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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte RAMAKRISHNA MUKKAMALA,
GOKUL SWAMY, and NICHOLAS BARI OLIVIER

Appeal 2017-000995
Application 12/993,544[1]
Technology Center 3700

Before: STEVEN D. A. McCARTHY, NATHAN A. ENGELS, and PAUL J. KORNICZKY, *Administrative Patent Judges*.

ENGELS, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Appellants appeal under 35 U.S.C. § 134 from a rejection of claims 1–4, 8–23, 26–33, 35, 36, 40, and 44–54. No other claims are pending. We have jurisdiction under 35 U.S.C. § 6(b).

We reverse.

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[1] Appellants identify the Board of Trustees of Michigan State University as the real party in interest. Appeal Br. 3.

THE CLAIMED SUBJECT MATTER

"[Appellants'] invention pertains generally to a technique for determining central aortic pressure from a single peripheral artery pressure waveform." Appeal Br. 7; *accord* Spec. ¶ 3. Central aortic pressure ("AP") is a measure of blood pressure within the aortic artery, which conducts blood from the heart to other portions of the body. Peripheral artery pressure ("PAP") is a measure of blood pressure in a peripheral artery, away from the heart. According to the Specification:

> As the arterial pressure wave traverses from the central aorta to the peripheral arteries, its contour becomes significantly distorted due to wave reflections in the arterial tree. Most notably, both systolic (maximum) pressure and pulse pressure (systolic minus diastolic (minimum) pressure) become amplified, with the extent of the amplification dependent on the circulatory state. Thus, it is the systolic and diastolic pressures measured specifically in the central aorta that truly reflect cardiac afterload and perfusion.

Spec. ¶ 4.

Although the AP waveform provides superior information regarding cardiac performance, it cannot be measured directly, such as by catheterization of the aortic artery, without subjecting the patient to undue risk of clot formation and embolism. Therefore, it was known to be desirable to measure the AP waveform indirectly, using a single PAP waveform. *See* Spec. ¶ 5. Nevertheless, known techniques for estimating the AP waveform from a single PAP waveform failed to account for differences in the behavior of the arterial tree from patient-to-patient, and

over time. *See* Spec. ¶ 7. Appellants' invention is directed to overcoming those problems.

Claims 1, 11, and 54 are independent claims. Claim 1, reproduced below, is illustrative of the claimed subject matter:

> 1. A method for determining a central aortic pressure (AP) waveform for a subject, comprising:
>
> measuring, by a sensor, a peripheral artery pressure (PAP) waveform from the subject;
>
> deriving a mathematical transformation relating PAP to AP using a distributed model, the transformation is defined in terms of unknown parameters;
>
> estimating, by a computing device, the unknown parameters by minimizing a variable representing the magnitude of central arterial flow during diastole when applied to the PAP waveform, wherein estimating the unknown parameters uses only one PAP waveform measured from the subject; and
>
> determining, by the computing device, the AP waveform for the subject by applying the derived mathematical transformation to the measured PAP, where the steps of estimating and determining are implemented by computer-executable instructions executed by a computer processor of the computing device.

THE REJECTION

Claims 1–4, 8–23, 26–33, 35, 36, 40, and 44–54 stand rejected under 35 U.S.C. § 101 as being directed to non-patentable subject matter.

ANALYSIS

"Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereto, may obtain a patent therefor, subject to the conditions and requirements of this title." 35 U.S.C. § 101. The Supreme Court has

recognized exceptions excluding from patentability laws of nature, physical phenomena, and abstract ideas. *See Bilski v. Kappos*, 561 U.S. 593, 601 (2010).

According to the Supreme Court, a two-step analysis is to be used to determine whether the subject matter of a claim falls within one of the exceptions to patent eligibility. First, one must determine whether the claim is "directed to one of [the] patent-ineligible concepts." *Alice Corp. Pty. Ltd. v. CLS Bank Int'l*, 134 S.Ct. 2347, 2355 (2014). Second, if so, one must determine if the remainder of the claim recites an "inventive concept," such that the claim as a whole recites a specific application of the patent-ineligible concept. *Id.* at 2357–58.

For claims that include computer-related technology, the first step of the *Alice* analysis includes identifying with specificity what the claims are directed to, *Thales Visionix Inc. v. United States*, 850 F.3d 1343, 1347 (Fed. Cir. 2017), and "ask[ing] whether the claims are directed to an improvement to computer functionality versus being directed to an abstract idea." *Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1327, 1335 (Fed. Cir. 2016). Although numerous decisions have held claims ineligible as directed to an abstract idea where the claims recite a mere collection of electronic information, display of information, or mental processes that could be performed by humans, *Elec. Power Grp., LLC v. Alstom S.A.*, 830 F.3d 1350, 1353–54 (Fed. Cir. 2016) (collecting cases), the Federal Circuit has explained that "[w]e must . . . ensure at step one that we articulate what the claims are directed to with enough specificity to ensure the step one inquiry is meaningful." *Thales*, 850 F.3d at 1347.

Here, the Examiner states that Appellants' claims are "directed to the abstract idea of an algorithm for determining a central aortic pressure waveform from a periphery artery pressure waveform." Final Act. 3. Further, the Examiner states "the abstract idea is directed to the deriving, estimating, and determining steps which are clearly mathematical functions" performed on generic computers. Ans. 2.

Although Appellants' invention certainly involves mathematics, recognition of that fact does not end the analysis required for step one. As the Federal Circuit has explained, "[t]hat a mathematical equation is required to complete [a claimed method] does not doom the claims to abstraction." *Thales*, 850 F.3d at 1349. Claims must be considered in their entirety to ascertain whether their character as a whole is directed to excluded subject matter. *McRo, Inc. v. Bandai Namco Games Am. Inc.*, 837 F.3d 1299, 1312 (Fed. Cir. 2016).

The Examiner's analysis focuses on the mathematics involved in Appellants' claims without proper consideration of the particular steps and context recited in Appellants' claims. As noted above, Appellants' invention recites a method for determining aortic pressure from measurements of peripheral artery pressure by deriving a mathematical transformation relating peripheral artery pressure to aortic pressure using a distributed model with unknown parameters; and estimating the unknown parameters by minimizing a variable representing the central arterial flow during diastole. As additional context, Appellants' Specification explains that "[t]he key innovation is to fully adapt the mathematical transformation relating PAP to AP to the inter-subject and temporal variability of the arterial tree by using a distributed model in conjunction with the fact that

central aortic flow is negligible during the diastolic intervals due to aortic valve closure." Spec. ¶ 22.

By reducing Appellants' invention to the abstract idea of an algorithm or mathematical functions performed on generic computers, the Examiner's analysis failed to consider the invention as a whole, in contravention of the controlling case law. Accordingly, we do not sustain the Examiner's rejections of claims 1–4, 8–23, 26–33, 35, 36, 40, and 44–54.

DECISION

We reverse the Examiner's rejection of claims 1–4, 8–23, 26–33, 35, 36, 40, and 44–54.

REVERSED