of invention *a priori*.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/IB2007/001215

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
WO	0004497	AU	49898/99	CA	2336885	EP	1095357
US	5982916	US	5896463				

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX