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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte THOMAS BUELOW, RAFAEL WIEMKER, CRISTIAN LORENZ, STEFFEN RENISCH, and THOMAS BLAFFERT[1]

Appeal 2018-002744
Application 14/334,176
Technology Center 3700

Before DANIEL S. SONG, JAMES P. CALVE, and ARTHUR M. PESLAK, *Administrative Patent Judges*.

SONG, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

The Appellant appeals under 35 U.S.C. § 134(a) from the Examiner's Final Office Action ("Final Act.") rejecting claims 1, 6–10, and 15–19 in the present application. (App. Br. 10–12, Claims App.). We have jurisdiction under 35 U.S.C. §§ 6(b) and 134(a).

We REVERSE.

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[1] The Appellant is the Applicant, Koninklijke Philips N.V., which is identified as the real party in interest (Appeal Brief ("App. Br.") 2).

The claimed invention is directed to "[a]n imaging method for identifying abnormal tissue in the lung." (Abstract). Representative independent claim 1 reads as follows (App. Br. 10, Claims App., emphasis added):

> 1. A method, comprising
>
> recording slice images of a lung through X-ray radiation to produce slice images of the lung, each slice image corresponds to a different position of the lung, where at least one slice image of the slice images includes lung cavity, blood vessels and an abnormal tissue, wherein the lung cavity, the blood vessels and the abnormal tissue are represented through gray-scale values;
>
> *segmenting the blood vessels in the slice images of the lung, wherein the gray-scale values of the blood vessels are differentiated from the gray-scale values of the abnormal tissue* through eigenvalues of a Hessian matrix;
>
> removing the segmented blood vessels from the slice images of the lung; and
>
> *displaying at least one of the slice images of the lung with the removed segmented blood vessels on an output device.*

Independent claim 10 is directed to a computer tomograph that performs the method as substantially claimed in claim 1, and independent claim 19 is directed to a computer readable storage medium having instructions for causing a processor to perform the method as substantially claimed in claim 1. (App. Br. 10, Claims App. 11–12).

REJECTION

The Examiner rejects claims 1, 6–10, and 15–19[2] under 35 U.S.C. § 103 as obvious over Lin et al. (US 2004/0151356 A1, pub. Aug. 5, 2004 ("Lin")) in view of Reeves et al. (US 2004/0252870 A1, pub. Dec. 16, 2004 ("Reeves")). (Final Act. 5).

ANALYSIS

In rejecting the claims, the Examiner finds that Lin discloses the invention as substantially recited in claim 1, including wherein "the blood vessels and the abnormal tissues are represented through gray-scale values" and "identifying the blood vessels in the slice images of the lung . . . wherein the gray-scale values of the blood vessels are differentiated from the gray-scale values of the abnormal tissue through eigenvalues of a Hessian matrix." (Final Act. 5–6). In that regard, the Examiner finds the identification of blood vessels to be satisfied by Lin's disclosure of "enhancement filters; fig. 10b shows enhancement of abnormal tissue/nodules created in S23, fig. 2; fig. 10c shows enhancement of blood vessels created in S25, fig. 2; par. 0133-0142 teach eigenvalues of a Hessian matrix." (*Id.*). The Examiner also finds that

> it is unclear if Li teaches "segmenting" the blood vessels. Image segmentation is generally known in the art as partitioning image pixels and classifying the pixels into defined segments. Li demonstrates pixel assignment/segmentation of candidate nodules (S28, fig. 2) but does not expressly teach segmentation of entire blood vessels. Instead, only the blood vessel features

[2] Claim 21 has been canceled. (App. Br. 10–12, Claims App.).

> that overlap with the initial nodule candidates (S24, fig. 2) are clearly segmented (S26, fig. 2).

(Final Act. 5–6; *see also* Answer ("Ans.") 3–4).

To remedy this deficiency, the Examiner finds that Reeves discloses "segmentation of blood vessels from the C[omputed] T[omography] image data (fig. 8, par. 0055, 0089)," and removing "segmented structures adjacent to structures of interest (i.e. nodules)" to "enhance the display of the structures of interest (i.e. nodules) (par. 0105)." (Final Act. 6). The Examiner concludes that it would have been obvious to one of ordinary skill in the art to have provided "the line-enhanced image of Li as a blood vessel segmentation image in order to enhance the display of structures of interest (i.e. nodules) as taught by Reeves." (Final Act. 6).

The Appellant argues that the rejection is inadequate because "Li discloses segmenting nodules and not blood vessels." (App. Br. 5, citing Li ¶ 142; *see also* App. Br. 6 ("Li cannot remove something that is not detected"); Reply Br. 3). The Appellant also argues that "Li does not disclose segmenting blood vessels and then removing the segmented blood vessels from the image." (App. Br. 6, citing Li ¶ 142).

However, these arguments are not persuasive in view of the Appellant's Specification, which utilizes the term "segmentation" to refer to the broader process of identifying particular structure from an image, for removal, for example. (Spec. 1, ll. 27–29 ("known segmentation methods, in which slice images of structures of the object to be examined are subtracted from one another and individual structures are thereby removed from the resulting image"); 5, l. 33–6, l. 1 ("After recording the tomograms, interfering structures of the body are segmented, for instance, the heart or

the thoracic cage, that is, these are removed from the image"); 6, l. 4–5 ("After segmentation of the structures of the body, the lung cavity 5 and the blood vessels 6 are left, as illustrated")).

The Examiner explains that "Li creates a blood vessel image (i.e. line image) as shown in Fig. 10C. This can be considered a type of blood vessel 'segmentation' image because pixel values are assigned only to structures representing lines (i.e. blood vessels)." (Ans. 6). This image is "compared to the nodule candidate image" and "removed from the final nodule candidate image." (Ans. 6). In order for the invention of Li to identify and display the nodules, the remaining structures of the lung, including the blood vessels, must be identified for removal. Accordingly, we agree with the Examiner that "boundaries of blood vessels are implicitly determined in a segmentation image to demonstrate blood vessel/not blood vessel interface." (Ans. 8).

The Appellant rebuts that "Li does not disclose, suggest or imply segmenting blood vessels where the gray-scale values of the blood vessels are differentiated from gray-scale values of abnormal tissue." (Reply Br. 2). According to the Appellant, there is no indication that "line enhanced image" or "image filtering" as disclosed in Li would be understood by those of ordinary skill in the art as segmentation based on grey-scale values (Reply Br. 2). We find the Appellant's contention to be persuasive and determine that the rejection as presently set forth is inadequate.

While Li discloses segmentation in the sense of identifying non-nodule structure in the lungs, it utilizes *filtering* to enhance images to do so such that better identification of nodules can be attained. While the claims recite a specific manner of attaining segmentation, Li discloses applying dot, line, and

plane filters to enhance the image and to distinguish nodules from other structures within the lung. (Li ¶¶ 44–47, 50–54, 140, 142). We do not understand, nor has the Examiner adequately explained, how a filter-enhanced image disclosed in Li is an image "wherein the gray-scale values of the blood vessels are differentiated from the gray-scale values of the abnormal tissue" as required by the claims.

The claims further require the displaying of "at least one *slice image of the lung with the removed segmented blood vessels* on an output device." (*See e.g.*, App. Br. 10, Claims App. (claim 1)). It is unclear from the Examiner's rejection where Li discloses such a display. The Examiner explains that "Li suggests display of image of nodules (i.e. an image with blood vessels removed) because it is the intended use of his invention. As shown in Fig. 2, step S28 results in a nodule image wherein the blood vessels have been removed." (Ans. 7). However, the image displayed are 3-D images of just the nodules as generated using the disclosed enhancement filters, and are not two-dimensional slice images of the lung with segmented blood vessels removed as claimed.

The Appellant also argues that "Reeves does not cure the deficiencies of Li." (App. Br. 5). We generally agree. While the Examiner explains that Reeves "teaches that a blood vessel segmentation image, analogous to the line image of Li, is subtracted from a lung image" such that "only nodule candidates remain" (Ans. 6–7), such general disclosure, as applied by the Examiner, does not adequately address the above-noted deficiencies of Li pertaining to gray-scale, and display of at least one of the slice images of the lung with the blood vessels removed. In that regard, the Appellant is correct

that Reeves eliminates "structures which are not nodules, which suggests that lung cavity and nodules are not included together in any image contrary to the claim limitations." (Reply Br. 4).

According to the Examiner:

> [A]s evidenced by Li, Reeves, and the lack of detail in Appellant's disclosure, one of ordinary skill would recognize that image segmentation is highly routine in the art and provides highly predictable results. The steps of the claimed method do not appear to provide any technical advantage or benefit over that which is taught by Li and Reeves and generally known by one of ordinary skill in the image processing art.

(Ans. 7).

However, the Appellant is correct that a proper rejection is "not based on advantage or benefit" (Reply Br. 3), but instead, must be based on the claim language and the prior art as understood by those of ordinary skill.

Finally, the Examiner also responds that "[o]ne of ordinary skill in the art would also find it routine to selectively highlight the desired tissues for display (e.g. lung cavity, nodules, blood vessels)." (Ans. 8). While this reasoning may be true, it is still inadequate to address the deficiencies of Li, and the Examiner's rejection as noted above. To be clear, the record indicates the use of gray-scale values to differentiate the lung from other structures in the body appears to be well-known in the art. For example, step S22 labeled "Lung Segmentation" in Figure 2 of Li discloses such a technique. (*See also* Li ¶¶ 140, 142). Nonetheless, the rejection, as presently articulated, does not adequately address the actual claim language pertaining to the recited segmentation and displaying.

As noted by the Appellant "[c]laims 10 and 19 include similar limitations" to those of claim 1. (App. Br. 6). Therefore, in view of the above considerations, we reverse the Examiner's rejections of claims 1, 10, and 19. The remaining claims depend from one of these independent claims, and as such, we also reverse the rejection of these claims as well.

CONCLUSION

The Examiner's rejection is REVERSED.

REVERSED