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(71) Applicant: **MINER S.R.L.** [IT/IT]; Via Benedetto Brin 55, 80142 Napoli (IT).

(72) Inventor: **AIELLO, Marco**; Via Benedetto Brin 55, 80142 Napoli (IT).

(74) Agent: **GARAVELLI, Paolo**; A.BRE.MAR. S.R.L., Via Servais 27, 10146 Torino (IT).

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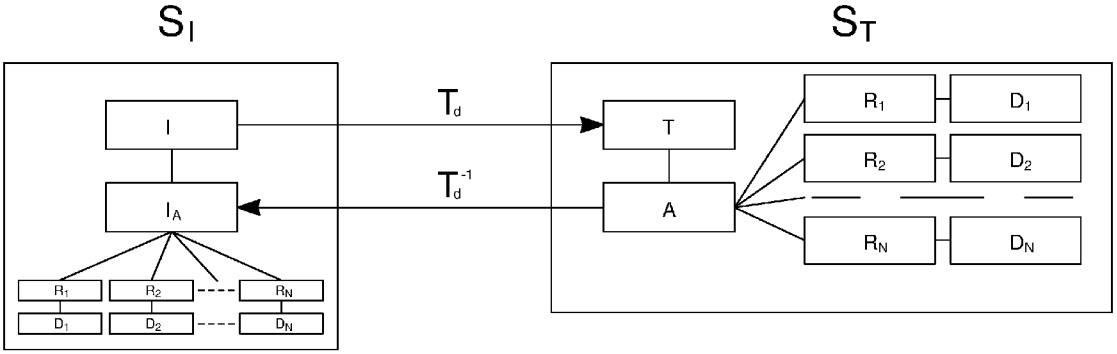

Fig. 1

(57) Abstract: A method for the didactic navigation of digital diagnostic images (I) is described, comprising the following steps: definition of a first space (SI) in which the digital diagnostic images are displayed (I); definition of a second template space (ST) in which a three-dimensional model (T) of the anatomical region is defined; construction of a digital atlas of human anatomy (A), starting from the three-dimensional model (T) and assigning to each voxel of the model the belonging to a remarkable anatomical region (R1, R2,.., RN), together with an appropriate didactic content (D1, D2,..., DN); transfer into the space of the original image (SI) of the classification of the anatomical regions (IA) together with the references to the anatomical regions (R1, R2,.., RN) and the related didactic contents (D1, D2,..., DN); implementation of an interactive navigation in such a way that it is possible to show the region of belonging (R1, R2,.., RN) together with an appropriate didactic content (D1, D2,..., DN).

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[Continued on next page]

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METHOD FOR THE DIDACTIC NAVIGATION OF DIAGNOSTIC IMAGES

The present invention relates to a method for the didactic visualization of diagnostic images.

The field of development of tools for the visualization of diagnostic images is extremely large and constantly growing. Despite this, the tools and technologies available are aimed at professional use by specialists who have adequate knowledge of human anatomy and the signal of tomography techniques, such as computed tomography or magnetic resonance. At the state of the art, there are no diagnostic image viewers that are intended for use by non-experts. This implies that the patients, who are ultimately the people most concerned, as these diagnostic images concern their health, are in fact excluded from the possibility of understanding directly, that is, without the intermediation of the healthcare professional where they are being treated, what is their state of health.

In this case it is necessary to devise technologies to automatically identify the anatomical sector in question and provide a description derived from a specially defined dictionary.

The limit of the state of the art consists mainly in the fact that there are no solutions that allow the didactic navigation of the images, a feature that necessarily involves the preparation of an atlas and a dictionary.

Object of the present invention is solving the problem of identifying, within the diagnostic images, the anatomical region concerned, framed for example by the mouse pointer, and show the user the name of the identified region and its description.

The above and other objects, as will be explained in the following, are achieved with a method, according to claim 1, for the didactic navigation of digital diagnostic images, in which said diagnostic images refer to an anatomical region.

This method is characterized by the following phases:

- definition of a first space in which said digital diagnostic images are displayed;

- definition of a second template space in which a three-dimensional model of said anatomical region is defined;

- construction of a digital atlas of human anatomy, starting from said three-dimensional model and assigning to each voxel of the model the belonging to a significant anatomical region, together with an appropriate didactic content;

- determination of a spatial transformation for the transfer into space of the original image of the classification of the anatomical regions together with the references to the anatomical regions and the related didactic contents;

- implementation of an interactive navigation in such a way that it is possible to show the region of belonging together with an appropriate didactic content.

Preferred embodiments and non-trivial variants of the present invention form the subject of the dependent claims.

The invention offers the possibility of introducing the concept of atlas to exploit co-registration algorithms to identify the regions within the image.

It is understood that all the attached claims

form an integral part of the present description.

The method according to the invention can be advantageously used for the development of a device and related software able to identify, within the diagnostic images, the anatomical region concerned and show the user the name of the identified region and the relative description.

This anatomical region can be selected by the user, for example, using the mouse pointer or a touch screen. At the same time, the user himself will be able to navigate within the program, receiving didactic information on the region itself, being able to access specific information on the anatomy and pathologies of that region.

It is immediately obvious that innumerable variations and modifications (for example relating to procedures, with equivalent functionality) can be made to what is described without departing from the scope of the invention, as appears from the attached claims.

The present invention will be better described by some preferred embodiments, provided by way of non-limiting example, with reference to FIG. 1 attached, which shows a diagram of the procedure for defining the regions and contents in the

diagnostic image being navigated.

The method according to the invention aims to solve the problem of navigation and interpretation of the content of the diagnostic images by subjects who do not have adequate knowledge of anatomy and radiology.

According to a preferred embodiment, the method envisages taking into consideration an anatomical region (for example the brain) and a diagnostic modality (for example magnetic resonance imaging - MRI). Digital diagnostic images (I) are formed of said anatomical region. In a suitable space (template space) a three-dimensional brain resonance model (T) of said anatomical region is defined, on which a digital atlas of human anatomy (A) is built, assigning to each voxel of the model the belonging to an anatomical region notable (for example, hippocampus). For each region a name and a description are defined with appropriate bibliographic references.

FIG. 1 shows a first space (SI), in which the original diagnostic image (I) is displayed, and a second template space (ST) in which said three-dimensional model (T) is defined.

Once said template space (ST) has been

properly defined, it is possible to estimate a deformable transformation (Td) from the original image space (SI) to the template space (ST), applying deformable or non-linear co-registration techniques to the image original (I).

Said first deformable transformation (Td) is obtained by means of first image processing means such as deformable co-registration algorithms which, with appropriate parameters, allow to detect an optimal transformation that brings the image in question on a template space, allowing a correspondence voxel to voxel between the two images.

In the template space ST, a digital atlas of human anatomy (A) is defined, providing an association between sets of voxels and anatomical region (Ri) and, for each anatomical region, an appropriate caption (Di).

By applying an inverse transformation (Td-1) to the digital atlas (A), it is possible to report in the space of the original image (SI) the classification of the regions (IA) of which it is composed, together with the related didactic contents.

Said second inverse transformation (Td-1) is

obtained through the inversion of the transformation matrix (Td), identified in the previous phase.

This procedure enables the possibility of implementing an interactive navigation of the images in which, when a pointer stops or selects a certain point, it is possible to show the anatomical region of belonging (R1, R2, .., RN) together to an appropriate didactic content (D1, D2, ..., DN) (for example, browsing the brain resonance images and focusing on a point, the procedure allows to identify the belonging of that point to the "hippocampus" region showing encyclopedic information on the hippocampal structure, its function and, possibly, appropriate links for further study).

Said interactive navigation of the images is obtained through third means of displaying the images, integrating the conventional display procedures.

CLAIMS

1. Method for the didactic navigation of digital diagnostic images (I), in which said diagnostic images (I) refer to an anatomical region, characterized in that it comprises the following phases:

- definition of a first space (SI) in which said digital diagnostic images (I) are displayed;
- definition of a second template space (ST) in which a three-dimensional model (T) of said anatomical region is defined;
- construction of a digital atlas of human anatomy (A), starting from said three-dimensional model (T) and assigning to each voxel of the model the belonging to a remarkable anatomical region (R1, R2, .., RN), together with an appropriate didactic content (D1, D2,…, DN);
- transfer into the space of the original image (SI) of the classification of the anatomical regions (IA) together with the references to the anatomical regions (R1, R2, .., RN) and the related didactic contents (D1, D2, ..., DN);
- implementation of an interactive navigation in such a way that it is possible to show the region of belonging (R1, R2, .., RN) together with an

appropriate didactic content (D1, D2,…, DN).

2. Method for the didactic navigation of diagnostic images according to claim 1, characterized in that said three-dimensional model (T) of said anatomical region is obtained by means of a first deformable transformation (Td), starting from said digital diagnostic images (I).

3. Method for the didactic navigation of diagnostic images according to claim 2, characterized in that said first deformable transformation (Td) is carried out by means of deformable or non-linear co-registration techniques of the original diagnostic image (I).

4. Method for the didactic navigation of diagnostic images according to claim 1, characterized in that said transfer in the space of the original image (SI) of the classification of the regions (IA) is carried out by means of a second inverse transformation (Td-1) of the digital atlas (A).

5. Method for the didactic navigation of diagnostic images according to claim 1, characterized in that said first deformable transformation (Td) is obtained by means of first image processing means, in particular co-registration algorithms which allow to identify a transformation spatial voxel-

to-voxel

6. Method for the didactic navigation of diagnostic images according to claim 1, characterized in that said second inverse transformation (Td-1) is obtained through the geometric inversion of the transformation matrix (Td) identified in the previous step.

7. Method for the didactic navigation of diagnostic images according to claim 1, characterized in that said interactive navigation of the images is obtained by means of third image display means on which the interaction functionality for the didactic display is integrated.

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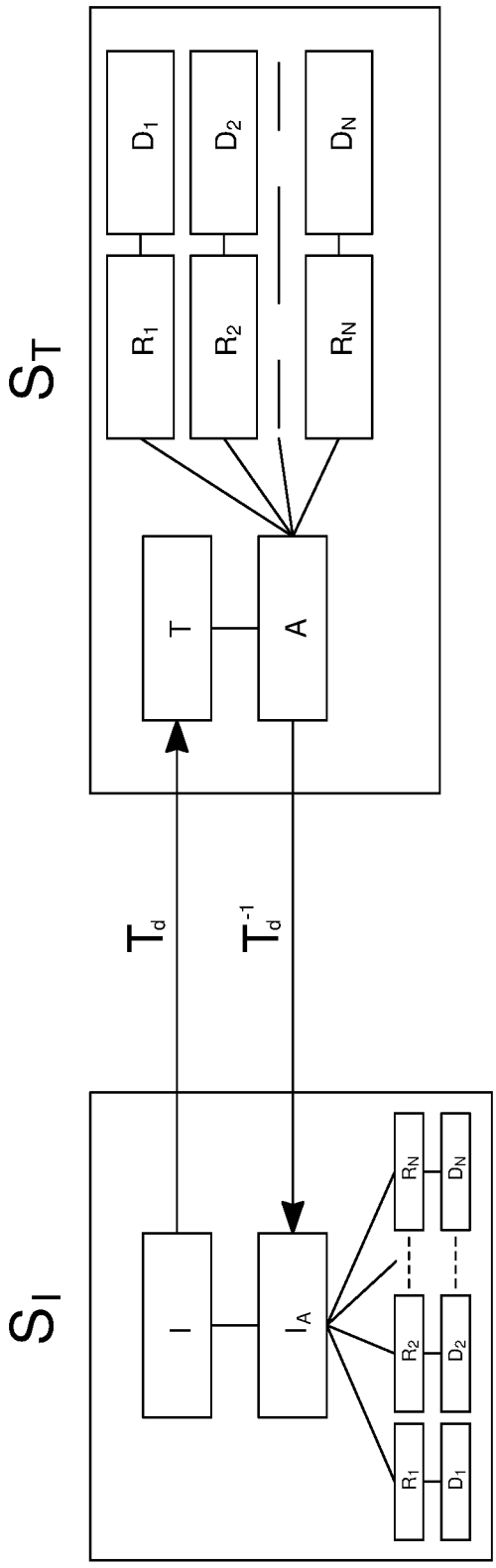

Fig. 1

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. G16H30/40 G16H40/67 G06T19/00
ADD.

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)
G16H 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 practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2016/155236 A1 (DAVEY ROBERT [GB]) 2 June 2016 (2016-06-02) abstract; figures 5-7 paragraph [0019] paragraph [0080] - paragraph [0086] paragraph [0136] - paragraph [0147] -----	1-7

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
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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, Fax: (+31-70) 340-3016	Menschner, Philipp

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2016155236 A1	02-06-2016	JP 6670595 B2	25-03-2020
		JP 2016101502 A	02-06-2016
		US 2016155236 A1	02-06-2016