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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte MEHDI HEDJAZI MOGHARI and
REZA NEZAFAT[1]

Appeal 2017-003933
Application 13/372,114
Technology Center 3700

Before DONALD E. ADAMS, TAWEN CHANG, and
KRISTI L. R. SAWERT, *Administrative Patent Judges*.

CHANG, *Administrative Patent Judge*.

DECISION ON APPEAL

This is an appeal under 35 U.S.C. § 134(a) involving claims to a method for producing an image of a subject with a magnetic resonance imaging (MRI) system, which have been rejected as directed to patent-ineligible subject matter and as obvious. We have jurisdiction under 35 U.S.C. § 6(b).

We REVERSE.

STATEMENT OF THE CASE

"Patient motion has been a long-standing challenge to clinical [magnetic resonance imaging (MRI)] procedures," because such motion can introduce errors and artifacts in the image. (Spec. ¶ 5.) In one prior art

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[1] Appellants do not identify the Real Party in Interest in the Brief.

method, motion artifacts resulting from patient respiration are mitigated by determining the location of the right hemi-diaphragm ("RHD") at end-expiration and placing a gating window around that position. (*Id.* ¶ 7.) The RHD position is then measured again before each acquisition of data (k-space lines),[2] and the data is accepted for image reconstruction only if the RHD position is within the gating window. (*Id.*) The Specification states that this approach "increases the duration of the MRI scan because the rejected k-space lines must be reacquired," and further results in "an unpredictable scan acquisition time." (*Id.*) Other prior art methods attempt to account for variations in patients' breathing patterns by, e.g., "track[ing] the position of the RHD at end-expiration and . . . updat[ing] the location of the gating window." (*Id.* ¶ 8.) According to the Specification, however, the scan acquisition times are still long and unpredictable when using these methods.

The Specification states that,

> [t]herefore, it would be desirable to have a system and method for mitigating patient motion artifacts in MRI that overcome the limitations of existing methods. Notable limitations include the presence of drifts and variations in a patient's breathing pattern not being accounted for, thereby generating residual motion artifacts. Notable limitations also include unpredictable scan times resulting

[2] K-space is "data matrix obtained directly from the magnetic resonance (MR) scanner before any kind of processing and the Fourier transform application, which will provide the final reconstructed image." D Moratal et al., *k-Space Tutorial: an MRI Educational Tool for a Better Understanding of k-Space*, Biomedical Imaging and Intervention Journal: A Multidisciplinary Online Journal (2008), http://www.biij.org/2008/1/e15/.

> from no *a priori* information as to how many repetitions will be required to obtain a complete k-space data set.

(*Id.* ¶ 10.) The Specification states that the invention provides a system and method in which "[an] adaptive gating window tracks the breathing pattern of the subject throughout the scan and adjusts the size of the gating window such that the gating efficiency is always fixed at a constant value," which system and method "allow free-breathing cardiac MRI in a relatively fixed time without compromising imaging quality due to respiratory motion." (*Id.* ¶ 18.)

Claims 1–14 are on appeal. Claim 1 is illustrative and reproduced below:

> 1. A method for producing an image of a subject with a magnetic resonance imaging (MRI) system, the steps of the method comprising:
>
> a) acquiring with an MRI system, navigator data from a subject;
>
> b) producing a gating window having a defined gating efficiency value using the navigator data acquired in step a);
>
> c) acquiring with the MRI system, image data from the subject while measuring a position of an anatomical location within the subject;
>
> d) storing the image data acquired in step c) for reconstruction when the position of the anatomical location measured in step c) is within the gating window, and discarding the image data acquired in step c) when the position of the anatomical location measured in step c) is outside the gating window;
>
> e) updating a size of the gating window using the position of the anatomical location measured in step c) while maintaining a substantially constant gating efficiency of the gating window;
>
> f) repeating steps c)-e) until a desired amount of image data has been acquired; and

g) reconstructing an image of the subject from the image data stored in step d).

(Appeal Br. A-1 (Claims App'x.).)

The Examiner rejects claims 1–14 under 35 U.S.C. § 101 as being directed to a judicial exception (i.e., a law of nature, a natural phenomenon, or an abstract idea) without significantly more. (Ans. 2.)

The Examiner rejects claims 1–3 and 7–11 under pre-AIA 35 U.S.C. § 103(a) as being unpatentable over Xu,[3] Feinberg,[4] and Finn.[5] (Ans. 4.)

The Examiner rejects claims 4–6 and 12–14 under pre-AIA 35 U.S.C. § 103(a) as being unpatentable over Xu, Feinberg, Finn, and Kolmogorov.[6] (Ans. 8.)

I.

Issue

The Examiner rejected claims 1–14 as being directed to a judicial exception without significantly more. In particular, the Examiner concludes that the claims are "directed to the production of a gating window that has a gating window efficiency value, which is an abstract idea fundamental in the practice of the art of image analysis" and "a fundamentally basic part of human intelligence." (Ans. 2–3.) The Examiner additionally concludes that

[3] Xu, US 2010/0234723 A1, published Sept. 16, 2010.
[4] David A. Feinberg et al., *Hybrid Ultrasound MRI for Improved Cardiac Imaging and Real-Time Respiration Control*, 63 MAGNETIC RESONANCE IN MEDICINE 290 (2010).
[5] J. Paul Finn et al., *Cardiac MR Imaging: State of the Technology*, 241 RADIOLOGY 338 (2006).
[6] Vladimir N. Kolmogorov et al., *Simultaneous Multiple Volume (SMV) Acquisition Algorithm for Real-Time Navigator Gating*, 21 MAGNETIC RESONANCE IMAGING 969 (2003).

the claimed invention "reads on mental activity." (*Id.* at 3, 12.) The Examiner concludes that, while the claims call for an MRI system, "the MRI system does not add significantly more than . . . mere computer algorithm," which would also be an abstract idea. (*Id.* at 10.) Finally, the Examiner finds that the "updating" limitation is "recited at such a high level of generality that it could potentially preempt any resizing of gating window in the art that would be done to accommodate a desired range." (*Id.* at 12.)

The Examiner finds that additional elements in the claim are routine and conventional and/or insignificant extra-solution activities that merely "link[] the abstract idea to a particular environment [i.e., magnetic resonance]," and that these elements are therefore not "sufficient to amount to significantly more than the judicial exception." (*Id.* at 2–3, 10–12.) The Examiner likewise finds that "[t]he claims . . . do not recite any means/steps of improvements to a technological field with the generic recitations; and/or improvements to the functioning of the computer." (*Id.* at 3, 11.)

The Examiner further concludes that dependent claims 2–8 and 10–14 are patent-ineligible because "the additional recited limitation(s) [in those claims] fail(s) to establish that the claim(s) is/are not directed to an abstract idea, as the additional elements/steps are also routine and conventional without any improvements." (*Id.* at 4.)

Appellants contend that the claims are not directed to an abstract idea, that they include "meaningful limitations that add significantly more than the mere computer implementation of an abstract idea," and that, when viewed as a whole, they recite methods "that provide[] an improvement in the technology of magnetic resonance imaging." (Br. 4.)

The issue with respect to this rejection is whether the Examiner erred in concluding that the claims on appeal are directed to patent-ineligible abstract ideas without significantly more.

Analysis

We analyze this case under the framework set forth by the Supreme Court in *Mayo Collaborative Servs. v. Prometheus Labs, Inc.*, 566 U.S. 66 (2012), and applied by our reviewing court in *Ariosa Diagnostics, Inc. v. Sequenom, Inc.*, 788 F.3d 1371 (Fed. Cir. 2015). As the *Ariosa* court explained:

> In *Mayo* . . . , the Supreme Court set forth a framework for distinguishing patents that claim laws of nature, natural phenomena, and abstract ideas from those that claim patent-eligible applications of those concepts. First, we determine whether the claims at issue are directed to a patent-ineligible concept. . . . If the answer is yes, then we next consider the elements of each claim both individually and "as an ordered combination" to determine whether additional elements "transform the nature of the claim" into a patent-eligible application. . . . The Supreme Court has described the second step of this analysis as a search for an "inventive concept"—*i.e.*, an element or combination of elements that is "sufficient to ensure that the patent in practice amounts to significantly more than a patent upon the [ineligible concept] itself."

Id. at 1375.

We begin with the first step of the *Mayo* test, namely whether a claim is "directed to" a patent-ineligible concept. On January 7, 2019, the Director of the USPTO issued the "2019 Revised Patent Subject Matter Eligibility Guidance" ("Revised Guidance"), which provides further details regarding how the Patent Office analyzes patent-eligibility questions under 35 U.S.C.

§ 101. 84 Fed. Reg. 50–57 (Jan. 7, 2019). Under the Revised Guidance, the first step of the *Mayo* test (i.e., Step 2A of the Revised Guidance) is "a two-pronged inquiry." *Id.* at 54. In prong one, we evaluate whether the claim recites a judicial exception, such as laws of nature, natural phenomena, or abstract ideas. *Id.* The Revised Guidance explains that

> the abstract idea exception includes the following groupings of subject matter, when recited as such in a claim limitation(s) (that is, when recited on their own or per se):
>
> (a) Mathematical concepts—mathematical relationships, mathematical formulas or equations, mathematical calculations;
>
> (b) Certain methods of organizing human activity—fundamental economic principles or practices (including hedging, insurance, mitigating risk); commercial or legal interactions (including agreements in the form of contracts; legal obligations; advertising, marketing or sales activities or behaviors; business relations); managing personal behavior or relationships or interactions between people (including social activities, teaching, and following rules or instructions); and
>
> (c) Mental processes—concepts performed in the human mind (including an observation, evaluation, judgment, opinion).

Id. at 52 (footnotes omitted). The Guidance states that, except in rare circumstances, "[c]laims that do not recite matter that falls within these enumerated groupings of abstract ideas should not be treated as reciting abstract ideas" and thus would be patent-eligible. *Id.* at 53.

We conclude that, under the Revised Guidance, the Examiner has not established a prima facie case that the claims on appeal are directed to a patent ineligible concept. The Examiner first concludes that the claims are directed to an abstract idea because "production of a gating window that has

a gating window efficiency" is "fundamental in the practice of the art of image analysis" and "a fundamentally basic part of human intelligence." (Ans. 2–3.)

We are not persuaded. The Examiner appears to contend that use of a "gating window that has a gating window efficiency" falls within "[c]ertain [patent-ineligible] methods of organizing human activity." Assuming for the sake of argument that the claims are indeed "directed to" "production of a gating window that has a gating window efficiency value," as the Examiner asserts, the Examiner provides no evidence or analysis showing how use of a gating window is a "fundamental *economic* principle[] or practice[]" such as hedging, insurance, or mitigating risk, a "*commercial or legal* interaction[]," or "managing *personal* behavior or relationships or interactions *between people*." 84 Fed. Reg. at 52 (emphasis added).

Neither are we persuaded by the Examiner's conclusion that the claimed invention "reads on mental activity" because the invention, "not requiring a particular machine, applies the abstract idea on a generic computer." (Ans. 3; *see also id.* at 12 (stating that "the steps [associated with MRI system] could be also performed by a human using mental steps or basic critical thinking").) As the Examiner concedes later in the answer, the claims require an MRI system, not a generic computer. (Ans. 10.) Neither does the Examiner explain how the steps associated with the MRI system, e.g., "producing a gating window having a defined gating efficiency value using the navigator data [from a subject] acquired [with an MRI system]," may be performed by a human using mental steps or basic critical thinking.

Finally, we are unpersuaded by the Examiner's conclusion that the claims are directed to a patent-ineligible abstract idea because "the MRI

system does not add significantly more than . . . mere computer algorithm." (*Id.* at 10.)[7] To the extent the Examiner asserts that the claims are directed to mathematical algorithms, the Examiner has not identified any specific mathematical algorithms recited by the claims.

Accordingly, we reverse the Examiner's rejection of claims 1–14 as being patent-ineligible for being directed to an abstract idea without significantly more.

II.

Issue

The Examiner rejected claims 1–3 and 7–11 as obvious over Xu, Feinberg, and Finn. The Examiner rejected claims 4–6 and 12–14 as obvious over Xu, Feinberg, Finn, and Kolmogorov. The same issues are dispositive for these rejections; we therefore discuss the rejections together.

The Examiner finds that Xu teaches all the limitations of independent claims 1 and 9, except Xu does not teach "discard[ing] the acquired image data when the measured position of the anatomical location is outside the gating window" and also does not teach "updat[ing] a size of the gating

[7] The Examiner also finds that the "updating" limitation is "recited at such a high level of generality that it could potentially preempt any resizing of gating window in the art that would be done to accommodate a desired range." (*Id.* at 12.) We are not persuaded. As an initial matter, the claims require updating a size of the gating window "while maintaining a substantially constant gating efficiency of the gating window," not any resizing of the gating window. (Br. A-1 (Claims App'x.)) Furthermore, as discussed above, the Examiner has not properly identified an abstract idea to which the claims are directed. Thus, the Examiner has not established a prima facie case that the claims will preempt *an abstract idea*, which is the relevant inquiry with respect to preemption in §101 patent eligibility analysis.

window using the measured position of the anatomical location while maintaining a substantially constant gating efficiency of the gating window." (Ans. 4–6.) The Examiner finds that Feinberg suggests the former limitation because it teaches tracking the position of the diaphragm to monitor respiration and "to decide whether to accept or reacquire the MR data in real time," where data was accepted only if it fell inside a predefined acceptance window. (*Id.* at 5.) The Examiner also finds that Finn suggests the latter limitation because it discloses a "sliding temporal window" that is updated and also teaches accepting data only if it is acquired within an acceptance window defined by diaphragm position. (*Id.* at 6.)

The Examiner concludes that it would have been obvious to an ordinarily skilled artisan to combine Xu, Feinberg, and Finn to arrive at the invention of claims 1 and 9, "in order to provide a fine acquisition matrix, extended coverage, and a high [signal-to-noise ratio (SNR)]," as discussed in Finn. (*Id.* at 6–7.)

With respect to dependent claims 3 and 11, the Examiner finds that, while Xu and Finn do not disclose "updating the motion profile using the position of the anatomical location," Feinberg teaches

> updat[ing] as soon as new positional data from the US system were available; the SSFP sequence moved to new acquisition locations without interrupting the sequence, using new position updates every eight echoes in an echo train of 128 echoes to make each image.
>
> In addition, Finn et al disclose during each cardiac cycle, the navigator signal updates the superior-to-inferior motion of the right hemidiaphragm.

(*Id.* at 7 (citations omitted).) The Examiner concludes that a skilled artisan would therefore have reason to combine Xu, Feinberg, and Finn by

"updating the motion profile using the position of the anatomical location," in order to "improve image quality and to provide a fine acquisition matrix, extended coverage, and a high signal to noise ratio," as discussed in Finn. (*Id.*)

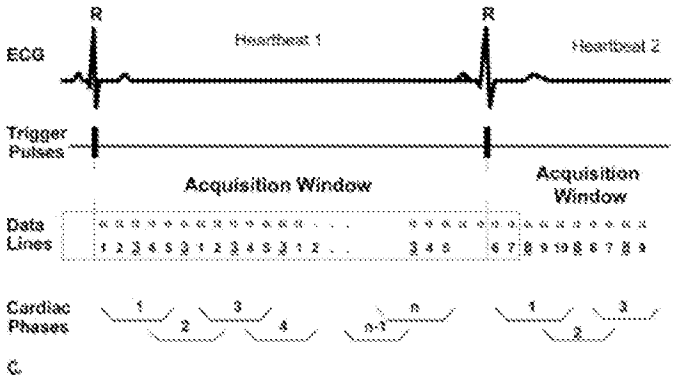
Appellants contend that the combination of Xu, Feinberg, and Finn does not teach or suggest "updating the size of a gating window while maintaining a constant gating efficiency" during an imaging session, as required by independent claims 1 and 9. (Br. 9–16.) With regard to claims 3 and 11, Appellants further contend that the combination of Xu, Feinberg, and Finn does not teach "updating [a] motion profile using the measured position of the anatomical location," as recited in those two claims. (*Id.* at 16–17.)

The issue with respect to this rejection is whether the Examiner erred in finding that the combination of Xu, Feinberg, and Finn suggests an MRI system, or a method for producing an image with an MRI system, comprising respectively a computer system programmed to update, or a step of updating, the size of a gating window using a measured position of an anatomical location while maintaining a substantially constant gating efficiency of the gating window, as recited in the independent claims on appeal.

Analysis

We agree with Appellants that the Examiner has not established a prima facie case that the combination of Xu, Feinberg, and Finn suggests updating the size of a gating window using a measured position of an anatomical location while maintaining a substantially constant gating efficiency of the gating window.

The Examiner contends that updating the size of a gating window is suggested by Finn's Figure 2c (Ans. 6), reproduced below:



(Finn 341, Figure 2c.) Figure 2c of Finn describes cardiac cine imaging with k-space segmentation[8] and echo-sharing.[9] (*Id.* at 339, right column–340, left column; *see also id.* at 341, Fig. 2 caption.) Finn explains that use of echo-sharing doubles "the number of frames (temporal resolution) . . . with little increase in imaging time." (*Id.* at 340, left column.)

The Examiner contends that Finn's Figure 2c suggests updating the size of a gating window because it teaches generating a "'sliding temporal window' that is five lines wide (which is the size of the window . . .) but is updated (meaning the size of the sliding window is updated . . .) almost twice as often as in the non-echo-shared version [of MRI]." (Ans. 6.)

We are not persuaded. The Examiner assumes, without providing any basis for the assumption, that Finn's reference to "updating" the "sliding temporal window" necessarily means updating the *size* of the window. As

[8] K-space segmentation involves "acquisition of multiple lines . . . of data after a single ECG trigger pulse," wherein "the sum of the[] lines form[] a segment of k-space." (Finn 339, right column.)

[9] Echo-sharing involves "acquisition of the central k-space point twice as often as the other k-space points and selection of appropriate neighboring points to fill the k-space segment." (*Id.* at 340, left column.)

Appellants point out, to the extent the Examiner asserts that the "size" of the sliding temporal window refers to the number of lines (i.e., five) in the window, the Examiner has not pointed to any "sliding temporal window" in Figure 2c that contains anything other than five lines of data. (Br. 13.) Thus, it is unclear how Figure 2c shows updating the *size* of a window. We also agree with Appellants that the Examiner has failed to explain how the "sliding temporal window" in Finn's Figure 2c may be considered a "gating" window or how the "sliding temporal window" is updated using the position of a measured anatomical position, as required by the claims. (*Id.* at 12–13.)

We also agree with Appellants that the Examiner has not established a prima facie case that the combination of cited prior art suggests updating a size of the gating window "while maintaining a substantially constant gating efficiency of the gating window," as required by the claims.

In the Answer, the Examiner responds to Appellants' arguments by asserting that Feinberg teaches respiratory gating combined with adaptive line-reordering algorithm, where "[t]he tracked position of the diaphragm was used to monitor respiration and to decide whether to accept or reacquire the MR data . . . in real time" and "the acceptance window position was dynamically adjusted during measurement." (Ans. 12–14.) The Examiner asserts that Feinberg teaches that "accessing the respiration position several times during the ECG cycle and using an adequate data reordering scheme may thus help to considerably improve image quality and scan efficiency." (*Id.* at 13.)

We are not persuaded. Feinberg teaches "[a] hybridized dual-imaging system combining real-time ultrasound imaging and MRI . . . for cardiac imaging." (Feinberg Abstract.) While Feinberg does teach using the

ultrasound-tracked position of the diaphragm to decide whether to accept or reacquire MR data in real time, as well as dynamically adjusting the acceptance window *position* (*id.* at 3, left column), the Examiner has not pointed to any teachings in Feinberg regarding updating a *size* of the gating window.

As to the limitation relating to "maintaining a substantially constant gating efficiency of the gating window" while updating a size of the gating window, the Examiner asserts:

> Inherently, every gating window has an initial gating efficiency value predetermined as the threshold for acceptable image quality and since gating efficiency value links to window, it would be expected that the initial value or threshold value inherently disclosed relied on the numerical value to maintain image quality. Regarding "substantially constant" gating efficiency, it is not clear what Applicant intends with this broad limitation that is given limited patentable weight because it appears to be referring to an intended result – it is not apparent what enables this result to be achieved. Taking the broadest reasonable interpretation of the term that is not specifically defined in the disclosure, Examiner submits that conventional respiratory gating linked to a regular cycle would appear to achieve the result that is broadly claimed.

(Ans. 13.)

We are not persuaded. To the extent the Examiner asserts that a skilled artisan would not understand the meaning of the phrase "substantially constant gating efficiency," the proper rejection is indefiniteness rather than obviousness based on reading out the limitation. *In re Wilson*, 424 F.2d 1382, 1385 (CCPA 1970) ("All words in a claim must be considered in judging the patentability of that claim against the prior art. If no reasonably definite meaning can be ascribed to certain terms in the claim, the subject

matter does not become obvious—the claim becomes indefinite.") Likewise, assuming for argument's sake that the Specification fails to enable maintaining a substantially constant gating efficiency of the gating window while updating a size of the window, as the Examiner asserts, the proper rejection is not obviousness but non-enablement. Finally, the Examiner fails to cite any evidence that, under the broadest reasonable interpretation of the limitation, conventional respiratory gating linked to a regular cycle would inherently "maintain[] a substantially constant gating efficiency of the gating window" while updating a size of the window. Indeed, the Examiner fails to provide an explanation of what such "broadest reasonable interpretation" of the limitation would be.

Accordingly, we reverse the Examiner's rejection of independent claims 1 and 9 as obvious over Xu, Feinberg, and Finn. We likewise reverse the Examiner's obviousness rejections of claims 2–8 and 10–14, which depend directly or indirectly from claims 1 and 9. "Dependent claims are nonobvious under section 103 if the independent claims from which they depend are nonobvious." *In re Fine*, 837 F.2d 1071, 1076 (Fed. Cir. 1988).

SUMMARY

For the reasons above, we reverse the Examiner's decision rejecting claims 1–14.

REVERSED