Paper No. 1

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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APPLE INC.,
Petitioner,

v.

OMNI MEDSCI, INC.,
Patent Owner.

Patent No. 9,757,040

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*Inter Partes* Review No. IPR2019-00917

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**Petition for *Inter Partes* Review of**
**U.S. Patent No. 9,757,040**

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| 1021 | Patel, et al., A review of wearable sensors and systems with application rehabilitation, Journal of Neuroengineering & Rehabilitation (2012) |
| 1022 | ScienceDirect Report on M. Kranz, et al., The mobile fitness coach: Towards individualized skill assessment using personalized mobile devices, Pervasive and Mobile Computing (2012), available at https://www.sciencedirect.com/science/article/pii/S1574119212000673?via%3Dihub |
| 1023 | "The Usage of Tablets in the HealthCare Industry," by Rauf Adil, available at https://www.healthcareitnews.com/blog/usage-tablets-healthcare-industry (Aug. 2, 2012) |
| 1024 | A. Omre, Bluetooth Low Energy: Wireless Connectivity for Medical Monitoring, Journal of Diabetes Science & Technology (Mar. 2010) |
| 1025 | 1. Absorption Coefficient and Penetration Depth, available at https://eng.libretexts.org/Bookshelves/Materials_Science/Supplemental_Modules_(Materials_Science)/The_Science_of_Solar (Accessed October 29, 2018) |
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| 1027 | P. Baum, et al., Strategic Intelligence Monitor on Personal Health Systems, Phase 2: Market Developments - Remote Patient Monitoring and Treatment, Telecare, Fitness/Wellnes and mHealth, JRC Scientific and Policy Reports of European Commission (2013) |
| 1028 | Compendium of Chemical Terminology Gold Book Version 2.3.3, February 24, 2014 |
| 1029 | M. Swan, Senior Mania! The Internet of Things, Wearable Computing, Objective Metrics, and the Quantified Self 2.0, Journal of Sensor and Actuator Networks (2012) |
| 1030 | Merriam-Webster’s Collegiate Dictionary, Eleventh Edition |
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| 1033 | Lister et al., Optical properties of human skin (Journal of Biomedical Optics 2012) |
| 1034 | Bashkatov et al., Optical properties of human skin, subcutaneous and mucous tissues in the wavelength range from 400 to 2000 nm, Journal of Physics D: Applied Physics (2005) |

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| 1035 | E.F. Schubert, Light-Emitting Diodes (Cambridge Univ. Press, 2nd ed. reprinted 2014) |
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| 1048 | U.S. Patent No. 6,044,283 |
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| 1050 | U.S. Patent No. 5,855,550 |
| 1051 | U.S. Patent No. 6,898,451 |
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| 1054 | Dr. Mohammed Islam, Faculty Profile, University of Michigan, College of Engineering (available at https://islam.engin.umich.edu) |
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## Petitioner's Mandatory Notices

### A. Real Party in Interest (§42.8(b)(1))

The real party in interest of this petition pursuant to § 42.8(b)(1) is Apple Inc. ("Apple") located at One Infinite Loop, Cupertino, CA 95014.

### B. Other Proceedings (§42.8(b)(2))

#### 1. Patents and Applications

U.S. Patent No. 9,757,040 ("the '040 Patent") is related to the following issued patents or pending applications:

- U.S. Patent No. 9,500,635
- U.S. Patent No. 9,861,286
- U.S. Patent No. 10,085,546
- U.S. Application No. 16/016,649

#### 2. Related Litigation

The '040 Patent has been asserted in the following litigations:

- *Omni MedSci, Inc. v. Apple Inc.*, Action No. 2-18-cv-00134-RWS (pending).

#### 3. Patent Office Proceedings

The '040 Patent is the subject of IPR2019-00910 filed by Apple. The '040 is related to U.S. Patent No. 9,861,286, which is subject to IPR2019-00914 and IPR2019-00911 filed by Apple.

### C. Lead and Backup Lead Counsel (§42.8(b)(3))

Lead Counsel is: Jeffrey P. Kushan (Reg. No. 43,401), jkushan@sidley.com, (202) 736-8914. Back-Up Lead Counsel are: Ching-Lee Fukuda (Reg. No. 44,334), clfukuda@sidley.com, (212) 839-7364; and Thomas A. Broughan III (Reg. No. 66,001), tbroughan@sidley.com, (202) 736-8314.

### D. Service Information (§42.8(b)(4))

Service on Petitioner may be made by e-mail (iprnotices@sidley.com), mail or hand delivery to: Sidley Austin LLP, 1501 K Street, N.W., Washington, D.C. 20005. The fax number for lead and backup lead counsel is (202) 736-8711.

## I. Introduction

Health monitoring systems based on optical sensors, which measure physiological parameters of a user based on light interaction with the user's tissue and blood, have been ubiquitous for decades. Once found only in hospitals and doctor's offices, these systems are now mainstream consumer devices. Over time, they evolved to become smaller, digital, wireless, and Internet-connected, an evolution driven by several market trends and forces. One sought to meet the needs and convenience of users for such devices to be wearable, unobtrusive and mobile. Another addressed the need to integrate these devices into a digital data processing environment based on real-time collection and delivery of user data. A third responded to consumer demand for personal health and fitness monitoring devices.

By 2012, the prior art described numerous wearable optical sensing devices with common attributes. They used LEDs emitting light at multiple wavelengths; were small, battery-powered and wearable on the wrist or ear; and could wirelessly communicate with other devices. This prior art also described solutions to the various challenges of developing such devices, including mitigating noise caused by user movement and ambient light, minimizing power consumption, and arranging the electronic and optical components within the smallest possible space.

Relative to this extensive body of prior art, contested claims 1-4 of the ’040 Patent recite nothing inventive. Rather, they cobble together well-known techniques for improving a signal-to-noise ratio with routine and predictable combinations of known optical components, which a well-known textbook describes as the “basic building blocks” of optical sensors. *See* Ex.1019 (“BE Handbook”), 765.

For example, U.S. Patent No. 9,596,990 (“Park”) (Ex.1010) describes a wearable device by FitBit that includes a conventional optical sensor in a wristband that wirelessly communicates with an external device such as a smart phone or tablet. Park recognizes the importance of using an optical sensor that produces accurate physiological data, and a skilled person would have turned to other references, such as Lisogurski (Ex.1011), Hanna (Ex.1007) and Mannheimer (Ex.1008), for descriptions of specific techniques for improving the accuracy of Park’s sensor. These references describe conventional techniques that correspond to those recited in the contested claims. Lisogurski teaches a “dark subtraction” technique for removing ambient noise from a signal of interest, while Hanna teaches modulating light to include information so that a signal of interest can be better detected. Mannheimer teaches how to spatially arrange multiple emitters and detectors in an optical sensor to remove noise interference from skin.

As described below, claims 1-3 would have been obvious to a skilled person based on Park in combination with Lisogurski. To the extent Patent Owner contends that neither Park nor Lisogurski teaches modulating to include information, Hanna provides that teaching. Dependent claim 4 would have been seen as an obvious variation of either of these combinations based on Mannheimer. Petitioner therefore respectfully requests that trial be instituted and claims 1-4 be cancelled.

## II. Regulatory Information

### A. Certification that Petitioner May Contest the ’040 Patent (§ 42.104(a))

Petitioner certifies that the ’040 Patent is available for *inter partes* review. Petitioner also certifies it is not barred or estopped from requesting *inter partes* review of the claims of the ’040 Patent. Neither Petitioner, nor any party in privity with Petitioner, has filed a civil action challenging the validity of any claim of the ’040 Patent. The ’040 Patent has not been the subject of a prior *inter partes* review by Petitioner or a privy of Petitioner.

Petitioner also certifies this petition for *inter partes* review is timely filed as this petition was filed less than one year after April 10, 2018, the date Petitioner was first served with a complaint alleging infringement of a claim of the ’040 Patent. *See* 35 U.S.C. § 315(b); Ex.1004.

### B. Identification of Claims Being Challenged (§ 42.104(b))

Claims 1-4 are unpatentable based on the following grounds.

(i) **Claims 1-3** would have been obvious under 35 U.S.C. § 103 based on U.S. Patent No. 9,596,990 ("Park") (Ex.1010), in combination with U.S. Patent No. 9,241,676 ("Lisogurski") (Ex.1011).

(ii) **Claims 1-3** also would have been obvious under § 103 based on Park and Lisogurski in view of U.S. Patent No. 6,505,133 ("Hanna") ("Ex.1007").

(iii) **Claims 4** would have been obvious under § 103 based on Park and Lisogurski, alone or with Hanna, in combination with U.S. Patent No. 5,746,206 ("Mannheimer") (Ex.1008).

### C. Fee for *Inter Partes* Review (§ 42.15(a))

The Director is authorized to charge the fee specified by 37 C.F.R. § 42.15(a) to Deposit Account No. 50-1597.

### D. Service on Patent Owner (§ 42.105)

Omni MedSci, Inc. is identified as the patent owner of record in the assignment records for the '040 Patent. The named inventor of the '040 Patent, Dr. Islam, has been a member of the faculty of the University of Michigan since 1992. Ex.1054. Based on the University of Michigan Bylaw 3.10 and Technology Transfer Policy, the University of Michigan is the owner of the '040 Patent. Ex.1055, Ex.1056 at 21-22. Dr. Islam has also purported to assign the patent to OmniMedSci. *Id*. Petitioner has thus served this petition on both the University of Michigan and Omni MedSci.

## III. Background Technology

### A. Photoplethysmography

Optical health monitors use a sensing technique called photoplethysmography ("PPG") that has been known and used for decades in medical monitoring systems. Ex.1003, ¶38; Ex.1019, 769-76, 1346-55 (discussing oximetry and other applications). PPG works by shining light through a person's tissue and measuring the light that is either reflected back or transmitted through the tissue. Ex.1019, 766. Different components of blood and tissue absorb and reflect different wavelengths of light. Ex.1003, ¶39. By measuring how much light is absorbed and how the absorption changes over time, a device can calculate the components of the blood and tissue. *Id*.

For example, hemoglobin (the substance in blood that carries oxygen to cells) reflects more red light when it is oxygenated and absorbs more red light when it is deoxygenated. Ex.1019, 769; *see* Ex.1003, ¶40. Hemoglobin, however, reflects the same amount of infrared (IR) light whether oxygenated or deoxygenated. Ex.1019, 769. If a device measures the absorbed red and IR light multiple times per second, the device can determine several things: (i) the ratio of oxygenated to deoxygenated hemoglobin (oxygen saturation), and (ii) how the volume of blood in the tissue changes over time, allowing it to detect a person's pulse. Ex.1019, 769, 771; Ex.1003, ¶40.

PPG is an optical technique, and as such, it uses conventional optical components. Ex.1003, ¶41. The 1995 BE Handbook explains that the "basic building blocks" of optical sensor systems include lenses, mirrors, filters, beam splitters, light sources, fiber optics, and detectors (Ex.1019, 765), and illustrates their use in an exemplary device below:

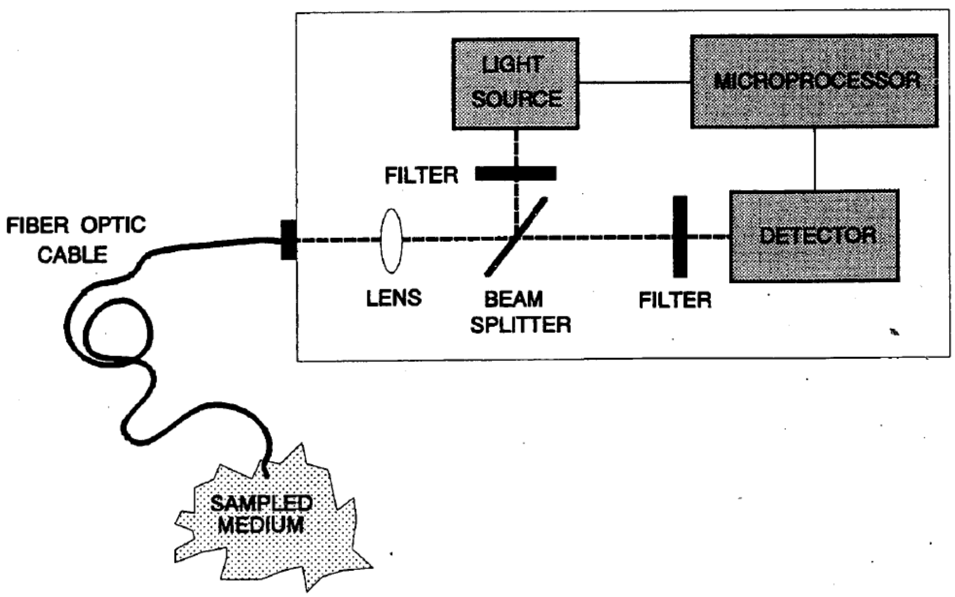



FIGURE 52.1 General diagram representing the basic building blocks of an optical instrument for optical sensor applications.

Ex.1019, 765.

Portable devices conventionally use light emitting diodes (LEDs) as the light source because LEDs are small and have low power requirements. Ex.1019, 765; Ex.1003, ¶41. As shown in the figure above, the light from the LED is directed through a lens and onto a sample. Ex.1019, 765. The light reflects back from the sample, is filtered, and sensed by a photodetector. Ex.1019, 765; Ex.1003, ¶¶41-44. The photodetector outputs a signal proportionate to the measured light intensity, and then analog-to-digital conversion and signal processing are performed to extract data. Ex.1019, 766. To improve the signal-to-noise ratio, the light source is typically modulated, and the detector uses "synchronized lock-in amplifier detection" to isolate signals that occur at the modulation frequency. Ex.1019, 764, 766. This allows the detector to reduce the noise in the detected signal. Ex.1003, ¶¶45-46.

### B. Prevailing Industry Trends Before 2012

From 2000 to 2012, several market trends and needs were driving the medical device industry to develop wearable, mobile sensor devices that could wirelessly communicate user data to remote devices. Ex.1003, ¶49.

One pronounced market need during this period was the challenge of providing medical care for patients in their homes or other locations where there was not easy access to a physician. This drove development of wireless monitoring technologies that could be worn by the patient and used to transmit data to a remote physician or care provider. Ex.1021, 2; Ex.1024, 462; Ex.1027, 15-31; *see* Ex.1003, ¶¶49, 53-54.

Another trend during this period was to bring heart rate sensing devices based on pulsoximetry to the consumer market for personal fitness tracking and other uses. Ex.1003, ¶¶50-51. This trend was reflected in numerous references published before and around 2012. For example, a June 2012 review observed:

> A multitude of commercial health devices and sensors, such as oximeters and heart rate monitors, formerly reserved for professional use, are now available and can be connected to smartphones. GPS watches, pedometers and heart rate monitors, allow recording and tracking of physical activity.

Ex.1020, 3; *see also, e.g.*, Ex.1007, [0004] ("Pulsoximetry measuring devices are also used in sports for control and survey of athletes."); Ex.1029, 221 ("Wristband sensors are a predecessor to smartwatches and remain a successful product category on their own…"); Ex.1005, [0003] ("There is growing market demand for personal health… monitors, for example, for gauging overall health, fitness, metabolism, and vital status during exercise, athletic training…"); Ex.1027, 33, 35.

A third trend was to take advantage of the miniaturization of electronics and communication technology, which led to the development of smaller, wearable monitoring systems for mobile health and fitness applications. Ex.1021, 3; Ex.1020, 2; *see* Ex.1003, ¶52.

A fourth trend in the medical industry was to use apps and smartphones to not only deliver care to patients but to give individuals access to health data for fitness or health issues. This drove integration of miniaturized, network-connected monitoring devices with smartphones and similar devices. Ex.1027, 9-10, 40-49; Ex.1023, 1-2 ("Doctors and nurses were the early adopters of tablets"); Ex.1021, 4; *see* Ex.1023, 5 (One of "the biggest usage of tablets stems from… [p]atient monitoring and data collection…, includ[ing] using the Bluetooth enabled sensor devices and Wi-Fi+ Bluetooth enabled interfaces to patient monitoring devices, to medical instruments that can transmit information to the tablet when in the vicinity."); Ex.1027, 41; *see* Ex.1003, ¶¶52-53. It also led to the prevalent use of cloud-based data transfer and storage of data. Ex.1003, ¶53.

Before 2012, the combined effect of these market trends was to provide a strong motivation to integrate medical optical sensing techniques into wearable consumer devices and to enable them to communicate wirelessly with smart devices and remote services. Ex.1003, ¶¶50-51. These trends led to a proliferation of products before 2012 that shared this distributed architecture supporting personal health, sports, and mobile monitoring systems. Ex.1003, ¶54.

One illustration of that architecture was reported in Patel 2012 (Ex.1021):

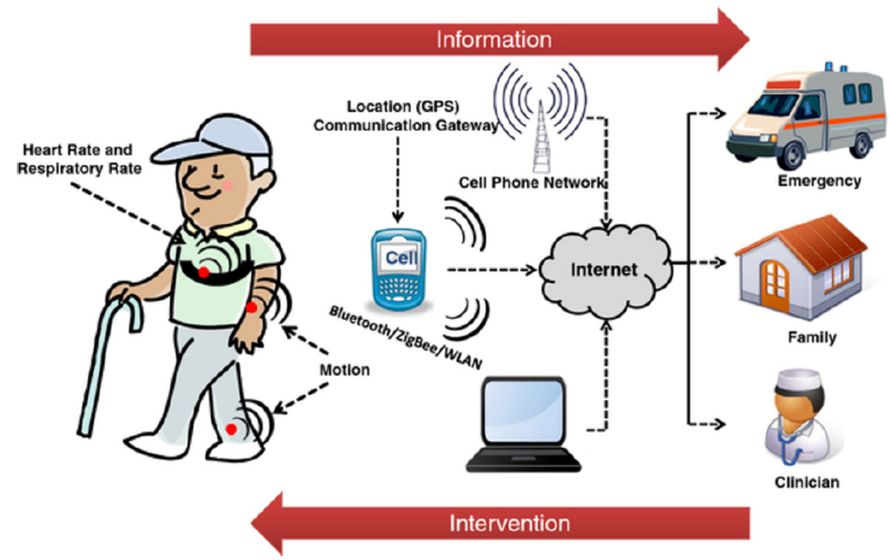



**Figure 1 Illustration of a remote health monitoring system based on wearable sensors.** Health related information is gathered via body-worn wireless sensors and transmitted to the caregiver via an information gateway such as a mobile phone. Caregivers can use this information to implement interventions as needed.

Ex.1021, 2. As this figure illustrates, data from wearable sensors is transmitted to a cell phone, which in turn transmits the data, along with GPS information, to remote devices used by a clinician or maintained by an emergency responder. The data also is shown being transmitted to and stored in the cloud. Ex.1021, 4.

A 2010 publication described a similar architecture in which "medical data can be sent from a wireless monitor to a cell phone or PC and from there to a remote physician." Ex.1024, 459. As depicted, it comprised three network-interconnected components: (i) the "sensor" device on the person that collected physiological data, (ii) a host device such as a smartphone, tablet, or computer that wirelessly captured and transmitted the physiological data, and (iii) a remote web service accessible over the Internet. Ex.1024, 460; Ex.1003, ¶55.

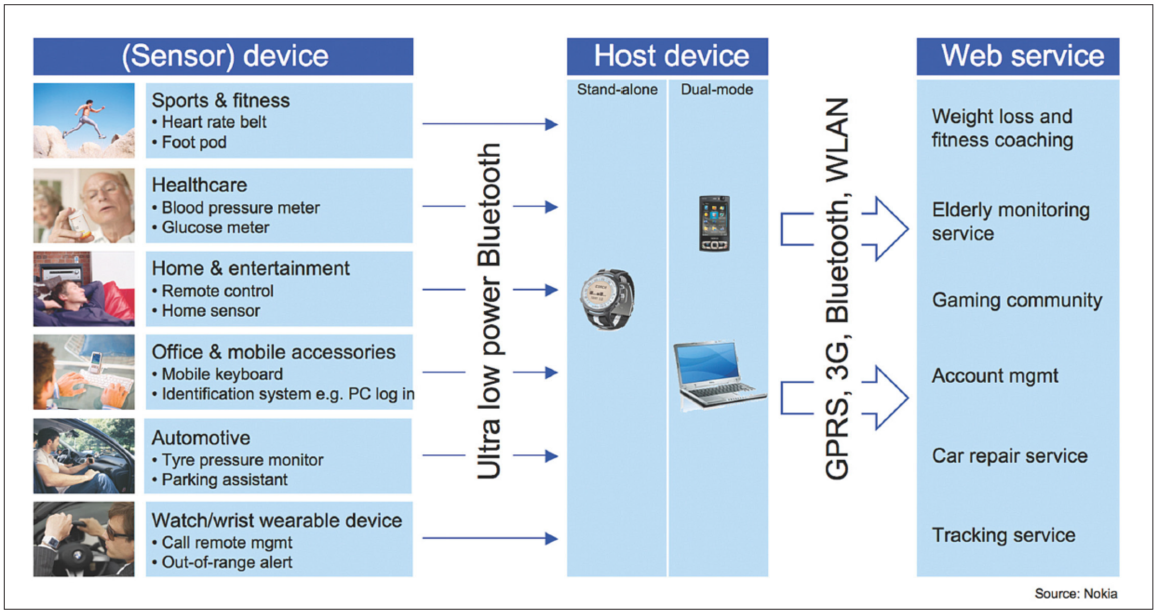
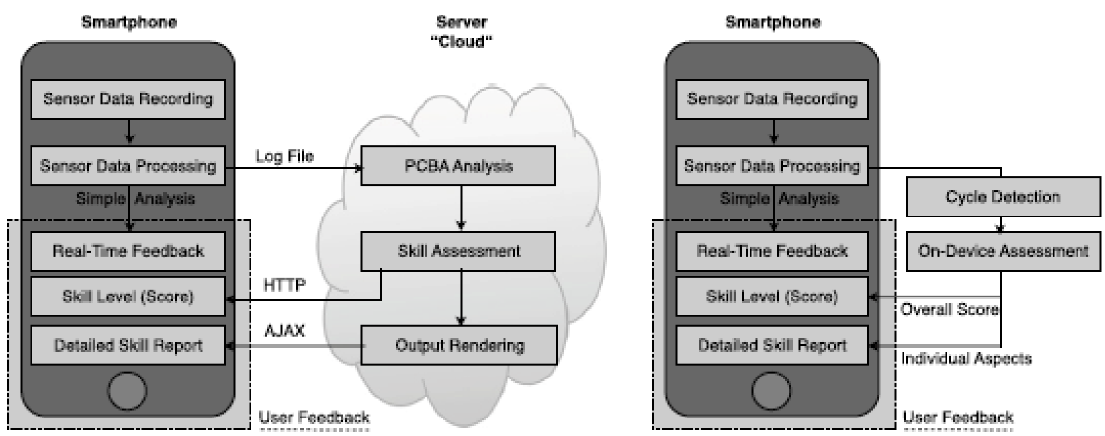



**Figure 2.** Bluetooth low energy will extend interoperable wireless connectivity to coin-cell-powered wireless sensors in health care, fitness, and related sectors. WLAN, wireless local area network; GPRS, general packet radio service.

Other articles from around 2012 likewise envisioned use of "cloud" based services to support this interconnected scheme. Ex.1003, ¶56. A 2012 article illustrated a cloud-based architecture implemented as a fitness app as follows:




(a) Iteration 1: the smartphone records sensor data during exercising, which are processed by a server after the training to generate skill assessment.

(b) Iteration 2: data is processed on the phone for real-time feedback as well as sophisticated feedback addressing individual aspects after the execution.

**Fig. 3.** Iterations of the GymSkill application.

Ex.1020, 7. In this example, a smartphone records and processes sensor data, then sends the data to a cloud server for further processing, and then the cloud server returns processed data back to the smartphone for display to the user. Ex.1020, 7; Ex.1020, 6, 12. This same article specifically recognized this type of system could be used with heart rate monitors and optical sensors. Ex.1020, 12 ("Coupling with devices like heart rate monitors using e.g. ANT+ further would increase the sensed database and allow for further, more detailed physical and physiological assessments.").

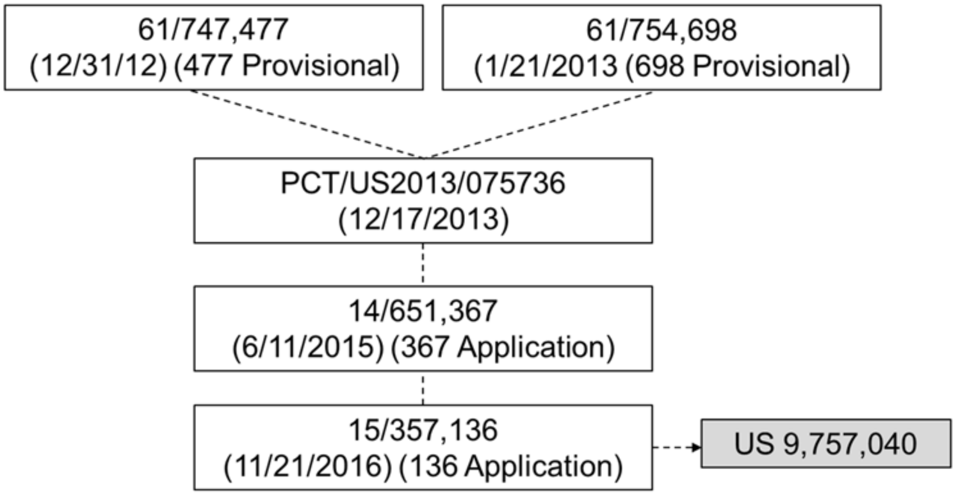
## IV. The '040 Patent

### A. Illustrative Claim

Claim 1 describes a wearable device comprising a number of well known-optical components and processing techniques. It also describes wireless communication with a smart phone or tablet. Claim 1 is reproduced in the attached claim appendix.

### B. The '040 Patent Is Subject to AIA

The '040 Patent issued from U.S. Application No. 15/357,136 (filed November 21, 2016) and purportedly claims benefit to U.S. provisional applications 61/747,477 and 61/754,698 as shown below. Ex.1002, [0001].




The '136 Application further incorporates by reference a number of other applications and provisional applications, without claiming priority to them.

The '477 and '698 Provisionals to which priority is claimed do not demonstrate possession of a measurement device as described by claims 1-4, comprising a receiver that: (i) captures light while the LEDs are off and converts that light into a first signal, (ii) captures light when at least one of the LEDs is on and converts that light into a second signal, and (iii) improves the signal-to-noise ratio of the input optical beam reflected from the tissue by differencing the first and second signals. Ex.1003, ¶¶32-32.

No passages in the '477 and '698 Provisionals provide written description support for these "differencing" elements. *Id*. This can be easily appreciated by observing that the passages in the '040 Patent concerning these elements are absent in the'477 and '698 Provisionals. *See* Ex.1001, 21:11-15 ("the detection system captures the signal with the light source on and with the light source off… Then, the signal with and without the light source is differenced”). Neither the ’477 nor the ’698 Provisional contains this passage or one that otherwise describes “differencing” signals as these claims require. Ex.1003, ¶32. Because the ’477 and ’698 Provisionals do not provide written description support for the claims as required by § 112 requires, claims 1-4 may not properly claim priority to these provisionals.

Notably, applicant cannot rely on provisional applications that were incorporated by reference, but to which priority was not claimed, to provide written description support for the claims. Any such disclosure is “essential material” that may only be incorporated by reference via “a U.S. patent or U.S. patent application ***publication*** which ‘does not itself incorporate such essential material by reference.’” 37 C.F.R. § 1.57(d); *Droplets, Inc. v. E*trade Bank*, 887 F.3d 1309, 1318 (Fed. Cir. 2018) (claim amendments can transform nonessential material into essential material, causing a § 112 violation). A provisional application cannot be a "U.S. patent application publication" specified in Rule 57(d) because it is never published.[1]

Patent Owner may contend that material from the incorporated provisionals is not "essential material." Plainly it is essential if it necessary to provide written description support for the claims. Regardless, Patent Owner may not rely on disclosures in any of the incorporated by reference provisionals *for any purpose* before the date on which they were incorporated by reference into the disclosure of an application to which the '040 Patent makes a valid claim of benefit or priority. The earliest date when this occurred was December 17, 2013.[2] Because that date is

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[1] A "patent application publication" is a non-provisional application filed under 35 U.S.C. § 111(a) that has been published pursuant to 35 U.S.C. § 122(b). A provisional patent application cannot be a patent application publication because it is filed under 35 U.S.C. § 111(b) and is expressly excluded from publication under § 122(b). *See* 35 U.S.C. §§ 122(b)(1), (b)(2)(A)(iii); 37 C.F.R. § 1.215; M.P.E.P. § 1121 (defining contents of a "patent application publication"); M.P.E.P. § 903.04.

[2] Petitioner reserves its right to dispute any assertion by Patent Owner that the claims are entitled to priority earlier than December 17, 2013.

after March 16, 2013, every claim of the ’040 Patent is subject to the first-to-file provisions of the AIA.[3]

### C. The ’040 Patent File History

The originally filed claims of the ’040 Patent were allowed without rejection after an interview with the Examiner. The Examiner initiated that interview and amended the claims to add the limitations: capturing light while the LEDs are on to generate a first signal, capturing light while the LEDs are off to generate a second signal, and then differencing the signals. Ex.1002, 297, 369-71.

### D. Person of Ordinary Skill

A person of ordinary skill in the art (“skilled person”) would have a good working knowledge of optical sensing techniques and their applications, and familiarity with optical system design and signal processing techniques. That knowledge would have been gained via an undergraduate education in engineering (electrical, mechanical, biomedical or optical) or a related field of study, along with relevant experience in studying or developing physiological monitoring devices (e.g., non-invasive optical biosensors) in industry or academia. Ex.1003, ¶36. This description is approximate; varying combinations of education and practical experience also would be sufficient. Ex.1003, ¶36.

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[3] Pub. L. 112-29, §3(n); *see* MPEP 2159.02.

Petitioner's positions regarding how a skilled person would have understood the '040 Patent claims and the prior art are supported by the testimony of Brian Anthony, Ph. D., an expert in optical sensing devices with over 20 years of experience. *Id.*, ¶¶1-9, 36.

## V. Claim Construction

The parties in related district court litigation agreed that the claim language should be given its plain and ordinary meaning, except for three terms. The parties offered alternative constructions for these terms, and the Court provided a preliminary construction of one. *See* Ex.1043, 5, 8-10 (parties' claim constructions), Ex.1045 (preliminary claim construction).[4]

To avoid any dispute linked to claim scope, the grounds in this petition demonstrate that the claims are unpatentable using the narrowest construction for each disputed claim term.[5] These constructions, explained below, are faithful to the patentee's lexicography, the specification, and the extrinsic evidence.

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4 Petitioner will file the final claim construction as an exhibit when the order issues.

5 If Patent Owner contends that special constructions should be used that are different from those it has advanced in the co-pending litigation, Petitioner may request leave to file a reply.

### A. "Beam"

The claim term "*beam*" is expressly defined in the specification: "As used throughout this disclosure, the terms 'optical light' and or 'optical beam' and or 'light beam' refer to photons or light transmitted to a particular location in space." Ex.1001, 8:24-26. This definition should be adopted verbatim as the patentee's chosen lexicography. *Sinorgchem Co., Shandong v. Int'l Trade Comm'n*, 511 F.3d 1132, 1136 (Fed. Cir. 2007). The definition is also consistent with extrinsic evidence reflecting that a skilled artisan would understand a "beam" to mean "a collection of nearly parallel rays." Ex.1046, 106; *see also* Ex.1042, 1. Such a collection of nearly parallel rays would necessarily travel to a particular location in space, as opposed to scattering in different directions. *See* Ex.1001, 6:57-63 (distinguishing a beam from "stray light from a reflection or scattering"), 15:45-47 (directing an array of beams), 3:37-41 (delivering a beam to a sample), Fig. 12C and 20:35-50 (showing a beam directed to sample and scattered light reflected from the sample). The district court's preliminary construction recognized that a beam does not include randomly directed light. *See* Ex.1045.

Petitioner therefore submits that "beam" should be construed to mean "photons or light transmitted to a particular location in space."

### B. “One or more lenses”

The only type of lens described by the ’040 Patent is one that will “collimate or focus the light.” Ex.1001, 15:7-8, 12:8-10, 12:39-40, 13:7-9. And, the claim language specifies the lenses are “configured to receive and to deliver a portion of the input optical beam to tissue.” In order to perform these claimed functions, the lens must be transparent to the received light so that it can pass through the lens and travel to the tissue. Ex.1003, ¶66. In order to deliver the received beam, the lens must collimate or focus the beam, rather than scatter the beam. *Id*. These defining characteristics of the claimed lens are consistent with the dictionary definition of lens: “a piece of transparent material … for forming an image by focusing rays of light.” Ex.1046, 712; Ex.1041, 481 (“glass or other transparent material”).

Petitioner therefore submits that “one or more lenses” should be construed to mean “one or more transparent surfaces used to collimate (make parallel) or focus rays of light.”

### C. “Modulating at least one of the LEDs”

The district court did not adopt either party’s proposed construction for “modulating” and instead proposed the following construction: “varying the amplitude, frequency, or phase of the light produced by at least one of the LEDs to include information.” This construction adopts definitional language provided by the ’040 Patent, stating that beams “may be modulated or unmodulated, *which also means that they may or may not contain information*.” Ex.1001, 8:28-29 (emphasis added). The construction also is consistent with extrinsic evidence relied on by both parties, including a dictionary definition both parties employed:

> To vary the amplitude, frequency, or phase of (carrier wave or a light wave) for the transmission of information (as by radio).

Ex.1046, 798; *see also* Ex.1039, 14-15 (describing modulation in the context of AM and FM radio used to transmit audio information).

At the Markman hearing, Apple urged the court to revise its preliminary construction to delete “amplitude” because the specification and claims distinguish modulating from varying the amplitude of the signal. Ex.1044, 21:16-22:1. Petitioner observes that whether “amplitude” is included in the construction of modulating ultimately has no consequence in this proceeding as the prior art renders the claims unpatentable under either construction. For consistency, Petitioner proposes that the Board use the court’s preliminary construction, with the express reservation that Petitioner may argue the narrow construction in district court.

# VI. Detailed Explanation Why The ’040 Patent Claims Are Unpatentable

## A. Park and Lisogurski Render Obvious Claims 1-3

The contested claims generally define a wearable measurement device configured to generate “a non-invasive measurement on blood” and wirelessly communicate with a smart phone or tablet. As described below, Park combined with Lisogurski would have rendered obvious claims 1-3.

### 1. Park

Park was filed on November 6, 2013 and issued on March 21, 2017. It is prior art under 35 U.S.C. § 102(a)(AIA).

Park describes a wearable device for measuring physiological data of a user. Ex.1010, Figs. 2, 15-16; Abstract, 1:34-53, 6:41-55.

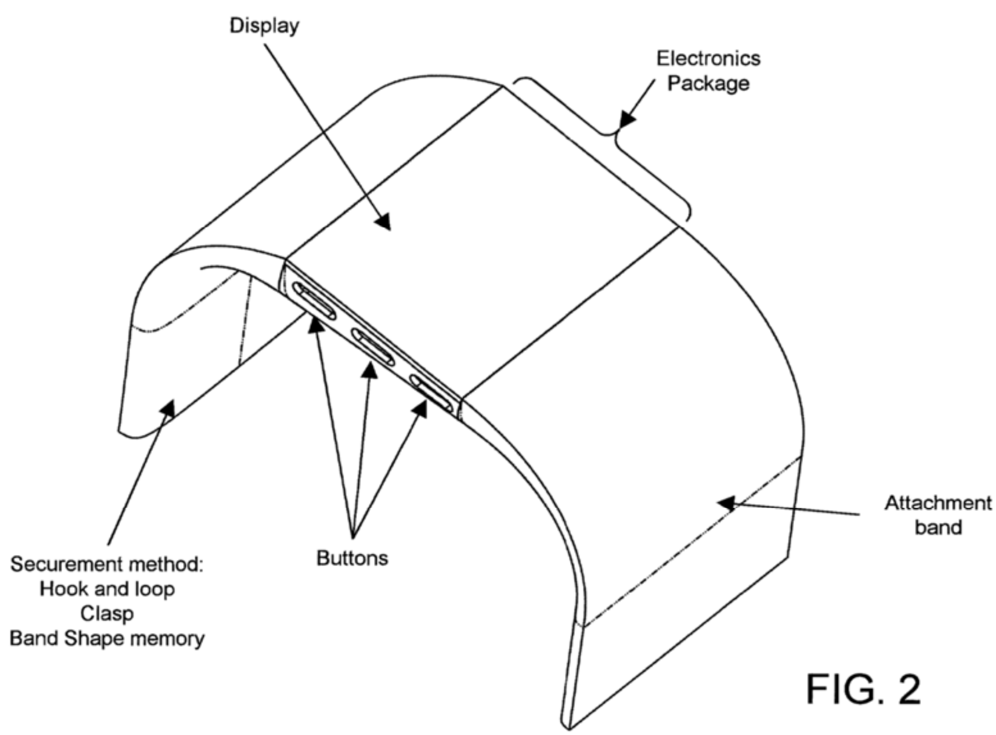


FIG. 2

The device has an optical sensor that directs light at the user's tissue and then detects reflected light representing physiological data. Ex.1010, 6:42-55. The optical sensor includes conventional components, LED emitters (6:49), photodetectors (6:50-51), lenses and a reflective surface for directing light (11:32-42, 11:58-12:8), and a processor such that the device is configured to operate as described herein (Fig. 1, 23:47-53).

Physiological data generated by the optical sensor can be processed to determine physiological parameters such as heart rate, blood oxygen saturation, and others. Ex.1010, 10:42-49. Data processing can be performed by the wearable device itself, by a smart phone or tablet in wireless communication with the wearable device, and/or by a remote device such as a server hosting a website in communication with the smart phone or tablet. Ex.1010, 9:13-16, 23:41-44, 27:22-26, 27:33-35.

Park teaches several techniques for increasing the signal-to-noise ratio ("SNR") of the signals measured by its devices while minimizing power consumption. For example, Park describes techniques for acquiring quality data in the presence of noise, particularly caused by motion. Ex.1010, 7:4-7, 11:4-16, 11:32-44, 12:31-67, 14:20-15:62, 16:8-20. Park also teaches techniques for optimizing power consumption of the battery powered device based on motion by the user. Ex.1010, 4:4-16, 6:56-8:2.

**2. Lisogurski**

Lisogurski was filed on May 31, 2012, and issued on January 26, 2016. It is prior art under 35 U.S.C. § 102(a)(AIA).

Lisogurski describes a portable physiological monitoring system that uses a wearable optical sensor to measure pulse rate and oxygen saturation. Ex.1011, 3:66-4:8. The system includes a sensor, monitor, and remote devices such as a server. Ex.1011, 11:28-32, 15:43-48. The sensor can be worn in various locations, such as a fingertip or wrist, Ex.1011, 4:6-8, 4:15-20, is battery powered, and can wirelessly communicate with the monitor, Ex.1011, 17:55-58. The sensor can include several LEDs and photodetectors. Ex.1011, 17:37-45, 10:48-64, 11:9-13. The modulated light emitted by the LEDs is passed into a person's tissue and the light reflected back is detected by a photodetector. Ex.1011, 4:7-11, 10:48-56, 11:13-20. The detector "convert[s] the intensity of the received light into an electrical signal." Ex.1011, 11:14-16. Lisogurski teaches that the sensor can send the detected signal directly to the monitor or can process the signal before transmission to the monitor. Ex.1011, 11:20-27. It also shows that the sensor can be connected to the monitor with a wire or cable, or it can be "wirelessly connected to [the] monitor." Ex.1011, 17:54-59, Fig. 3. Either way, the device applies signal processing techniques to the detected signal to isolate the signal from the reflected light. Ex.1011, 7:16-21, 12:48-49; *see generally id.*, 13:7-14:55 (describing various signal processing).

### 3. Motivation to Combine Park and Lisogurski

Skilled persons in the 2012-2013 timeframe recognized that building an optical monitor meeting the evolving market demand for a small, wearable, wireless device presented many challenges. Ex.1003, ¶83. One challenge was acquiring accurate data in the presence of noise caused by user motion, which Park recognized could be a significant problem during exercise. Ex.1003, ¶84; Ex.1010, 7:4-7, 14:58-65. Another challenge was minimizing power consumption of the battery-powered device so that it could be worn by the user for extended periods of time. Ex.1003, ¶¶83, 85. Park teaches several techniques for addressing these challenges. Ex.1003, ¶88

For example, Park describes configuring the optical sensor to maximize optical coupling and minimize relative motion between the device and the user's skin, thereby improving SNR and efficiency while also reducing power consumption. Ex.1010, 11:32-44, 12:31-67, 14:4-65, 14:66-15:24. These techniques, which include using light guiding elements and incorporating the optical sensor into a protrusion that provides frictional contact with the user's skin, "increase the quality of the cardiac signal of interest" and "improve measurement accuracy…by reducing motions of the sensor relative to the user's skin during operation, especially whilst the user is in motion." Ex.1010, 14:20-27, 14:58-65, 15:49-62. Park also describes adjusting the wavelength and intensity of the optical sensor's light sources to optimize the quality of collected physiological data. Ex.1010, 11:4-16, 16:8-20.

Park also teaches using motion data to improve operation of the device. Ex.1003, ¶88. For example, Park explains that adjusting the modulation, sampling rate and resolution mode of the sensor in response to user motion (or lack thereof) will improve robustness to motion artifacts and enable more accurate adaptive filtering of the heart rate signal. Ex.1010, 4:4-16, 6:56-7:42. At the same time, this motion data can be used to optimize power consumption of the device. Ex.1010, 7:42-8:2. For example, if the device determines that the user is not moving, the device can lower its sampling rate so that it does not consume as much power. Ex.1010, 4:13-16. 7:42-54.

Thus, Park teaches several techniques for increasing the signal-to-noise ratio of the signals measured by its sensor while minimizing power consumption. As Dr. Anthony explains, these teachings would motivate a skilled person to look for other techniques for achieving the same objectives, particularly those used with analogous wearable sensors. Ex.1003, ¶¶88. A skilled person would do that as part of the ordinary design process he or she follows to improve the operation of a device; they naturally would look to complementary designs and techniques in analogous systems. *Id*.

That would have led the skilled person to Lisogurski, which describes techniques for improving pulse oximetry devices by improving both signal measurement and energy consumption. Ex.1011, 1:4-6, 3:50-53; Ex.1003, ¶¶88-89. Lisogurski describes a PPG system that is designed to optimize power consumption to allow "for increased battery life" and "for increased portability." Ex.1011, 1:16-18. As an example, Lisogurski explains that its techniques could improve oximeter systems by reducing power requirements, allowing for smaller devices or longer life. Ex.1011, 4:63-67. Lisogurski describes these improvements in a system that includes a wearable sensor that can be worn on the wrist, Ex.1011, 4:15-20, 17:51-58, in order to address noise, motion and ambient light. Ex.1011, 9:57-59.

Park and Lisogurski thus describe analogous systems with common applications and utility; both describe techniques for improving the power consumption of wearable optical sensing devices while improving their performance and utility. Ex.1003, ¶90. The skilled person would have considered the references together when implementing a system based on Park's teachings. *Id*.

**1. Claim 1**

**a) "A wearable device for use with a smart phone or tablet, the wearable device comprising"**

Park describes a wearable device, such as a wristband, that includes a biometric monitoring device for detecting physiological data of a user. Ex.1010, Figs. 2, 3, 11-13, 3:49-54, 12:60-63, 13:15-20, 24:52-25:45 ("Methods of Wearing the Device").

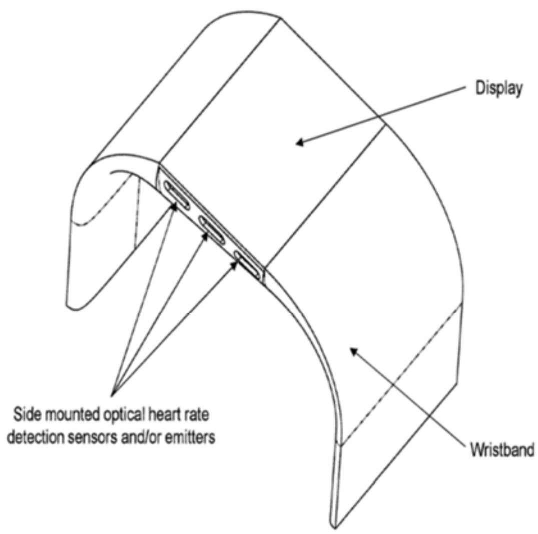


FIG. 12

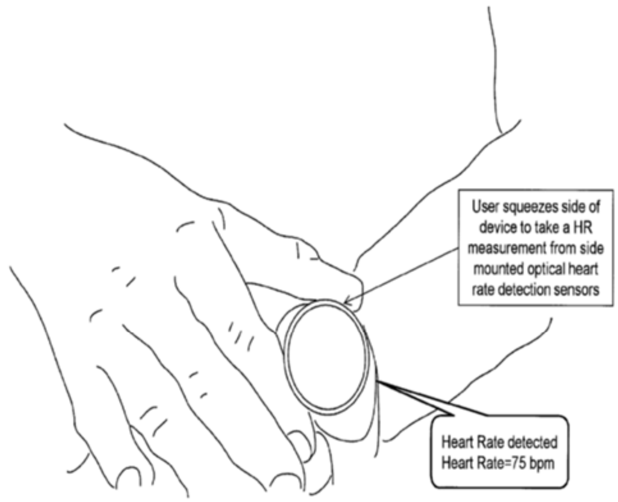


FIG. 13

The device can be equipped with Bluetooth or other technologies that enable it to communicate with external devices, such as a smart phone or tablet. Ex.1010, 9:8-13, 29:30-42, 34:11-14. Park therefore discloses the preamble of claim 1. Ex.1003, ¶¶93-94.

**b) "a measurement device including a light source comprising a plurality of light emitting diodes (LEDs) for measuring one or more physiological parameters"**

Park's biometric monitoring device includes an optical sensor comprising a plurality of LED light sources, as shown in Figure 10 (annotated):

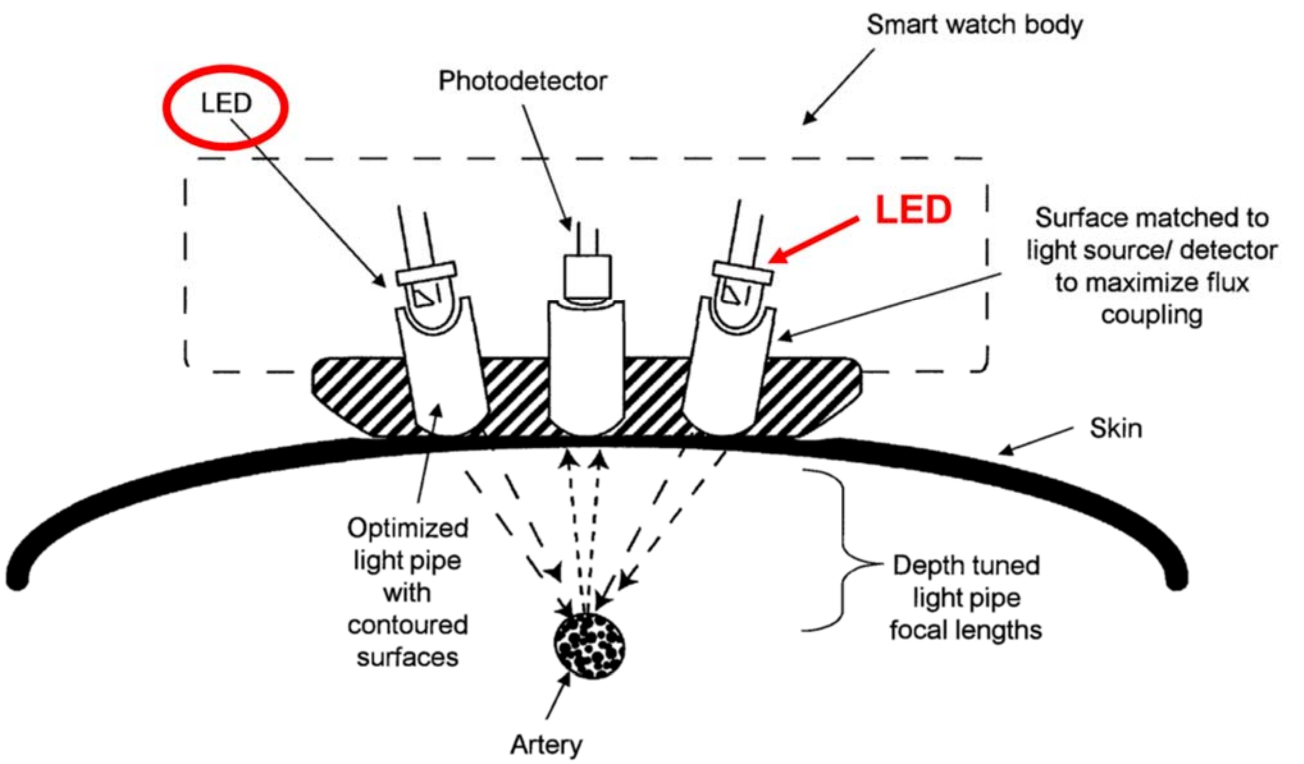


FIG. 10

Ex.1010, Fig. 10; *see also* Figs. 5-9, 11, 12, 20. Particular LED light sources are selected based on the "type of physiological data to be collected." Ex.Park, 10:50-11:16. As Park explains, "a light source emits light upon the skin of the user" and the reflected light is used to "detect physiological data which then may be processed or analyzed…to obtain data which is representative of, for example,…oxygen saturation (SpO2)…" Ex.1010, 10:34-49. Park therefore discloses this limitation of claim 1.

**c) "the measurement device configured to generate, by modulating at least one of the LEDs having an initial light intensity, an input optical beam"**

Park teaches "amplitude modulating the intensity of the light source," including varying the intensity of the light source. Ex.1010, 17:26-41. This disclosure meets the court's definition of modulating as "varying the amplitude, frequency or phase." Ex.1003, ¶101.

As noted in §IV.C, the '040 Patent distinguishes varying the amplitude of a signal from modulation; therefore, Apple suggested to the court that "modulating" should be construed to mean "varying the frequency or phase of light." A skilled person would have found it obvious to modify the Park device to modulate a signal by varying frequency, as described by Lisogurski, and thus satisfy Apple's proposed construction to the court. Ex.1003, ¶102. Lisogurski explains that each of the LEDs may be modulated using a variety of techniques. Ex.1011, 7:38-40 ("the system may modulate multiple light sources using a plurality of modulation techniques"), 5:2-7, 5:48-61 ("drive cycle modulation"), 5:25-47 (cardiac cycle modulation), 6:31-38 ("various cardiac cycle modulation schemes"), 8:16-44.

Lisogurski explains that light drive circuitry controls the modulation, and can alter the LED light drive parameters, such as "drive current or light brightness, duty cycle, [and] ***firing rate***" amongst others. Ex.1011, 27:44-52; *id.*, 2:1-2 ("light source firing rate"), *id*., 8:29-35, 25:49-55. The firing rate or frequency of the LEDs can change over time, and can, for example, be correlated to the sampling rate of an analog-to-digital converter. Ex.1011, 33:47-49 ("sampling rate modulation may be correlated with light drive signal modulation"); *see also id.*, 11:43-46; 11:52-55. Lisogurski explains "the time between 'on' periods [for an LED] may be the length of time of 'off' period 220 of FIG. 2A… [D]ecreasing the duration of the 'off' periods (i.e., ***increasing the emitter firing rate***) relates to an increased sampling rate." Ex.1011, 35:27-31. Thus, Lisogurski teaches that the LED firing rate or frequency can change. Ex.1003, ¶102. Lisogurski therefore teaches varying the frequency of the LEDs, as required by Apple's claim construction.

A skilled person would have been motivated to modify the Park device to use frequency modulation as taught by Lisogurski as a known and predictable alternative to amplitude modulation for enabling synchronous detection by the detector. Ex.1010, ¶103. Park teaches using amplitude modulation for synchronous detection, Ex.1010, Fig. 21, 17:33-38, 4:41-43, while Lisogurski describes using frequency modulation for the same purpose. Ex.1003, ¶103. Lisogurksi describes embodiments where the firing rate of an LED is correlated to the sampling rate of an analog-to-digital converter in the detector. Ex.1011, 33:47-

49 ("In some embodiments, sampling rate modulation may be correlated with light drive signal modulation."); *see also* 2:1-2, 27:44-52 (LED firing rate can be modulated), 35:27-31 ("increasing the emitter firing rate… correlates to an increased sampling rate"). Lisogurski teaches an analogous embodiment where the measurements taken by the receiver have a one-to-one correlation, with one sample taken per on period. Ex.1011, 35:17-19. A skilled person would have understood that in this embodiment, the LEDs and the receiver are synchronized. Ex.1003, ¶103.

Lisogurski also explains that its technique for synchronous detection using frequency modulation can reduce or optimize power consumption and result in more accurate and reliable data. 33:46-64. A skilled person would have been motivated by these benefits to implement Lisogurski's technique in the Park device. Ex.1003, ¶104. And, doing so would have been a simple substitution of one known modulating technique for another, yielding the predictable result of enabling synchronous detection. Ex.1003, ¶105.

Patent Owner may contend that Park and Lisogurski do not expressly describe modulating light *to include information*, as required by the court's construction. But a skilled person would have read either reference as describing modulating light to include information and would have considered doing so to have been an obvious selection between a limited number of known and predictable options. Ex.1003, ¶106.

As the ’040 Patent explains, light may be modulated (which contains information) or unmodulated (which does not).[6] Ex.1001, 8:27-29. This was a well-understood technical fact. Ex.1003, ¶106; Ex.1046, 798. The use of “modulated” without further discussion in Park would have been read by a skilled person as describing either known type of light – that which is modulated to include information and that which is not. Ex.1003, ¶106. *See In re Petering*, 301 F.2d 676, 681 (C.C.P.A. 1962) (disclosure of a limited class allows “one skilled in the art [to] at once envisage each member of this limited class….”).

A skilled person also would have found it obvious to select one of these known options for light, and doing so would yield predictable results when implemented in the Park device. Ex.1003, ¶107. *See KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007) (“When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or

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[6] Omni conceded as much in its proposed district court claim construction, which included in its definition that a beam “may be modulated or unmodulated, and which may or may not contain information.” *See* Ex. 1039, 14.

her technical grasp."); *Perfect Web Tech., Inc. v. InfoUSA, Inc.*, 587 F.3d 1324, 1328-29, (Fed. Cir. 2009) (finding claimed invention obvious to try based on only three possibilities).

As Dr. Anthony explains, a skilled person would have had obvious reasons to use a beam in the Park device that was modulated to include information because of the benefits obtained by doing so. Ex.1003, ¶107. For example, the beam of light could be modulated to embed an identification code that would enable a detector to identify the source of received light. Ex.1003, ¶108; Ex.1007, 2:26-29. Similarly, the signal could be modulated to encode a unique identifier in the modulated light keyed to the user or to the serial number of the device, to enable unique identification by the receiver in order to reduce the risks for device tampering. Ex.1003, ¶109. The signal also could be modulated to be encrypted for security purpose. *Id*. The signal also could be modulated to contain information about the operational characteristics of the LED, such as a number representing an expected intensity value, which would allow the detector to determine if the LED is operating properly. Ex.1003, ¶110.

Modulating the emitters in the Park sensor to include any of these types of exemplary information would have been a combination of familiar elements of an optical sensor according to known modulation techniques, yielding predictable results. Ex.1003, ¶¶111-112. A skilled person would have recognized that implementing these technique in the Park device would have resulted in improving the performance of the sensor, as described by Hanna for example, or to ensure the sensor was operating properly, to produce more accurate data. *Id.* That skilled person would have been motivated to implement any one of these exemplary modulating techniques in order to achieve these predictable benefits. *Id*.

Moreover, Patent Owner did not contend that the nature of the beam was relevant to patentability and the examiner did not rely on that aspect of the signal in allowing the claims. The ’040 Patent does not identify any benefit of using modulated light to convey information, nor does it describe the nature of information to be conveyed or a reason for doing so. Ex.1003, ¶109. The ’040 Patent thus reflects the conventional nature of modulating a beam to contain information if desired. Indeed, modulating energy to include information is a technique that has been used for decades in any number of contexts, and it would have been obvious to do so in the context of the Park device as one way to achieve the performance benefits identified above. Ex.1003, ¶112.

Finally, Park explains that its device has a light source intensity control that can either increase or decrease “a given light intensity” of the LEDs (“*LEDs having an initial light intensity*”) based on conditions and in order to maintain a desirable signal. Ex.1010, Figs. 17-23, 9:50-10:2, 16:8-20. Moreover, the device is configured to “focus light towards a specific volume at a specific depth in the [user's] skin ("*the measurement device configured to generate…an input optical beam*")." Ex.1010, 12:31-34.[7] Here, Park is referring to focused light that is directed to a particular location in space – a specific volume and depth in the user's skin – and is therefore describing a "beam" in the same way as the '040 Patent. Ex.1003, ¶64.

**d) "[the input optical beam] having one or more optical wavelengths, wherein at least a portion of the one or more optical wavelengths is a near-infrared wavelength between 700 nanometers and 2500 nanometers;"**

Park explains that the LEDs "may emit light having one or more wavelengths which are specific or directed to a type of physiological data to be collected." Ex.1010, 10:50-53. For example, one of the LEDs may emit light having a wavelength in the red spectrum and another LED may emit light in the infrared spectrum. Ex.1010, 10:65-11:1, 10:47. A skilled person would have understood that the infrared spectrum encompasses wavelengths from 700 nanometers to 1000 millimeters. Ex.1003, ¶115.

Park's disclosure of infrared wavelengths within the claimed range of near-infrared wavelengths creates a presumption of obviousness. *E.I. DuPont de*

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[7] This disclosure also meets the definition of "beam" proposed by Omni in the related district court litigation. Ex.1003, ¶106.

*Nemours & Co. v. Synvina C.V.*, 904 F.3d. 996, 1008 (Fed. Cir. 2018) (holding that this presumption applies to IPR proceedings such that Patent Owner must rebut the presumption). Patent Owner has the burden of overcoming this presumption by presenting evidence of "teaching away, unexpected results or criticality, or other pertinent objective indicia indicating that the overlapping ranges would not have been obvious in light of the prior art." *Id*.

Patent Owner cannot meet that burden. The '040 Patent demonstrates that using near-infrared wavelengths is not critical to the purported invention, or an aspect of the purported invention that creates unexpected results. While the'040 Patent describes specific embodiments "which may cover the wavelength range of approximately 1400 nm to 2500 nm" (a broader range than that specified in the claims), it also admits that "[o]ther wavelength ranges may also be used for the applications described in this disclosure, so the discussion below is merely provided as exemplary types of light sources." Ex.1001, 14:1-4. The '040 Patent further states that "other parts of the infrared, near-infrared or visible wavelengths may also be used consistent with this disclosure." Ex.1001, 10:47-48.

Moreover, the wavelength used by LED light sources is a well-understood, result-effective variable of an optical sensor that a skilled person would have known how to select based on a desired application. *See E.I. DuPont*, 904 F.3d at 1011; Ex.1003, ¶117. As Park explains, wavelength should be selected based on the "type of physiological data to be collected." Ex.1010, 10:50-53, 10:65-11:1, 10:47. It was well-known at the time that near-infrared light was suitable for collecting physiological data related to a user's blood constituents. Ex.1003, ¶117; Ex.1008, Fig. 6, 7:18-24. Thus, a skilled person, motivated by the desire to gather specific physiological data related to blood constituents, would have known to select a near-infrared wavelength from the infrared spectrum. Ex.1003, ¶117.

Should Patent Owner overcome the presumption of obviousness or otherwise argue that Park does not teach this limitation, it would have been obvious to modify the Park device to use a near-infrared wavelength as described by Lisogurski. Ex.1003, ¶118. Lisogurski explains that the LEDs are "configured to emit photonic signals having one or more wavelengths of light (e.g., Red and IR) into a subject's tissue." Ex.1011, 10:49-52; *see id.*, 4:42-45. It also states that "the IR wavelength may be between about 800 nm and about 1000 nm," *id.*, 10:56-58, which is within the claimed near-infrared range.

Lisogurski explains that the intensity of light reflected by a user's tissue is directly related to wavelength. "That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is received from the tissue by the detector 140." Ex.1011, 11:16-20. Thus, a skilled person who desired to optimize the intensity of a detected signal of interest, *see* Ex.1010, 16:12-15, would have been motivated to select a wavelength in the near-infrared range suggested by Lisogurski. Ex.1003, ¶119. Using a near-infrared wavelength in the Park device would have involved using familiar LED components according to their known methods of operation, and yielded the predictable result of the light being absorbed or reflected by the user's tissue in a known fashion. *See, e.g.*, Ex.1008, Fig. 6. Thus using a near-infrared wavelength in the Park device would have been obvious based on the teachings of Lisogurski. Ex.1003, ¶119.

**e) "the measurement device comprising one or more lenses configured to receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of input optical beam delivered to the tissue;"**

Park teaches using "light pipes" for directing light from the LEDs to a user's skin. Ex.1010, Fig. 10 (annotated), *id.*, 11:32-37. Park explains that a light pipe can be a lens, and that a lens can be transparent to infrared light. Ex.1010, 11:39-42, 11:29-31. As shown in Figure 10, these lenses focus light received from the LEDs toward an artery in the user's skin.

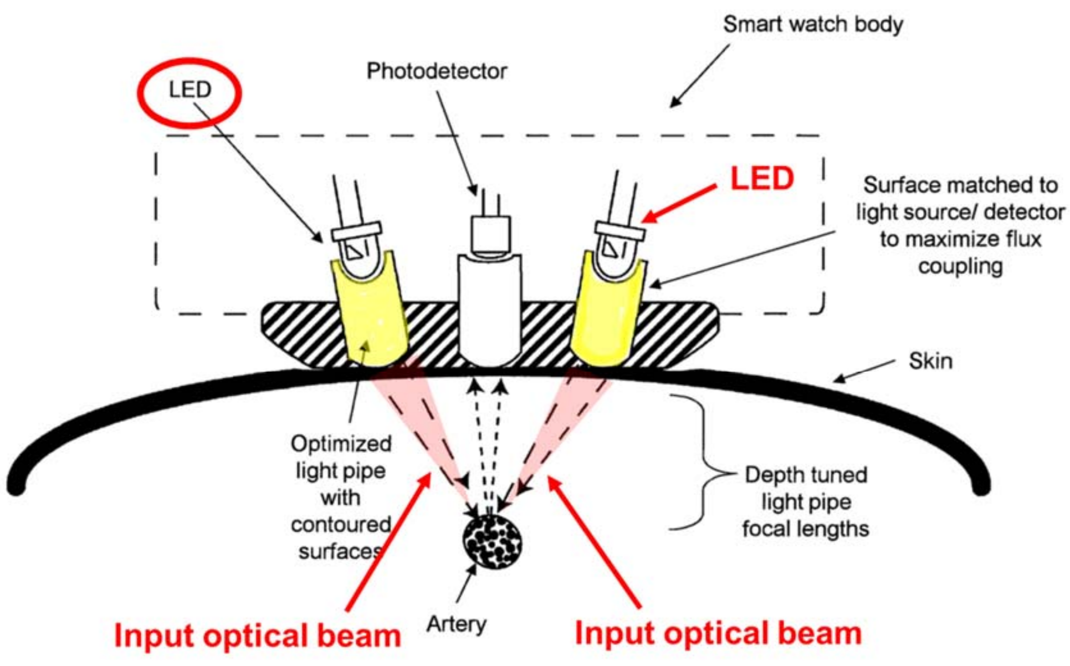



FIG. 10

Park therefore teaches one or more transparent surfaces used to collimate (make parallel) or focus rays of light, corresponding to the claimed "*one or more lenses configured to receive and deliver a portion of the input optical beam to tissue*."[8] Ex.1003, ¶¶121-122.

This light is then reflected from the user's tissue toward a photodetector. Ex.1010, Fig. 10, 11:32-38 ("[s]cattered or reflected light from the user's body may be directed back to and detected by the optical circuitry").

[8] This disclosure also meets the definitions of lens proposed by Omni and by the court in the related district court litigation. Ex.1003, ¶122.

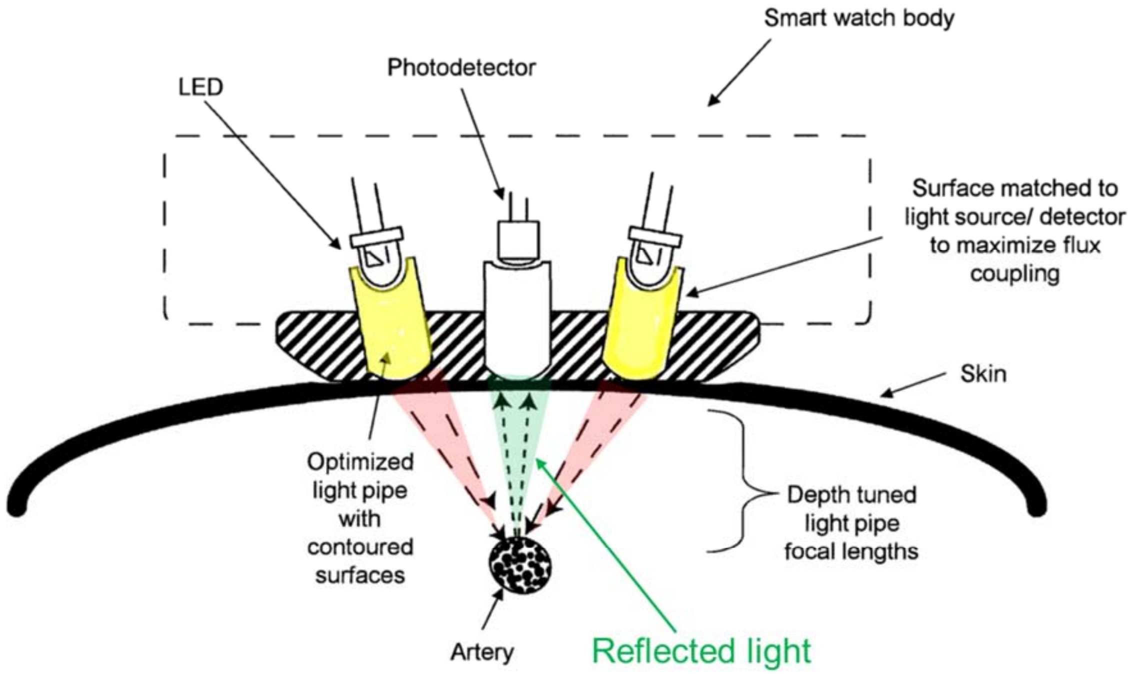



FIG. 10

Park thus discloses this claim limitation. Ex.1003, ¶¶123-124.

**f) "the measurement device further comprising a reflective surface configured to receive and redirect at least a portion of light reflected from the tissue;"**

Park describes using a light pipe or other "light transmissive structure" to direct light reflected from the user's tissue towards a detector. Ex.1010, Fig. 10, 11:32-39. Park explains that this light transmissive structure can be comprised of an optically opaque material that is "reflective to a specific wavelength range so as to more efficiently transport light…from the user's body back to and detected by the detector…." Ex.1010, 11:58-12:8. Moreover, the biometric monitoring device "may include a material disposed on the skin or interior side which includes high reflectivity characteristic—for example, polished stainless steel, reflective paint, and polished plastic. In this way, light scattered/reflected off the skin side of the device may be scattered/reflected back into the skin in order to, for example, improve the SNR." Ex.1010, 15:49-57. Thus, Park discloses at least two "*reflective surfaces*" corresponding to this claim limitation. Ex.1003, ¶126

**g) "the measurement device further comprising a receiver configured to capture light while the LEDs are off and convert the captured light into a first signal and capture light while at least one of the LEDs is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue"**

The Park device includes a "*receiver*" comprising a photodetector that "samples, acquires, and/or detects a response or scattered/reflected light from the skin (and/or from inside the body)." Ex.1010, Figs. 5-10, 17-23; 10:34-39, 6:42-55.

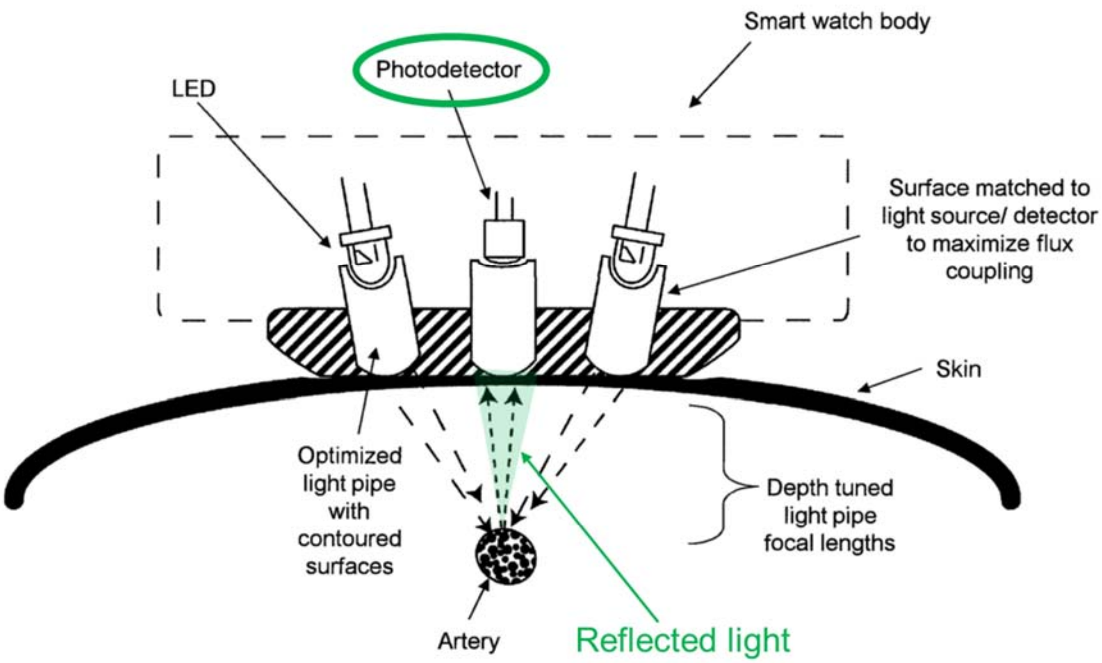



FIG. 10

Thus, Park discloses a measurement device "*comprising a receiver configured to capture light…the captured light including at least a portion of the input optical beam reflected from the tissue*." Ex.1003, ¶129.

The Park device also has a "Light Source Intensity and on/off control" for increasing or decreasing the intensity of the LEDs, including turning the LED light sources on and off. Ex.1010, Figs. 17-23, 4:25-27, 4:37-40; 17:26-41, 19:58-63;Ex.1003, ¶130.

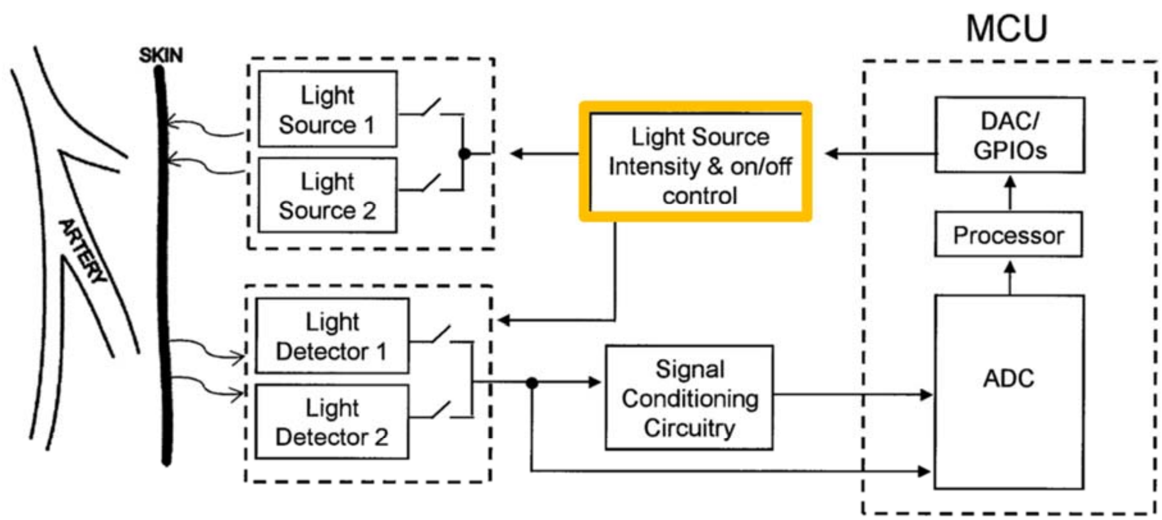



FIG. 20

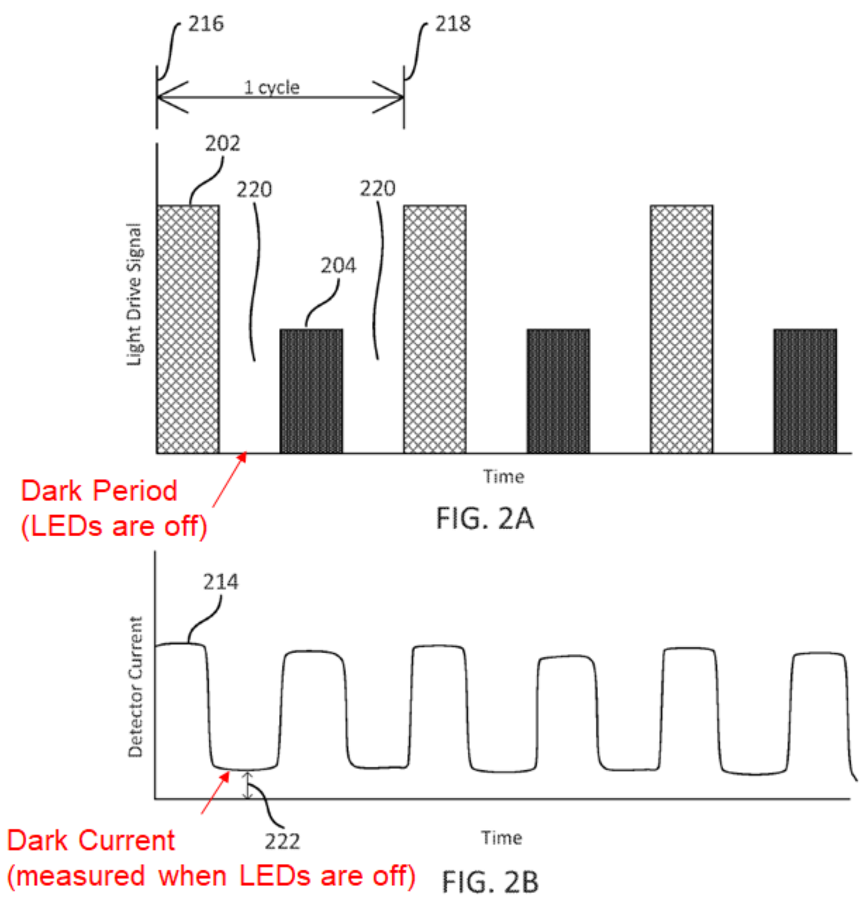
Park explains that the detector can measure ambient light when the light sources are turned off ("*capture light while the LEDs are off*"), and that a detector will "provide data" based on the detected light ("*convert the captured light into a first signal*.") Ex.1010, 10:32-33 (optical sensors may obtain data related to ambient light conditions), *id*., 17:38-41 ("if the ambient light is of sufficient brightness…the light source may be…turned off completely"); *id*., 6:50-52 (detector will "detect a response or reflection and provide data"); Ex.1003, ¶¶130-131.

Park also explains that the detector will "sample, measure, and/or detect a response or reflection and provide data" when the LEDs are on, corresponding to the claimed "*capture light while the LEDs are on and convert the captured light into a second signal*." Ex.1010, 6:42-55, 10:34-39.

Should Patent Owner contend that Park does not disclose these aspects of claim 1, it would have been obvious to modify the Park device to use Lisogurski's "dark subtraction" technique. Ex.1003, ¶¶132-133. Lisogurski teaches that dark subtraction can "remove ambient and background signals [and] may be used in addition to or in place of a power saving light modulation scheme. Ex.1011, 6:7-10. Ex.1011, 13:60; *see generally*, Ex.1011, 6:7-19, 13:60-14:10, 16:33-54 (describing dark signal subtraction process). Lisogurski explains that a detector is used to measure the light when the LEDs are on and off to remove "dark current" or ambient light from the signal. Ex.1011, 12:59-13:6 ("The peaks of detector current waveform 214 may be synchronous with light 'on' periods… The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source… [D]ark current 222 may be removed.").

Lisogurski explains that "the system [may] turn[] on a first light source, followed by a 'dark' period, followed by a second light source, followed by a 'dark' period." Ex.1011, 6:12-15. "The system may measure the ambient light detected by the detector during the 'dark' period and then subtract this ambient contribution from the signals received during the first and second 'on' periods." Ex.1011, 6:16-19.

Lisogurski measures a "dark signal" by "determining the amount of dark signal during [each] 'off' period 220"—in other words, it measures the light received by the detectors while the LEDs are off. Ex.1011, 13:67-14:6. To determine the dark signal, each detector "convert[s] the intensity of the received light into an electrical signal." Ex.1011, 11:14-16; *see* Ex.1011, 13:35-41. The dark signal 222 (also called dark current 222) is measured during dark period 220, and is depicted in Figures 2A and 2B, annotated below:

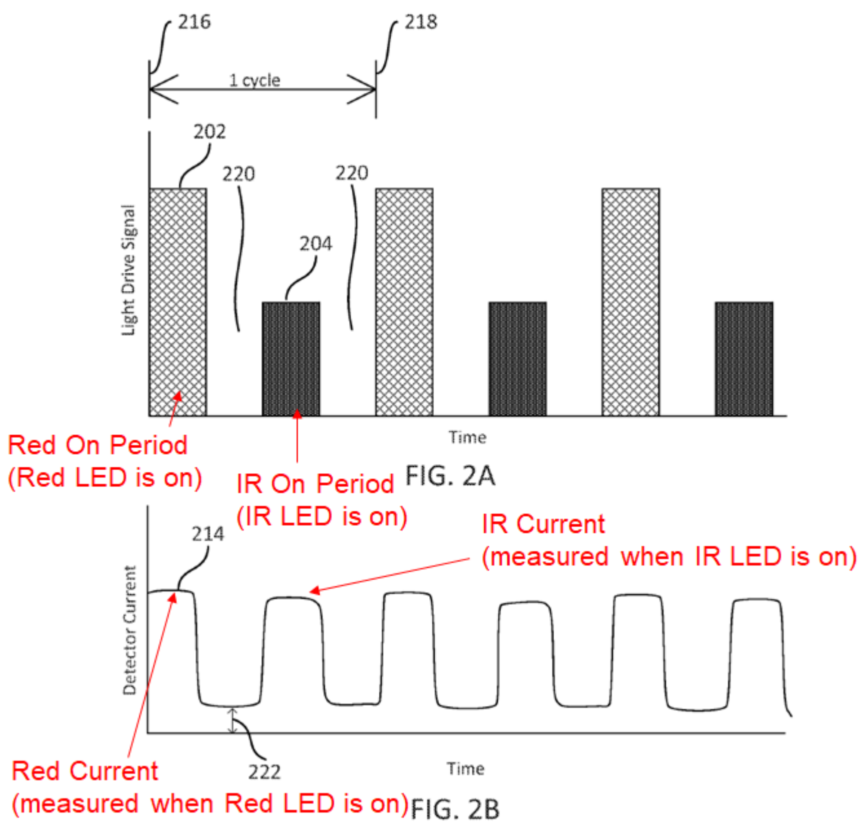


Ex.1011, Figs. 2A (current used to illuminate the LEDs) & 2B (the current output by the detector), *id*., 12:64-13:6; *see id*., 13:67-14:6 ("in reference to FIG. 2A, a detection signal peak corresponding to red 'on' period 202 may be adjusted by determining the amount of dark signal during the 'off' period 220 preceding red 'on' period 202"). The front-end processing circuitry uses the current measured when the LEDs are off to generate a "dark signal." Ex.1011, 13:35-41 ("Demultiplexer 156 may operate on detector current waveform 214 of FIG. 2B to generate… a ***first dark signal*** (e.g., corresponding to the dark component that occurs immediately after the Red component), and ***a second dark signal*** (e.g., corresponding to the dark component that occurs immediately after the IR component).") (emphasis added).

Therefore, Lisogurski teaches detectors configured to capture light during a dark period ("*while the LEDs are off*") and to convert that to a dark signal ("*first signal*"). Ex. 1003, ¶¶133-134.

Lisogurski also measures light while at least one LED is on. As explained above with respect to when the LEDs are off, "the system [may] turn[] on a first light source, followed by a 'dark' period, followed by a second light source, followed by a 'dark' period." Ex.1011, 6:12-15. "The system may measure the ambient light detected by the detector during the 'dark' period and then subtract this ambient contribution from ***the signals received during the first and second 'on' periods***." Ex.1011, 6:16-19 (emphasis added).

The system will measure a red signal, Ex.1011, 13:67-14:2 ("a detection signal peak corresponding to red 'on' period 202") and an IR signal, Ex.1011, 17:8-10 ("the levels received during… IR 'on' period 278."). *See* Ex.1011, 11:14-16 (detector "converts the intensity of the received light into an electrical signal"); Ex.1011, 13:35-41 ("Demultiplexer 156 may operate on detector current waveform 214 … to generate ***a Red signal*** [and] ***an IR signal***…") (emphasis added). This is depicted in Figures 2A and 2B, annotated below:




Ex.1011, Figs. 2A & 2B, 12:52-13:6.

The light received by the detector includes "the light that is reflected by or has traveled through the subject's tissue." Ex.1011, 17:40-42; *id*., 11:12-20 ("[L]ight may enter detector 140 after passing through the subject's tissue… ***The light intensity may be directly related to the*** absorbance and/or ***reflectance of light in the tissue***.")(emphasis added). This includes the IR light ("*input optical beam*") emitted by the LEDs. Ex.1011, 17:8-10 ("the levels received during… IR 'on' period 278."), *id*., 13:35-41.

Therefore, Lisogurski describes a receiver configured to capture light when one of the IR LEDs is on ("*while at least one of the LEDs is on*") and convert that to an electrical signal ("*second signal*"). Ex.1003, ¶¶135-137.

Lisogurski teaches capturing and converting light in this manner in order to implement its dark subtraction technique, which removes ambient light from a detected signal. Ex.1011, 13:60-14:10. A skilled person who wanted to improve the quality of a detected signal in the Park device, *see* Ex.1010, 11:10, 14:27, would have been motivated to implement this technique in order to remove noise in the same way it was removed in Lisogurski's similar optical sensor. Ex.1003, ¶138. Doing so would have involved using familiar components of the optical sensor according to known processing methods, yielding the predictable result of improving a signal-to-noise ratio of a detected signal. Ex.1003, ¶139. Thus, this claim limitation would have been obvious based on Park and Lisogurski.

**h) "the measurement device configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by differencing the first signal and the second signal;"**

Lisogurski explains that the dark subtractor subtracts the digital dark signal from the IR signals to generate an "adjusted… IR signal[]":

> [D]ark subtractor 162 ***may subtract dark values from the Red and IR components to generate adjusted Red and IR signals***. For example, dark subtractor 162 ***may determine a subtraction amount from the dark signal*** portion of the detection signal and subtract it from the peak portion of the detection signal in order to reduce the effect of the dark signal on the peak…. ***The dark signal amount determined in this manner may be subtracted from the detector peak corresponding to red "on" period 202***.

Ex.1011, 13:60-14:10 (emphasis added); *see* Ex.1011, 16:51-54 ("The system may subtract the background or dark level from the levels received during red 'on' portion 274 and IR 'on' period 278."). Thus, Lisogurski teaches subtracting ("differencing") the dark signal ("first signal") from the IR signal ("second signal"). Ex.1003, ¶¶141-142.

Because the dark signal subtraction process removes noise from the IR signal, a skilled person would have understood that it increases the signal-to-noise ratio. Ex.1003, ¶142. SNR is calculated by dividing the signal power by the noise power: S/N. Ex.1003, ¶142. Decreasing the noise necessarily increases the signal-to-noise ratio. *Id*.

A skilled person who wanted to improve the quality of a detected signal in the Park device, *see* Ex.1010, 11:10, 14:27, would have been motivated to implement this technique in order to remove noise, in the same way the technique removed noise in Lisogurski's similar optical sensor. Ex.1003, ¶144. This would have involved using familiar components of the optical sensor according to known processing methods, yielding the predictable result of improving SNR of a detected signal. Ex.1003. Thus, this claim limitation would have been obvious based on Park and Lisogurski.

**i) "the light source configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing the light intensity relative to the initial light intensity from at least one of the LEDs;"**

Park explains that its optical sensor has a light source intensity control that can either increase or decrease "a given light intensity" of the LEDs ("*initial light intensity from at least one of the LEDs*") to "maintain a desirable scattered/reflected intensity signal" ("*input optical beam reflected from the tissue*"). Ex.1010, Figs. 17-23, 9:50-10:2, 16:8-20. As one example, "***the light source intensity may be increased*** to maintain the output signal from the light detector within a desired range of output values." Ex.1010, 16:18-20 (emphasis added). Park further explains that increasing the input light signal is one way to improve signal-to-noise ratio. Ex.1010, 15:53-57.

Park provides examples of conditions that can impact the quality of an output signal of interest. Ex.1010, 14:19-27. A skilled person would have understood that when conditions such as these cause noise intensity to increase, SNR decreases. Ex.1003, ¶148. This is because SNR is calculated by dividing the signal power (intensity) by the noise power: $\frac{S}{N}$. *Id*. Increasing the intensity of the light sources in response to an increase in noise necessarily will improve the signal's SNR. Ex.1003, ¶148, Ex.1010, 15:53-57. Thus, a skilled person would have understood Park to disclose increasing the intensity of the LEDs "*to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue*." Ex.1003, ¶148.

Should Patent Owner contend that Park does not teach increasing an intensity of the light sources in order to "*further improve the signal-to-noise ratio,*" it would have been obvious from Lisogurski that it would be desirable to increase the intensity of the Park emitters for this purpose. Ex.1003, ¶149. Lisogurski explains that the sensor may receive "an increased level of background noise in the signal due to patient motion. The system may ***increase the brightness of the light sources*** in response to the noise ***to improve the signal-to-noise ratio***." Ex.1011, 9:46-52 (emphases added); *see id.*, 37:6-22, 6:3-6 (describing increasing SNR by increasing brightness); Ex.1003, ¶¶149-150.

A skilled person would have been motivated to increase intensity of the Park sensor for the purpose of improving a signal-to-noise ratio, using the same technique as taught by Lisogurski, in order to meet Park's objective to "maintain the output signal from the light detector within a desired range of output values." Ex.1010, 16:18-20. Doing so would have combined familiar components of an optical sensor with known processing techniques, yielding the predictable result of improving SNR. Ex.1003, ¶151.

**j) "the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue;"**

Park teaches that an optical sensor's photodetectors "sample, acquire and/or detect physiological data" from light reflected by the user's tissue. Ex.1010, 10:34-43. A skilled person would have understood that applying light to the user in order to acquire this data would be non-invasive. Ex.1003, ¶153. In addition, this physiological data can be used to determine a "***physiological parameter***" of the user, such as blood oxygen saturation (SpO2), for example. Ex.1010, 10:42-49, 10:52-56, 10:60-11:3. Thus, the physiological data "*represent at least in part a non-invasive measurement on blood contained within the tissue.*" Ex.1003, ¶¶153-154.

The biometric monitoring device generates an "*output signal*" for this physiological data, as shown in Fig. 1 (annotated):

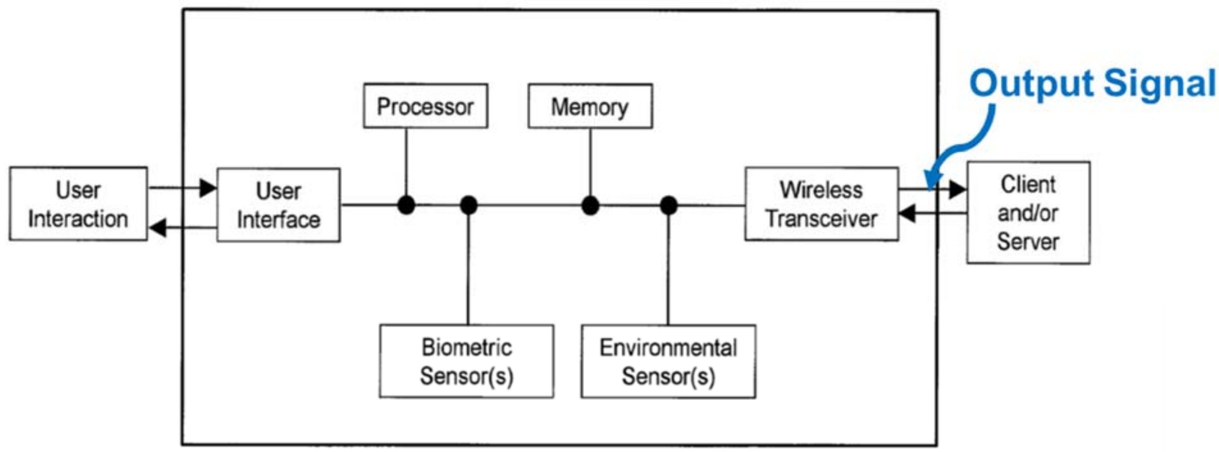



FIG. 1

Ex.1010, 2:23-25, 6:2-4 ("sensor output data"), *id*., 29:25-27 (biometric monitoring device "may transmit…its data to other peripheral devices").

**k) "the wearable device configured to communicate with the smart phone or tablet,"**

The Park wearable device includes a wireless transceiver for communicating with an "external device (for example, a client and/or server)."[9] Ex.1010, Figs. 1, 25, 2:19-25, 22:32-47. The device can be configured to implement "wireless communication techniques/methods and protocols such as Bluetooth, Bluetooth 4.0, RFID, NFC or WLAN." Ex.1010, 8:60-64, 9:4-8, 29:17-42. Ex.1003, ¶157.

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9 In some instances, Park refers to the external device as a "secondary device" *E.g.*, Ex.1010, 8:53-57.

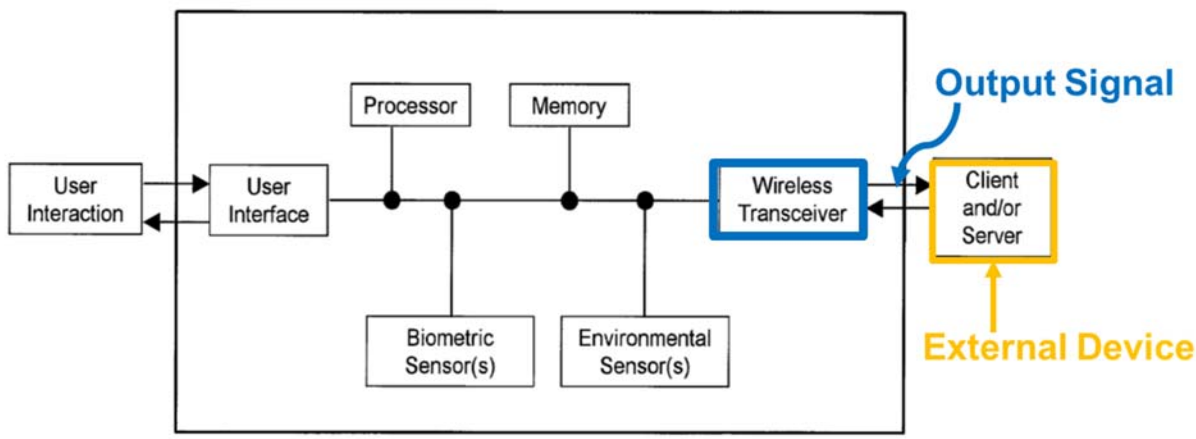


FIG. 1

Parks also explains that the "external device" can be a smart phone or tablet. Ex.1010, 9:8-13, 29:36-42, 34:11-14. Thus, Park discloses "*the wearable device [is] configured to communicate with the smart phone or tablet*."

**(1) "the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen,"**

As just described, Park teaches that its wearable device is configured to communicate with an external device such as a smart phone or tablet. It was well known in 2012 that smart phones and tablets included a wireless receiver, a wireless transmitter, a display, a voice input module such as a microphone, a speaker, and a touch screen. Ex.1003, ¶¶160-161. Nothing in the '040 Patent suggests that the terms "smart phone" or "tablet" were being used with a special meaning such that they would not contain these known components. Ex.1003, ¶¶160-161.

Park also teaches that the external device wirelessly communicates data to and from the biometric monitoring device using WLAN, Bluetooth, RFID, NFC or cellular technologies. Ex.1010, 8:61-64, 9:4-10. A skilled person would have understood that the external device necessarily would have a wireless receiver and wireless transmitter in order to implement these wireless technologies. Ex.1003, ¶161. Park also teaches that the external device may be equipped with a display (Ex.1010, 9:17), speaker (*id.*, 9:36-37), and touch screen (*id.*, 9:38), and it may receive audio commands (*id.*, 27:62-65). A skilled person would have understood that the external device would necessarily have a voice input module such as a microphone in order to receive audio commands. Ex.1003, ¶¶160-161.

Thus, Park discloses this limitation of claim 1.

#### (2) "the smart phone or tablet configured to receive and to process at least a portion of the output signal,"

As previously described for limitation (k), Park's wearable device generates physiological data from detected light. Ex.1010, 10:42-49, 10:52-56, 10:60-11:3. Park further explains that the device "may transmit… its data to other peripheral devices" such as a smart phone or tablet. Ex.1010, 29:25-27; *see also* Figs. 1, 25, 2:19-25, 8:60-64, 9:4-13, 29:30-42, 34:11-14. As shown in Fig. 1, the external device receives this data from the wearable device as an "*output signal*":

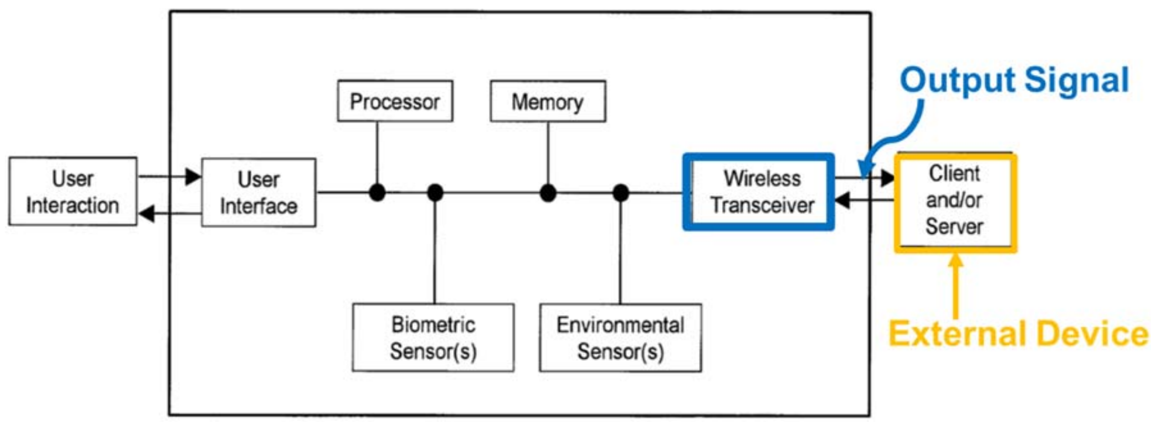


FIG. 1

Ex.1010, Fig. 1, 9:8-10 (external device can receive data "from the biometric monitoring device"), *id*., 9:17-20 (data "transferred to it by the biometric monitoring device"). Park therefore teaches that the external device, which can be a smart phone or tablet, is "*configured to **receive** … at least a portion of the output signal*" from the wearable device. Ex.1003, ¶¶164-166.

In addition, Park teaches that the physiological data ("*output signal*") from the wearable device can be "processed or analyzed" by the external device to determine a physiological parameter of the user, such as blood oxygen saturation (SpO2), for example. Ex.1010, 9:13-15 (calculations may be performed by the external device using data from the wearable device), *id*., 23:43-45 ("signal processing could also be performed remotely and communicated back to the devices after processing”), *id*., 10:42-49, 10:52-56, 10:60-11:3. The external device can also “give real-time feedback of heart rate, heart rate variability, and/or stress to the user.” Ex.1010, 27:38-43. Thus, Park teaches a “*smart phone or tablet configured to receive* ***and to process*** *at least a portion of the output signal*” received from the wearable device. Ex.1003, ¶166.

**(3) “wherein the smart phone or tablet is configured to store and display the processed output signal,”**

Parks teaches that external device “may be equipped with a display” so that it may “display data indicative of the user’s heart rate” and other types of physiological parameters corresponding to the “*processed output signal*” from the previous claim limitation. Ex.1010, 9:17-29, Ex.1003, ¶171. A skilled person would have understood that the external device would necessarily store these physiological parameters in order to display them. Ex.1003, ¶171. Moreover, Park teaches that a database of “physiological data may be compiled, developed, ***and/or stored*** on the … external computing device.” Ex.1010, 23:22-25 (emphasis added). A skilled person would have understood that a smart phone or tablet is such an external computing device for performing these functions. Ex.1003, ¶171. Park therefore teaches “*wherein the smart phone or tablet is configured to store and display the processed output signal*.”

**(4) "wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link."**

Park teaches that the external device, which can be a smart phone or tablet, transfers data ("*at least a portion of the processed output signal*") to "an external service such as www.fitbit.com or server (e.g., personal computer)." Ex.1010, 9:2-8. This transfer from the external device to a website or server can be achieved using "WLAN, Bluetooth, RFID, NFC [or] cellular" communication ("*transmitted over a wireless transmission link*"). Ex.1010, 9:4-8. A skilled person would therefore understand that the external device in Park generates "*a processed output signal*" as described in the previous claim limitation that is "*configured to be transmitted over a wireless transmission link*." Ex.1003, ¶173.

**4. Dependent Claim 2**

Claim 2 depends from claim 1 and specifies that "*the receiver is configured to be synchronized to the modulation of the at least one of the LEDs*."

Park teaches that its device can operate by "amplitude modulating the intensity of the light source and demodulating the output of the light detector (***e.g., synchronous detection***)." Ex.1010, Fig. 21, 17:33-38 (emphasis added), *id.*, 4:41-43. As previously described, the Park detector corresponds to the claimed "*receiver*," and a skilled person would have understood that a detector performing the described synchronous detection corresponds to the claimed receiver "*configured to be synchronized to the modulation of at least one of the LEDs*." Ex.1003, ¶173. Thus, Park discloses dependent claim 2, which would have been obvious based on Park in combination with Lisogurski, as described for claim 1.

### 5. Dependent Claim 3

Claim 3 specifies "[t]he wearable device of claim 1, further comprising:

> [a] a remote device configured to ***receive*** over the wireless transmission link an output status comprising the at least a portion of the processed output signal,
>
> [b] to ***process*** the output status to generate processed data and to ***store*** the processed data, and
>
> [c] wherein the remote device is capable of storing ***a history*** of at least a portion of the output status over a specified period of time, and
>
> [d] wherein the remote device is further configured to ***transmit*** at least a portion of the processed data to one or more ***other locations***, wherein the one or more other locations is selected from the group consisting of the smart phone or tablet, a doctor, a healthcare provider, a cloud-based server and one or more designated recipients."

#### a) "A remote device configured to receive…"

Park describes a "*remote device*" that can be a server, cloud server, or personal computer. Ex.1010, 9:2-4, 9:14-15. The remote device can host an external service, such as an Internet website like www.fitbit.com. Ex.1010, 9:2-4, 9:14-15, 29:46-55. Park provides the following example of how a remote device can interact with a smart phone:

> the [biometric monitoring] device ("*measurement device*") may be equipped with Bluetooth. If a Bluetooth-enabled smart phone ("*smart phone or tablet*") comes within reach of the device, the device may transmit data to or receive data from the Internet ("*remote device*") through the smart phone's cell phone network ("*wireless transmission link*"). Data from another device may also be transmitted to the device and stored (and vice versa) or transmitted at a later time.

Ex.1010, 29:36-42. Thus, Park teaches "*a remote device that is configured to receive [data] over the wireless transmission link*" from the smart phone. Ex.1003, ¶¶176-177.

A skilled person would have understood that the data sent to the Internet in this example would have included physiological parameters from the smart phone ("*at least a portion of the processed output signal*"). Ex.1003, ¶¶176-177. As explained for claim limitation (k)(2), Park teaches that a smart phone is configured to process physiological data from the wearable device in order to determine physiological parameters ("*processed output signal*"). Ex.1010, 23:22-25, 27:38-43; 10:52-56, 10:60-11:3, 9:13-15. Park also explains that a website can store these parameters. Ex.1010, 29:43-55. Thus, Park teaches a "*remote device*" such as a server hosting a website that is "*configured to receive over the wireless* *transmission link an output status comprising the at least a portion of the processed output signal*" from the smart phone. Ex.1003, ¶¶176-177.

**b) a remote device configured "to process…and to store…"**

Park explains that a server ("*remote device*") can determine when to generate a user alert, such as when the user's heart rate has reached a specific value or is in a specific range. Ex.1010, 27:1-2, 27:23-26. The server can also set a goal for the user, such as a certain goal range for the user's heart rate, or "a certain fatigue goal or limit." Ex.1010, 27:3-7, 27:13-16, 27:33-35. The criteria for meeting these goals may be based on physiological parameters such as heart rate. Ex.1010, 27:30-33 As previously explained, these parameters can be received from the smart phone. Ex.1010, 27:13-16, 27:20-22, 27:30-33. A skilled person would have understood that the server processes these physiological parameters from the smart phone ("*output status*") in order to generate the described goals or alerts ("*processed data*"). Ex.1010, 9:2-16, Ex.1003, ¶178.

Park also explains that a database of "physiological data may be ***compiled, developed**, **and/or stored*** on the … external computing device." Ex.1010, 23:22-25 (emphasis added). A skilled person would have understood that the external computing device would be either an external device such as a smart phone, or a server or computer hosting an external service such as a website. Ex.1003, ¶178.

Thus, this is another example of a remote device processing and storing physiological parameters received from the smart phone. Ex.1003, ¶179.

#### c) "wherein the remote device is capable of storing a history…"

Park provides several examples of "web content" comprising "*a history of at least a portion of the output status [received from the smart phone] over a specified period of time*," including:

> Historical graphs of heart rate and/or other data measured by the device but stored remotely
> Historical graphs of user activity and/or foods consumed and/or sleep data that are measured by other devices and/or stored remotely (e.g., fitbit.com)
> Historical graphs of other user-tracked data stored remotely. Examples include heart rate, blood pressure, arterial stiffness, blood glucose levels, cholesterol, [etc.].

Ex.1010, 29:13-55. As indicated, these histories are "stored remotely" as "web content," which a skilled person would have understood to mean that a remote device, hosting an external service such as fitbit.com, stores these histories. Ex.1003, ¶180. A skilled person would have also understood that generating "historical graphs" would necessarily require collecting a history of data over a specified period of time, which would be reflected by the x- or y-axis used by the graphs. Ex.1003, ¶180; *see also* Ex.1010, 9:29 (total *weekly* step count can be calculated).

**d) the remote device configured "to transmit…to one or more other locations…"**

Park teaches that the remote device is configured to transmit processed data to other locations, including the external device ("*smart phone or table*") and the user's biometric monitoring device ("*one or more designated recipients*").

Park explains that the external device "may be equipped with a display to output data … transferred to it by …the external service, or a combination of data from the biometric monitoring device, the secondary device, and/or the external service." Ex.1010, 9:17-22. Park also explains that the external device may transfer data to ***and from*** "an external service such as www.fitbit.com or other service (e.g., news, social network updates, email, calendar notifications), or server (e.g., personal computer, mobile phone, tablet)." Ex.1010, 9:2-13. Thus, Park teaches "*a remote device configured to transmit at least a portion of the processed data to … a smart phone or tablet*." Ex.1003, ¶182.

Park further explains that "signal processing could also be performed remotely and communicated back to the [biometric monitoring] devices after processing." Ex.1010, 23:28-45, *id*., 9:29-33 ("the biometric monitoring device may …display data obtained by the biometric monitoring device, the secondary device, the external service, or a combination of the three sources"). For example, web content from the remote device comprised of historical graphs can be streamed or transmitted to the user's biometric monitoring device for display.

Ex.1010, 29:43-55. Park also explains that a remote device determines when goals have been met or an alert should be sent, and that this information is communicated to the user. Ex.1010, 27:17-37. Park further describes an embodiment of the biometric measurement device that includes "apps" that display data received from a server. Ex.1010, 32:34-40. Thus, Park teaches "*a remote device configured to transmit at least a portion of the processed data to … one or more designated recipients*." Ex.1003, ¶183.

Should Patent Owner contend that Park must also disclose that the remote device transmits at least a portion of the processed data to a doctor, healthcare provider ***and*** cloud-based sever, a skilled person would have found it obvious to do so based on the teachings of Park. Ex.1003, ¶¶184-185. Park explains that an app on the user's device can display health-related information such as a

> fever tracker (e.g., measuring the risk, onset, or progress of a fever, cold, or other illness, possibly in combination with seasonal data, disease databases, user location, and/or user provided feedback to assess the spread of a particular disease (e.g., flu) in relation to a user, and possibly prescribing or suggesting the abstinence of work or activity in response),

Ex.1010, 32:6-12. Park further explains that the information for this app may be provided by a server ("*remote device*"). Ex.1010, 32:34-40. A skilled person would have found it obvious for the remote device to send processed data to a doctor or healthcare provider, as well as to a cloud-based server accessible by a doctor or healthcare provider, in order to generate the information displayed by this app. Ex.1003, ¶185. Park also describes providing content from Facebook and Twitter, as well as sharing web based content from a remote device with a user's "friends." Ex.1010, 29:63-67. A skilled person would have understood from these teachings that the remote device would send processed data to a cloud-based server housing these social media websites in order to enable these functions. Ex.1003, ¶185.

Thus, Park teaches or renders obvious this limitation of claim 3.

### B. Park, Lisogurski and Hanna Render Obvious Claims 1-3

Should Patent Owner may contend that Park and Lisogurski do not teach modulating one or more LEDs to include information, modifying the Park devices to do that would have been obvious based on Hanna. Hanna issued on January 7, 2003, and is prior art under 35 U.S.C. § 102(a)(AIA).

Hanna describes a pulse oximeter (Figure 1), that can be applied to a user's ear or finger to measure oxygen saturation or other constituents of the user's blood:

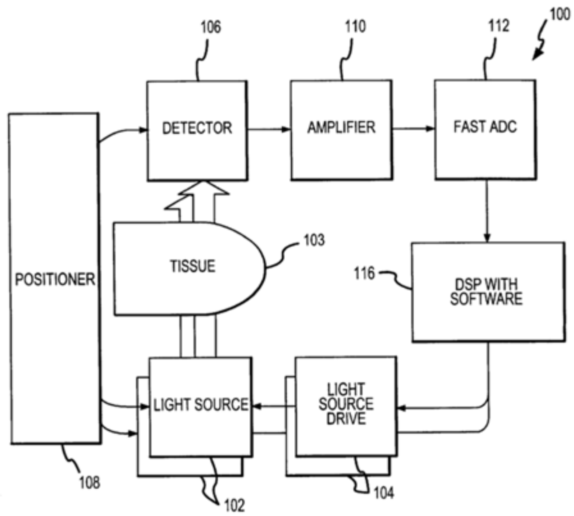


FIG.1

Ex.1007, Fig. 1, 1:25-39. The sensor has multiple emitters 102, which can be a red LED and an infrared LED. Ex.1007, 4:34-43. The signals from these light sources "are modulated using different code sequences." *Id.*, 4:43-51, Fig. 2-4, 6:13-8:25 (describing encoded signals). The modulated light is applied to the user's tissue 103, and the transmitted or reflected light is detected by one or more detectors 106. *Id.*, 4:67-5:18, 8:26-33, 1:48-49. Hanna explains that the purpose of encoding the light is to "allow the contribution of each source to the detector output to be determined." Ex.1007, 1:49-51, 2:23-29. The described coding technique also allows the detector to discriminate between noise and a signal of interest, because the modulated light generated by each emitter includes a unique code that is not found in noise. Ex.1007, 2:29-31.

As Hanna describes, each code represents identifying information that is included in a modulated emitter signal. Ex.1007, 6:13-8:25; Ex.1003, ¶¶188, 192.

Thus, Hanna teaches modulating light to include information, as required by the district court's preliminary claim construction. Ex.1003, ¶192.

Hanna teaches using this technique in the same kind of optical sensor described by Park and Lisogurski, and identifies the benefits of doing so, including to better extract discrete optical signals from multiple emitters in the presence of noise. Ex.1003, ¶193. A skilled person would have recognized that implementing the Hanna technique in the Park and Lisogurski sensors would improve their performance in the same way the techniques improved the performance of the Hanna sensor. Ex.1003, ¶¶190-194. That skilled person would have been motivated to incorporate the modulated coding techniques described by Hanna into the sensor described by Park to improve the performance of a wearable, wireless device consistent with prevailing market demands. Ex.1003, ¶195. Thus, Park in view of Lisogurski and further in view of Hanna would have rendered obvious claims 1-3.

### C. Park, Lisogurski, and Mannheimer (with or without Hanna) Render Obvious Claim 4

As explained in Ground 1, Park and Lisogurski would have rendered obvious independent claim 1. And, as explained in Ground 2, Park, Lisogurski and Hanna also would have rendered obvious claim 1. Dependent claim 4 is unpatentable based on either of these combinations in view of Mannheimer.

### 1. Mannheimer

Mannheimer issued on May 5, 1998 and is prior art under 35 U.S.C. § 102(a) (AIA).

Mannheimer discloses a pulse oximetry monitoring and measurement system that includes a sensor 26 comprised of emitter(s) 16 and detectors 20 and 24:

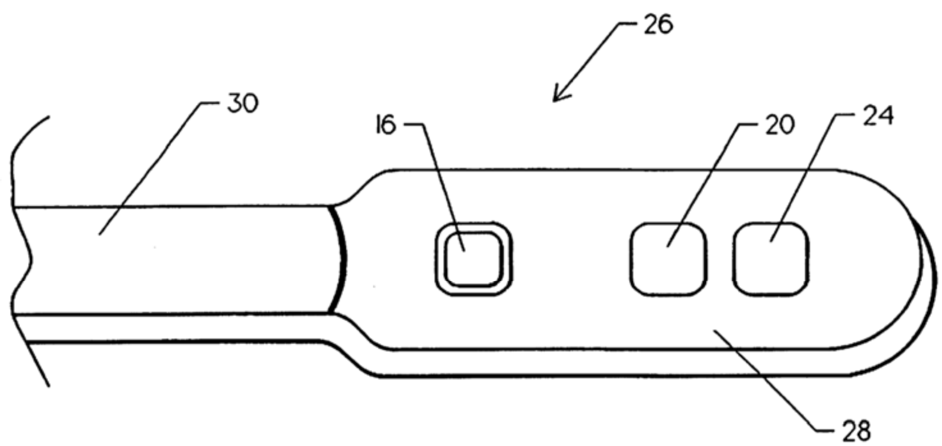


FIG. 2

Ex.1008, 6:17-36, Figs. 2, 4. The sensor uses one or more LEDs to alternately emit red and infrared light at a desired modulation frequency. Ex.1008, 6:20-21, 6:66-7:4. The emitted light is dispersed by the user's tissue, and the reflected light is collected by one or more detectors. Ex.1008, 6:22-23.

Mannheimer teaches using emitters that are spaced at different distances from a detector in order to obtain deep and shallow tissue measurements. Ex.1008, 1:40-54, 2:1-6, 3:25-35, Figs. 1B, 7. For example, Mannheimer includes an embodiment with two LEDs each spaced a different distance from a single detector. Ex.1008, Fig. 1B, 3:38-40, 5:58-62. In this way, reflected light from a surface layer of skin, which is non-vascular and susceptible to noise from motion and ambient light, can be removed so that light reflected by deeper, more vascular tissues layers can be used to identify a pulsatile signal of interest. Ex.1003, ¶201; Ex.1008, 3:25-35, 5:1-5.

#### 2. A Skilled Person Would Have Modified the Park Device As Described by Mannheimer

As described in Grounds 1 and 2, a skilled person would have found it obvious to configure the Park device to implement techniques taught by Lisogurski and/or Hanna in order to improve the performance of the described optical sensors. A person of ordinary skill reading any these references would have looked to other references that disclosed additional techniques for improving the operation of similar optical sensing systems. Ex.1003, ¶¶202-203. It was part of the ordinary design process to look for ways to improve the operation of a device by looking to complementary designs and techniques. *Id.*

Lisogurski in particular recognizes that light is attenuated differently depending on the tissue, and that skin pigmentation in particular can have an adverse effect on signal quality. Ex.1011, 19:42-50 ("The interaction of the emitted light with the subject may cause the light to become attenuated… [T]he attenuation of the light may depend on… the tissue with which the light interacts."), *id.*, 44:43-48 ("The red waveforms may be 25% of the intensity of the IR waveforms, as may occur in patients with dark skin pigmentation"). Mannheimer describes a solution to this problem, teaching that interference from skin can be removed by using signals detected from LEDs spaced different distances from a detector. Ex.1003, ¶¶201-202; Ex.1008, 3:25-35, 5:1-5.

A skilled person would have looked to Mannheimer for the additional reason that it teaches how to position emitters at different distances relative to a detector. Park explains "one or more sources and detectors may be arranged in an array or pattern that optimizes the SNR and/or reduces or minimizes power consumption by light sources and detectors." Ex.1010, 10:39-42; Ex.1003, ¶202. But Park does not specifically identify the spacing that should be used between these elements. A person of ordinary skill would have looked to other prior art for guidance on how to arrange multiple LEDs with respect to a detector, one example of which is described in Mannheimer. Ex.1003, ¶¶202-204.

Park, Lisogurski, Hanna and Mannheimer are also analogous references, each describing techniques for improving the measurements taken by optical sensors with multiple emitters and detectors. Ex.1003, ¶205. The skilled person would have considered the references together when implementing a system based on Park's teachings. *Id.*

### 3. Claim 4

Claim 4 depends from claim 1 and specifies that "*the receiver is located a first distance from a first one of the LEDs and a different distance from a second one of the LEDs such that the receiver can capture a third signal from the first LED and a fourth signal from the second LED, and wherein the output signal is generated in part by comparing the third and fourth signals*."

Mannheimer teaches emitters that are spaced at different distances from a detector, as shown in Fig. 1B (annotated), in order to obtain deep and shallow tissue measurements:

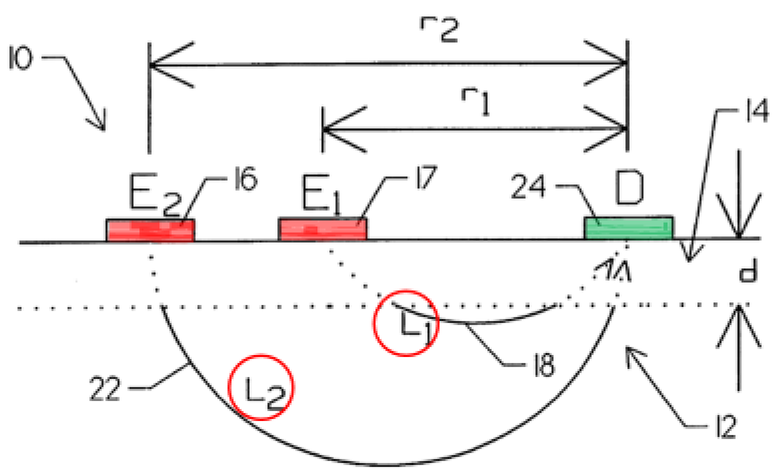


FIG. 1 B

Ex.1008, 1:40-54, 2:1-6, 3:25-35, Figs. 1B, 7. As shown, Emitter $E_1$ is located a first distance $r_1$ from the detector D. Ex.1008, 3:23. Emitter $E_2$ is located a second distance $r_2$ from the detector D, wherein $r_2$ is greater than $r_1$. Ex.1008, 3:24. The detector receives light signal 18 (*a first signal*) from emitter $E_1$ that has a path length $L_1$. Ex.1008, 3:18-21. The detector receives light signal 22 (*a second signal*) from emitter $E_2$ that has a path length $L_2$, wherein $L_2$ is greater than $L_1$. Ex.1008, 3:19-22.

Mannheimer teaches that this configuration allows reflected light from a surface layer of skin, which is non-vascular and susceptible to noise from motion and ambient light, can be removed so that light reflected by deeper, more vascular tissues layers can be used to identify a pulsatile signal of interest. Ex.1003, ¶¶198-201; Ex.1008, 3:25-35, 5:1-5. Mannheimer describes "calculating an arterial oxygen saturation level of [a] patient" from the intensity of signals 18 and 22. Ex.1008, 2:16-18. This calculation includes determining a first intensity $I_1$ corresponding to the signal 18 detected from light emitted by $E_1$ and a second intensity $I_2$ corresponding to the signal 20 detected from light emitted by $E_2$. Ex.1008, 3:35-54, 4:15-20. Mannheimer then teaches calculating a ratio R from $I_1$ and $I_2$ for purposes of calculating "a result related only to the arterial blood saturation of…deeper tissue." Ex.1008, 3:55-5:9; *see also* Ex.1008, 5:23-57 (providing an alternative calculation for the ratio R based on $I_1$ and $I_2$). Mannheimer therefore teaches comparing a signal 18 reflected by surface tissue and a signal 22 reflected by deep tissue in order to subtract the effects of light reflected by the surface tissue. Ex.1003, ¶201. Mannheimer therefore teaches dependent claim 4.

A skilled person would have found it obvious to spatially arrange the emitters and detector of the sensor described in Park in the manner described by Mannheimer. Ex.1003, ¶202. Both references describe using multiple emitters while recognizing the importance of optimizing a detected signal. Ex.1011, 10:34-49; Ex.1008, Ex.1008, 1:64-2:30. A skilled person considering how to implement the Park sensor would have considered other prior art for solutions for removing noise, in particular Mannheimer, which provides extensive guidance on how to configure emitters and detectors being used in optical sensing. Ex.1003, ¶¶202-204. That person would have been motivated by the benefits identified in Mannheimer, including removing the effects of light reflected by a surface layer of skin so that a signal of interest can be extracted from a deeper tissue layer. Ex.1003, ¶¶202-204; Ex.1008, 3:25-35, 5:1-5. A skilled person thus would have been motivated to arrange the Park emitters relative to the detector as taught by Mannheimer to remove noise caused by a person's skin. Ex.1003, ¶¶202-204.

The modifications to the Park sensor suggested by Mannheimer would also yield predictable results. An ordinary artisan would expect in the Park sensor that light from an emitter spaced further away from the detector would penetrate deeper into the user's skin as compared to light from a closer emitter. Ex.1003, ¶202. It would have been reasonably predictable that comparing the received light from these different penetration depths, as described by Mannheimer, could be used to improve performance of the Park sensor in the same way it improved the performance of the similar Mannheimer sensor. Ex.1003, ¶202.

It would have been obvious for a skilled person to configure the Park device to perform the comparison in the manner described by Mannheimer in order to remove the effects of noise at the surface layer of skin. Ex.1003, ¶¶202-203. Lisogurski recognizes that light is attenuated differently depending on the tissue, and that skin pigmentation in particular can have an adverse effect on signal quality. Ex.1011, 19:42-50 44:43-48. This adverse effect can be mitigated by implementing the teachings of Mannheimer, which removes light reflected by the surface layer of skin. Ex.1003, ¶204. A skilled person would be motivated to implement the comparison described by Mannheimer in the system of Lisogurski in order to increase a signal-to-noise ratio and provide an improved measurement device. Ex.1003, ¶205.

### D. No Secondary Considerations Exist

Park, in combination with Lisogurski as described in Ground 1, and in combination with Lisogurski and Hanna as described in Ground 2, and in combination with Lisogurski, Hanna and Mannheimer as described in Ground 3, teaches systems and devices that render *prima facie* obvious the challenged claims of the '040 Patent. No secondary indicia of non-obviousness exist having a nexus to the putative "invention" of the '040 Patent contrary to that conclusion. Petitioner reserves its right to respond to any assertion of secondary indicia of non-obviousness advanced by Patent Owner.

## VII. Conclusion

Petitioner respectfully submits that there is a reasonable likelihood that Petitioner will prevail in establishing that the challenged claims are unpatentable, and requests that Trial be instituted.

Dated: April 10, 2019 Respectfully submitted,

/Jeffrey P. Kushan/


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**Claim Appendix**

1. A wearable device for use with a smart phone or tablet, the wearable device comprising:

a measurement device including a light source comprising a plurality of light emitting diodes (LEDs) for measuring one or more physiological parameters, the measurement device configured to generate, by modulating at least one of the LEDs having an initial light intensity, an input optical beam having one or more optical wavelengths, wherein at least a portion of the one or more optical wavelengths is a near-infrared wavelength between 700 nanometers and 2500 nanometers;

the measurement device comprising one or more lenses configured to receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue;

the measurement device further comprising a reflective surface configured to receive and redirect at least a portion of light reflected from the tissue;

the measurement device further comprising a receiver configured to:

capture light while the LEDs are off and convert the captured light into a first signal and capture light while at least one of the LEDs is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue;

the measurement device configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by differencing the first signal and the second signal;

the light source configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing the light intensity relative to the initial light intensity from at least one of the LEDs;

the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue; and

the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen, the smart phone or tablet configured to receive and to process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link.

2. The wearable device of claim 1, wherein the receiver is configured to be synchronized to the modulation of the at least one of the LEDs.

3. The wearable device of claim 1, further comprising a remote device configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the output status to generate processed data and to store the processed data, and wherein the remote device is capable of storing a history of at least a portion of the output status over a specified period of time, and

wherein the remote device is further configured to transmit at least a portion of the processed data to one or more other locations, wherein the one or more other locations is selected from the group consisting of the smart phone or tablet, a doctor, a healthcare provider, a cloud-based server and one or more designated recipients.

4. The wearable device of claim 1, wherein the receiver is located a first distance from a first one of the LEDs and a different distance from a second one of the LEDs such that the receiver can capture a third signal from the first LED and a fourth signal from the second LED, and wherein the output signal is generated in part by comparing the third and fourth signals.

## CERTIFICATE OF COMPLIANCE

I hereby certify that this brief complies with the type-volume limitations of 37 C.F.R. § 42.24, because it contains 13,973 words (as determined by the Microsoft Word word-processing system used to prepare the brief), excluding the parts of the brief exempted by 37 C.F.R. § 42.24.

Dated: April 10, 2019

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**CERTIFICATE OF SERVICE**

I hereby certify that on this 10th day of April, 2019, copies of this Petition for *Inter Partes* Review, Attachments and Exhibits have been served in its entirety by Federal Express on the following counsel of record for Patent Owner:

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