

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TRW AUTOMOTIVE US LLC,
Petitioner,

v.

MAGNA ELECTRONICS INCORPORATED,
Patent Owner.

Case IPR2014-00261
Patent 7,339,149 B1

Before JUSTIN T. ARBES, PATRICK R. SCANLON, and
JO-ANNE M. KOKOSKI, *Administrative Patent Judges*.

SCANLON, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

A. *Background*

Petitioner, TRW Automotive US LLC, filed a corrected Petition (Paper 17, “Pet.”)¹ to institute an *inter partes* review of claims 1–5, 7, 8, 13, and 41 of U.S. Patent No. 7,339,149 B1 (Ex. 1002, “the ’149 patent”) pursuant to 35 U.S.C. §§ 311–319. Patent Owner, Magna Electronics Inc., subsequently filed a Preliminary Response (Paper 7, “Prelim. Resp.”). On June 26, 2014, we instituted an *inter partes* review of claims 1–5, 7, 8, and 13 on three grounds of unpatentability (Paper 19, “Dec. on Inst.”).

After institution, Patent Owner filed a Patent Owner Response (Paper 25, “PO Resp.”), and Petitioner filed a Reply (Paper 29, “Reply”).

An oral hearing was held on February 18, 2015. A transcript of the hearing is included in the record. Paper 38 (“Tr.”).

We have jurisdiction under 35 U.S.C. § 6(b). This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons that follow, we determine that Petitioner has shown by a preponderance of the evidence that claims 1–5, 7, 8, and 13 of the ’149 patent are unpatentable.

B. *The ’149 Patent*

The ’149 patent, titled “Vehicle Headlight Control Using Imaging Sensor,” issued on March 4, 2008. The ’149 patent describes a system for “controlling [a] vehicle’s headlamps in response to sensing the headlights of oncoming vehicles and taillights of leading vehicles.” Ex. 1002, 1:33–35.

¹ Paper 17 is a corrected Petition for *inter partes* review filed May 9, 2014. The original Petition for *inter partes* review (Paper 1) was accorded a filing date of December 17, 2013. See Papers 3, 16.

According to the '149 patent, prior attempts at automatic vehicle headlight controls included a single light sensor, wherein the headlights were dimmed in response to sensed light exceeding a threshold. *Id.* at 1:50–53. The '149 patent states that such systems are ineffective at detecting oncoming headlights at a distance and detecting taillights of leading vehicles. *Id.* at 1:54–62.

The '149 patent describes vehicle headlight dimming control 12 comprising imaging sensor module 14, imaging control circuit or digital signal processor 13, and vehicle lighting control logic module 16. *Id.* at 3:54–58; Fig. 2. Imaging sensor module 14 includes optical device 36, light sensing array 38, and spectral separation device 40 disposed between optical device 36 and light sensing array 38. *Id.* at 4:32–37; Fig. 2. Imaging sensor module 14 may be mounted to, or near, the vehicle's windshield via bracket 34. *Id.* at 4:13–15; Fig. 2. This positioning provides an interior location that substantially eliminates environmental dirt and moisture problems and provides a relatively clear view forward of the vehicle. *Id.* at 4:16–20.

Light sensing array 38 includes a plurality of photosensor elements 42 arranged in a matrix. *Id.* at 4:43–45, Fig. 4. Digital signal processor 13, which receives output 56 from light sensing array 38, includes taillight detection circuit 76 and headlight detection circuit 78. *Id.* at 4:64–5:1, Fig. 3. Taillight detection circuit 76 detects red light sources above a particular threshold, and headlight detection circuit 78 detects white light sources above a particular threshold. *Id.* at 5:12–30. Thus, “the control identifies light sources that are either oncoming headlights or leading taillights by identifying such light sources according to their spectral makeup.” *Id.* at 2:50–52.

Vehicle lighting control logic module 16 receives input 20 from digital signal processor 13. *Id.* at 4:6–7, Fig. 2. Vehicle lighting control logic module 16 responds to the input by switching headlights 18 to an appropriate mode. *Id.* at 5:57–59. For instance, the headlights might be switched from high-beam mode to low-beam mode in response to detecting oncoming headlights. *Id.* at 7:47–50.

C. Illustrative Claims

Of the challenged claims in the '149 patent, claims 1 and 7 are independent. Claims 2–5, 8, and 13 depend, directly or indirectly, from claim 1, which is reproduced below:

1. A control system for automatically controlling the state of the headlamps of a controlled vehicle, said control system comprising:

an optical system for imaging external sources of light within a predetermined field of view; and

an imaging processing system for processing images from said optical system and providing a control signal for controlling the state of the headlamps as a function of the output of pixels imaging the same spectral band of light.

Ex. 1002, 12:49–58.

Claim 7 recites:

7. A control system for automatically controlling the state of the headlamps of a controlled vehicle, said control system comprising:

an optical system for imaging external sources of light within a predetermined field of view, said optical system including an image array sensor containing a plurality of pixels; and

an imaging processing system for processing images from said optical system and providing a control signal for controlling the state of the headlamps as a function of the output of pixels

imaging the same spectral band of light, wherein said optical system is further configured to spatially segregate light sources having different spectral compositions on said pixel image array sensor.

Ex. 1002, 13:7–20.

D. Prior Art

The pending grounds of unpatentability in this *inter partes* review are based on the following prior art:

1. Japanese Kokai Application No. S62-131837, published June 15, 1987 (“Yanagawa”) (Ex. 1005)²;
2. U.S. Patent No. 4,521,804, issued June 4, 1985 (“Bendell”) (Ex. 1006);
3. Oliver Vellacott, *CMOS in camera*, IEE Review, 111–114 (May 1994) (“Vellacott”) (Ex. 1007);
4. U.S. Patent No. 4,758,883, issued July 19, 1988 (“Kawahara”) (Ex. 1008); and
5. U.S. Patent No. 5,075,768, issued December 24, 1991 (“Wirtz”) (Ex. 1009).

E. Pending Grounds of Unpatentability

We instituted the instant *inter partes* review on the following grounds of unpatentability:

² Petitioner’s Exhibit 1005 contains both the Japanese patent document and an English translation of the document; Petitioner provided an affidavit attesting to the accuracy of the translation. *See* Ex. 1005; 37 C.F.R. § 42.63(b). Our references to Yanagawa in this decision refer to the English translation.

References	Basis	Claim(s) Challenged
Yanagawa and Bendell	§ 103	1–4, 7, and 8
Yanagawa, Bendell, and Vellacott	§ 103	5
Yanagawa, Bendell, and Wirtz	§ 103	13

Dec. on Inst. 28–29.

II. ANALYSIS

A. *Claim Construction*

Petitioner contends, and Patent Owner does not dispute, that the ’149 patent has expired. Pet. 1. The Board’s interpretation of the claims of an expired patent is similar to that of a district court’s review. *See In re Rambus, Inc.*, 694 F.3d 42, 46 (Fed. Cir. 2012). We are guided, therefore, by the principle that the words of a claim “are generally given their ordinary and customary meaning” as understood by a person of ordinary skill in the art in question at the time of the invention. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc). “In determining the meaning of the disputed claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17).

The Office interprets limitations arising under 35 U.S.C. § 112, sixth paragraph, in light of the corresponding structure, material, or acts described in the specification. *In re Donaldson Co.*, 16 F.3d 1189, 1193 (Fed. Cir. 1994) (“[P]aragraph six applies regardless of the context in which the interpretation of means-plus-function language arises, i.e., whether as part of

a patentability determination in the PTO or as part of a validity or infringement determination in a court.”). The sixth paragraph of § 112 states that a claim limitation expressed in means-plus-function language “shall be construed to cover the corresponding structure . . . described in the specification and equivalents thereof.”³

1. “configured to spatially segregate light sources having different spectral compositions on said pixel image array sensor” (Claim 7)

In the Decision on Institution, we construed the phrase “configured to spatially segregate light sources having different spectral compositions on said pixel image array sensor” to mean that the claimed optical system is configured for distributing light across the pixel image array sensor, and that the structure may include at least mirrors with dichroic surfaces or prisms. Dec. on Inst. 7–8.

Patent Owner argues that the Board’s interpretation is inconsistent with the language of both claim 7 and the Specification of the ’149 patent. PO Resp. 6. Patent Owner supports its argument with the Declaration of Matthew A. Turk, Ph.D. (Ex. 2032).

Patent Owner argues that this phrase “should be construed to mean that the system is configured to segregate light sources having different spectral compositions onto a *single* or common image array sensor,” such that the limitation means “different spectral compositions (i.e., the likes of red, green, and blue light) are directed onto a single or common imaging array sensor.” *Id.* at 7 (citing Ex. 2032 ¶¶ 40–42).

³ Section 4(c) of the Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (“AIA”) re-designated 35 U.S.C. § 112, sixth paragraph, as 35 U.S.C. § 112(f). Because the ’149 patent has a filing date prior to September 16, 2012, the effective date of the AIA, we refer to the pre-AIA version of 35 U.S.C. § 112.

In support of this position, Patent Owner asserts:

The language of claim 7 is directed towards embodiments having a filter (40a/b) for filtering light having different spectral compositions onto a single image array sensor 38. Claim 7 is not directed towards embodiments having a dichroic mirror or prisms and multiple image array sensors each imaging a respective single spectral composition of light.

Id. at 8–9 (citing Ex. 2032 ¶ 42). Based on this assertion, Patent Owner argues claim 7 is consistent with the portions of the Specification that describe filter elements that direct light spectra onto a single or common “image array sensor,” but is contrary to the portions that describe the use of dichroic mirrors or prisms that separate and direct different spectral compositions onto different arrays designed to detect different spectral compositions of light. *Id.* at 9. According to Patent Owner, “[t]his distinction renders the Board’s claim construction of claim 7 inconsistent with the specification of the ’149 Patent.” *Id.*

Petitioner replies that Patent Owner is proposing to insert the wording “single or common” into the claim construction where no such language is found in claim 7. Reply 2. Petitioner also argues that our preliminary construction is “fully consistent” with the Specification and does not contradict the language of claim 7. *Id.* at 4–5.

We agree with Petitioner in part and Patent Owner in part. First, Petitioner is correct that the claim is not limited to a single image array sensor. Claim 7 recites “an image array sensor,” not a “single” image array sensor. Ex. 1002, 13:12; *see KCJ Corp. v. Kinetic Concepts, Inc.*, 223 F.3d 1351, 1356 (Fed. Cir. 2000) (“This court has repeatedly emphasized that an indefinite article ‘a’ or ‘an’ in patent parlance carries the meaning of ‘one or

more’ in open-ended claims containing the transitional phrase ‘comprising.’”). Patent Owner’s argument that claim 7 is “directed” to a particular embodiment employing a single image array sensor is not persuasive because it is inconsistent with the language of the claim and essentially seeks to improperly read limitations from the Specification into the claim. *See In re Am. Academy of Sciences Tech. Ctr.*, 367 F.3d 1359, 1369 (Fed. Cir. 2004) (“We have cautioned against reading limitations into a claim from the preferred embodiment described in the specification, even if it is the only embodiment described, absent clear disclaimer in the specification.”).

Second, Patent Owner is correct that light sources must be spatially segregated onto a common pixel image array sensor. Claim 7 recites that the optical system is “configured to spatially segregate light sources having different spectral compositions on *said* pixel image array sensor” (emphasis added). Thus, at least two light sources must be spatially segregated on the same image array sensor.

The parties’ dispute, however, is really over the interpretation of “image array sensor.” Patent Owner’s position appears to be that the term excludes the use of different light sensing arrays with light segregated by dichroic mirrors and prisms, as shown in Figure 6 of the ’149 patent. PO Resp. 7–9. Petitioner, on the other hand, believes that an “image array sensor” may have multiple contiguous arrays. Reply 2–5.

The term “image array sensor” appears in the claims of the ’149 patent but is not described in the Specification.⁴ The ’149 patent discloses imaging sensor module 14, which includes optical device 36, array 38 of

⁴ The Abstract of the ’149 patent uses the term “imaging array sensor.”

photon-accumulating light sensors (also referred to as light-sensing array 38), and spectral separation device 40 disposed between optical device 36 and array 38. Ex. 1002, 4:32–37, Fig. 2. Spectral separation device 40, which may be a filter array, separates light from the scene forward of the vehicle into a plurality of spectral bands. *Id.* at 4:34–36.

Importantly, however, claim 7 does not recite an “array”; it recites an “image array sensor.” The Specification states that Figure 5 is a “block diagram of an imaging sensor,” and Figure 6 is “an alternative embodiment of an imaging sensor.” *Id.* at 3:35–36. The sensor depicted in Figure 5 includes a single photosensor array 38a, whereas the sensor depicted in Figure 6 includes multiple photosensor arrays 38b. *Id.* at 6:1–10, 8:38–41. In yet another embodiment, “imaging sensor module 14c includes three light-sensing arrays (not shown) and a spectral separation device overlying the light-sensing arrays which directs spectral bands to different arrays.” *Id.* at 8:56–60. Thus, we do not see any basis in the Specification to limit the claimed “image array sensor” to a sensor with just one array. *See also* Reply 3 (citing for the ordinary meaning of “sensor” a dictionary definition that would encompass a device with multiple components, Ex. 1012 (renumbered as Ex. 1057)).⁵

Patent Owner’s arguments regarding the Specification pertain to element 38, which Patent Owner calls “image array sensor 38.” PO Resp. 7–8. The Specification, however, never refers to element 38 as an “image array sensor.” The Specification calls it an “array,” “light-sensing array,” or

⁵ Petitioner filed Exhibits 1012–14 on April 17, 2014, and then filed different documents also numbered as Exhibits 1012–14 on December 15, 2014. To ensure a clear record, we renumber the documents filed on December 15, 2014 as Exhibits 1057–59.

“photosensor array.” See, e.g., Ex. 1002, 4:32–48, 5:2–7, 6:1–17 (“single photosensor array 38a”), 8:30–55 (“two or more pairs of photosensor arrays 38b”). Patent Owner’s position would require us to read out “sensor” from the claim, when Patent Owner deliberately chose that language instead of merely reciting an “array.”⁶

Accordingly, on the full record, we maintain our construction of “configured to spatially segregate light sources having different spectral compositions on said pixel image array sensor” to mean that the claimed optical system is configured for distributing light across the pixel image array sensor, and that the structure may include at least mirrors with dichroic surfaces or prisms. We also construe “image array sensor” to mean a device that senses a two-dimensional image, which may comprise a single light sensing array or multiple light sensing arrays.

2. *“as a function of the output of pixels imaging the same spectral band of light” (Claims 1 and 7)*

In the Decision on Institution, we interpreted the phrase “as a function of the output of pixels imaging the same spectral band of light” to mean “as a function of the output of pixels imaging the same color band.” Dec. on Inst. 8–9. The parties do not dispute this interpretation, and we see no reason to modify this interpretation in light of the record developed at trial.

⁶ For example, claim 15 recites “wherein said image processing system includes at least two photosensor arrays, and wherein said optical system comprises at least two lenses, one of said at least two lenses being configured to image onto one of said at least two photosensor arrays, and the other of said at least two lenses being configured to image onto the other of said at least two photosensor arrays.”

3. “means for filtering infrared light from said external sources of light” (*Claim 13*)

In the Decision on Institution, we interpreted “means for filtering infrared light from said external sources of light” as follows:

Function: “filtering infrared light from said external sources of light”;

Corresponding structure: an infrared filter.

Dec. on Inst. 9–10. The parties do not dispute this interpretation, and we see no reason to modify this interpretation in light of the record developed at trial.

B. *Asserted Obviousness of Claims 1–4, 7, and 8 over Yanagawa and Bendell*

Petitioner asserts that claims 1–4, 7, and 8 are unpatentable under 35 U.S.C. § 103(a) over the combination of Yanagawa and Bendell. Pet. 11–19, 22–28.^{7,8} To support its assertions, Petitioner relies on the Declarations of Jeffrey A. Miller, Ph.D. (Exs. 1011, 1059). Patent Owner disagrees with Petitioner’s assertions. PO Resp. 10–24.

A claim is unpatentable under 35 U.S.C. § 103 if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

⁷ We note that on pages 3–4 of the Petition, Petitioner indicates that claims 1–4 and 8 are “anticipated” by Yanagawa in view of Bendell under 35 U.S.C. § 102(a) (pre-AIA). We determined that this identification is a typographical error. Dec. on Inst. 16. Petitioner also mistakenly references 35 U.S.C. § 102(a) (pre-AIA) in discussing its obviousness ground on page 11 of the Petition.

⁸ In the Petition, Petitioner asserted that claim 7 is unpatentable under 35 U.S.C. § 103(a) over either (1) Yanagawa and Bendell or (2) Yanagawa, Bendell, and Kawahara. Pet. 22–28. We did not institute *inter partes* review of claim 7 based on the combination of Yanagawa, Bendell, and Kawahara. See Dec. on Inst. 24–25.

invention was made to a person having ordinary skill in the art to which the subject matter pertains. *KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 406 (2007). In the Petition, Petitioner proposed that a person having ordinary skill in the art of the '149 patent at the time of the invention would have had at least the qualifications of, or equivalent to, either (1) a master's degree in electrical engineering or computer science, with course work or research in vision systems, or (2) an undergraduate degree in electrical engineering or computer science with at least two years of work making optical vision systems. Pet. 13 (citing Ex. 1011 ¶ 14). Patent Owner argued that this definition was incorrect because it failed to make any mention of expertise in vehicle technologies. Prelim. Resp. 27. In our Decision on Institution, we found Patent Owner's argument unpersuasive because Patent Owner did not explain how the allegedly incorrect definition led to an incorrect obviousness analysis. Dec. on Inst. 17. The parties have not disputed this definition further. Based on our review of the record developed during trial, including the disclosure of the '149 patent and the cited prior art, and the testimony of the parties' declarants, we adopt the above-mentioned definition of a person having ordinary skill in the art for the purposes of this Final Written Decision.

1. *Overview of Yanagawa*

Yanagawa discloses a "traveling vehicle recognition device capable, for example, of automatically controlling headlight beams to high and low beams according to the state of whether there is a vehicle ahead." Ex. 1005, 2. The device includes color television camera 11 mounted to image the forward direction of vehicle 12. *Id.* A video signal from television camera 11 is supplied to decoder 13, which separates the video signal into R (red), G

(green), and B (blue) color image signals that are supplied to image signal processor 14. *Id.* Image signal processor 14 processes the color image signals to recognize or detect the presence of taillights or headlights within the imaged video. *Id.* at 2–3.

2. *Overview of Bendell*

Bendell discloses a television camera including four-port color-splitting prism 22 and four solid-state imagers: blue-responsive imager 14, red-responsive imager 16, and green-responsive imagers 18, 20. Ex. 1006, 3:23–25, 46–52, Fig. 1a. Bendell further discloses that each “solid-state imager may be of the CCD [charge coupled device] type.” *Id.* at 3:53.

3. *Claim 1*

Petitioner contends that Yanagawa discloses all elements of the control system of claim 1 except for the use of “pixels.” Pet. 13. In particular, Petitioner asserts that Yanagawa’s color television camera 11 corresponds to the claimed optical system for imaging external sources of light within a predetermined field of view. *Id.* at 13–14. Petitioner also asserts that “Yanagawa describes an *imaging processing system* utilizing images from ‘television camera 11’ that supplies images to ‘a decoder 13’ that ‘forms R (red), G (green) and B (blue) color image signals based on the video signal,’” and decoder 13 “supplies the R, [G] and B color image signals to an image signal processor 14,” wherein the R, G, and B signals constitute separate images in the same spectral band of light. *Id.* at 14 (quoting Ex. 1005, 2). Petitioner further asserts that image signal processor 14 “operates on these respective images to provide *a control signal for controlling the state of the headlamps.*” *Id.* at 14–15 (quoting Ex. 1005, 2–3). Petitioner indicates that Yanagawa does not disclose expressly a

television camera that uses “pixels,” but asserts that Bendell discloses a television camera having “pixels.” *Id.* at 15 (citing Ex. 1006, Abstract).

In view of these assertions, Petitioner contends that “the substitution of the television camera of Bendell for the unspecified type of television camera of Yanagawa, is an equivalent (and unpatentable) interchange of television cameras.” *Id.* (referring to *KSR*). As a further reason for combining the references, Petitioner submits that Bendell’s camera has “the advantages of long life, light weight, ruggedness, signal-to-noise and low power consumption [which] make the solid-state imager very attractive for color camera use.” *Id.* at 16 (quoting Ex. 1006, 2:4–7).

Patent Owner argues that a person of ordinary skill in the art would not have found claim 1 obvious based on the combination of Yanagawa and Bendell. PO Resp. 10–11. More specifically, Patent Owner contends that the proposed modification (1) would render Yanagawa’s system unsatisfactory for its intended purpose (*id.* at 11–16), (2) would change Yanagawa’s principles of operation (*id.* at 17–19), and (3) relies on impermissible hindsight (*id.* at 19–20). Patent Owner also contends the proposed modification would not have been obvious because Bendell teaches away from the combination with Yanagawa. *Id.* at 20–21. All of these arguments are based on Patent Owner’s assertion that Bendell’s CCD imager has inferior resolution relative to Yanagawa’s television camera. *Id.* at 13 (citing Ex. 1006, 2:2–4, Ex. 2032 ¶ 26); *id.* at 18 (citing Ex. 2032 ¶ 32); *id.* at 19; *id.* at 20–21 (citing Ex. 2032 ¶¶ 23–26, 29). For example, Patent Owner argues “[r]eplacing a sensor having a superior resolution (the analog imaging sensor in Yanagawa) with a sensor having inferior resolution would tend to render Yanagawa’s system incapable of accurately

recognizing headlights and taillights.” *Id.* at 13–14 (citing Ex. 2032 ¶¶ 24, 26, 29).

Petitioner asserts that Patent Owner’s argument based on the allegedly inferior resolution of CCD imagers lacks credibility. Reply 9. For example, Petitioner notes that Dr. Turk responded “I’m not sure what they were at that time,” when asked what were the available resolutions for CCD imagers in 1996. *Id.* (citing Ex. 1058, 127:16–24). Relying on the testimony of Dr. Miller, Petitioner argues Dr. Turk is incorrect regarding the resolution issue. *Id.* (citing Ex. 1059 ¶¶ 30–38).

We are not persuaded by Patent Owner’s arguments. Patent Owner and Dr. Turk rely on Bendell’s statement that “discrete sensing sites cause resolution of the CCD imager to be limited by comparison with that of a modern camera tube” as showing that Bendell’s CCD imager has inferior resolution. PO Resp. 13 (citing Ex. 1006, 2:2–4); Ex. 2032 ¶ 23 (citing Ex. 1006, 2:2–4). This passage of Bendell, however, continues with “but the advantages of long life, light weight, ruggedness, signal-to-noise and low power consumption make the solid state imager very attractive for color camera use.” Ex. 1006, 2:4–7. Thus, taken in full context, we are not persuaded that Bendell’s description of limited resolution, with five countervailing advantages making a CCD imager “very attractive,” would have caused a person of ordinary skill in the art not to consider Bendell. A given course of action often has simultaneous advantages and disadvantages, which does not necessarily obviate a reason to combine references. *See Winner Int’l Royalty Corp. v. Wang*, 202 F.3d 1340, 1349 n. 8 (Fed. Cir. 2000) (“The fact that the motivating benefit comes at the expense of another benefit, however, should not nullify its use as a basis to modify the

disclosure of one reference with the teachings of another. Instead, the benefits, both lost and gained, should be weighed against one another.”).

We are not persuaded that the disadvantage of limited resolution with solid-state imagers outweighs the advantages of long life, lighter weight, low power consumption, etc. In addition, regarding Patent Owner’s argument that the proposed modification would render Yanagawa’s system unsatisfactory for its intended purpose, Petitioner asserts that this “argument is premised upon an erroneous perspective that Yanagawa ‘must be understood to be a non-pixelated sensor.’” Reply 6 (quoting PO Resp. 12). According to Petitioner, Yanagawa teaches the use of a ‘television camera,’ without distinguishing between pixelated (solid state) and non-pixelated (analog) forms of television cameras,” and Bendell, for example, expressly contemplated solid-state television cameras as an improvement to tube-based systems. *Id.* at 6–7. Petitioner also asserts that the proposed modification does not change Yanagawa’s basic principle of operation for similar reasons. *Id.* at 11–12. We find Petitioner’s assertions persuasive.

For the above reasons, we do not agree that Bendell teaches away from the combination with Yanagawa or that the proposed modification would render Yanagawa’s system unsatisfactory for its intended purpose, change Yanagawa’s principles of operation, or require impermissible hindsight.

After considering Petitioner’s and Patent Owner’s positions, as well as their supporting evidence, we determine that Petitioner has shown, by a preponderance of the evidence, that claim 1 is unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Yanagawa and Bendell.

4. *Claims 2–4*

Claim 2 depends from claim 1, and further requires that “said optical system is configured to image light sources over a predetermined horizontal and vertical range defining said predetermined field of view.” Ex. 1002, 12:59–62. Petitioner asserts that Yanagawa’s description of television camera 11 being “mounted and set up in the front of a vehicle 12 as shown in Fig. 2, for example, and . . . set so as to be able to image the forward direction of the vehicle 12, especially a vehicle 121 traveling ahead and a vehicle 122 traveling in the oncoming lane” inherently discloses the claimed configuration such that claim 2 is obvious. Pet. 17 (citing Ex. 1005, 2; Ex. 1011 ¶ 20). We are persuaded that, based on the cited disclosure in Yanagawa, one of ordinary skill in the art would have understood television camera 11 to image light sources over a predetermined horizontal and vertical range defining a predetermined field of view, as shown in Figures 2, 5, and 6 of the reference, for example.

Claim 3 depends from claim 2, and further requires the optical system be “fixed relative to said controlled vehicle.” Ex. 1002, 12:63–64. Petitioner argues that claim 3 is obvious because Yanagawa discloses television camera 11 may be mounted in a fixed position. Pet. 18 (citing Ex. 1005, 5; Ex. 1011 ¶ 22). Particularly, Yanagawa discloses:

The television camera for imaging in the forward direction may be mounted at any location from which the forward direction can be imaged. The television camera may *also* be configured such that the mounting angle of the camera can be varied, such that, for example, the angle is automatically controlled in response to the angle of steering maneuvers.

Ex. 1005, 5 (emphasis added). We agree with Petitioner that, because the second sentence of this passage describes a *variable* camera mounting as an alternative to the mounting discussed in the first sentence, the first sentence suggests a fixed camera mounting.

Claim 4 depends from claim 2, and further requires that the optical system include “an image array sensor containing a plurality of pixels.” Ex. 1002, 12:65–67. Petitioner argues that claim 4 is obvious because “Bendell describes the camera thereof where a ‘first imager coupled to the optical system responds to a first color and includes an array of light-sensing pixels.’” Pet. 18 (citing Ex. 1006, 3:8–10; Ex. 1011 ¶ 24). We find Petitioner’s argument persuasive.

Patent Owner does not present separate arguments against the unpatentability of claims 2–4, instead relying on these claims’ dependence from claim 1 as the basis for their patentability. PO Resp. 21.

After considering Petitioner’s and Patent Owner’s positions, as well as their supporting evidence, we determine that Petitioner has shown, by a preponderance of the evidence, that claims 2–4 are unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Yanagawa and Bendell.

5. *Claim 7*

Petitioner relies on substantially the same disclosures of Yanagawa and Bendell that it cites in arguing that independent claim 1 is unpatentable, and likewise proposes to combine these references in the same manner proposed in its assertions regarding the unpatentability of claim 7. Pet. 23–26. Petitioner asserts that Bendell discloses “an image array sensor containing a plurality of pixels.” *Id.* at 23–24 (citing Ex. 1006, 1:66–2:2;

Ex. 1011 ¶30). Regarding the claim 7 limitation of the optical system being “configured to spatially segregate light sources having different spectral compositions on said pixel image array sensor,” Petitioner contends that Bendell discloses an optical system so configured when the claim language is construed to include spatial segregation by use of a prism or a mirror with dichroic surfaces. *Id.* at 25.

Again referring to *KSR*, Petitioner contends that “the substitution of the television camera of Bendell for the unspecified type of television camera of Yanagawa, is an equivalent (and unpatentable) interchange of television cameras.” *Id.* at 24. As a further reason for combining the references, Petitioner submits that Bendell’s camera has “the advantages of long life, light weight, ruggedness, signal-to-noise and low power consumption [which] make the solid-state imager very attractive for color camera use.” *Id.* at 16 (quoting Ex. 1006, 2:4–7).

Patent Owner makes two arguments with respect to claim 7. First, Patent Owner contends that its argument that a person of ordinary skill in the art would not have found the combination of Yanagawa and Bendell obvious, discussed above in connection with claim 1, also applies to claim 7. PO Resp. 10–21. We do not find this argument persuasive for the reasons discussed with respect to claim 1. *See supra* Section II.B.3.

Second, Patent Owner argues that Petitioner’s reliance on Bendell as disclosing an optical system “configured to spatially segregate light sources having different spectral compositions on said pixel image array sensor” is wrong because “Bendell does not meet the proper construction of claim 7,” as proposed by Patent Owner. PO Resp. 22. According to Patent Owner, Bendell discloses at least three separate imagers (blue-responsive imager 14,

red-responsive imager 16, and green-responsive imagers 18 and 20), and as such, does not teach or suggest a *single* image array sensor. *Id.* at 22–23.

Petitioner argues in reply that “Bendell teaches the use of a single array formed of multiple imagers.” Reply 13. More specifically, Petitioner argues that “the cooperative arrangement of [Bendell’s] imagers 14, 16, 18, 20 constitutes an imaging array sensor as claimed.” *Id.* at 3.

Although we do not agree with Patent Owner’s contention that the disputed phrase should be limited to a single image array sensor (*see supra* Section II.A.1), our construction calls for the optical system to be “configured for distributing light across *the* pixel image array sensor” (emphasis added), which means light is distributed over one image array sensor. Accordingly, the essential dispute between the parties is whether Bendell’s imagers 14, 16, 18, 20 can be considered to constitute an “image array sensor.”

Applying our construction of “image array sensor” as a device that senses a two-dimensional image, which may comprise a single light sensing array or multiple light sensing arrays (*see supra* Section II.A.1), we determine that imagers 14, 16, 18, 20 form such a device and, thus, constitute an image array sensor. *See* Tr. 28:19–29:7 (Patent Owner acknowledging that “Bendell is configured to spatially segregate light sources having different spectral compositions,” just onto multiple light-sensing arrays). Although imagers 14, 16, 18, 20 are separate elements, there is no requirement that a group of light-sensing arrays be disposed in a common housing or on a single substrate, or otherwise be physically connected, to comprise collectively a “sensor.” Furthermore, imagers 14, 16, 18, 20 operate in a cooperative manner in the sense that their respective

signals are processed to form a composite signal. Ex. 1006, 4:30–34. In other words, none of the imagers operate independently to produce an image. For these reasons, Patent Owner’s second argument is unpersuasive.

Accordingly, we determine that Petitioner has shown, by a preponderance of the evidence, that claim 7 is unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Yanagawa and Bendell.

6. *Claim 8*

Claim 8 depends from claim 1, and further recites that “said image processing system processes images on a frame by frame basis and examines various frames in order to detect the motion of various light sources relative to said controlled vehicle.” Ex. 1002, 13:21–25. Petitioner argues that Yanagawa discloses processing images in successive frames to detect motion because image signal processor 14 calculates the distance between vehicles based on image data stored every 0.05 second. Pet. 19 (citing Ex. 1005, 4; Ex. 1011 ¶ 26).

We find this argument persuasive. Yanagawa discloses periodically capturing image data, such as every 0.05 seconds, to calculate the distance between vehicles and relative traveling speeds. Ex. 1005, 4. Figures 5(A) and 5(B) of Yanagawa depict two images, or frames, of the same pair of taillights 52, 53, where the image of Figure 5(B) occurs 0.05 seconds after the image of Figure 5(A) and shows the apparent change in the distance between taillights 52, 53 resulting from the relative movement of the vehicles. *Id.*

Patent Owner does not present separate arguments against the unpatentability of claim 8, instead relying on its dependence from claim 1 as the basis for patentability. PO Resp. 21.

After considering Petitioner's and Patent Owner's positions, as well as their supporting evidence, we determine that Petitioner has shown, by a preponderance of the evidence, that claim 8 is unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Yanagawa and Bendell.

C. Asserted Obviousness of Claim 5 over Yanagawa, Bendell, and Vellacott

Claim 5, which depends from claim 4, recites that the pixel image array sensor is a CMOS (complementary metal oxide semiconductor) active pixel image array sensor. Ex. 1002, 13:1–3. Petitioner asserts that Vellacott teaches this limitation of claim 5, arguing that Vellacott “shows the advantages of substituting CMOS sensors in place of CCD sensors” because of lower power consumption by CMOS sensors.⁹ Pet. 20–21 (citing Ex. 1007, 2). Petitioner concludes that “[a] person of ordinary skill in the art would substitute the CMOS sensor of Vellacott in place of the CCD of Bendell, doing so to save power consumption.” *Id.* at 21.

Relying on Dr. Turk's testimony, Patent Owner argues that Vellacott's CMOS sensor uses a “rolling shutter” process in which “objects in the image will be distorted if there is relative movement between the CMOS sensor and the object.” PO Resp. 26 (citing Ex. 2032 ¶ 36). Patent Owner further argues that because Yanagawa's algorithms cannot account for such distortion, one of ordinary skill in the art “would not have substituted Vellacott's CMOS sensor with Bendell's CCD image sensor, in combination with Yanagawa's system, due to technical difficulties posed by image distortion arising from the relative movement between a vehicle's

⁹ We note that Bendell discloses that MOS (metal oxide semiconductor) and CCD imagers were commonly used solid-state image arrays. Ex. 1006, 1:63–66.

image sensor and another vehicle's headlights.” *Id.* (citing Ex. 2032 ¶¶ 36–39).

We do not find this argument persuasive. Dr. Turk's statement that the “algorithms in Yanagawa would not be able to account for distortion created by the use of a CMOS image sensor” (Ex. 2032 ¶ 36) is not supported by any objective evidence or analysis. Rather, Dr. Turk merely labels Yanagawa's algorithms “hopelessly naïve.” *Id.* Furthermore, Vellacott describes using the CMOS sensor in an automotive application to automatically reduce headlamp glare from behind by recognizing the presence of headlamps in the field of view and accordingly dimming rear view and side mirrors. Ex. 1007, 4. This disclosure demonstrates that accounting for distortion resulting from relative movement between the CMOS sensor and the object was within the level of ordinary skill in the art at the time of the invention.

Patent Owner also argues that Yanagawa's algorithms would have to be redesigned to accurately detect and locate headlights and taillights with a CMOS sensor, and such a redesign “would result in a substantial change to the principle operation of the Yanagawa system.” PO Resp. 27 (citing Ex. 2032 ¶¶ 32, 37). Patent Owner does not explain precisely what principle of operation allegedly would be changed, but does state that changing Yanagawa's algorithms “would directly affect the principle of Yanagawa's system” because the “algorithms in Yanagawa are a core aspect of Yanagawa's system that ultimately dictate whether or not the state of the headlights is adjusted.” *Id.* at 17–18 (citing Ex. 1005, 3–4; Ex. 2032 ¶ 32).

Patent Owner's argument is overly narrow because it suggests any change to Yanagawa's algorithms would change the principle of operation.

Instead, the system resulting from the proposed modifications to Yanagawa would operate on the same principle in that it would use an image sensor to image the field of view, process the image signals to detect the presence of headlights or taillights, and control the vehicle's headlamps in response to such detection, with the only difference being the type of imager used. *See In re Magna Elecs., Inc.*, 2015 WL 2110525 at *4 (holding that replacement of CCD camera with CMOS camera in a similar context was “nothing more ‘than the predictable use of prior art elements’”). Thus, we disagree that any redesign of Yanagawa's algorithms required for the proposed modification would change Yanagawa's principle of operation.

Finally, Patent Owner argues that the proposed modification would render Yanagawa inoperable for its intended purpose because of “the inability of Yanagawa's algorithms to account for the rolling shutter of Vellacott's CMOS sensor.” *Id.* at 27 (citing Ex. 2032 ¶ 38). This argument is not persuasive. Dr. Turk testifies that “substituting Vellacott's CMOS image sensor into Yanagawa's system would *tend* to render Yanagawa's system *essentially* incapable of accurately detecting and locating headlights and taillights.” Ex. 2032 ¶ 38 (emphases added). This qualified statement, which is not supported by objective evidence or analysis, is insufficient to establish that the proposed modification would render Yanagawa inoperable. Moreover, as noted above, Vellacott discloses using CMOS sensors to recognize headlights in a field of view in automotive control systems, showing that algorithms for processing the resulting signals were within the level of ordinary skill in the art at the time of the invention. Ex. 1007, 4.

After considering Petitioner's and Patent Owner's positions, as well as their supporting evidence, we determine that Petitioner has shown, by a

preponderance of the evidence, that claim 5 is unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Yanagawa, Bendell, and Vellacott.

D. Asserted Obviousness of Claim 13 over Yanagawa, Bendell, and Wirtz

Claim 13, which depends from claim 1, further recites that the optical system includes “means for filtering infrared light from said external sources of light.” Ex. 1002, 13:39–41. Petitioner asserts that Wirtz teaches this limitation of claim 13 based on its disclosure of “the desirability of using an *infrared filter*, such that the ‘infrared filter may also be provided to reduce undesired response of the CCD detector in the infrared region of the spectrum.’” Pet. 29–30 (quoting Ex. 1009, 2:66–3:2). Petitioner concludes that “[a] person of ordinary skill in the art would use the infrared filter of Wirtz in the device of Bendell, in order to reduce undesired response of the CCD detector in the infrared band.” *Id.* at 30.

Patent Owner argues that Wirtz discloses use of an infrared filter with a linear detector scanner “to reduce undesired response of the linear detector due to the fluorescent lights and mirrors of the scanner,” and there “is no disclosure in Bendell or Wirtz to use such a filter to filter infrared light from external sources of light within a predetermined field of view.” PO Resp. 28. Petitioner argues that Patent Owner “presents the reference too narrowly,” and the “features of the CCD detector response drive use of Wirtz’s infrared filter, not the nature of [the] infrared light source.” Reply 15.

We agree with Petitioner. Wirtz discloses a scanner in which table 10 supports workpiece 12 under fluorescent lights 16 and mirror 18. Ex. 1009, 2:51–53, Figs. 2, 3. Light reflected from workpiece 12 is focused onto linear

detector 20, which may be a CCD. *Id.* at 2:54–59. Wirtz also discloses providing an infrared filter “to reduce undesired response of the CCD detector in the infrared region of the spectrum.” *Id.* at 2:67–3:2. Although fluorescent lights 16 likely are the primary source of infrared radiation, Wirtz does not exclude the possibility that the infrared filter would reduce undesired response from other sources. In any event, we conclude that one of ordinary skill in the art would have understood from Wirtz’s disclosure that an infrared filter would reduce undesired response of a CCD detector in the infrared region resulting from both internal and external sources.

Accordingly, a person of ordinary skill in the art would have recognized that Wirtz’s disclosure of using an infrared filter to reduce undesired response of a CCD detector in the infrared region would be applicable to the CCD imager of Bendell. An obviousness analysis “need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ.” *KSR*, 550 U.S. at 418. Furthermore, “if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.” *Id.* at 417; *see also id.* at 421 (“A person of ordinary skill is also a person of ordinary creativity, not an automaton.”).

After considering Petitioner’s and Patent Owner’s positions, as well as their supporting evidence, we determine that Petitioner has shown, by a preponderance of the evidence, that claim 13 is unpatentable under 35

U.S.C. § 103(a) as obvious over the combination of Yanagawa, Bendell, and Wirtz.

III. CONCLUSION

Petitioner has shown, by a preponderance of the evidence, that claims 1–4, 7, and 8 of the '149 patent would have been obvious over the combination of Yanagawa and Bendell.

Petitioner has shown, by a preponderance of the evidence, that claim 5 of the '149 patent would have been obvious over the combination of Yanagawa, Bendell, and Vellacott.

Petitioner has shown, by a preponderance of the evidence, that claim 13 of the '149 patent would have been obvious over the combination of Yanagawa, Bendell, and Wirtz.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1–5, 7, 8, and 13 of the '149 patent are determined to be *unpatentable*;

FURTHER ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2; and

FURTHER ORDERED that the copies of Exhibits 1012–14 filed on December 15, 2014 are renumbered as Exhibits 1057–59, respectively.

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Patent 7,339,149 B1

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