

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SHARKNINJA OPERATING LLC,
SHARKNINJA MANAGEMENT LLC, AND
SHARKNINJA SALES COMPANY,
Petitioner,

v.

IROBOT CORPORATION,
Patent Owner.

IPR2020-00733
Patent 9,550,294 B2

Before TERRENCE W. MCMILLIN, AMANDA F. WIEKER, and
JASON W. MELVIN, *Administrative Patent Judges*.

WIEKER, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. Background and Summary

SharkNinja Operating LLC, SharkNinja Management LLC, and SharkNinja Sales Company (“Petitioner”) filed a Petition requesting *inter partes* review of claims 1–13 (“challenged claims”) of U.S. Patent No. 9,550,294 B2 (Ex. 1001, “the ’294 patent”). Paper 1 (“Pet.”). iRobot Corporation (“Patent Owner”) filed a Preliminary Response. Paper 6 (“Prelim. Resp.”).¹ We instituted an *inter partes* review of all challenged claims 1–13 on all grounds of unpatentability, pursuant to 35 U.S.C. § 314. Paper 11 (“Dec. on Inst.”).

After institution, Patent Owner filed a Response (Paper 19, “PO Resp.”) to the Petition, Petitioner filed a Reply (Paper 21, “Reply”), and Patent Owner filed a Sur-reply (Paper 25, “Sur-reply”). An oral hearing was held on July 12, 2021, and a transcript of the hearing is included in the record. Paper 30 (“Tr.”).

We issue this Final Written Decision pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons set forth below, Petitioner has met its burden of showing, by a preponderance of the evidence, that challenged claims 1–13 of the ’294 patent are unpatentable.

B. Real Parties in Interest

Petitioner identifies SharkNinja Operating LLC, SharkNinja Management LLC, SharkNinja Sales Company, and JS Global Lifestyle Co.

¹ Prior to institution and with our authorization, Petitioner filed a Preliminary Reply and Patent Owner filed a Preliminary Sur-reply, directed to 35 U.S.C. §§ 312(a)(2), 325(d), and claim construction. Papers 7, 9.

Ltd. as real parties in interest. Pet. 73; Paper 13, 1; *see also* Dec. on Inst. 43–47 (addressing real party in interest arguments).

Patent Owner identifies iRobot Corporation as the real party in interest. Paper 4, 2.

C. Related Matters

The parties identify the following matters related to the '294 patent:

SharkNinja Operating LLC v. iRobot Corporation,
No. 1:19-cv-01935 (D. Del.) (filed Oct. 11, 2019);

iRobot Corporation v. SharkNinja Operating LLC, et al.,
No. 1:19-cv-12125 (D. Mass.) (filed Oct. 15, 2019); and

SharkNinja Operating LLC v. iRobot Corporation,
No. 1:19-cv-12236 (D. Mass.) (filed Oct. 30, 2019).

Pet. 74; Paper 4, 2.

D. The '294 Patent

The '294 patent is titled “Autonomous Robot Auto-Docking and Energy Management Systems and Methods,” and issued on January 24, 2017, from U.S. Patent Application No. 14/946,999, filed November 20, 2015. Ex. 1001, codes (21), (22), (45), (54).

The '294 patent discloses an energy management system for a robotic device. *Id.* at code (57). Figures 1 and 2A are reproduced below.

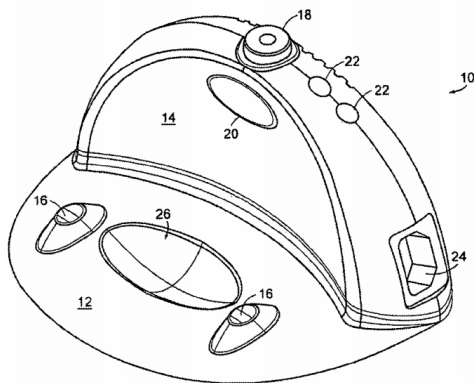


FIG. 1

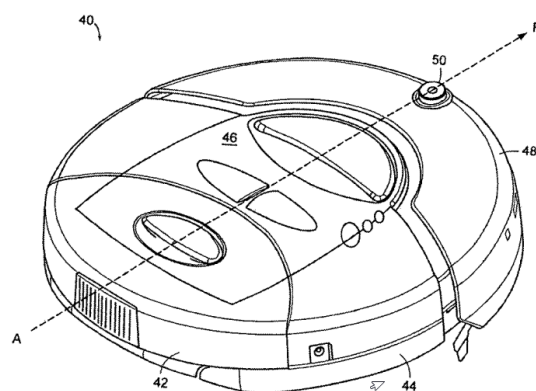


FIG. 2A

Figure 1 (above left) depicts a base station, and Figure 2A (above right) depicts a perspective view of a robot. *Id.* at 4:64–67.

As shown in Figure 1, base station 10 includes electrical charging contacts 16 that engage corresponding contacts on the bottom of the robot, to charge the robot's battery. *Id.* at 5:24, 5:35–38, 5:49–51. Base station 10 includes top signal emitter 18 and front signal emitter 20, which project, e.g., avoidance signals or homing signals to the robot. *Id.* at 6:4–36.

As shown in Figure 2A, autonomous robot 40 includes chassis 44, cover 46, and bumper 48, and the robot is configured to mate with base station 10 for charging. *Id.* at 6:37–39. When “bumper 48 encounters a stationary object or obstacle of predetermined mass,” the bumper displaces toward the chassis and the robot evades the object or obstacle. *Id.* at 7:1–14. Robot 40 also includes detectors 50, 52 for receiving signals projected by the base station's emitters 18, 20. *Id.* at 7:15–18. Robot 40 includes, e.g., motors, wheels, drive shafts, or tracks, to move the robot. *Id.* at 8:5–11. The robot also includes a battery (unlabeled). *Id.* at 13:60–61.

In operation, “robotic device 40 uses a variety of behavioral modes to vacuum effectively a working area.” *Id.* at 8:26–27; *see also id.* at 8:26–11:26 (providing detail of modes). During operation, the energy level of the robot's battery is measured. *Id.* at 15:37–43. When the robot has completed vacuuming a room, or when its battery needs to be recharged, the robot will seek the base station by detecting signals projected from the base station, which allow the robot to dock accurately with the base station. *Id.* at 13:58–65, 14:26–27. Once docked, the robot autonomously recharges its battery, either fully or partially. *Id.* at 16:46–47, 18:59–19:3. Additionally, “the

robot may employ room-mapping programs, using the base station 10 and/or walls and large objects as points of reference.” *Id.* at 16:41–43.

E. Illustrative Claim

Of the challenged claims, claim 1 is independent. Claim 1 is illustrative and is reproduced below.

1. [a] An autonomous cleaning robot, comprising:
 - [b] an undercarriage;
 - [c] a motive system configured to propel the undercarriage across a ground surface;
 - [d] an energy storage unit supported by the undercarriage and configured to be charged while the robot is positioned at a base charging station; and
 - [e] a navigational control system configured to autonomously:
 - [f] control the motive system to direct the robot about a room, *while mapping the room with respect to objects as points of reference*;
 - [g] return the robot to the base charging station before completing a cleaning task in the room, in response to detecting a need to recharge the energy storage unit;
 - [h] dock the robot to the base charging station upon return;
 - [i] recharge the energy storage unit with the robot docked; and then to
 - [j] control the motive system to direct the robot to continue to clean the room.

Ex. 1001, 19:25–45 (alphabetical identifiers and emphasis added).

F. Evidence

Petitioner relies upon the following references:

Kopmann, U.S. Patent No. 4,677,363, filed Feb. 26, 1986, issued June 30, 1987 (Ex. 1010, “Kopmann”);

Kim, U.S. Patent No. 5,440,216, filed June 8, 1993,
issued Aug. 8, 1995 (Ex. 1003, “Kim”);²

Han, U.S. Patent No. 5,646,494, filed Mar. 3, 1995,
issued July 8, 1997 (Ex. 1005, “Han”);

Jeong, U.S. Patent No. 5,896,488, filed Nov. 27, 1996,
issued Apr. 20, 1999 (Ex. 1004, “Jeong”);

Fiegert et al., U.S. Patent No. 6,240,342 B1, filed Feb. 3,
1999, issued May 29, 2001 (Ex. 1006, “Fiegert”); and

Ohsawa et al., JP 2001-125641 A, filed Oct. 29, 1999,
published May 11, 2001 (Ex. 1008, “Ohsawa”).³

Pet. 2–3.

Petitioner relies upon, *inter alia*, the Declaration of Alonzo J. Kelly, Ph.D. Ex. 1020. Patent Owner relies upon, *inter alia*, the Declaration of Donald A. Coates, Ph.D (Ex. 2029), the November 4, 2019, deposition of Dr. Kelly (Ex. 2028), and the January 12, 2021, deposition of Dr. Kelly (Ex. 2027).

² Petitioner identifies several references by a combination of Applicant-Inventor name. *See* Pet. v (identifying short form names for Exs. 1003–1005 as “Samsung-Kim,” “Samsung-Jeong,” and “Samsung-Han”). In this Decision, we identify all references by first named Inventor.

³ Exhibit 1007 is the Japanese-language publication of Ohsawa, and Exhibit 1008 is its English-language translation. *See also* Ex. 1009 (certificate of translation). In this Decision, we cite to Exhibit 1008. Petitioner identifies this reference by Applicant name, “Sony.” Pet. v.

G. Asserted Grounds of Unpatentability

Petitioner asserts that claims 1–13 are unpatentable based upon the following grounds (Pet. 2–3):

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–5, 8, 9, 11–13	§ 102	Kim
1–5, 8, 9, 11–13	§ 103	Kim
1–5, 8, 9, 11–13	§ 103	Kim, Jeong
2, 4, 5	§ 103	Kim, Fiegert
2, 4, 5	§ 103	Kim, Jeong, Fiegert
3	§ 103	Kim, Han
3	§ 103	Kim, Jeong, Han
6, 7	§ 103	Kim, Ohsawa
6, 7	§ 103	Kim, Jeong, Ohsawa
10	§ 103	Kim, Kopmann
10	§ 103	Kim, Jeong, Kopmann

II. ANALYSIS

A. Legal Standards

“Both anticipation under [35 U.S.C.] § 102 and obviousness under [35 U.S.C.] § 103 are two-step inquiries. The first step in both analyses is a proper construction of the claims. . . . The second step in the analyses requires a comparison of the properly construed claim to the prior art.”

Medichem, S.A. v. Rolabo, S.L., 353 F.3d 928, 933 (Fed. Cir. 2003).

A claim is unpatentable under 35 U.S.C. § 102 if a prior art reference discloses every limitation of the claimed invention, either explicitly or inherently. *Glaxo Inc. v. Novopharm Ltd.*, 52 F.3d 1043, 1047 (Fed. Cir. 1995). To establish an inherent disclosure, the extrinsic evidence “must make clear that the missing descriptive matter is necessarily present” in the

single anticipating reference. *Cont'l Can Co. v. Monsanto Co.*, 948 F.2d 1264, 1268 (Fed. Cir. 1991).

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 invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of non-obviousness.⁴ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). When evaluating a combination of teachings, we must also “determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). Whether a combination of prior art elements would have produced a predictable result weighs in the ultimate determination of obviousness. *Id.* at 416–417.

In an *inter partes* review, the petitioner must show with particularity why each challenged claim is unpatentable. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016); 37 C.F.R. § 42.104(b). The burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). We analyze the challenges presented in the Petition in accordance with the above-stated principles.

⁴ Patent Owner has not presented objective evidence of non-obviousness.

B. Level of Ordinary Skill in the Art

Petitioner identifies the appropriate level of skill in the art as a person having “at least a four year degree in mechanical engineering or electrical engineering or a closely related field and at least one year of experience in the design and implementation of robotics and embedded systems,” where additional education could substitute for experience, or vice versa. Pet. 4 (citing Ex. 1020 ¶¶ 50–54). Patent Owner does not provide an assessment of the appropriate skill level. *See generally* PO Resp.

We adopt Petitioner’s assessment, which appears consistent with the level of skill reflected in the Specification and prior art.

C. Claim Construction

For petitions filed on or after November 13, 2018, a claim shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b) (2020). Accordingly, claim terms are generally given their ordinary and customary meaning as would have been understood by one with ordinary skill in the art in the context of the specification, the prosecution history, other claims, and even extrinsic evidence including expert and inventor testimony, dictionaries, and learned treatises, although extrinsic evidence is less significant than the intrinsic record. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–1317 (Fed. Cir. 2005). Usually, the specification is dispositive, and it is the single best guide to the meaning of a disputed term.

The parties address the claim limitation “mapping the room with respect to objects as points of reference,” and dispute the meaning of “objects” within that limitation. Ex. 1001, 19:35–36; Pet. 5–7; PO

Resp. 10–34; Reply 2–15; Sur-Reply 1–15. Petitioner contends that the ’294 patent uses “objects” consistent with its plain meaning—“something material that may be perceived by the senses”—which includes walls. Pet. 5–7 (citing, e.g., Exs. 1014, 1015); Ex. 1014, 4. By contrast, Patent Owner contends that “the ’294 patent distinguishes between obstacles that define a work area and obstacles within the defined work area, referring to the former as ‘walls’ . . . and the latter as ‘objects,’ ‘obstacles,’ or ‘obstructions’ that are located within the mapped area.” PO Resp. 10–11. Accordingly, Patent Owner argues that the claim “requires a map that specifies objects within the perceived boundaries of the room as points of reference.” *Id.* at 10, 11–12.

In our Decision on Institution, we preliminarily determined that “walls are within the scope of the term [‘objects’].” Dec. on Inst. 13–14; *see also id.* at 7–15. We also encouraged the parties to address several related issues, including whether further explicit construction of “objects” is required; whether disclosures directed to “obstacles” should inform our construction of the claim language; whether the pertinent evidence is limited to room mapping; and whether a distinction between objects that *define* a working area as opposed to objects *within* a working area is supported. *Id.* at 14–15.

1. The Claimed Invention

Patent Owner notes that our claim construction inquiry seeks “the correct construction—the construction that most accurately delineates the scope of the claim[ed] invention.” *PPC Broadband, Inc. v. Corning Optical Comm’ns RF, LLC*, 815 F.3d 734, 740–42 (Fed. Cir. 2016) (cited at PO Resp. 10; Sur-reply 12). With this in mind, we assess the invention disclosed and claimed in the ’294 patent. *See supra* § I.D.

The '294 patent discloses a method for “energy management” of an autonomous robot. Ex. 1001, codes (54), (57). Specifically, “[t]he present invention relates generally to robotic systems and, more specifically, to auto-docking and energy management systems for autonomous robots.” *Id.* at 1:27–29. The invention seeks to avoid known problems related to safe and effective robot charging, namely, problems with “proper mating” and inadvertent collisions between the robot and a charging base station. *Id.* at 1:52–2:25. The '294 patent discloses various energy management features, and the Specification’s focus on energy management also appears in the claims, where independent claim 1 and dependent claims 2 and 4–13 are largely drawn to energy management. *See, e.g., id.* at 2:29–4:62 (summarizing the invention as, e.g., determining battery quantity and performing tasks based on battery level, returning to base station when quantity is low), 19:25–48; *see supra* § I.E (limitations d, g, h, i, j).

Contrary to this facial focus on energy management, Patent Owner describes the '294 patent as providing

an improvement over prior art cleaning techniques by providing a robot that maps a room defined by ‘walls’ (i.e., *obstacles that define a working area*) using ‘objects,’ which include obstacles distinct from ‘walls’ (i.e., *obstacles within the defined working area*), as points of reference and uses the map to direct the robot about the room to thereby enhance both the robot’s cleaning and its recharging efficiency.

PO Resp. 4; *see also id.* at 5–8. Patent Owner’s support for this alleged “improvement” in mapping rests primarily in the Background section of the '294 patent, which purports to incorporate “[a]dditional robot control and navigation systems,” although the Background does not mention “mapping” at all. Ex. 1001, 1:47–51; *see infra* § II.C.1.c. To be sure, however,

mapping is recited in one limitation of independent claim 1 and in dependent claim 3. Ex. 1001, 19:35–36, 20:1–4; *see supra* § I.E (limitation f).

Considering the '294 patent as a whole, we discern that the disclosed and claimed invention is primarily an energy management system that optimizes the safe and effective charging of a robot. It is within this context that we resolve “the correct construction” of “objects,” i.e., “the construction that most accurately delineates the scope of the claim[ed] invention.” *PPC Broadband*, 815 F.3d at 740–42.

a) '294 Claims

Claim 1 recites “mapping the room with respect to objects as points of reference,” and dependent claim 3 further recites that “a known position of the base charging station” is used as a point of reference in mapping. Ex. 1001, 19:35–36, 20:1–4. The claim language and context provide little insight to the term “objects,” except to confirm that “objects” at least encompasses the recited “base charging station” of claim 3.

b) '294 Specification

The '294 patent describes mapping only once: “the robot may employ room-mapping programs, using the base station 10 and/or walls and large objects as points of reference.” *Id.* at 16:41–43. Patent Owner argues that “by separately calling out ‘objects’ in addition to ‘walls’ in the context of mapping, this sentence is certainly consistent with an interpretation of the ‘objects’ in the recited ‘mapping’ feature being distinct from ‘walls.’” PO Resp. 20. Patent Owner argues that when read in the context of the remainder of the '294 patent, a person of ordinary skill in the art would find this sentence to support Patent Owner’s construction. *Id.* at 20–21.

In our view, this sentence simply indicates various structures—base stations, walls, large objects—that may serve as points of reference when mapping. This language does not speak to whether these items are inclusive or mutually exclusive, i.e., whether “large objects” excludes walls. Thus, this sentence provides little substantive evidence as to the meaning of “objects.”

We also disagree that the broader “context” of the Specification supports Patent Owner’s construction. *Id.* at 20–21. Patent Owner does not identify any other portion of the ’294 Specification itself that describes “mapping the room with respect to objects.” PO Resp. 10–34.⁵ Nor does Patent Owner identify any portion of the ’294 Specification that distinguishes between objects that *define* a working area (e.g., walls) and objects *within* a working area (e.g., furniture). *See, e.g., id.* at 20–32. Given the ’294 patent’s focus on energy management—not mapping—this is unsurprising.

The ’294 patent utilizes “objects” in other instances apart from its singular discussion of mapping. *See, e.g.,* Ex. 1001, 7:8 (“encounters a stationary object or obstacle”), 7:50 (“a solid overhanging object”), 9:10 (“evade a stationary object or obstacle”), 12:43 (“keep all objects to its right”), 17:1 (“electrically conductive objects”).⁶ These usages of “objects,” however, appear consistent with the term’s plain meaning as identified by Petitioner.

⁵ Patent Owner’s reliance on purportedly incorporated material is discussed below.

⁶ We disagree with Patent Owner’s assertion that these usages are irrelevant because they concern “detecting” not “mapping.” *See infra* § II.C.1.c.

Indeed, Petitioner and Patent Owner appear to agree that the plain meaning of “objects” includes walls, although Patent Owner disputes that the plain meaning applies here, largely due to the prosecution history. *See, e.g.,* Pet. 5–7; Reply 4–5; PO Resp. 19 (“[T]he prosecution history would have led a [person of ordinary skill in the art] to conclude that the recited ‘objects’ are distinct from ‘walls,’ *despite the use of plain meaning of ‘objects’ suggesting that walls alone would suffice* to satisfy the ‘mapping’ limitation.”) (emphasis added); Sur-reply 3 (“In the context of detecting, the term ‘object’ may refer more generally to ‘something material that may be perceived by the senses,’ such as walls and furniture, which appear the same to the robot’s sensor.”), 6–10 (disputing plain meaning’s application); *see infra* § II.C.2.a. We will return to the plain meaning of “objects” after considering the additional evidence and Patent Owner’s arguments.

c) Incorporation by Reference – ’278 Patent

Patent Owner relies heavily upon the disclosure of U.S. Patent No. 7,024,278 B2 (Ex. 2001, the “’278 patent”). PO Resp. 20–28; Sur-reply 13–15. Patent Owner contends the ’278 patent is “incorporated by reference in its entirety in the ’294 patent” and supports its construction of “objects.” PO Resp. 6 (citing Ex. 1001, 1:42–51), 6–8. The ’278 patent is the primary evidence Patent Owner cites to support the alleged distinction between objects that *define* a working area (e.g., walls) and objects *within* a working area (e.g., furniture). *See, e.g., id.* at 3, 8, 10–11, 20–28.

Patent Owner’s reliance on the ’278 patent fails, however, for three reasons.

First, the '278 patent does not meaningfully use the term “objects,”⁷ and Patent Owner fails to demonstrate that its disclosures related to “obstacles” are pertinent to the construction of the claim term “objects.” We invited the parties to address “whether support for the term ‘objects’ can be found in disclosures directed to ‘obstacles.’” Dec. on Inst. 14. In its Response, Patent Owner relies on Dr. Coates’ testimony to assert that it can: “Disclosures directed to ‘obstacles’ *in the context of room mapping* can provide support for the term ‘objects.’” PO Resp. 3, 11 n.1 (same) (citing Ex. 2029 ¶ 39). But this is not supported by any persuasive evidence or reasoning.

For example, Dr. Coates asserts that the challenged '294 patent produces maps by distinguishing between obstacles that *define* a work area from those *within* the work area, which he refers to as “objects,” “obstacles,” or “obstructions,” “consistent with how these words were used in the art.” Ex. 2029 ¶ 39 (citing Ex. 1001, 16:41–43; Ex. 2001, 9:39–43, 18:1–16; Ex. 2004, Figs. 3, 5). Thus, Dr. Coates appears to assert that these terms can be used interchangeably. The evidence that Dr. Coates cites, however, does not support this testimony.

Indeed, the '294 patent does not use the term “obstruction” at all. And although the '294 patent utilizes the term “obstacle,” neither Patent Owner nor Dr. Coates show where the '294 patent equates it with “objects,” or explains why a skilled artisan would have considered them to be equivalent. Ex. 2029 ¶ 39; PO Resp. 3, 11. Moreover, the '294 patent utilizes the term “obstacles” in reference to, *inter alia*, walls; it does not use

⁷ The '278 patent uses “objects” only to describe three goals, or purposes, of the invention. Ex. 2001, 3:14, 21, 26.

that term to distinguish between obstacles that *define* a work area from those *within* the work area, as Dr. Coates asserts. For example, the '294 patent plainly states that the robot “maintain[s] its position with respect to *an obstacle, such as a wall or a piece of furniture.*” Ex. 1001, 9:31–33.⁸

The remainder of Dr. Coates’ citations also fail to equate “objects,” “obstacles,” and “obstructions,” and fail to show the terms are used to distinguish between obstacles that *define* a work area from those *within* a work area. *See* Ex. 1001, 16:41–43 (“walls and large objects”); Ex. 2001, 18:1–16 (identifying hot spots that trigger, e.g., Obstacle-Following mode, which cleans the perimeter of walls and furniture); Ex. 2004, Figs. 3, 5 (depicting running patterns for a robot around obstruction(s)).

It is not our position that a person of ordinary skill in the art would necessarily understand “objects,” “obstacles,” and “obstructions” to refer to different things. Rather, we simply determine that Patent Owner and its declarant fail to support the contention that disclosures related to the unclaimed term “obstacles” are pertinent to the proper construction of the claimed term “objects,” despite having been invited to do so. Dec. on Inst. 14. Accordingly, we give Dr. Coates’ testimony little weight in this regard, and decline to speculate as to the import of the '278 patent’s disclosures regarding “obstacles.” 37 C.F.R. § 42.65(a).

Second, even if we were to consider the disclosure of the '278 patent, it does not support Patent Owner’s distinction between objects that *define* a working area (like walls) and objects *within* a working area (like furniture). To be sure, we agree with Patent Owner that the '278 patent describes a

⁸ Indeed, Dr. Coates loosely admits that “walls” are sometimes referred to as “obstacles.” Ex. 2029 ¶ 39 n.2.

“working area” bounded by walls. Ex. 2001, 19:41–51, Fig. 6A, 7; PO Resp. 21–22. We also recognize that the ’278 patent discloses storing a “grid map” of the “working area.” Ex. 2001, 12:12–30; PO Resp. 21. And, as Patent Owner notes, “one or more cells in the stored grid map are pre-identified . . . as ‘hot spots’ in the defined working area” and, when the robot encounters such a hot spot, a predetermined cleaning behavior, like Spot Coverage mode or Obstacle-Following mode, is triggered. Ex. 2001, 17:66–8:16; PO Resp. 23–24.

Importantly, however, the cited disclosure does not explain how these hot spots are mapped, or what these hot spots indicate, e.g., whether the hot spots indicate an object *within* a working area as opposed to an object *defining* a working area. Ex. 2001, 17:66–8:16. Given the triggered cleaning behaviors, it appears that the presence of a hot spot may indicate a condition warranting Spot Coverage mode—such as a high traffic area—or may indicate a condition warranting Obstacle-Following mode—such as an obstacle or a wall—although no specifics are disclosed expressly. *Id.*; *see also id.* at 9:1–13 (Spot Coverage), 9:39–50 (Obstacle-Following Coverage).

Indeed, the ’278 patent’s disclosure of Obstacle-Following mode casts doubt on Patent Owner’s distinction between objects that *define* a working area versus those *within* a working area. The ’278 patent discloses that Obstacle-Following mode applies to obstacles (furniture) within a working area *and also* applies to the walls defining the working area itself: “The Obstacle-Following Coverage pattern causes the robotic device 100 to clean the perimeter of the defined working area, e.g., a room bounded by walls, and/or the perimeter of an obstacle (e.g., furniture) within the defined working area.” Ex. 2001, 9:39–43 (cited at PO Resp. 11, 24). The ’278

patent further explains that the robot “continuously maintain[s] its position with respect to *an obstacle, e.g., wall, furniture.*” *Id.* at 9:43–45 (emphasis added) (cited at PO Resp. 24; Sur-reply 14). Thus, the ’278 patent does not support Patent Owner’s distinction between objects (or obstacles) *within* a working area, as opposed to those *defining* a working area; rather, it appears that Obstacle-Following mode applies to *both types* of obstacles.⁹

To the extent that Patent Owner suggests in its Sur-reply that this disclosure of Obstacle-Following mode is not relevant because it concerns detection, not mapping, we disagree. Sur-reply 1–3. As an initial matter, Patent Owner relies upon the disclosure of Obstacle-Following mode to support its position. PO Resp. 11 (citing Ex. 2001, 9:39–43), 24 (citing Ex. 2001, 9:38–50); Sur-reply 14 (citing Ex. 2001, 9:44–45). Moreover, we do not agree that disclosures related to detection are irrelevant, when Patent Owner and Dr. Coates admit that detection is a prerequisite for mapping. PO Resp. 5 (“This is achieved by *active searching* for objects within the defined room as points of reference to build a map of the room while also using the map to direct the robot about the room.”) (emphasis added); Ex. 2029 ¶ 29 (same); *see infra* § II.C.1.d.

In sum, we find little support for Patent Owner’s argument that the ’278 patent distinguishes between obstacles within the room (furniture) and obstacles defining the room (walls). Patent Owner reads too much into the ’278 patent’s limited disclosure of “hot spots.”

⁹ We recognize that this mode may be applied at times other than when the robot encounters a mapped hot spot. However, as discussed above, Patent Owner does not identify any portion of the ’278 patent that speaks directly to what the mapped hot spots indicate, other than by reference to the disclosure of Obstacle-Following mode.

Third, we note that the '278 patent is not properly incorporated by reference. In its Background section, the '294 patent identifies “[a]dditional robot control and navigation systems,” including that disclosed in U.S. Patent Application No. “10/661,835” (the “’835 application”), “which [is] hereby incorporated by reference.” Ex. 1001, 1:47–51. Patent Owner is correct that the '835 application issued as the '278 patent. *See* Ex. 2001, code (21); PO Resp. 6. However, the '294 patent incorporates *only* the '835 application, not the '278 patent. Patent Owner did not offer the identified '835 application into the record as evidence.

Moreover, Patent Owner relies upon the incorporated disclosure to support its understanding of the “mapping” limitation of claim 1. Therefore, this appears to be “essential material” necessary to satisfy 35 U.S.C. § 112. *See* 37 C.F.R. § 1.57(d)(1)–(3). But, essential material may only be incorporated by reference “by way of . . . a *U.S. patent or U.S. patent application publication*,” not by incorporation of an unpublished application like the '835 application. *See id.* § 1.57(d) (emphasis added); *but cf. id.* § 1.57(e) (“Non-essential material may be incorporated from . . . prior and concurrently filed commonly owned U.S. applications.”). As such, the incorporation of the '835 application is not effective as regards essential material. *Id.* § 1.57(h). Although raised by Petitioner, *see* Reply 7 n.4, Patent Owner declined to meaningfully address this issue, instead making the conclusory assertion that the '278 patent “is properly incorporated,” without explanation or support. Sur-reply 14.

Nonetheless, regardless of whether it is properly incorporated by reference, the '278 patent is prior art identified on the face of the '294 patent

and, as such, is considered as part of the intrinsic record. *See infra* § II.C.2.b; Ex. 1001, code (56).

d) Incorporation by Reference – '844 Patent

The '294 patent properly incorporates U.S. Patent No. 6,594,844 (Ex. 1019, the "'844 patent"). Ex. 1001, 1:42–46; 37 C.F.R. § 1.57(d). Petitioner contends the following disclosure is pertinent: "If the object is the surface, the output from the circuit causes the robot to be directed to avoid an obstacle. *If, on the other hand, the object is a wall*, the output from the circuit causes the robot to be directed back towards the wall." Pet. 6 (quoting Ex. 1019, 3:11–14 (emphasis added)). Patent Owner argues this statement is out of context and directed to object detection and avoidance, not mapping. PO Resp. 28–32 ("[B]eing detected by a robot does not inform the meaning of the term 'objects,' within the context of the recited 'mapping' feature, which specifically requires that the 'objects' not merely be detected but also be accounted for as 'points of reference' in a room map."). Patent Owner relies on Dr. Coates' testimony in support. *Id.* at 28–32 (citing Ex. 2029 ¶¶ 63–67).

We agree with Petitioner that this evidence is pertinent. The '844 patent is properly incorporated and forms part of the intrinsic record. Additionally, the '844 patent utilizes the claim term "objects." The '844 patent is directed to an autonomous cleaning robot that detects both obstacles and walls, and seeks to improve its detection sensor systems. Ex. 1019, code (57), 1:33–44. In describing the sensor subsystem, the '844 patent explains that, when a detected object is a wall, the sensor output causes the robot to turn toward the wall. *Id.* at 3:3–15.

We disagree that evidence directed to object detection is “out-of-context.” PO Resp. 28. As discussed above, the ’294 patent does not explain how its map is created, other than to say the map uses objects as points of reference. Ex. 1001, 16:41–43. But Patent Owner states that the map is created by *first detecting* objects and building a map from there. PO Resp. 5 (“This is achieved by *active searching* for objects within the defined room as points of reference to *build a map* of the room while also using the map to direct the robot about the room.”) (emphasis added). Dr. Coates agrees. Ex. 2029 ¶ 29 (same). Neither Patent Owner nor Dr. Coates explain persuasively why we should disregard evidence directed to detecting objects, when detecting objects is an admitted part of the “mapping” process. Ex. 2029 ¶¶ 63–67; PO Resp. 28–32. Further, we recognize that not all detected objects are mapped. PO Resp. 31. But this does not discredit the ’844 patent’s description of “objects” as including walls, because detection is a necessary part of “mapping,” for whichever objects are built into that map. PO Resp. 5; Ex. 2029 ¶ 29.

Accordingly, the ’844 patent’s use of “object,” consistent with its plain and ordinary meaning as something material perceived by the senses, including walls, is persuasive evidence as to the meaning of “objects.”

2. *The Prosecution History*

“In addition to consulting the specification, . . . a court ‘should also consider the patent’s prosecution history, if it is in evidence.’” *Phillips v. AWH Corp.*, 415 F.3d 1303, 1317 (Fed. Cir. 2005). “Like the specification, the prosecution history provides evidence of how the PTO and the inventor understood the patent. . . . Yet because the prosecution history represents an ongoing negotiation between the PTO and the applicant, rather than the final

product of that negotiation, it often lacks the clarity of the specification and thus is less useful for claim construction purposes.” *Id.* at 1317.

a) Examination

The ’294 patent issued from Application Number 14/946,999 (the “’999 application”). Ex. 1001, code (21). During prosecution, the Examiner rejected pending claims 31–43 for non-statutory double patenting over U.S. Patent No. 9,215,957 (the “’957 patent”)—the parent of the ’999 application. *Id.* at 315–316; Ex. 1001, code (60). In response, the applicant filed a Terminal Disclaimer (Ex. 1002, 94–95) and “request[ed] withdrawal of the foregoing rejection[] of claims 31–43” (*id.* at 91).

Appellant also amended pending claims 31–33 and 36–39, without further comment. *Id.* Pending independent claim 31 was amended as follows:

31. (Currently Amended) An autonomous cleaning robot, comprising:
 an undercarriage;
 a motive system configured to propel the undercarriage across a ground surface;
 an energy storage unit supported by the undercarriage and configured to be charged while the robot is positioned at a base charging station; and
 a navigational control system configured to autonomously:
 control the motive system to direct the robot about a room, while mapping the room with respect to ~~walls and~~ objects as points of reference;
 return the robot to a the base charging station before completing a cleaning task in the room, in response to detecting a need to recharge the energy storage unit;
 dock the robot to the base charging station upon return;
 recharge the energy storage unit with the robot docked; and then to

control the motive system to direct the robot to continue to clean the room.

Ex. 1002, 88. The applicant also made minor changes to pending claims 32, 33, and 36–39. *Id.* at 88–89. Thereafter, the '999 application was allowed, with pending application claim 31 issuing as claim 1 of the '294 patent. *Id.* at 20–27.

Patent Owner makes several arguments regarding the prosecution history, which we address in turn.

Patent Owner argues that the amendment to pending claim 31 “indicates an express intent by the inventors to distinguish between [‘walls’ and ‘objects’] i.e., that ‘objects’ are distinct from ‘walls’ *within the context of room mapping*.” PO Resp. 12–13, 15–16. Patent Owner contends this amendment “had actual substantive import, and was not simply for ‘streamlining’ the claim.” *Id.* at 15–16 (citing Dec. on Inst. 13–14).

We do not discern any clear “intent” in the prosecution history. In response to the Examiner’s double patenting rejection, the applicant filed a Terminal Disclaimer and, accordingly, requested that the rejection be withdrawn. Ex. 1002, 91. The filing of the Terminal Disclaimer obviated the outstanding double patenting rejection; therefore, we decline to speculate as to any meaning to be attributed to the accompanying claim amendment, which was made without comment. *Id.*

Although the amendment was made without comment, Patent Owner argues that the conjunction “and” in the pending claims before amendment indicates that “mapping with respect to ‘objects’ is not satisfied by mere mapping with respect to ‘walls.’” PO Resp. 18–19. Patent Owner argues that interpreting “objects” to “NOT be distinct from ‘walls’ . . . reads out the ‘and objects’ part of the [pre-amendment] limitation” because “any disclosed

mapping ‘with respect to walls’ would also be a disclosed mapping ‘with respect to walls and objects’ because, under this interpretation, walls are also objects.” PO Resp. 13–14 (also arguing that different claim terms are presumed to have different meaning and scope), 16. Patent Owner notes that the parent ’957 patent claims recite “walls and objects,” and argues that the ’294 patent’s prosecution history must be read in view of the other patents in its family, including the ’957 patent. *Id.* at 17–18; *see also* Sur-Reply 8 (“If ‘objects’ alone included ‘walls,’ as Petitioner argues, there would be no need for the additional ‘and objects’ claim language in the ’957 patent.”).

As an initial matter, we do not interpret “objects” to be indistinct from “walls,” as Patent Owner’s argument presumes. Rather, we understand the plain meaning of “objects” to be a broad term that includes “walls.” Second, we do not agree that “any disclosed mapping ‘with respect to walls’¹⁰ would also be a disclosed mapping ‘with respect to walls and objects.’” This is incorrect: the first mapping (“with respect to walls”) requires mapping with respect to only *one thing*, i.e., walls. The second mapping (“with respect to walls and objects”) requires mapping with respect to *two things*, i.e., walls and objects. Thus, a broad understanding of “objects” does not “read out” anything. The amended claims simply have a different scope than the pre-amendment claims and those in the ’957 patent, i.e., the amended claims require only mapping with respect to *one thing (objects)* as opposed to *two things (walls and objects)*.

¹⁰ Importantly, the claims do *not* recite “with respect to walls”; they recite “with respect to objects.” We address this argument because it is presented by Patent Owner, even though it misrepresents the claim language.

According to Patent Owner, “the prosecution history would have led a [person of ordinary skill in the art] to conclude that the recited ‘objects’ are distinct from ‘walls,’ despite the use of plain meaning of ‘objects’ suggesting that walls alone would suffice to satisfy the ‘mapping’ limitation.” PO Resp. 19. Despite this admitted plain meaning, Patent Owner contends that a person of ordinary skill in the art would not have interpreted “objects” according to its plain meaning because

it would render the “with respect[] to objects” portion of the “mapping” limitation meaningless. That is, all “mapping” of a room in the context of mobile robotic cleaning systems would be “with respect to objects as points of reference” under Petitioner’s proposed plain meaning because all room mapping by such systems would involve the mobile robotic cleaner’s sensors perceiving materials in the robot’s environment.

Id. at 19–20 (citing Ex. 2029 ¶ 50); *see also* Sur-reply 6.

Again, we disagree. Mapping with “respect to objects as points of reference” does not become meaningless if “objects” is interpreted according to its admitted and broad plain meaning as something material that is perceived by the senses, including walls. As discussed above, this limitation requires mapping with respect to one specified thing (objects), and also requires that the objects are reflected “as points of reference” in the map. This is not meaningless and, in fact, is consistent with the extent of disclosure of “mapping” in the ’294 patent Specification. *See* Ex. 1001, 16:41–43 (“Alternatively, the robot may employ room-mapping programs, using the base station 10 and/or walls and large objects as points of reference.”). Certainly, the scope of the ’294 patent claim language is broader than the scope of the pre-amendment claims and those in the ’957 patent, but that does not render the limitation meaningless.

For the foregoing reasons, we do not find the examination history of the '999 application to support Patent Owner's proposed construction.

b) Prior Art Cited in the '294 Patent

"The prosecution history, which we have designated as part of the 'intrinsic evidence,' consists of the complete record of the proceedings before the PTO and includes the prior art cited during the examination of the patent." *Phillips*, 415 F.3d at 1317.

Petitioner identifies several references cited on the face of the '294 patent that it argues "uniformly confirm[] that 'objects' include 'walls.'" Reply 15 (citing Ex. 1005, 4:40–42, Ex. 1027, 16:46–47; Ex. 1028, 1:48–49); Ex. 1001, code (56). Patent Owner does not dispute that these references describe "objects" as including "walls," but instead argues that these references describe only object detection, not mapping.

Han (one of the cited references), like the '294 patent, is directed to an energy management system for a robotic cleaner that aims to "accurately induce the robot to a power source supplier" when its battery level drops. Ex. 1005, code (57); *see also infra* § II.F. As the parties note, Han detects "a distance to a fixed object . . . more precisely, a distance to a wall surface." Ex. 1005, 4:40–42. Likewise, the cited reference to Allen also discloses a cleaning robot that detects "most large, immobile objects in the operating environment including walls, posts, furniture." Ex. 1027, 16:46–47.

As discussed above, we disagree that evidence directed to detecting objects is irrelevant. PO Resp. 5; Ex. 2029 ¶ 29 (same). Accordingly, Han's and Allen's use of "object," consistent with its plain and ordinary meaning

as something that may be perceived by the senses, including walls, is persuasive evidence as to the meaning of “objects.”¹¹

c) Prior Art Cited in the Parent '957 Patent

Patent Owner identifies U.S. Patent No. 4,674,048 (Ex. 2004, “Okamura”), which is cited on the face of the ’957 patent—the parent to the challenged ’294 patent. PO Resp. 32; Ex. 2001, code (56). Patent Owner alleges that Okamura’s robot “studies the boundary of the” area to be cleaned, stores the boundary as a map, and then traverses the map area and updates the map to reflect obstructions internal to the boundaries of the mapped area. *Id.* at 32–33 (citing Ex. 2004, 4:33–5:18). Patent Owner alleges that “Okumura expressly distinguishes between boundaries, i.e., ‘walls,’ of the mapped work area and obstructions, i.e., ‘objects,’ that are mapped as points of reference internal to the mapped work area.” *Id.* at 33.

Okamura does not meaningfully use the term “objects.” Ex. 2004, 1:58–2:53 (identifying “objects” for purposes of the invention). In the portion cited by Patent Owner, Okamura explains that the robot proceeds through an area “to see if any obstruction is present” and, if so, “it is stored in the storage 10.” *Id.* at 5:2–9. As discussed above, however, Patent Owner and Dr. Coates fail to support the contention that disclosures related to “obstructions” are pertinent to the proper construction of “objects,” despite having been invited to do so. Dec. on Inst. 14; Ex. 2029 ¶ 39; *see supra* § II.C.1.c. Accordingly, we decline to speculate as to the import of Okamura’s disclosures regarding “obstructions.”

¹¹ We find the cited reference to Chiappetta less instructive, as the parties do not address whether its list of “walls, obstacles, or other objects” is inclusive or exclusive, i.e., whether the listed “walls” are included in, or excluded from, “objects.” *Compare* Ex. 1028, 1:48–49, *with* Ex. 1001, 16:41–43.

3. *Extrinsic Evidence*

“[W]hile extrinsic evidence ‘can shed useful light on the relevant art,’” it is generally considered to be “less significant than the intrinsic record in determining ‘the legally operative meaning of claim language.’” *Phillips v. AWH Corp.*, 415 F.3d 1303, 1317–18 (Fed. Cir. 2005).

a) *Dictionary Definitions*

“Within the class of extrinsic evidence, the court has observed that dictionaries and treatises can be useful in claim construction. . . . Such evidence, we have held, may be considered if the court deems it helpful in determining ‘the true meaning of language used in the patent claims.’” *Id.* at 1318.

Petitioner provides several dictionaries and robotics textbooks that it contends confirm that the term “objects” is used in the ’294 patent claims in accordance with its plain meaning. *See, e.g.*, Ex. 1014, 4 (“something material that may be perceived by the senses”); Ex. 1015, 4 (“[s]omething perceptible by one or more of the senses”); Ex. 1016, 293 (describing mapping permanent objects such as walls, desks, filing cabinets); Ex. 1017, 631 (describing mapping walls and furniture). Patent Owner and its declarant accept this plain meaning of “objects” and, as discussed above, present no persuasive reasoning to explain why this meaning does not apply here. PO Resp. 19 (arguing an artisan would “conclude that the recited ‘objects’ are distinct from ‘walls,’ *despite the use of plain meaning of ‘objects’ suggesting that walls alone would suffice* to satisfy the ‘mapping’ limitation”); Sur-reply 3 (“In the context of detecting, the term ‘object’ may refer more generally to ‘something material that may be perceived by the senses,’ such as walls and furniture, which appear the same to the robot’s

sensor.”); Ex. 2029 ¶ 49; *see supra* § II.C.2.a (addressing arguments that the prosecution history compels rejection of the plain meaning).

These dictionaries and textbooks support Petitioner’s contentions.

4. Conclusion

For the foregoing reasons, we maintain our preliminary determination that we need not provide an express construction of “objects,” other than to determine that walls are included within the scope of the term, consistent with the plain and ordinary meaning of “objects.” Dec. on Inst. 13–14; *see, e.g.*, Ex. 1014, 4. This determination is supported by the ’294 patent Specification, the ’844 patent incorporated therein, prior art cited in the ’294 patent, and several dictionaries and robotic textbooks. *See, e.g.*, Ex. 1001, 7:8, 7:50, 9:31–33, 16:41–43; Ex. 1005, 4:40–42; Ex. 1014, 4; Ex. 1015, 4; Ex. 1016, 293; Ex. 1017, 631; Ex. 1019, 3:3–15; Ex. 1027, 16:46–47. For the reasons explained above, Patent Owner does not show persuasively that this admitted plain meaning should not apply.

D. Anticipation or Obviousness over Kim, or Obviousness over the Combined Teachings of Kim and Jeong

Petitioner contends that claims 1–5, 8, 9, and 11–13 of the ’294 patent are unpatentable as (1) anticipated by Kim, (2) obvious over Kim, or (3) obvious over the combined teachings of Kim and Jeong. Pet. 8–55. Petitioner relies on Kim for all claim limitations. *Id.* With respect to the “mapping” limitation of claim 1, Petitioner also provides alternative contentions relying on Jeong. *Id.* at 22–34.

Patent Owner disputes Petitioner’s contentions regarding only the “mapping” limitation of claim 1. PO Resp. 34–57. Specifically, Patent Owner argues that Petitioner advances an improper claim construction (*id.* at 34–36), that Kim does not map objects within a defined working area (*id.* at

36–41), that it would not have been obvious for Kim’s system to map obstacles within a defined working area (*id.* at 41–49), and that Petitioner’s contentions based on the combination of Kim and Jeong fail (*id.* at 49–57).

1. Kim (Ex. 1003)

Kim is a U.S. patent that discloses a robot cleaner. Ex. 1003, code (57). Kim’s robot 1 includes microprocessor 2, memory 3, driving means 5, roller 6, vacuum motor 8, and dirt collecting chamber 16. *Id.* at 3:13–31. The robot also includes navigation sensor 23, magnet 32, magnet sensing means 34, and charging receptacle 31 for guiding the robot to automatic charging means 30 to recharge its battery. *Id.* at 3:31–50.

During its initial circulation prior to actually cleaning a room, the robot “moves along and parallel to walls of the room” to “memorize[] a structure and a size of the room in the microprocessor 2 by detection of the navigation sensor 23.” *Id.* at 10:4–13. “[M]icroprocessor 2 compares the [detected] structure with its cleaning programs previously stored in the memory 3 of the microprocessor 2 to select that program which is most similar to the structure” of the room. *Id.* at 9:55–64. “Therefore, the robot cleaner 1 can carry out a cleaning operation according to the selected program.” *Id.* at 10:13–14; *see also id.* at 9:55–11:65, Figs. 13–15. In this way, the robot “select[s] the most efficient cleaning program” for the room to be cleaned. *Id.* at 10:1–2.

Kim also discloses that the charge level of the battery is continually monitored during cleaning. *Id.* at 14:3–6. If the battery voltage decreases below a certain level, the robot is “moved to the position of the charging means 30” and the battery is “charged with direct current.” *Id.* at 14:7–62. “When the battery 26 is completely charged . . . the robot cleaner 1 moves to

the position at which the cleaning operation is interrupted . . . and then again carries out the cleaning operation at that position.” *Id.* at 14:63–15:2.

2. *Jeong (Ex. 1004)*

Jeong is a U.S. patent that discloses a self-propelled robot capable of cleaning and monitoring a work area. Ex. 1004, code (57), 1:8–11. During an initial operation, Jeong’s robot “makes an environmental map for the work area [A],” which includes a plurality of cells C with obstacles H (e.g., furniture) and walls W. *Id.* at 5:4–10, Fig. 3. To create the map, Jeong’s robot utilizes ultrasonic sensors 411, 421, 431 to determine the distance between the robot and various wall surfaces, to move the robot along the wall surfaces, and to segment and assign cell numbers to portions of the room. *Id.* at 5:37–7:1, 7:6–64. When the robot has returned to its initial position, travel is stopped and the data associated with the cells is stored. *Id.* at 6:65–7:5.

Jeong explains that use of the environmental map allows the robot to properly perform tasks and to travel accurately. *Id.* at 8:27–29. Moreover, Jeong explains that

the present invention enables the apparatus to create the environmental map requiring relatively smaller memory capacity without separate external devices for storage during the initial tasks, recognize the current location of the activated robot based upon the created environmental map and update the associated position, and thus perform the given tasks of the robot while the robot accurately travels to the target point.

Id. at 8:30–38.

3. *Analysis of Claim 1 - Anticipation*

Petitioner contends that Kim anticipates claim 1. Pet. 8–55. Patent Owner disputes Petitioner’s contentions regarding only the “mapping” limitation. PO Resp. 34–41.

a) *“An autonomous cleaning robot”*

Petitioner contends that Kim discloses the subject matter of the preamble, including a “self-moving robot cleaner” that is autonomous.¹² Pet. 14–15 (citing, e.g., Ex. 1003, code (57)).

The evidence of record supports Petitioner’s undisputed contention. Kim discloses a “self moving robot cleaner.” Ex. 1003, code (57), 1:5–7 (“capable of cleaning a floor while moving on a floor by itself”).

b) *“an undercarriage”*

Petitioner contends that Kim discloses an undercarriage as claimed, e.g., the underside of the robot cleaner and bottom plate 4, on which various structures are mounted. Pet. 16–17 (citing, e.g., Ex. 1003, 3:17–18, 3:35–39, 4:4–40, 5:48–6:2, Fig. 1).

The evidence of record supports Petitioner’s undisputed contention. Kim discloses an “underside of the cleaner” and bottom plate 4 on which various structures are mounted. Ex. 1003, 3:17–18, 3:35–39, Fig. 1.

c) *“a motive system configured to propel the undercarriage across a ground surface”*

Petitioner contends that Kim discloses a motive system as claimed, e.g., driving means 5. Pet. 17–18 (citing, e.g., Ex. 1003, 3:13–21, 3:66–4:52).

¹² We need not resolve whether the preamble is limiting because Petitioner shows sufficiently that the recitation in the preamble is satisfied by the prior art, regardless of whether the preamble is limiting.

The evidence of record supports Petitioner's undisputed contention. Kim discloses "driving means 5 mounted on an underside of the cleaner 1 and adapted to drive a driving roller 6 . . . to cause the robot cleaner 1 to be moved forward and backward and to turn left and right." Ex. 1003, 3:17–21.

d) *"an energy storage unit supported by the undercarriage and configured to be charged while the robot is positioned at a base charging station"*

Petitioner contends that Kim discloses an energy storage unit as claimed, e.g., battery 26, which is supported by the underside and bottom plate of the robot cleaner. Pet. 18–21 (citing, e.g., Ex. 1003, 3:42–46, 3:57–59, 8:18–21, 9:21–35, Figs. 1–2).

The evidence of record supports Petitioner's undisputed contention. Kim discloses battery 26, which is charged when the robot is positioned at automatic charging means 30. *See, e.g.*, Ex. 1003, 3:42–46, 3:57–59, 9:21–35 ("When the robot cleaner 1 is precisely located with respect to the automatic charging means 30 . . . the battery 26 [may] be completely charged."). As seen in Figures 1 and 2, the battery is supported by the underside and bottom plate of the robot via intermediate structures. *Id.* at Fig. 1; *see also* Ex. 1020 ¶¶ 82–83.

e) *"a navigational control system configured to autonomously . . ."*

Petitioner contends that Kim discloses a navigational control system that operates autonomously, as claimed. Pet. 21–22 (citing, e.g., Ex. 1002, 1:7–8, 3:13–18, 11:33–39).

The evidence of record supports Petitioner's undisputed contention. Kim discloses the robot cleaner includes "microprocessor 2 for controlling the overall operation of the cleaner" and "memory 3 for storing driving programs for the cleaner . . . and driving means 5 . . . to cause the robot cleaner 1 to be moved forward and backward and to turn left and right,"

wherein the robot is capable of moving by itself, e.g., autonomously. *See, e.g.*, Ex. 1003, 1:5–8, 3:13–21; *see also* Ex. 1020 ¶ 88.

f) “[the] navigational control system configured to autonomously: control the motive system to direct the robot about a room, while mapping the room with respect to objects as points of reference”

Petitioner contends that Kim’s control system directs the self-moving robot about a room while mapping the room with respect to (at least) walls as points of reference, as claimed, during its “initial circulation.” Pet. 22–27 (citing, e.g., Ex. 1003, 2:62–66, 3:13–21, 9:55–10:14, 10:18–11:65).

Patent Owner argues only that Petitioner relies upon “an improper interpretation of ‘objects’ as being fully satisfied by obstacles that define the room (i.e., the ‘walls’)” and, accordingly, “Kim’s memorization of room structure and size using only walls . . . does not meet this requirement” of claim 1. PO Resp. 34–35; *see also id.* at 34–36. As discussed above, however, we determine that walls fall within the scope of “objects.” *See supra* § II.C.

The evidence of record supports Petitioner’s contention. Kim’s robot is directed about a room during an “initial circulation” in which the robot cleaner “does not clean a floor but memorizes only the structure of the floor.” *See, e.g.*, Ex. 1003, 9:55–59. Specifically, the robot “moves along and parallel to walls of the room” to “memoriz[e] a structure and a size of the room.” *Id.* at 10:4–8, 9:65–68. Kim’s robot memorizes the size and structure of the room so that it can be compared against cleaning programs previously stored in the robot’s memory, and the program most closely matching the room’s structure may be selected as the cleaning operation program. *Id.* at 9:59–64.

Figure 13, reproduced below, shows the initial circulation of the robot cleaner.

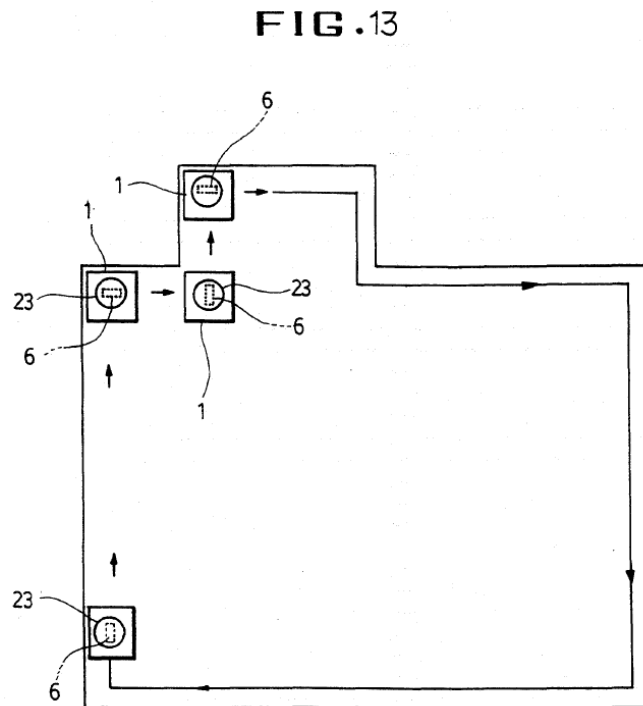


Figure 13 depicts robot cleaner 1 performing an initial circulation in which the robot travels around the periphery of the room, parallel to the room's walls. *Id.* at 9:55–56, 10:4–8.

Thus, we are persuaded by Petitioner's contention that Kim's initial circulation satisfies this limitation of claim 1 because Kim's robot is directed about the room while mapping the room with respect to the walls of the room as points of reference. *Id.* at 9:55–59, 10:4–8, Fig. 13; *see also* Ex. 1020 ¶¶ 90–97; § II.D.3.e.

- g) “[the] navigational control system configured to autonomously . . . return the robot to the base charging station before completing a cleaning task in the room, in response to detecting a need to recharge the energy storage unit”

Petitioner contends that Kim’s self-moving robot returns to charging means 30, as claimed. Pet. 35–36 (citing, e.g., Ex. 1002, 1:6–13, 8:44–62, 14:3–33).

The evidence of record supports Petitioner’s undisputed contention. Kim discloses that the self-moving robot cleaner “mov[es] to an automatic charging means to charge its battery when a charging voltage of the battery is decreased to below a predetermined level during a cleaning operation and then returning to the interrupted cleaning position to again carry out the cleaning operation.” See, e.g., Ex. 1003, 1:6–13; see also *id.* at 8:44–46; § II.D.3.e.

- h) “[the] navigational control system configured to autonomously . . . dock the robot to the base charging station upon return”

Petitioner contends that Kim’s self-moving robot cleaner docks at charging means 30, as claimed. Pet. 37–40 (citing, e.g., Ex. 1003, 2:58–59, 7:64–9:35, 8:31–41, 14:47–62, Figs. 10, 11a–b, 12).

The evidence of record supports Petitioner’s undisputed contention. Kim discloses that charging means 30 emits an ultrasonic wave that the robot uses to locate the charging means, detects the position of the robot by detecting a magnetic force of the robot, and “cause[s] the robot cleaner to be precisely moved to the charging position” for charging, by generation of a line of magnetic force. See, e.g., Ex. 1003, 8:6–25, Fig. 12; § II.D.3.e.

- i) “[the] navigational control system configured to autonomously . . . recharge the energy storage unit with the robot docked”

Petitioner contends that Kim’s self-moving robot cleaner is recharged by charging means 30, as claimed, when docked. Pet. 40–41 (citing, e.g., Ex. 1003, 9:21–35, 14:37–62, Fig. 16).

The evidence of record supports Petitioner’s undisputed contention. Kim discloses that “[w]hen the robot cleaner 1 is precisely located with respect to the automatic charging means 30, . . . the direct current applying plug 156 of the charging means 30 is positively connected to conductor 31a of the charging receptacle 31, thereby permitting the battery 26 to be completely charged.” See, e.g., Ex. 1003, 9:21–35, Fig. 16 (S11); § II.D.3.e.

- j) “[the] navigational control system configured to autonomously . . . then to control the motive system to direct the robot to continue to clean the room”

Petitioner contends that Kim’s self-moving robot cleaner continues to clean the room after being recharged. Pet. 40–41 (citing, e.g., Ex. 1003, 1:12–14, 3:13–21, 9:42–54, 14:63–15:2, Fig. 16).

The evidence of record supports Petitioner’s undisputed contention. Kim discloses that “after the battery is completely charged, the robot cleaner 1 can return to the discontinued cleaning location of the floor and then again carry out its cleaning operation.” See, e.g., Ex. 1003, 9:42–54; § II.D.3.e.

k) *Summary*

Accordingly, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 1 is unpatentable as anticipated by Kim.

4. *Analysis of Claim 1 – Obviousness over Kim*

To account for Patent Owner’s construction of “objects,” *see supra* § II.C, Petitioner alternatively contends it would have been obvious to modify Kim to map the room with respect to non-wall obstacles as points of reference.¹³ *Id.* at 28–30. Petitioner relies upon Kim for all remaining limitations, and we incorporate our findings set forth above. Pet. 14–42; *see supra* § II.D.3. Patent Owner disputes the “mapping” contentions only. PO Resp. 41–49.

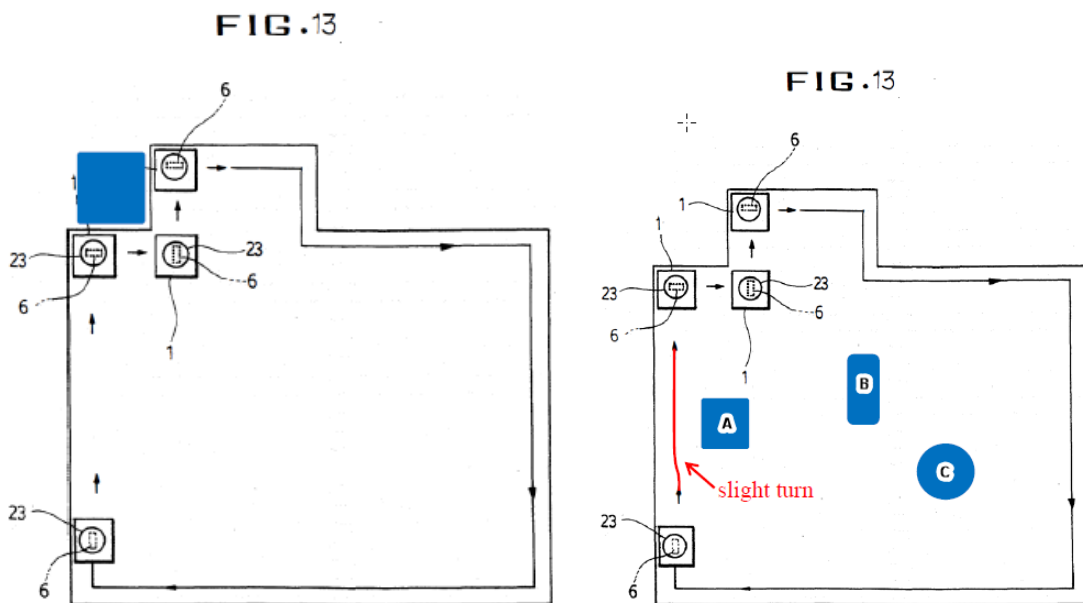
Petitioner contends that, during Kim’s room mapping process, navigation sensor 23 “detect[s] a presence of an environmental obstacle,” as well as its distance and direction. Pet. 28 (quoting Ex. 1003, 3:32–35, 7:59–60; citing Ex. 1003, 10:18–11:16, Fig. 15). If an obstacle is detected, Petitioner contends the robot turns to avoid it. *Id.* at 29 (citing Ex. 1003, 11:1–7). Additionally, Kim’s microprocessor “inputs the data of the moved distance [and] the positions and turning directions at which the robot cleaner 1 has been turned.” *Id.* (quoting Ex. 1003, 11:57–65).

According to Petitioner, it would have been obvious to map this obstacle-avoiding turn information because Kim already maps turns that are made to avoid walls during the initial circulation. *Id.* at 30 (citing Ex. 1020 ¶ 99). Petitioner contends this would have been the simple substitution of one known element—“data related to the position of non-wall obstacles”—for another—“data related to the position of walls”—“to achieve the predictable and desired result of increasing the granularity with which the

¹³ Although we reject Patent Owner’s claim construction, *see supra* § II.C, we apply Patent Owner’s construction here for completeness in evaluating Petitioner’s asserted grounds.

room was mapped by including not only the outer boundaries of the room but also the internal obstacles within those boundaries,” which “would improve overall robot performance and coverage of the area.” *Id.*

Patent Owner disputes these contentions. Patent Owner contends that Kim does not disclose an algorithm to allow the robot to traverse the *interior* of the room when mapping, but simply follows along and parallel to the walls of the room. PO Resp. 42–43. Patent Owner describes two potential scenarios that Kim’s wall-traversing robot might encounter, which it depicts in two modified versions of Kim’s Figure 13, reproduced below. *Id.* at 45–46. We added identifiers A, B, and C to the second (right) modified figure.



Patent Owner’s modified versions of Kim’s Figure 13 depict added “objects,” shown in blue. In the above left figure, one object is added to the left corner of the room (the “First Scenario”). In the above right figure, three objects are added, with Object A near the left wall and with Objects B and C in the interior of the room (the “Second Scenario”).

In the First Scenario, Patent Owner admits that if Kim’s robot detects the object when moving parallel to a wall, it turns to avoid it. PO Resp. 43

(citing Ex. 1003, 11:1–7). Patent Owner does not dispute Petitioner’s contention, or Dr. Kelly’s testimony, that a person of ordinary skill in the art would have found it obvious to save turn information for this obstacle-avoiding turn into the map; indeed, Patent Owner admits as much.¹⁴ *Id.* at 44 (explaining that Kim’s robot “maps the turn performed in step S12 in response to detecting the obstacle as a boundary of the room (i.e., as a wall)”). But, according to Patent Owner, Kim’s robot still only maps the room with respect to “walls” because these wall-adjacent objects are seen by the robot as a “wall” that effectively defines the boundary of the working area. *Id.* at 43–44.

In the Second Scenario, Patent Owner contends that Object A is placed away from the wall but is still detectable by Kim’s robot as it moves along the wall. *Id.* at 45. Patent Owner argues that the robot recognizes that the wall is on its left and, therefore, that Object A is not a wall, so will maneuver to pass between the wall and Object A by making a slight left turn toward the wall. *Id.* In this circumstance, Patent Owner argues that Kim does not save this slight object-avoiding turn. *Id.* at 45–46. Patent Owner contends there is no reason to save this information because this would capture only the corner of Object A and would not capture the entire perimeter, which “would have no value in terms of improving cleaning . . . [or] selecting a cleaning pattern.” *Id.* Additionally, Patent Owner argues that because Kim’s robot only moves along and parallel to the walls, the

¹⁴ Patent Owner describes such objects as “against or close enough to the actual wall” to be seen as a wall by the robot. PO Resp. 44. For simplicity, we refer to them as “wall-adjacent.”

robot does not detect objects that are fully interior to the room, like Objects B and C in the Second Scenario depicted above. *Id.* at 47.

We are persuaded by Petitioner’s contentions regarding Kim’s teachings and what they would have suggested to a person of ordinary skill in the art. Specifically, Kim explains that during its “initial operation,” the robot determines the distance to and direction of an environmental obstacle, and turns to avoid it. Ex. 1003, 10:18–20, 10:34–38, 11:1–7. Additionally, the robot “inputs data of . . . the turned angle.” *Id.* at 11:30–31. We credit Dr. Kelly’s opinion that, in view of this disclosure, a skilled artisan would have found it obvious to save into the map this information regarding turns based on obstacles, in the same manner as turns based on walls, to increase the granularity of the map and improve robot coverage of the area. Ex. 1020 ¶¶ 98–99.

We disagree with Patent Owner’s arguments against these contentions. As an initial matter, the claims do not require that the robot traverse the interior of the room. The claims simply require that the robot map the room “with respect to objects as points of reference,” without exclusion of objects that are placed adjacent to a wall.

Patent Owner’s claim construction position is that this limitation requires mapping more than “walls,” i.e., more than obstacles that define the boundaries of a mapped work area but instead requires mapping “objects within the perceived boundaries of the room as points of reference.” PO Resp. 10, 11–12. Despite asserting this construction, Patent Owner’s briefing does not explain how a robot perceives the difference between an object that *defines* the boundary of the room versus one *within* the boundary of the room. Based on the First and Second Scenarios depicted above,

Patent Owner’s implicit argument appears to be that the distinction turns on whether the robot can traverse the space between a wall and the potential object; if it cannot (First Scenario), it is perceived as a wall and, if it can (Second Scenario), it is perceived as an object within the room. But Patent Owner identifies *no support* for such a distinction, where the driving factor in distinguishing between items perceived as “walls” and “objects” is the size of the robot itself. Such a distinction is not warranted.¹⁵

As such, we understand a wall-adjacent object located within a room, such as that depicted in Patent Owner’s First Scenario above, to be an “object” within the boundary of the room, in accordance with Patent Owner’s construction. Here, Patent Owner admits that, in the First Scenario, Kim’s robot turns to avoid wall-adjacent objects within a room, and would have included them in the map. PO Resp. 44 (“In one scenario, the obstacle is against or close enough to the actual wall along which the robot is moving such that the robot sees the obstacle as a ‘wall’ in step S12 and *maps the turn* performed in step S12 in response to detecting the obstacle as a boundary of the room (i.e., as a wall).”) (emphasis added). This satisfies the “mapping” limitation of claim 1.

¹⁵ During the hearing, we asked Patent Owner’s counsel about an intermediate scenario, in which an item is located between the position of the object in the First Scenario and the position of Object A in the Second Scenario, i.e., where the item is closer to the wall than Object A such that the robot cannot fit between it and the wall, but is nonetheless not adjacent the wall. Tr. 33:8–23. Patent Owner’s counsel stated this would be understood as an “object” and not a “wall.” *Id.* Given this statement, we can discern *no* standard for evaluating whether a given item is perceived to be a wall or an object.

Despite admitting that it would have been obvious for Kim's robot to map wall-adjacent objects located within a room, Patent Owner also argues that it makes little sense to map "a few obstacles that the robot just so happened to have encountered as it was moving parallel to and along a wall" because it would "require development of cleaning programs for largely incomplete room maps." *Id.* at 48. Moreover, if Kim were modified to map objects within the room, Patent Owner argues that Kim would have to be modified "to store a preposterously large number of cleaning programs" against which to match the map "to account for every possible room structure and configuration of internal obstacles in a room." *Id.*

We disagree. Kim discloses matching the size and structure of the room to pre-stored cleaning programs to select the stored program that most closely matches the room map generated during the initial circulation. Ex. 1003, 9:62. Thus, Kim already stores cleaning programs "for largely incomplete room maps" that are based solely on the size and structure of the room, as dictated by its walls. Also including wall-adjacent objects within the map, as proposed by Petitioner, only further "completes" the map.

Additionally, we disagree that a "preposterously large number of cleaning programs" must be stored. Patent Owner misinterprets Kim's disclosure. Kim seeks to select the pre-stored cleaning program that is "most similar" to the structure of the room, not to store all the programs necessary to ensure a full and complete match between every mapped room configuration and its exact pre-stored cleaning program equivalent. *Id.* at 9:62; *see also id.* at 10:2 ("most efficient"), 10:12 ("most similar"), 12:7 ("most effective"). Moreover, Patent Owner does not allege (or show, for that matter) that it would have been beyond the capability of an ordinarily

skilled artisan to implement Kim’s disclosed cleaning technique consistent with a modified map, i.e., by storing, selecting, and implementing cleaning patterns that include both walls and obstacles, even if such were required. *See KSR*, 550 U.S. at 421 (“A person of ordinary skill is also a person of ordinary creativity, not an automaton.”).

Accordingly, for the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 1 is unpatentable as obvious over Kim.

5. *Analysis of Claim 1 – Obviousness over Kim and Jeong*

To account for Patent Owner’s construction of “objects,” *see supra* § II.C, Petitioner alternatively contends it would have been obvious, in light of the teachings of Jeong, to modify Kim to map the room with respect to non-wall obstacles as points of reference.¹⁶ *Id.* at 31–34. Petitioner relies upon Kim for all remaining limitations, and we incorporate our findings set forth above. *Pet.* 14–42; *see supra* § II.D.3–4. Patent Owner disputes the “mapping” contentions only. *PO Resp.* 49–57.

Petitioner contends that Jeong discloses an initial operation in which the robot makes an environmental map of the work area, which includes both walls (W) and obstacles (H). *Pet.* 31 (citing, e.g., *Ex.* 1004, 5:4–6, 5:8–12). Petitioner contends that Jeong’s map reduces memory requirements by storing data as cells. *Id.* at 32 (citing *Ex.* 1004, 8:30–38). Therefore, according to Petitioner, it would have been obvious to combine Jeong’s mapping with Kim, for two reasons. *Id.* First, this would have been the

¹⁶ Although we reject Patent Owner’s claim construction, *see supra* § II.C, we apply Patent Owner’s construction here for completeness in evaluating Petitioner’s asserted grounds.

simple substitution of one known element (Jeong’s mapping with respect to walls and obstacles) for another (Kim’s mapping with respect to walls) to achieve the predictable and desired result of “increasing the granularity with which the room is mapped,” which “would improve robot performance and coverage because the map would allow the robot to navigate with respect to both the walls and the internal non-wall obstacles.” *Id.* at 33 (citing Ex. 1020 ¶ 103). Second, incorporating Jeong’s mapping technique based on stored cells would have required smaller memory and been cheaper to produce. *Id.* at 33–34 (citing, e.g. Ex. 1020 ¶ 104).

Patent Owner disputes these contentions. First, Patent Owner contends that Petitioner fails to explain how a person of ordinary skill in the art would have combined Kim’s cleaning patterns with Jeong’s map. PO Resp. 50. For example, Patent Owner alleges that Petitioner does not provide details about how the modification would be implemented, or how Kim’s disclosed cleaning technique would be modified to use Jeong’s environmental map, e.g., “how a POSITA would marry Jeong’s mapping with Kim’s cleaning techniques given that billions of Kim’s cleaning programs would be needed to account for every possible room structure and configuration of internal obstacles in a room.” *Id.* at 51–52, 53 (comparing Jeong’s flexible navigation techniques to Kim’s library of static cleaning programs). Petitioner responds to this argument by arguing that the claims do not require use of the map, therefore, Patent Owner’s arguments are irrelevant. Reply 21. Additionally, Petitioner contends that “the Petition explained that the Kim/Jeong combination uses the Jeong map and navigation techniques.” *Id.* at 21–22 (citing Pet. 14, 33–34).

Second, Patent Owner argues that Petitioner fails to explain how Jeong's sensor configuration would be implemented in Kim's robot, which employs different sensors. *Id.* at 53. For example, Patent Owner compares Jeong's front, left, and right ultrasonic sensors that calculate distance and angles to calculate X-Span and Y-Span data to identify cell boundaries for three directions at the same time, with Kim's single 360-degree sensor that provides distance data in one direction at a time. *Id.* at 54–56. Patent Owner alleges that Petitioner fails to address how Jeong's sensor configuration would be migrated to Kim's robot, or the modifications necessary to make the proposed combination. *Id.* at 56.

We are persuaded by Petitioner's contentions. Petitioner demonstrates that Jeong maps a room using walls and obstacles, "such as a piece of furniture," as points of reference in its map. Pet. 31; Ex. 1004, 5:4–12. Jeong explains that its environmental map stores data as cells, which reduces memory requirements. Ex. 1004, 8:30–38, Figs. 3, 8. Petitioner's contention that it would have been obvious to combine Jeong's mapping with Kim is supported. First, Jeong itself supports the contention that such a combination would have reduced memory requirements in storing map data. Ex. 1004, 8:30–38; Ex. 1020 ¶¶ 102, 104, 105 (also supported by Dr. Kelly's testimony). Second, we credit Dr. Kelly's testimony that a person of ordinary skill in the art would have found the proposed combination to increase the granularity of the map. Ex. 1020 ¶¶ 103–104. Although Patent Owner and Dr. Coates make several arguments, addressed below, neither disputes that the proposed combination would have reduced memory usage and increased map granularity, as proposed by Petitioner and Dr. Kelly.

We do not agree with Patent Owner’s first argument. To be clear, however, we also do not agree with Petitioner’s assertion that its proposed combination “uses the Jeong map and navigation techniques.” Reply 21–22 (citing Pet. 14, 33, 34). The Petition plainly relies upon Jeong for its mapping technique only, and not for use of that map in Jeong’s navigation or cleaning process. *See, e.g.*, Pet. 32 (“It would have been obvious to combine [Jeong’s] obstacle mapping with [Kim] for at least two reasons.”), 33 (“Doing so would have been the simple substitution of one known element ([Jeong’s] mapping with respect to both walls and non-wall obstacles) for another ([Kim’s] mapping with respect to walls, according to iRobot).”), 33 (explaining that it would have been “obvious to include [Jeong’s] mapping and map storage techniques into [Kim]”), 33–34 (“A skilled artisan would have found it obvious to modify [Kim] to include [Jeong’s] grid-based mapping that includes mapping with respect to walls and obstacles as reference points.”). That Petitioner recognizes Jeong’s use of its own map in its own processes does not amount to a contention that it would have been obvious to incorporate Jeong’s cleaning process into Kim. *Contra* Reply 21–22; Pet. 14 (quoting Ex. 1004, 1:10–11).

Nonetheless, we do not agree that Petitioner fails to explain how Kim’s disclosed navigation and cleaning technique would be modified to use Jeong’s environmental map. Importantly, Petitioner is correct that the claims do not require *using* the map. Reply 21. Claim 1 simply requires “mapping the room with respect to objects as points of reference,” but does not specify any further action taken in association with the map.

As noted above, Petitioner presents the supported and unchallenged assertion that modifying Kim to map both wall and non-wall objects, as

taught by Jeong, would realize memory savings by storing map data that depicts walls and obstacles as cells. Pet. 32 (citing Ex. 1004, 8:30–38). This holds true *even if* the map is never used by Kim’s robot, as Patent Owner contends. Ex. 2029 ¶¶ 101–103. We are persuaded that a person of ordinary skill in the art would have found it obvious to modify Kim to create a cell-based map of the room, including its walls and obstacles, as taught by Jeong, to reduce the memory storage associated with the map. Ex. 1020 ¶¶ 102, 104, 105.

Petitioner presents an additional motivation for the combination: to increase granularity of the map by including both walls and obstacles, which, it contends, would “improve overall robot performance and coverage of the area.” Pet. 33; Ex. 1020 ¶ 103. Although the claims themselves do not require “use” of the map, this alternative reasoning proposed by Petitioner *does* at least imply such use.

We do not agree, however, that using Jeong’s map with Kim’s cleaning technique is insufficiently explained in the Petition. PO Resp. 50. As discussed above in Section II.D.4, Patent Owner misinterprets Kim’s disclosure. Kim seeks to select the pre-stored cleaning program that is “most similar” to the structure of the room, not to store all the programs necessary to ensure a full and complete match between every mapped room configuration and its exact pre-stored cleaning program equivalent. *See, e.g., id.* at 9:62. Therefore, we do not agree that “billions” of cleaning programs must be stored, against which the detailed map suggested by Jeong would be compared. PO Resp. 52. Moreover, we discern that a person of ordinary skill in the art would have been capable of weighing such tradeoffs (storage of more cleaning programs) against the identified benefits (more

granular mapping). *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.”); *see also In re Urbanski*, 809 F.3d 1237, 1244 (Fed. Cir. 2016).

We also do not agree with Patent Owner’s second argument, which primarily focuses on whether components of Kim’s and Jeong’s structures can be physically combined together.¹⁷ “The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference . . . Rather, the test is what the combined teachings of those references would have suggested to those of ordinary skill in the art.” *In re Keller*, 642 F.2d 413, 425 (CCPA 1981); *see also In re Sneed*, 710 F.2d 1544, 1550 (Fed. Cir. 1983) (“[I]t is not necessary that the inventions of the references be physically combinable to render obvious the invention under review.”).

Here, our inquiry concerns what would have been suggested to a skilled artisan from Jeong’s teaching of including obstacles in the map generated by a robot, not whether Jeong’s sensors could be included in Kim’s robot, or vice versa. The record before us demonstrates that both Kim

¹⁷ At the end of the section addressing the alleged incompatibility between Kim’s and Jeong’s sensors, Patent Owner alleges that “Petitioner has failed to recognize that the initial circulation and cleaning algorithm of Kim is fundamentally different than Jeong’s techniques, irrespective of their physical combinability.” PO Resp. 56. This argument has already been addressed in considering Patent Owner’s first argument. Despite this statement, Patent Owner’s second argument really is drawn to “physical combinability.” *Id.*

and Jeong use sensors to generate environmental maps of the room to be cleaned, wherein Kim's map includes walls and Jeong's map includes both walls and obstacles. *See, e.g.*, Ex. 1003, 10:4–11; Ex. 1004, 5:4–12. We credit Dr. Kelly's testimony that it would have been a simple substitution of Jeong's mapping for Kim's mapping. Ex. 1020 ¶ 103. Petitioner has identified persuasive reasons explaining why an ordinarily skilled artisan would have modified Kim to include obstacles in the map in the grid-based manner taught by Jeong, e.g., to create a more detailed map and to reduce memory space, as proposed. Ex. 1020 ¶¶ 103–105.

We do not agree that Kim's sensor arrangement necessarily would require modification in order to detect and store obstacles in the map, in the same way walls are already detected and stored. Patent Owner does not make a persuasive showing in this regard.¹⁸ *See, e.g.*, PO Resp. 53–57; Ex. 2029 ¶¶ 104–106. But, even if modification of Kim's sensors *were* required, we do not discern that this would have been beyond the skill level of a person of ordinary skill in the art. *See, e.g., ClassCo, Inc. v. Apple, Inc.*, 838 F.3d 1214, 1219 (Fed. Cir. 2016) (“*KSR* does not require that a combination only unite old elements without changing their respective functions. Instead, *KSR* teaches that ‘[a] person of ordinary skill is also a person of ordinary creativity, not an automaton.’ And it explains that the ordinary artisan recognizes ‘that familiar items may have obvious uses beyond their primary purposes, and in many cases a person of ordinary skill will be able to fit the teachings of multiple patents together like pieces of a

¹⁸ Indeed, although Patent Owner details ways in which the sensors differ, as discussed above, these differences do not preclude Kim from detecting the presence of obstacles. *See* § II.D.4; Ex. 1003, 10:34–38 (determining “a distance to an obstacle . . . [and] a direction of the obstacle”).

puzzle.’ The rationale of *KSR* does not support [Patent Owner’s] theory that a person of ordinary skill can only perform combinations of a puzzle element A with a perfectly fitting puzzle element B. To the contrary, *KSR* instructs that the obviousness inquiry requires a flexible approach.”).

Accordingly, for the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 1 is unpatentable as obvious over the combined teachings of Kim and Jeong.

6. Analysis of Dependent Claims 2–5, 8, 9, and 11–13

Petitioner contends that dependent claims 2–5, 8, 9, and 11–13 are anticipated and/or obvious over Kim, or over the combined teachings of Kim and Jeong. Pet. 43–55. Petitioner relies upon Kim’s teachings to satisfy the limitations of these dependent claims. *Id.* Patent Owner does not dispute these contentions. PO Resp. 34–57. The evidence of record supports Petitioner’s undisputed contentions.

Claim 2 depends from claim 1 and further recites “the control system is configured to track a cleaning route of the robot and monitor an amount of the room remaining to be cleaned.” Kim discloses that the cleaning robot operates according to its selected program, recharges its battery during operation, and returns to the point at which cleaning was discontinued in order to resume cleaning from that position. *See, e.g.*, Ex. 1003, 12:6–15, 9:51–55, Fig. 14; Pet. 43–46. We credit Dr. Kelly’s un rebutted testimony that a person of ordinary skill in the art would have understood that the robot monitors the amount of the room remaining to be cleaned based on, *inter alia*, these teachings. *See, e.g.*, Ex. 1020 ¶¶ 124–125; Pet. 43–46.

Claim 3 depends from claim 1 and further recites “the control system is configured to use a known position of the base charging station as a point of reference in mapping the room.” Kim discloses initializing the initial circulation at a particular location and finishing the initial circulation when the robot returns to “the initial start location.” *See, e.g.*, Ex. 1003, 10:21–24, 11:57–65; Pet. 46–47. We credit Dr. Kelly’s un rebutted testimony that a person of ordinary skill in the art would have understood this location to be that of the charging means 30, because that is the location to which robot returns when cleaning is complete and, therefore that this position is used as a point of reference when mapping. Ex. 1020 ¶ 128.

Claim 4 depends from claim 1 and further recites “the control system is configured to determine, through use of route-tracking subroutines while controlling the motive system to direct the robot about the room, which portion of the room still requires cleaning.” Kim discloses that “the microprocessor 2 outputs data regarding that portion of the floor which has been cleaned, that is, the data of a distance and a direction of cleaned floor,” and that the robot returns to a discontinued cleaning location after the battery is recharged. *See, e.g.*, Ex. 1003, 9:43–46, 9:51–55; Pet. 47–49. We credit Dr. Kelly’s un rebutted testimony that a person of ordinary skill in the art would have found it obvious that these functions are implemented with routine-tracking subroutines. And that the device would determine the portion of the floor that continues to require cleaning. Ex. 1020 ¶¶ 131–132.

Claim 5 depends from claim 1 and further recites “the control system is configured to direct the robot to the portion of the room still requiring cleaning, following recharging the energy storage unit.” Kim discloses that the robot cleaner “mov[es] to an automatic charging means to charge its

battery . . . and then return[s] to the interrupted cleaning position to again carry out the cleaning operation.” *See, e.g.*, Ex. 1003, 1:8–14; Pet. 49–50.

Claim 8 depends from claim 1 and further recites “the control system is configured to return the robot to the base charging station before completing the cleaning task in the room, in response to a quantity of energy remaining in the energy storage unit falling to a predetermined threshold.” Kim discloses that the robot cleaner “mov[es] to an automatic charging device by itself and repeatedly charg[es] its battery when power of the battery is discharged to below a predetermined level during a cleaning operation” and then resumes the cleaning operation from its position prior to recharging. *See, e.g.*, Ex. 1003, 1:58–62, 14:3–62; Pet. 50–51.

Claim 9 depends from claim 8 and further recites “the navigational control system is configured to direct the robot to the base charging station by seeking a base station homing signal.” Kim discloses that the robot cleaner seeks an “ultrasonic wave generat[ed] from the ultrasonic wave oscillator 150 of the automatic charging means 30.” *See, e.g.*, Ex. 1003, 14:6–23; Pet. 52–53; *see also* Ex. 1001, 7:37–38 (“ultrasonic sensors and transducers may be employed”), 15:27–36 (“sound waves”).

Claim 11 depends from claim 1 and further recites “the robot is configured to disable a cleaning function while returning to the base charging station.” Kim discloses that while the robot is returning to the charging station, “the vacuum motor is not operated.” *See, e.g.*, Ex. 1003, 14:33–35; Pet. 53.

Claim 12 depends from claim 1 and further recites “the energy storage unit comprises a battery.” Kim discloses battery 26. *See, e.g.*, Ex. 1003, 3:57–59; Pet. 53.

Claim 13 depends from claim 1 and further recites “the energy storage unit comprises electrical contacts arranged to automatically make electrical contact with the base charging station upon docking of the robot.” Kim discloses plug 156 of charging means 30, which makes electrical contact with the robot cleaner’s conductor 31a, which is electrically connected to battery 26. *See, e.g.*, Ex. 1003, 8:31–41, 14:56–62, Fig. 12; Pet. 53–55.

Accordingly, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 2–5, 8, 9, and 11–13 are unpatentable as anticipated or obvious over Kim, or over the combined teachings of Kim and Jeong. *See supra* § II.D.3–5.

E. Obviousness over the Combined Teachings of Kim and Fiegert, or Kim, Jeong, and Fiegert

Petitioner relies upon its contentions regarding Kim (*see supra* § II.D.3–4) and the combination of Kim and Jeong (*see supra* § II.D.5), as discussed above, and further contends that dependent claims 2, 4, and 5 also would have been obvious over the combined teachings of Kim, with or without Jeong, and Fiegert. Pet. 55–60. Other than its arguments set forth above regarding claim 1, Patent Owner does not dispute these contentions. PO Resp. 57.

1. Fiegert (Ex. 1006)

Fiegert is a U.S. patent that discloses an autonomous mobile unit for surface processing that seeks to cover completely a floor surface. Ex. 1006, 1:5–8, 1:46–47, 3:19–20. Fiegert discloses that the system tracks, and computes the percentage of, areas that have been cleaned. *Id.* at 6:54–67.

2. Analysis

Claim 2 depends from claim 1 and further recites, “wherein the control system is configured to track a cleaning route of the robot and

monitor an amount of the room remaining to be cleaned.” Ex. 1001, 19:46–49. Claim 4 depends from claim 1 and further recites, “wherein the control system is configured to determine, through use of route-tracking subroutines while controlling the motive system to direct the robot about the room, which portion of the room still requires cleaning.” *Id.* at 20:5–9. And claim 5 depends from claim 4 and further recites, “wherein the control system is configured to direct the robot to the portion of the room still requiring cleaning, following recharging the energy storage unit.” *Id.* at 20:10–13.

Petitioner contends that Fiegert teaches “dividing an area to be cleaned into grid areas that ‘are at first initialized as uncleaned.’ . . . The traversed regions ‘then can be calculated’ and ‘corresponding grid cells are entered as cleaned in a memory field for this purpose.’” Pet. 56 (quoting Ex. 1006, 6:55–56, 6:58–61). According to Petitioner, “this process yields ‘two numbers, the one thereby denoting an overall number of all grid cells and *the second indicating the plurality of cells that have not yet been cleaned,*’” i.e., a percentage of the cleaned area, from which a skilled artisan would discern the percentage of the area that remains uncleaned. *Id.* at 56–57 (quoting Ex. 1006, 6:61–645; citing Ex. 1020 ¶¶ 148–150).

Petitioner contends that a person of ordinary skill in the art would have found it obvious to combine Fiegert’s teachings with Kim, or with Kim and Jeong, because, “by adding *Fiegert’s* method of calculating which grid cells remain to be cleaned, the robot cleaner described in [Kim] (and in its combination with [Jeong]) would have determined, with greater accuracy, which portions of the room had been cleaned and which portions remained to be cleaned.” Pet. 57–58 (citing Ex. 1020 ¶ 151). Petitioner contends this

“would have improved [Kim’s and Kim/Jeong’s] tracking and return/resume method” and “would further improve the autonomous nature” of Kim’s robot. *Id.* at 58. Petitioner asserts this would have been the simple combination of known elements to achieve the predictable result of “improved tracking, increased granularity into which parts of the rooms still required cleaning, and more efficient battery charging.” *Id.* (citing Ex. 1020 ¶ 152).

We have considered Petitioner’s undisputed contentions and determine that Petitioner has met its burden with respect to claims 2, 4, and 5. Petitioner shows that Fiegert discloses dividing the area “into grid areas” where “all grid areas are at first initialized as uncleaned.” Ex. 1006, 6:54–56. As each grid area is cleaned, “[t]he corresponding grid cells are entered as cleaned in a memory field,” and “two numbers” are obtained: “one thereby denoting an overall number of all grid cells and the second indicating the plurality of cells that have not yet been cleaned. The percentage of the area already cleaned can be determined from these two numbers.” *Id.* at 6:58–65. We credit Dr. Kelly’s un rebutted testimony that, from this information, an ordinarily skilled artisan would have calculated the portion of the area that remains uncleaned, including through the use of subroutines. Ex. 1020 ¶¶ 150, 157. Petitioner provides adequate reasoning explaining why an ordinarily skilled artisan would have been motivated to combine the teachings of Fiegert with Kim, or with Kim and Jeong, e.g., to improve accuracy when determining the remaining areas to be cleaned. *Id.* ¶¶ 151–153.

Accordingly, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 2, 4, and 5 are

unpatentable over the combined teachings of Kim (both with and without Jeong) and Fiegert.

F. Obviousness over the Combined Teachings of Kim and Han, or Kim, Jeong, and Han

Petitioner relies upon its contentions regarding Kim (*see supra* § II.D.3–4) and the combination of Kim and Jeong (*see supra* § II.D.5), as discussed above, and further contends that dependent claim 3 also would have been obvious over the combined teachings of Kim, with or without Jeong, and Han. Pet. 61–67. Patent Owner does not dispute these contentions. PO Resp. 57.

1. Han (Ex. 1005)

Han is a U.S. patent that discloses “a charging apparatus for a robot cleaner and a method for charging the robot cleaner by which the robot cleaner can be accurately induced to a power source supplier to receive a battery charge when a battery power source drops below a predetermined level.” Ex. 1005, code (57). Han explains that the robot cleaner moves toward the charging apparatus based on “initial position information” that has been stored. *Id.* at 3:41–47, Fig. 10 (power source supplier 110).

2. Analysis

Claim 3 depends from claim 1 and further recites, “wherein the control system is configured to use a known position of the base charging station as a point of reference in mapping the room.” Ex. 1001, 20:1–4.

Petitioner contends that Han teaches storing initial position information of robot cleaner 1 and power source supplier 110, prior to beginning an initial circulation of the room. Pet. 63–64 (citing Ex. 1005, 7:57–60, Fig. 8A). Petitioner contends that “this stored position is used in [Han’s] mapping because [Han] discloses ‘moving the cleaner to the electric

power source supplier according to the initial position information stored at the initial position information storage step in order to charge a battery.”

Id. at 64–65 (quoting Ex. 1005, 3:42–44; citing Ex. 1005, 3:30–35, 7:30–61, 12:39–48, Figs. 9–10; Ex. 1020 ¶ 166).

Petitioner contends that a person of ordinary skill in the art would have found it obvious to combine Han’s teachings with Kim, or Kim and Jeong, because this would have (1) “allow[ed] the robot to know where the charging station was, which would enable the cleaning robot to return to the base station as quickly as possible when it sensed a need to recharge,” and (2) “allow[ed] the cleaning robot to find the charging station without needing to rely solely on [Kim’s] homing signals.” *Id.* at 66 (citing Ex. 1020 ¶ 167). Petitioner asserts this would have been the simple addition of one known element for another to achieve the predictable result of “increasing the likelihood that the robot cleaner would reach the base station before depleting the battery.” *Id.* at 67 (citing Ex. 1020 ¶ 168).

We have considered Petitioner’s undisputed contentions and determine that Petitioner has met its burden with respect to claim 3. Petitioner shows that Han discloses storing “initial position information (X,Y) in a state where the robot cleaner 1 is connected to the power source supplier 110.” Ex. 1005, 7:55–60. Han explains that this stored position is used as a point of reference in the room, such that the cleaner moves to that position in order to charge the battery. *Id.* at 3:42–44, Figs. 8A, 9, 10. Petitioner provides adequate reasoning explaining why an ordinarily skilled artisan would have been motivated to combine the teachings of Han with Kim, or with Kim and Jeong, e.g., to allow the robot cleaner to more

quickly return to the power source supplier for recharging, without homing signals. *See, e.g.*, Pet. 65–67; *see, e.g.*, Ex. 1020 ¶¶ 167–168.

Accordingly, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 3 is unpatentable over the combined teachings of Kim (both with and without Jeong) and Han.

G. Obviousness over the Combined Teachings of Kim and Ohsawa, or Kim, Jeong, and Ohsawa

Petitioner relies upon its contentions regarding Kim (*see supra* § II.D.3–4) and the combination of Kim and Jeong (*see supra* § II.D.5), as discussed above, and further contends that dependent claims 6 and 7 would have been obvious over the combined teachings of Kim, with or without Jeong, and Ohsawa. Pet. 67–71. Patent Owner disputes Petitioner’s contentions regarding claim 7. PO Resp. 57–61.

1. Ohsawa (Ex. 1008)

Ohsawa is a Japanese-language patent publication that discloses a charging system for charging a mobile robot. Ex. 1008, code (57). Ohsawa explains that when the robot detects a decline in battery charge, it automatically stops work and docks at a charging station to recharge the battery. *Id.* ¶ 15. Once the battery is partially or fully recharged, the robot leaves the charging station and resumes the work that had been interrupted to recharge the battery. *Id.*

2. Analysis of Claim 6

Claim 6 depends from claim 1 and further recites, “wherein the robot is configured to control charging at the base charging station by only partially charging the energy storage unit before leaving the base charging station to continue cleaning the room.” Ex. 1001, 20:15–19.

Petitioner contends that Ohsawa teaches “recharging the battery of its mobile robot either ‘fully’ or ‘to a certain capacity’”—i.e., partially charging, as recited in claim 6—“before undocking to resume its work.” Pet. 68 (citing Ex. 1008 ¶¶15, 88; Ex. 1020 ¶¶ 171–172).

Petitioner contends that a person of ordinary skill in the art would have found it obvious to combine Ohsawa’s teachings with Kim, or with Kim and Jeong, because this would have allowed the robot to “charge[] more quickly (because a partial charge does not take as long as a full charge),” which would have “reduc[ed] charging time when a small portion of the room needs to be cleaned and thus a full charge is unnecessary.” *Id.* at 68–69 (citing Ex. 1020 ¶¶ 174, 176). According to Petitioner, “[b]ecause the [Kim] robot knows how much of the room remains to be cleaned, it would have been obvious to a skilled artisan to use this data in combination with [Ohsawa’s] disclosed ability to partially charge the battery, to only charge the battery as needed to finish cleaning the room.” *Id.* at 69. Petitioner contends this would have been a simple substitution of a known element into a known system to achieve “the predictable result of a cleaning robot that can partially charge its battery to complete the interrupted cleaning task more quickly.” *Id.*

We have considered Petitioner’s undisputed contentions and determine that Petitioner has met its burden with respect to claim 6. Petitioner shows that Ohsawa’s robot resumes cleaning the room “[o]nce the battery is fully charged *or restored to a certain capacity*.” Ex. 1008 ¶ 15. We credit Dr. Kelly’s un rebutted testimony that a skilled artisan would have understood this teaching to include partially charging the battery. Ex. 1020 ¶ 172. Petitioner provides adequate reasoning explaining why an ordinarily

skilled artisan would have been motivated to combine the teachings of Ohsawa with Kim, or with Kim and Jeong, e.g., to partially charge the battery to complete an interrupted cleaning task more quickly. Pet. 69; Ex. 1020 ¶ 174.

Accordingly, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 6 is unpatentable over the combined teachings of Kim (both with and without Jeong) and Ohsawa.

3. Analysis of Claim 7

Claim 7 depends from claim 6 and further recites, “wherein the robot is configured to leave the base charging station and continue to clean the room upon determining that the energy storage unit has reached a minimum amount of stored energy necessary to complete the cleaning task in the room.” *Id.* at 20:20–24.

Petitioner relies upon its contentions made regarding claim 6 and further contends that

[Kim] prepares a cleaning path, tracks the progress of the cleaning robot along the cleaning path, identifies a location where the robot stopped to charge, determines the portion of the room that has been cleaned and thus that still requires cleaning, and resumes cleaning where it stopped to charge. Because [Kim’s] cleaning robot knows how much of the room remains to be cleaned, it would have been obvious to a skilled artisan to combine this data with [Ohsawa’s] ability to partially charge the battery, and only charge the battery as needed to finish cleaning.

Pet. 70 (citing Ex. 1020 ¶ 176). According to Petitioner, this would have been the substitution of a known element—Ohsawa’s partial charging—into a known system—Kim’s cleaning robot, which tracks its progress within a room to be cleaned—“to achieve the predictable result of a cleaning robot

that can partially charge its battery to complete the interrupted cleaning task more quickly.” *Id.* at 71.

Patent Owner disagrees. PO Resp. 57–61. Patent Owner argues that “the Petition does not point to any disclosure in Kim or [Ohsawa] that describes ‘determining that the energy storage unit has reached a minimum amount of stored energy necessary to complete the cleaning task in the room.’” *Id.* at 58. Specifically, Patent Owner argues that Kim fails to describe “any mechanism to relate the remaining portion of a cleaning task to an amount of energy stored in an energy storage unit.” *Id.* (citing Ex. 2029 ¶ 108). Likewise, Patent Owner contends that Ohsawa fails to cure this deficiency because it “is silent as to any relationship between the ‘certain capacity’ that the robot’s battery is partially charged to and the current operation or task that the robot is performing.” *Id.* at 60 (citing Ex. 2029 ¶¶ 110–111). Patent Owner also relies on Dr. Coates’ testimony that “it is well known that batteries typically degrade faster when repeatedly recharged to 100% or with excessive temperature increases” and, because of this, Ohsawa may recharge to less than full capacity to avoid degradation—not because of any relationship between the recharged capacity and the portion of the room remaining to be cleaned. *Id.* at 60–61 (citing Ex. 2029 ¶¶ 112–113).

We are persuaded by Petitioner’s contentions and evidence. First, it is not determinative that neither Kim nor Ohsawa explicitly disclose the precise claim language. *Contra* PO Resp. 58–60. This is an obviousness ground and, therefore, “the question under 35 [U.S.C. §] 103 is not merely what the references expressly teach but what they would have suggested to one of ordinary skill in the art at the time the invention was made.” *Merck*

& Co. v. Biocraft Labs., Inc., 874 F.2d 804, 807–08 (Fed. Cir. 1989) (quoting *In re Lamberti*, 545 F.2d 747, 750 (CCPA 1976) (citation omitted)).

We are persuaded that Kim discloses tracking a robot’s cleaning progress within a room and resuming cleaning at a location in the room at which cleaning was paused in order to charge the robot’s battery, and that Ohsawa teaches resuming a self-propelled, autonomous task when a robot’s battery is “fully charged or restored to a certain capacity.” Ex. 1003, 9:51–55, 14:63–15:2; Ex. 1008 ¶ 15. Patent Owner does not dispute these disclosures. *See, e.g.*, PO Resp. 58 (discussing “Kim’s disclosure of determining the portion of the room that has been cleaned and thus that still requires cleaning, and resuming cleaning where it stopped to charge”), 59 (quoting Ex. 1008 ¶ 15). We recognize that neither reference provides an express disclosure sufficient for anticipation under 35 U.S.C. § 102.

However, we credit Dr. Kelly’s un rebutted testimony that “a partial charge does not take as long as a full charge.” Ex. 1020 ¶ 174. Dr. Kelly testifies that, in light of the teachings of Kim and Ohsawa, “it would have been obvious to one skilled in the art . . . to only charge the battery to the extent necessary to finish cleaning the room,” which would have been “nothing more than the substitution of a known element ([Ohsawa’s] partial charging) into a known system ([Kim’s] cleaning robot that tracks its progress along a cleaning path, including how much of the room remains to be cleaned) to achieve the predictable and desired result of a cleaning robot that can partially charge its battery to complete the interrupted cleaning task more quickly.” Ex. 1020 ¶ 176; *see also id.* ¶ 174 (explaining the modification would have “reduce[d] charging time when only a small

portion of the room needs to be cleaned and thus a full charge is not needed”).

Neither Patent Owner nor Dr. Coates dispute Dr. Kelly’s testimony in this regard but instead focus on each reference’s purported deficiencies individually. PO Resp. 57–61; Ex. 2029 ¶¶ 107–113. However, the Supreme Court’s decision in *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007) “does not support [the] theory that a person of ordinary skill can only perform combinations of a puzzle element A with a perfectly fitting puzzle element B. To the contrary, *KSR* instructs that the obviousness inquiry requires a flexible approach,” recognizing that “[a] person of ordinary skill is also a person of ordinary creativity, not an automaton.” *ClassCo, Inc. v. Apple, Inc.*, 838 F.3d 1214, 1219 (Fed. Cir. 2016). In this case, we are persuaded by Dr. Kelly’s testimony that a person of ordinary skill in the art, recognizing that Kim already tracks the robot’s cleaning progress through a room, would have found it obvious to charge the battery only to the extent necessary to finish cleaning the room, i.e., to determine that the battery has reached a sufficient charge to complete the cleaning task, such that the cleaning task could be resumed and completed more quickly. Ex. 1020 ¶¶ 174, 176.

We recognize Dr. Coates’ testimony that there may be *other* reasons to partially recharge a battery, e.g., to avoid degradation (Ex. 2029 ¶¶ 112–113), however, that alone does not discredit the rationale advanced by Dr. Kelly in support of the proposed modification. Petitioner advances an obviousness ground, not an inherency ground. *Cf. Akamai Techs., Inc. v. Cable & Wireless Internet Servs., Inc.*, 344 F.3d 1186, 1192 (Fed. Cir. 2003) (“A claim limitation is inherent in the prior art if it is necessarily present in

the prior art, not merely probably or possibly present.”). In other words, that a skilled artisan might partially recharge a battery to avoid degradation is not at odds with Dr. Kelly’s testimony that such an artisan would have found it obvious to recharge the robot’s battery only to the point necessary to complete the cleaning task in the room, in light of the cited prior art teachings. Ex. 1020 ¶¶ 174, 176.

Accordingly, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 7 is unpatentable over the combined teachings of Kim (both with and without Jeong) and Ohsawa.

H. Obviousness over the Combined Teachings of Kim and Kopmann, or Kim, Jeong, and Kopmann

Petitioner relies upon its contentions regarding Kim (*see supra* § II.D.3–4) and the combination of Kim and Jeong (*see supra* § II.D.5), as discussed above, and further contends that dependent claim 10 would have been obvious over the combined teachings of Kim, with or without Jeong, and Kopmann. Pet. 71–73. Other than its arguments set forth above with respect to claim 1, Patent Owner does not dispute these contentions. PO Resp. 57.

1. Kopmann (Ex. 1010)

Kopmann is a U.S. patent that discloses a method and apparatus for monitoring the state of charge of a battery, including through use of coulometry and time. Ex. 1010, code (57). Specifically, Kopmann teaches:

A method of and an apparatus for monitoring the state of charge of a rechargeable battery . . . , which use a reference value corresponding to a defined state of charge stored in a memory. During each battery charging and discharging cycle, *the terminal voltage, the current and time are measured* and are converted

into energy delivered to the battery or by the battery depending on the direction of current flow. The actual state of charge is then calculated from the reference value stored. The characteristic terminal voltage curve during charging and discharging is used for minimizing the differences between the quantities measured and the actual state of charge of the battery so monitored by monitoring the rate of change in the terminal voltage during the charging and the discharging cycles, by determining, after a phase of a relatively steady and small rate of change in voltage, at least one point at which the rate of change in voltage is higher and by *adjusting the actual state of charge determined at this point by coulometry* to the predetermined reference value.

Id. (emphasis added).

2. Analysis

Claim 10 depends from claim 8 and further recites, “wherein the robot is configured to determine the quantity of energy in the energy storage unit using at least one of coulometry and operating time.” Ex. 1001, 20:35–38.

Petitioner contends that Kim teaches determining the quantity of energy in the battery (Pet. 72 (citing Ex. 1003, 1:7–11)) and that a person of ordinary skill in the art would have understood that using coulometry and operating time were well-known techniques to do so. *Id.* (citing Ex. 1020 ¶¶ 179–181; Ex. 1010, code (57), 2:55–3:52, 5:36–37). Petitioner contends that a person of ordinary skill in the art would have found it obvious to combine Kopmann with Kim, or with Kim and Jeong, because Kopmann provides details for measuring the energy remaining in the battery, as suggested by Kim. *Id.* at 73 (citing Ex. 1020 ¶ 182). Petitioner asserts this would have been the application of a known technique to a known system to achieve the predictable results of “a battery monitoring functionality that improves upon prior art coulometric methods” and “allows the reliable

interruption of discharging [circuits] prior to passing minimum or maximum voltage limits, thereby warranting long life of the battery.’” *Id.* (citing Ex. 1010, 7:17–22; Ex. 1020 ¶¶ 182–183).

We have considered Petitioner’s undisputed contentions and determine that Petitioner has met its burden with respect to claim 10. Petitioner shows that Kopmann determines the state of battery charge utilizing a combination of operating time and coulometry. *See, e.g.*, Ex. 1010, code (57), 2:28–3:52; Ex. 1020 ¶¶ 179, 181. Petitioner provides adequate reasoning explaining why an ordinarily skilled artisan would have been motivated to combine the teachings of Kopmann with Kim, or with Kim and Jeong, e.g., to monitor battery charge levels. Pet. 73; Ex. 1020 ¶¶ 182–183 (providing details regarding battery measurement to ensure long battery life).

Accordingly, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 10 is unpatentable over the combined teachings of Kim (both with and without Jeong) and Kopmann.

III. CONCLUSION

In summary:¹⁹

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
1–5, 8, 9, 11–13	§ 102	Kim	1–5, 8, 9, 11– 13	
1–5, 8, 9, 11–13	§ 103	Kim	1–5, 8, 9, 11– 13	
1–5, 8, 9, 11–13	§ 103	Kim, Jeong	1–5, 8, 9, 11– 13	
2, 4, 5	§ 103	Kim, Fiegert	2, 4, 5	
2, 4, 5	§ 103	Kim, Jeong, Fiegert	2, 4, 5	
3	§ 103	Kim, Han	3	
3	§ 103	Kim, Jeong, Han	3	
6, 7	§ 103	Kim, Ohsawa	6, 7	
6, 7	§ 103	Kim, Jeong, Ohsawa	6, 7	
10	§ 103	Kim, Kopmann	10	
10	§ 103	Kim, Jeong, Kopmann	10	
Overall Outcome			1–13	

¹⁹ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1–13 of the '294 patent have been shown to be unpatentable; and

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.

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