Trials@uspto.gov
571-272-7822

Paper 51
Entered: January 6, 2025

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

META PLATFORMS, INC.,
META PLATFORMS TECHNOLOGIES, LLC, and
TWISTED PIXEL GAMES, LLC,
Petitioner,

v.

EIGHT KHZ, LLC,
Patent Owner.

IPR2023-01023
Patent 10,798,509 B1

Before JUSTIN T. ARBES, LYNNE H. BROWNE, and
SCOTT RAEVSKY, *Administrative Patent Judges.*

BROWNE, *Administrative Patent Judge*.

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

I. INTRODUCTION

We have authority to hear this *inter partes* review under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons discussed below, we determine that Petitioner, Meta Platforms, Inc., Meta Platforms Technologies, LLC, and Twisted Pixel Games, LLC, has shown by a preponderance of the evidence that claims 1, 3–9, and 11–14 (the "challenged claims") of U.S. Patent No. 10,798,509 B1 (Ex. 1001, "the '509 patent") are unpatentable. *See* 35 U.S.C. § 316(e) (2018); 37 C.F.R. § 42.1(d) (2022). We further determine that Petitioner has not shown by a preponderance of the evidence that claims 2, 10, and 17–20 are unpatentable.

A. Procedural History

Petitioner filed a Petition (Paper 2, "Pet." or "Petition") requesting *inter partes* review of the challenged claims of the '509 patent. Patent Owner, Eight KHZ, LLC, filed a Preliminary Response. Paper 7. Based upon the record at that time, we instituted *inter partes* review on all challenged claims on the grounds presented in the Petition. Paper 10 ("Institution Decision" or "Dec.").

After institution, Patent Owner filed a Response (Paper 21, "PO Resp."), Petitioner filed a Reply (Paper 27, "Pet. Reply"), and Patent Owner filed a Sur-reply (Paper 37, "PO Sur-reply").

On October 17, 2024, an oral hearing was held. The transcript of this hearing was entered in the record of this proceeding as Paper 47 ("Tr.").

B. Real Parties-in-Interest

Petitioner identifies itself as the real party-in-interest in this proceeding. Pet. 71. Patent Owner identifies itself as the real party-in-interest. Paper 5, 2.

C. Related Matters

The parties indicate that the '509 patent is involved in *Eight kHz, LLC v. Meta Platforms, Inc.; Meta Platforms Technologies, LLC; Twisted Pixel Games, LLC*, 6:22-cv-00575-ADA (W.D. Tex. 2022). Pet. 71; Paper 5.

The parties identify U.S. Application Nos. 17/062,633 and 17/520,584 as applications related to the '509 patent. Pet. 71; Paper 5. Petitioner additionally identifies U.S. Application Nos. 15/049,071, 15/424,901, 15/944,796, 16/162,416, 16/445,268, 16/588,078, and 16/938,936 as applications related to the '509 patent. Pet. 71. Patent Owner identifies U.S. Patent Nos. 11,172,316, 10,440,489, 10,117,038, 9,980,072, and 9,591,427 as patents related to the '509 patent. Paper 5.

Additionally, the following proceedings before the Board involve the same parties as the instant proceeding: IPR2023-01003 (U.S. Patent No. 9,226,090 B1), IPR2023-01004 (U.S. Patent No. 9,282,196 B1), IPR2023-01005 (U.S. Patent No. 9,674,628 B1), IPR2023-01019 (U.S. Patent No. 10,368,179 B1), IPR2023-01020 (U.S. Patent No. 10,448,184 B1), IPR2023-01021 (U.S. Patent No. 10,917,737 B2), IPR2023-01022 (U.S. Patent No. 11,172,316 B1), and IPR2023-01024 (U.S. Patent No. 11,290,836 B2).

D. The '509 Patent

The '509 patent for a "Wearable Electronic Device Displays a 3D Zone from Where Binaural Sound Emanates" relates to "creat[ing] and

maintain[ing] virtual environments, virtual reality, and augmented reality." Ex. 1001, code (54), 1:7–23. According to the '509 patent, Head Related Transfer Functions ("HRTFs") may be used to artificially create localized binaural sound, but HRTFs vary depending on various individual physiological traits and are difficult to measure and obtain. *Id.* at 1:7–23. The '509 patent seeks to obtain more accurate HRTFs and "accurately localize binaural sound." *Id.* at 2:59–65.

The '509 patent discloses a portable electronic device ("PED") that "divides an area around a user into a three-dimensional ([']3D[']) zone" and a head-worn device that displays the zone when the head-worn device detects that the user is leaving the zone and "plays binaural sound that emanates to the user from sound localization points ([']SLPs[']) inside the zone." Ex. 1001, code (57).

E. Challenged Claims

Petitioner challenges claims 1–14 and 17–20 of the '509 patent. Pet. 4–70. Of the challenged claims, claims 1, 9, and 17 are independent. Independent claims 1 and 9 are illustrative of the challenged claims and are reproduced below with Petitioner's labeling of the limitations for ease of reference.

1. 1[pre] A method comprising:

> 1[a] dividing, with a portable electronic device (PED) held in a hand of a user, an area around the user into a zone that includes multiples sound localization points (SLPs) from where binaural sound originates to the user;
>
> 1[b] determining, with a wearable electronic device (WED) worn on a head of the user, when the user is located inside the zone;
>
> 1[c] highlighting, while the user is located in the zone and with a display of the WED, one of the multiple SLPs in the zone

> when the PED held in the hand of the user is pointed at the one of the multiple SLPs in the zone; and
>
> 1[d] playing, with the WED worn on the head of the user, the binaural sound that emanates from the one of the multiple SLPs in response to the one of the multiple SLPs being pointed at by the PED held in the hand of the user.

Ex. 1001, 40:58–41–7.

> 9. 9[pre] A non-transitory computer readable storage medium storing instructions that one or more electronic devices execute as a method, the method comprising:
>
> 9[a] dividing, with a portable electronic device (PED) held in a hand of a user, an area around the user into a zone that includes sound localization points (SLPs) in empty space from where binaural sound originates to the user;
>
> 9[b] determining, with a wearable electronic device (WED) worn on a head of the user, when the user is located inside the zone;
>
> 9[c] determining, with the WED worn on the head of the user, when the user is leaving the zone; and
>
> 9[d] displaying, with the WED worn on the head of the user, a three dimensional (3D) virtual image of the zone in response to the WED determining that the user is leaving the zone.

Ex. 1001, 41:57–42:4.

F. The Alleged Grounds of Unpatentability

Petitioner asserts the following grounds of unpatentability (Pet. 2–3):

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–14, 17–20	103	Pedrotti,[1] Jang,[2] Begault[3]
1–14, 17–20	103	McCulloch,[4] Pedrotti, Flaks[5]

G. Evidence

In support of its proposed grounds, Petitioner relies on the Declaration and Supplemental Declaration of Gregory F. Welch, Ph.D. ("Dr. Welch"). Exs. 1003, 1173. In our analysis below, we consider Dr. Welch's testimony.

II. ANALYSIS

A. Principles of Law: Obviousness

A claim is unpatentable as obvious under 35 U.S.C. § 103 if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious to a person having ordinary skill in the art to which the claimed invention 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

[1] U.S. Patent No. 9,851,786 B2, filed July 7, 2015, issued December 26, 2017 (Ex. 1005, "Pedrotti").
[2] U.S. Patent No. 8,520,872 B2, issued August 27, 2013 (Ex. 1006, "Jang").
[3] DURAND R. BEGAULT, NAT'L AERONAUTICS AND SPACE ADMIN., 3D SOUND FOR VIRTUAL REALITY AND MULTIMEDIA (2000) (Ex. 1007, "Begault").
[4] U.S. Patent No. 9,041,622 B2, issued May 26, 2015 (Ex. 1008, "McCulloch").
[5] U.S. Patent No. 8,767,968 B2, issued July 1, 2014 (Ex. 1009, "Flaks").

(4) objective evidence of nonobviousness, i.e., secondary considerations.[6] *See Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 17–18 (1966).

The Supreme Court has made clear that we apply "an expansive and flexible approach" to the question of obviousness. *KSR*, 550 U.S. at 415. Whether a patent claiming a combination of prior art elements would have been obvious is determined by whether the improvement is more than the predictable use of prior art elements according to their established functions. *Id.* at 417. Reaching this conclusion, however, "requires more than a mere showing that the prior art includes separate references covering each separate limitation in a claim." *Unigene Labs., Inc. v. Apotex, Inc.*, 655 F.3d 1352, 1360 (Fed. Cir. 2011). "Rather, obviousness requires the additional showing that a person of ordinary skill . . . would have selected and combined those prior art elements in the normal course of research and development to yield the claimed invention." *Id.*

B. Level of Ordinary Skill in the Art

In determining the level of skill in the art, we consider the type of problems encountered in the art, the prior art solutions to those problems, the rapidity with which innovations are made, the sophistication of the technology, and the educational level of active workers in the field. *Custom Accessories, Inc. v. Jeffrey-Allan Indus. Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986); *Orthopedic Equip. Co. v. U.S.*, 702 F.2d 1005, 1011 (Fed. Cir. 1983).

Petitioner asserts that a person of ordinary skill in the art ("POSITA") "would have had a Bachelor's degree in computer science/engineering, or a related field, and at least two years of industry experience or academic

[6] Patent Owner does not present or address any objective evidence of nonobviousness.

research experience in virtual/augmented reality, including visual and audio modeling and rendering" and that "[a]dditional education can compensate for less experience, and vice-versa." Pet. 4–5 (citing Ex. 1003 ¶¶ 32–37). "Patent Owner accepts Petitioner's definition of [a POSITA]." PO Resp. 2.

For purposes of this Decision, we also adopt Petitioner's proposal as reasonable and consistent with the prior art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (the prior art may reflect an appropriate level of skill in the art).

C. Claim Construction

We apply the same claim construction standard used in district court actions under 35 U.S.C. § 282(b), namely that articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). *See* 37 C.F.R. § 42.100(b) (2022). In applying that standard, claim terms generally are given their ordinary and customary meaning as would have been understood by a person of ordinary skill in the art at the time of the invention and in the context of the entire patent disclosure. *Phillips*, 415 F.3d at 1312–13. "In determining the meaning of the disputed claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence." *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17).

Petitioner asserts that "[t]he challenged claims are unpatentable under any reasonable construction, including their plain meaning." Pet. 5. We understand Petitioner's position to be that no claim construction is required. *See id.* Patent Owner contends "that 'no express constructions of the claims are necessary.'" PO Resp. 2 (citing Dec. 10).

We agree with the parties that no claim terms require express construction. *See Vivid Techs. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (holding that only terms that are in controversy need to be construed, and "only to the extent necessary to resolve the controversy"). To the extent that the meaning of any claim term is addressed, we use its ordinary and customary meaning as discussed in our analysis below.

D. Ground One: Alleged Obviousness of Claims 1–14 and 17–20 in View of the Combined Teachings of Pedrotti, Jang, and Begault

1. Pedrotti (Ex. 1005)

Pedrotti is a U.S. patent for a "System and Method for Assisting a User in Remaining in a Selected Area While the User is in a Virtual Reality Environment" that seeks to aid a user in avoiding physical obstacles while in a virtual environment. Ex. 1005, codes (54), (57). Pedrotti discloses an embodiment in which the user "wear[s] a head-mounted display ([']HMD[']) and hold[s] a handheld controller" that includes a tracker that "provides information regarding a position of the handheld controller." *Id.* at 2:44–49.

Pedrotti further discloses determining a selected area, for example, a "safe area," in "which the user or another person has determined is clear of physical obstacles in the physical world so that the user may move freely without coming into contact with such physical obstacles." Ex. 1005, 4:32–36. Additionally, Pedrotti discloses that the handheld controller may be in the shape of an object that appears in the virtual world. *Id.* at 16:35–42.

2. Jang (Ex. 1006)

Jang is a U.S. patent for an "Apparatus and Method for Sound Processing in a Virtual Reality System." Ex. 1006, code (54). Jang describes the generation of sound in a virtual reality system, which "may use a localization technique capable of expressing the virtual location." *Id.*

at 1:42–43. Specifically, Jang uses a sound processing unit to generate a sound output from a "focus area" that is different from a sound output generated from an "unfocused area." *Id.* at 2:32–3:4. For example, as a control unit detects a space shift from a first space to a second space in the virtual reality space, the volume of sound from the first space may be gradually decreased as the volume of sound from the second space is gradually increased. *Id.*

3. Begault (Ex. 1007)

Begault is a book titled "3-D Sound for Virtual Reality and Multimedia." Ex. 1007, 1–2. Begault discloses "a sound subsystem in a virtual reality system" that includes a signal source, a signal processor, and active noise cancellation technology. *Id.* at 12–13. Begault discloses an example in which "[a]ll types of sonic input could be directionalized to a specific location, controlled by the user." Ex. 1007, 172. In this example, "the audio spatial mapping can correspond to a **prioritization** scheme." *Id.* (emphasis omitted). Begault further discloses that the user may hear different sound inputs from different spatial locations, such that "spatial location informs the listener as to the prioritization" of the sound. *Id.* at 172–173.

4. Rationale to combine Pedrotti, Jang, and Begault

Petitioner asserts that "Pedrotti discloses 'sight and sound' as the 'most commonly used' senses in virtual environments ([Ex. 1005], 1:14–20) but does not address sound processing." Pet. 9. Petitioner reasons that a person of ordinary skill in the art "would have been motivated to look to references, like Jang and Begault, which disclose advantageous sound

processing techniques providing 'a higher sense of realism' and enabling 'a rich auditory environment.'" *Id.* (citing Ex. 1006, 1:42–56, 2:9–11, 2:26–28; Ex. 1007, 10–11, 13). Petitioner reasons further that "[a]dding Jang and Begault's sound processing techniques would have amounted to no more than applying known techniques (e.g., binaural sound processing) to a known device (Pedrotti's HMD) ready for improvement to yield predictable results (spatialization of sound for an immersive VR experience)." *Id.* (citing Ex. 1003 ¶¶ 211–212, 219).

Petitioner also reasons that a person of ordinary skill in the art "would have understood that providing binaural sound would enhance the sense of 'presence' for users, making the VR experience more immersive" and that "binaural sound was known to enhance perception of space, distance, and size within virtual environments." Pet. 9. In addition, Petitioner asserts that "binaural sound, as disclosed by Jang and Begault, was a computationally efficient way of achieving these goals." *Id.* at 10 (citing Ex. 1007, 11; Ex. 1139; Ex. 1003 ¶¶ 220–223).

Noting that "Pedrotti and Jang are Sixense and Samsung patents, respectively," Petitioner reasons that a person of ordinary skill in the art "would have known that both companies were working on VR systems, including in concert and on complementary technologies" such that a person of ordinary skill in the art "would have reasonably expected to succeed in combining the teachings of these references, which disclose well-known hardware." Pet. 10 (citing Ex. 1003 ¶¶ 214–216; Ex. 1086; Ex. 1080).

5. Independent Claim 1

Petitioner asserts that the combined teachings of Pedrotti, Jang, and Begault disclose or suggest all of the limitations of claim 1. Pet. 9–24.

Patent Owner disagrees, contending that "Petitioner's proposed combination does not teach or render obvious limitations 1[c] and 1[d]." PO Resp. 5. For the reasons discussed below, we agree with Patent Owner.

a) Limitation 1[c]: highlighting, while the user is located in the zone and with a display of the WED, one of the multiple SLPs in the zone when the PED held in the hand of the user is pointed at the one of the multiple SLPs in the zone;

(1) Petitioner's Assertions

For limitation 1[c], Petitioner asserts that "Pedrotti's system is used by a user in a zone—Pedrotti's 'safe area' for gameplay (with boundary and virtual fence)" and that "Pedrotti's HMD displays virtual images to a user in the zone." Pet. 19 (citing *id.* at 5–7, 11–19; Ex. 1005, code (57), Fig. 8; Ex. 1003 ¶¶ 262–264). Regarding the recitation of "when the PED held in the hand of the user is pointed at the one of the multiple SLPs in the zone," Petitioner asserts that this requirement "would have been obvious over Pedrotti," as "Pedrotti's controllers (PEDs) manipulate and control virtual objects in VR" "[a]nd '[t]he Pointing Pattern is one of the most fundamental and often-used patterns for selection' in VR." *Id.* at 20 (citing Ex. 1005, 4:9–10, 5:25–46, 8:14–35; Ex. 1003 ¶¶ 265–266).

Regarding the requirement for "highlighting," Petitioner asserts that "Pedrotti explained that a virtual image, e.g., its fence, 'can be glowing or colored if desired to be more visible.'" Pet. 20 (citing Ex. 1005, 12:66–13:11). Based on this assertion, Petitioner reasons that a person of ordinary skill in the art "would have understood that Pedrotti's system could (or at a minimum obviously could) use 'highlighting'—i.e., 'visually outlining or changing the color of an object'—which was frequently used to facilitate user selection." *Id.* (citing Ex. 1003 ¶¶ 267–269). Petitioner reasons further

that a person of ordinary skill in the art "would have known that Pedrotti's controllers could and would be pointed at virtual objects to select or move them, and that selected objects would be highlighted to facilitate selection." *Id.* at 21 (citing Ex. 1003 ¶¶ 270–270).

In addition, Petitioner asserts that

> Pedrotti's system could and would highlight an SLP's image "when the PED . . . is pointed at" an SLP because the processor in Pedrotti's HMD tracks "the position and orientation of one or more trackers in the physical controllers," and it was common for controllers (PEDs) to convey target locations for VR interactions.

Pet. 21 (citing *id.* at 11–18; Ex. 1005, 4:37–44, 5:8–36; Ex. 1003 ¶¶ 84–100, 271).

(2) Patent Owner's Response

Patent Owner responds that "Petitioner fails to meet its burden to show the cited references disclose even highlighting a SLP much less highlighting a SLP in response to the user pointing at the SLP." PO Resp. 6. According to Patent Owner, "Pedrotti is completely silent on highlighting virtual items within the zone and Jang is likewise silent on using a handheld controller to select or emphasize images associated with the sounds from the focus area or the non-focus area." *Id.*

In support of these contentions, Patent Owner asserts that Petitioner's reliance on Pedrotti's teaching that "its virtual fence 'can be glowing or colored if desired to be more visible'" for the concept of highlighting is flawed because "Pedrotti's virtual fence is not a sound localization point" such that even if Pedrotti suggests highlighting, it does not teach highlighting one of the multiple SLPs as required by limitation 1[c]. PO Resp. 6. Patent Owner contends further that "even if combining Pedrotti

with Jang were a proper combination, . . . such combination does not disclose this limitation" because "Jang does not disclose anything regarding the selection or emphasis of images associated with the sounds from the focus area or the non-focus area." *Id.* Thus, Patent Owner asserts that "this combination does not teach or suggest highlighting of an SLP, let alone one of multiple SLPs in a zone while the user is in the zone." *Id.*

In addition, Patent Owner responds that "Petitioner has mischaracterized the manipulation and control of the 'virtual objects' described in Pedrotti, construing these objects as items that can be 'selected' and then bridging the selection to a statement not found in the references that the pointing pattern is often-used for selection." PO Resp. 8. According to Patent Owner, "none of the references teach or suggest pointing to virtual objects with a PED, let alone pointing to one SLP of multiple SLPs in the zone to highlight the particular SLP." *Id.*

In support of these contentions, Patent Owner asserts that "Pedrotti does not disclose pointing to its virtual objects, let alone for selection, and Jang does not disclose selection of one of its sound sources." PO Resp. 8. Thus, according to Patent Owner, "even if Pedrotti and Jang were a proper combination, . . . this hypothetical combination does not support Petitioner's position." *Id.* Specifically, Patent Owner contends that "Jang teaches that a control unit 114 determines the priority of the sound sources within the focus area based upon a 'predetermined scheme.'" *Id.* at 8–9 (citing Ex. 1006, 9:45–60). According to Patent Owner, "Jang does not suggest dynamic selection of audio sources for prioritized processing, but instead, at best moves a character's perspective to change a focus area." *Id.* at 9 (citing Ex. 1006, 10:33–36; 6:39–59). Thus, Patent Owner asserts that "Petitioner's

hypothetical of dynamically suggesting a pep band sound, or a conference attendee is a conclusory leap that is not taught or even suggested by the proposed combination." *Id.*

Finally, Patent Owner contends that "there is no disclosure in Pedrotti of highlighting only while the user is in the zone, let alone while the user is in the zone and the hand-held PED is pointing to the SLP." PO Resp. 9. According to Patent Owner, Pedrotti at most teaches the user using its system in a zone. *Id.*

(3) Petitioner's Reply

Petitioner replies that "Pedrotti discloses virtual images at boundaries, including a 'virtual fence' and 'other shapes,' that are highlighted—e.g., their 'brightness . . . may increase'—as a user approaches the boundary." Pet. Reply 5 (citing Ex. 1005, 12:66–13:11; Ex. 1003 ¶¶ 267–269). Petitioner replies further that "Petitioner[] and [Patent Owner] agree that an SLP is a '***location*** where a listener localizes sound' (Ex. 1126, 2; Ex. 1127, 3), and the '509 patent teaches that such a 'location' can be a 'point,' 'area,' or 'shape.'" *Id.* (citing Ex. 1001, 14:58–61, 28:19–22, Fig. 13, 37:19–31; Ex. 2012, 197:12–200:1). Thus, according to Petitioner, "Pedrotti's virtual fence is (or is obviously) an SLP—it has a set 'location' and 'shape' and accompanying sound ([Ex. 1005,] 15:56–58), which, in view of Jang and/or Begault, would have been binaural." *Id.* at 5–6 (citing Pet. 19–20, 22–24). Based on these assertions, Petitioner argues that "when Pedrotti's system (combined with Jang and/or Begault) increases the brightness of the fence, it highlights an SLP." *Id.* at 6 (citing Ex. 1003 ¶¶ 33–38).

In addition, Petitioner asserts that a person of ordinary skill in the art would have known that highlighting "happens (or obviously happens) when

the user's PED is pointed at the fence" and that "Pedrotti's fence is displayed when a controller is 'within a preselected distance of the boundary' and is highlighted when the user 'get[s] still closer,'" such that "[POSITAs] would have known that Pedrotti's system would highlight the fence when a user extends his/her controllers toward the boundary, pointing—or obviously pointing—at the fence's SLP(s)." Pet. Reply 6 (citing Ex. 1005, 12:51–13:11, 15:30–32; Ex. 1003 ¶¶ 226–267; Ex. 1173 ¶¶ 39–40).

> Petitioner asserts further that persons of ordinary skill in the art would have used Pedrotti's system to highlight other SLPs, such as Pedrotti's virtual "weapon[s]," "sporting implement[s]," and "other toy[s] or device[s]" ([Ex. 1005], 9:26–40, 16:33–42), Jang's "avatar[s], [] character[s], and [] objects," ([Ex. 1006], 6:44–47), or the "sound inputs" displayed with a Begault-type GUI ([Ex. 1007], 72, Fig.5, 12), including when Pedrotti's controllers are pointed at such objects.

Pet. Reply 6 (citing Pet. 20–22; Ex. 1003 ¶ 239).

(4) Patent Owner's Sur-reply

In reply, Patent Owner contends that "Pedrotti does not disclose either pointing to virtual objects with a PED or pointing to one SLP of multiple SLPs in the zone to highlight the particular SLP, as required by limitation 1c." PO Sur-reply 1. Specifically, Patent Owner argues that "Pedrotti's 'virtual objects' clearly address a method of representing the PED in the virtual space, *i.e.*, making the PED appear as a pistol in the virtual space as shown in Figures 1A and 1B of Pedrotti" and that "making the PED appear as a pistol in the virtual space is completely unrelated to using the PED to point to one of multiple SLPs in the zone to highlight a particular SLP." *Id.*

at 3.[7] In addition, Patent Owner contends that "Pedrotti's virtual objects, such as the 'virtual weapon' Petitioner relies on (*see* [Pet. Reply] 7), are virtual representations of the controller, ***not an SLP that the controller can point to***, as required by the claim language." *Id.* (citing PO Resp. 7–8).

Patent Owner responds further that "Pedrotti's virtual fence *defines* the zone itself and thus is not *in the zone*, much less be [sic] *multiple* SLPs in the zone, as required by the claim limitation." PO Sur-reply 4. According to Patent Owner, "[i]t is inapposite whether the zone itself is highlighted when the user is pointing at the virtual fence with a controller—the claim requires that 'one of the multiple SLPs ***in the zone***' be highlighted upon the user pointing at it." *Id.*

In addition, Patent Owner responds that "[e]ven accepting Petitioner's argument that the virtual fence is an SLP . . . Petitioner still has not satisfied its burden on this claim limitation" because "Petitioner argues the virtual fence is highlighted ***by proximity of the user*** within the virtual space, not pointing," which "does not disclose or render obvious limitation 1[c], which requires highlighting in response to pointing, not proximity." PO Sur-reply 4 (citing Pet. Reply 6).

Finally, Patent Owner responds that "[t]he additional prior art relied upon by Petitioner ([Pet. Reply] 8–10) are not in the grounds and cannot be considered. The law is clear that Petitioner cannot rely on additional prior art that was not a part of its original petition." PO Sur-reply 5 (citing *In re IPR Licensing, Inc.*, 942 F.3d 1363, 1369 (Fed. Cir. 2019)).

---

[7] Patent Owner cites Paper 35 in support of these arguments. PO Sur-reply 3. Paper 35, however, is the Order regarding oral argument. It appears that Patent Owner intended to cite its Response, Paper 21.

(5) Discussion

We agree with Patent Owner that Petitioner has not demonstrated by a preponderance of the evidence that the combined teachings of Pedrotti, Jang, and Begault disclose or suggest "*highlighting*, while the user is located in the zone and with a display of the WED, one of the multiple SLPs in the zone when the PED held in the hand of the user *is pointed* at one of the multiple SLPs in the zone" as required by claim 1. Even if we assume (without deciding) that Pedrotti's virtual fence is an SLP, we agree with Patent Owner that Pedrotti's virtual fence is "at the boundary" of its "safe area" (i.e., zone), not "in the zone" as required by limitation 1[c]. PO Sur-reply 4; Ex. 1005, 11:66–12:15. In other words, the virtual fence "*defines* the zone itself and thus is not *in the zone*" as the claim requires. PO Sur-reply 4. Petitioner has not addressed this difference between what is claimed and what is disclosed by Pedrotti or explained why the combined teachings of Pedrotti, Jang, and Begault would have rendered placement of the virtual fence "in the zone" obvious to one of ordinary skill in the art.

We further agree with Patent Owner that Petitioner has not adequately demonstrated that it would have been obvious for highlighting to occur in response to the user pointing a PED at the virtual fence (or any other virtual image). Rather, Petitioner repeatedly asserts that a person of ordinary skill in the art would have understood that Pedrotti's system *could* have used highlighting when the PED is pointed at one of the SLPs, without pointing to sufficient basis in Pedrotti's disclosure or explaining why one of ordinary skill in the art would have been motivated to implement highlighting in the manner claimed. Pet. 20–22. Dr. Welch similarly testifies, without sufficient support in Pedrotti, regarding what a person of ordinary skill in the

art "could" have done. *See, e.g.*, Ex. 1003 ¶¶ 268–272, 275–276. Such reasoning is inadequate to demonstrate obviousness because "obviousness concerns whether a skilled artisan not only could have made but would have been motivated to make the combinations or modifications of prior art to arrive at the claimed invention." *Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015) (emphasis omitted) (citing *InTouch Techs., Inc. v. VGO Commc'ns, Inc.*, 751 F.3d 1327, 1352 (Fed. Cir. 2014)).

To the extent Petitioner relies on a virtual object like virtual sword 802 in Figure 8 (rather than the virtual fence) as an SLP that can be pointed at, we also are not persuaded. *See* Pet. 19. Petitioner does not point to any disclosure in Pedrotti of highlighting the sword in response to the user pointing the controller at it, or even highlighting the sword at all. *See id.* Further, Figure 8 depicts virtual sword 802 as being held in user's virtual right hand 214 (which corresponds to the physical controller held in the user's actual hand). *See* Ex. 1005, 9:41–52, Fig. 8. It does not show the virtual hand pointing at the sword. Nor does it show "multiple" SLPs that may be pointed at.

Petitioner also makes a number of new arguments in its Reply that a person of ordinary skill in the art "would have used Pedrotti's system to highlight other SLPs, such as Pedrotti's virtual 'weapon[s],'" relying in part on "additional references." Reply 6–10. Petitioner, however, only briefly referenced virtual sword 802 in its Petition and did not advocate the same theories for limitation 1[c] in its Petition. *See* Pet. 13 (mentioning a "virtual weapon" in connection with limitation 1[a]), 19–20; Tr. 53:17–55:1. Accordingly, these arguments in the Reply are improper new arguments, which we do not consider. *See* 37 C.F.R. § 42.23(b) ("[a] reply may only

respond to arguments raised in the corresponding . . . patent owner response"); Patent Trial and Appeal Board Consolidated Trial Practice Guide at 74 (Nov. 2019) (available at https://www.uspto.gov/TrialPracticeGuideConsolidated) ("CTPG") ("'Respond,' in the context of 37 C.F.R. § 42.23(b), does not mean proceed in a new direction with a new approach as compared to the positions taken in a prior filing."); *Acceleration Bay, LLC v. Activision Blizzard Inc.*, 908 F.3d 765, 775 (Fed. Cir. 2018) (concluding that the Board did not err in refusing to consider portions of a reply declaration "rais[ing] a new obviousness argument for [a claim] limitation that could have been made in the petition" but was not); *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369–70 (Fed. Cir. 2016) (concluding that the Board did not err in refusing to consider reply brief arguments advocating a "new theory" of unpatentability under 37 C.F.R. § 42.23(b)).

b) Limitation 1[d]: playing, with the WED worn on the head of the user, the binaural sound that emanates from the one of the multiple SLPs in response to the one of the multiple SLPs being pointed at by the PED held in the hand of the user.

(1) Petitioner's Assertions

For limitation 1[d], Petitioner asserts that "Pedrotti's HMD plays sound" and that "Jang taught outputting sound 'to the user to represent the virtual environment,' and that its binaural sound processing mixes visual elements of a virtual environment, including 'characters, objects, or features,' with associated audio before sounds are output, to provide 'sound sources occurring in real time according to the[ir] relative locations.'" Pet. 23 (citing Ex. 1005, 15:56–58; Ex. 1006, 6:17–20, 6:36–42, 7:24–32; Ex. 1003 ¶¶ 282–286). Petitioner asserts further that "it was well known before

February 2016 that playing a sound (e.g., Jang's binaural sound) could, like highlighting, facilitate user selection." *Id.* (citing Ex. 1003 ¶ 288). Thus, according to Petitioner, a person of ordinary skill in the art "would have known that a Pedrotti-Jang or Pedrotti-Jang-Begault system could and would 'play[] binaural sound' from an SLP 'in response to' Pedrotti's controller (PED) pointing at the SLP." *Id.* at 23–24 (citing Ex. 1003 ¶¶ 287, 289; Ex. 1007, 159–160).

(2) Patent Owner's Response

Patent Owner responds that "the cited references do not disclose pointing to an SLP with a PED held in the hand of the user" and thus, "the references clearly do not disclose playing the binaural sound that emanates from the pointed to SLP, in response to such pointing." PO Resp. 10. Specifically, Patent Owner contends that "Pedrotti is silent regarding SLPs," "Jang, at best, teaches changing prioritization of sound processing of sound sources based upon user perspective changes," and "Begault simply provides a user interface that enables configuration of sound sources for subsequent received sound." *Id.* at 11 (citing Ex. 1006, 6:39–59; 7:3–7; 8:26–28; 9:46–47; Ex. 1007, 172). Thus, according to Patent Owner, "the cited combination does not render the current claim limitation obvious." *Id.*

(3) Petitioner's Reply

Petitioner replies that persons of ordinary skill in the art would have known that "when a user points a controller at virtual boundary images, SLPs are highlighted and play binaural sound." Pet. Reply 13. In support of its position, Petitioner asserts that "Pedrotti discloses that both a visual and an audio warning will be provided to the user approaching the fence, e.g., when (or at a minimum obviously when) the user's pointing hand and

controller extends to within the predetermined distance that triggers the fence and its sound" and that "the sound would obviously be binaural." *Id.* (citing Pet. 23–24; Ex. 1005, 15:56–58; Ex. 1003 ¶¶ 282–287; Pet. Reply 5–12; Ex. 1007, 171).

Further, Petitioner replies that persons of ordinary skill in the art "would have known that binaural sounds would, like highlighting, be used to facilitate interaction with, and selection of, other sound-producing virtual objects disclosed by Pedrotti, Jang, and Begault." Pet. Reply 13–14 (citing Pet. 22–24; Ex. 1003 ¶¶ 75–77, 239, 280–289, 539).

In addition, Petitioner replies that persons of ordinary skill in the art "would have known that binaural sound playback would be used for interface navigation, such as when a user points a controller at different virtual objects and their SLPs, e.g., to facilitate—not just after, or as a result of—selection." Pet. Reply 14 (citing Pet. 23–24; Ex. 1007, Fig. 5.12). According to Petitioner, "[s]uch playback could be sounds associated with the virtual objects, or it could be as simple (and obvious) as the binaural 'menu selection' sounds that Begault discloses, which [Patent Owner] ignores." *Id.* (citing Pet. 23–24; Ex. 1007, 159–160; Ex. 1003 ¶¶ 78–82).

(4) Patent Owner's Sur-reply

Patent Owner replies that "Petitioner's attempt to map the SLPs that are located ***inside the zone*** to Pedrotti's virtual fence, which defines the zone itself, fails" and that "[e]ven overlooking this, approaching the virtual fence is different from pointing at the virtual fence, which is what is required by the express language of this limitation, and Petitioner's attempt to equate the two fails." PO Sur-reply 7. Patent Owner replies further that "the binaural sound in limitation 1[d] must 'emanate' from the SLP being pointed at,

whereas Pedrotti's audio warning—even if binaural (which it is not)—does not emanate from the virtual fence, and Petitioner offered no evidence to the contrary." *Id.*

(5) Discussion

For reasons similar to those discussed in Section II.D.5.a.5 above, we agree with Patent Owner that Petitioner does not show that the combined teachings of Pedrotti, Jang, and Begault disclose or suggest limitation 1[d]. As with its assertions regarding limitation 1[c], Petitioner's assertions regarding limitation 1[d] merely aver that Pedrotti's system *could* have played binaural sound when an SLP is pointed at by the PED, without explaining why one of ordinary skill in the art would have been motivated to play binaural sound as claimed (i.e., "in response to the one of the multiple SLPs being pointed at by the PED"). Pet. 22–24. For these reasons, we determine that Petitioner does not show that the combined teachings of Pedrotti, Jang, and Begault would have rendered limitation 1[d] obvious to a skilled artisan at the time of the invention.

c) Conclusion For Claim 1

For the reasons discussed in the preceding sections, Petitioner does not demonstrate that the combined teachings of Pedrotti, Jang, and Begault would have rendered claim 1 obvious to one skilled in the art.

6. Dependent Claims 2–8

Claims 2–8 depend from claim 1. Ex. 1001, 41:8–55. Petitioner's challenge to these claims based on the combined teachings of Pedrotti, Jang, and Begault suffers from the same deficiencies as its challenge to claim 1. Accordingly, we determine that Petitioner fails to demonstrate by a preponderance of the evidence that the combined teachings of Pedrotti, Jang,

and Begault would have rendered claims 2–8 obvious to one of ordinary skill in the art.

7. Independent Claim 9

Petitioner asserts that the combined teachings of Pedrotti, Jang, and Begault disclose or suggest all of the limitations of claim 9. Pet. 36–40. Patent Owner disagrees, contending that "Petitioner's proposed combination does not teach or render obvious limitations 9[b] and 9[c]." PO Resp. 29. For the reasons discussed below, we agree with Petitioner.[8]

a) Limitations 9[b]: determining, with a wearable electronic device (WED) worn on a head of the user, when the user is located inside the zone; and 9[c]: determining, with the WED worn on the head of the user, when the user is leaving the zone;

(1) Petitioner's Assertions

For limitation 9[b], Petitioner refers to its assertions regarding limitation 1[b]. Pet. 37. Regarding limitation 1[b], Petitioner asserts that "[u]sers of Pedrotti's system wear HMDs (WEDs worn on heads), and hold controllers." *Id.* at 18 (citing Ex. 1005, 2:44–47). Petitioner asserts further that "Pedrotti's processor, which may be 'in the HMD' ([Ex. 1005,] 16:20–24), tracks the HMD and controllers so it 'knows where the user's head'—i.e., the user—'and hands are located.'" *Id.* (citing Ex. 1005, 2:49–57; 4:32–44, 12:31–47, 15:7–12). According to Petitioner, Pedrotti's "HMD then makes determinations of when a user is located inside Pedrotti's zone to help

[8] Patent Owner does not contest Petitioner's assertions with respect to the other limitations of claim 9. Although we do not reproduce Petitioner's assertions challenging the other limitations, we have reviewed these assertions, as well as the evidence and testimony in support thereof, and find them persuasive. Pet. 36–38.

the user remain in the zone during gameplay." *Id.* at 18–19 (citing *id.* at 5–7, 11–18; Ex. 1003 ¶¶ 251–261).

For limitation 9[c], Petitioner refers to its assertions for limitations 2[a] and 3[a]. Pet. 37 (citing *id.* at 24–26, 28). For limitation 2[a], Petitioner asserts that Pedrotti "taught that trackers in controllers, e.g., 'light-emitting trackers,' 'provide position and orientation information' to sensors, e.g., 'a camera mounted on [a] base station or elsewhere.'" *Id.* at 24 (citing Ex. 1005, 5:8–24). Based on this assertion, Petitioner reasons that a person of ordinary skill in the art "would have known and been motivated to use Pedrotti's HMD with sensors, e.g., cameras, to track the trackers in Pedrotti's controllers, e.g., light-emitting controller trackers." *Id.* (citing Ex. 1003 ¶¶ 292–294).

Petitioner asserts further that

> the processor in Pedrotti's HMD "determine[s] from the position of [a] handheld controller that the handheld controller is within a first preselected distance from [a] boundary" and "generates instructions to the HMD to include in a display of a virtual world a visual warning such as a grid or virtual fence" when the user "comes within a preselected distance of the boundary" or goes "beyond the boundary," e.g., to provide "a warning that the user is about to move out of the selected area."

Pet. 25 (citing Ex. 1005, 2:44–59, 3:54–58, 4:37–44, 12:35–13:11, 13:46–14:5, 13:63–67, 15:4–39, Figs. 11, 15). Petitioner also asserts that "Pedrotti taught that 'the preselected distance' triggering its warning 'may vary by application' and users' expected body movements" and that "Pedrotti taught that if the user 'goes beyond the boundary,' i.e., moves outside a zone, 'the processor can cause the HMD to fade to black, and present, for example, only a warning message and/or a beacon or arrows directing the user to move in the direction of the boundary and the selected area." *Id.* (citing Ex.

1005, 13:46–62, 13:67–14:5). Thus, according to Petitioner, "Pedrotti disclosed or at a minimum rendered obvious tracking a PED (a Pedrotti controller) with one or more sensors in a WED worn on a user's head (e.g., a camera on Pedrotti's HMD) to determine when the PED moves outside the zone (when Pedrotti's controller leaves the 'safe area' zone's boundary)." *Id.* at 25–26 (citing Ex. 1003 ¶¶ 298–301).

For limitation 3[a], Petitioner asserts that

> Pedrotti's HMD (WED), with its processor, tracks "trackers in the physical controllers" (PEDs) and "the positions and orientation of [a] HMD tracker," i.e., the user wearing the HMD, so it "knows where the user's head and hands are located" and can trigger display of a virtual fence, including when (or obviously when) the user moves outside the zone.

Pet. 28 (citing *id.* at 18–19, 24–28; Ex. 1005, 12:35–36; Ex. 1003 ¶¶ 310–314).

(2) Patent Owner's Response

Patent Owner responds "that express language of the limitations requires that the determination of whether the user is inside the zone or not be made exclusively with the WED." PO Resp. 29–30. According to Patent Owner, "this requires that the processor responsible for making the determination is located in the WED." *Id.* at 30. Patent Owner contends that "Petitioner's argument indicates that Petitioner interpret[s] these limitation[s] as requiring that the determining processor be located in the WED," such that "[t]he conundrum for Petitioner lies in the fact[] that in Pedrotti the processor responsible for performing the determination is not (nor can it be) located in the WED." *Id.* Patent Owner contends further that Petitioner's "argument at best shows that Pedrotti's HMD contains a processor to determine whether the controller is inside the zone or leaving

the zone. Pedrotti cannot determine the location of the user—but only the controllers in the user's hands." *Id.* at 30–31.

Acknowledging Pedrotti's disclosure that "'a processor may be located in the base station, or in a separate location, or even in the HMD or one of the controllers if desired,'" Patent Owner contends that "nowhere does Pedrotti state that this processor performs the act of determining whether the PED is inside the zone or not." PO Resp. 31. In addition, Patent Owner contends that "[t]he primary purpose of Pedrotti is to track both the HMD and the controller, and this function is performed by a base station or other apparatus that emits an electromagnetic field sensed by the HMD to derive its position relative to the base station." *Id.* (citing Ex. 1005, 4:49–58). According to Patent Owner, "Pedrotti provides no teaching whatsoever or even a suggestion as to how the HMD could track itself or the user without the use of a separate base station, video game console, or other apparatus." *Id.* at 31–32.

(3) Petitioner's Reply

Petitioner replies that Patent Owner "admits limitations 9[b] and 9[c] do ***not*** preclude use of a base station," but "nevertheless argues that, regardless of the presence of a base station, the Ground 1 art does not suggest a WED that 'exclusively' performs recited determinations." Pet. Reply 3 (citing PO Resp. 29–30). Petitioner replies further that "even if limitations 9[b] and 9[c] require determinations 'be made ***exclusively*** with the WED' . . . the Petition demonstrated that Pedrotti teaches that, or at the very least renders it obvious." *Id.*

According to Petitioner, "Pedrotti's system comprises a processor that tracks the HMD and controllers and determines when the user is leaving the

zone, which may be 'in the HMD'—i.e., in the WED." Pet. Reply 3 (citing Pet. 18–19). Petitioner asserts that "Pedrotti teaches determining the locations of both (i) controllers ***and*** (ii) the HMD worn on the user's head—i.e., the user," and that even Patent Owner's "pre-institution expert," John C. Hart, Ph.D., "conceded that Pedrotti discloses using trackers, on the HMD and controllers, '[t]o determine ***the user's*** position within the "safe zone."'" *Id.* at 4 (citing Pet. 18–19, 28, 37; Ex. 1003 ¶¶ 293–301, 311–313; Ex. 2001 ¶ 27).

Petitioner asserts further that "Pedrotti's base station can be 'only a cradle or dock' with 'the processor . . . located elsewhere,' e.g., 'in the HMD.'" Pet. Reply 4–5 (citing Ex. 1005, 5:64–6:1; 16:20–24; Ex. 2012, 240:22–242:7; Ex. 1003 ¶¶ 24–25). According to Petitioner, a person of ordinary skill "would have known this processor 'determine[s] whether the user leaves the zone,' contrary to what [Patent Owner] argues," as "[t]hat is how Pedrotti's 'safe area' method works." *Id.* at 5 (citing Pet. 5–6, 18–19, 28, 37–38; Ex. 1003 ¶¶ 254–259, 297–301, 312–313, 367–368).

(4) Patent Owner's Sur-reply

Patent Owner replies that Petitioner never shows that the processor in the HMD "is used for determining the user's location as required by the claim language." PO Sur-reply 11. Patent Owner responds further that "Petitioner's reliance on the Hart declaration (Reply at 4), submitted with Patent Owner's Preliminary Response . . . is contrary to the Consolidated Trial Practice Guide. Because Dr. Hart's declaration has been withdrawn by Patent Owner, neither the declaration nor any arguments based on the declaration should be considered by the Board." *Id.* at 12 (citing CTPG 51). According to Patent Owner, "Petitioner confuses a tracker with a processor

and ignores the basic fact that a tracker cannot determine anything. And, that is the point: Pedrotti's system does not use the HMD to determine the position of the user." *Id.* at 13. In addition, Patent Owner argues that "Petitioner's argument that tracking capabilities are commonly contained in HMDs is inapposite" because "[c]laim 9 requires tracking of the ***user*** wearing the WED, not the controllers." *Id.*

(5) Discussion

We agree with Petitioner that the combined teachings of Pedrotti, Jang, and Begault suggest limitation 9[b]. Leaving aside the issue of whether or not claim 9 requires a processor in the WED, Patent Owner's argument that "in Pedrotti the processor responsible for performing the determination [of whether or not the user is in the zone or is leaving the zone] is not (nor can it be) located in the WED" is unconvincing because Pedrotti discloses a HMD with a tracker and a processor that "tracks the position and orientation of the HMD tracker" as well as trackers in the handheld controls which are also tracked by the processor. PO Resp. 30; Ex. 1005, 4:4–8, 4:37–39. Pedrotti states that

> There may be a single processor, or multiple processors performing different functions of the functions described herein. As above, a processor may be located in the base or in a separate location, or *even in the HMD* or one of the controllers if desired. One of skill in the art will appreciate how to determine which and how many processors will be appropriate for a specific intended application.

Ex. 1005, 16:20–26. These disclosures explicitly suggest a processor in the HMD that tracks the position of the HMD and the controllers. Further, we credit Dr. Welch's testimony, consistent with these disclosures, that Pedrotti's "WED 'knows where the user's head,' and thus the user him or herself, 'and hands are located'" and that "because Pedrotti teaches that the

processor tracking movement of the handheld controller may be 'in the HMD,' Pedrotti teaches an HMD tracking the user's location, as the user holds the handheld controller."[9] Ex. 1003 ¶ 252 (citing Ex. 1005, 2:49–57, 4:32–44, 12:31–41, 15:7–12, 16:22–24). Thus, even assuming that claim 9 requires a processor in the WED that tracks the user location, Pedrotti suggests such a processor.

Further, Patent Owner's argument that "Pedrotti provides no teaching whatsoever or even a suggestion as to how the HMD could track itself or the user without the use of a separate base station, video game console, or other apparatus" is unavailing, because it is not responsive to all of Petitioner's reasoning. PO Resp. 31–32. As discussed above, Petitioner's reasoning is based on Dr. Welch's testimony that the processor in the HMD tracks the trackers in the handheld controllers, thus determining the position of the user from the position of the controllers. Neither limitation 9[b] nor any other part of claim 9 requires the WED to track itself.

In its Response, Patent Owner argues limitations 9[b] and 9[c] together. PO Resp. 29–32. Patent Owner's arguments as they pertain to limitation 9[c] are unconvincing for the reasons discussed in the preceding section.

Finally, we agree with Patent Owner that "[b]ecause Dr. Hart's declaration has been withdrawn by Patent Owner, neither the declaration nor any arguments based on the declaration should be considered by the Board." PO Sur-reply 12; *see* PO Resp. 2 (withdrawing the declaration filed as Ex.

[9] We quote Dr. Welch's testimony regarding limitation 1[b] as Dr. Welch refers to this testimony in his discussion of similar limitation 9[b]. Ex. 1003 ¶ 366.

2001); CTPG 51 ("If a patent owner withdraws a declaration submitted with its preliminary response, that declarant will usually not be subject to deposition on the withdrawn declaration. If, on the other hand, the patent owner does not withdraw a declaration submitted with its preliminary response, that declaration may be relied upon during the trial, and the declarant would usually be subject to discovery and deposition in the ordinary course of the trial."). We accordingly do not consider Dr. Hart's declaration, which has been withdrawn by Patent Owner, in making our determination that the combined teachings of Pedrotti, Jang, and Begault suggest limitations 9[b] and 9[c].

b) Conclusion For Claim 9

For the reasons discussed in the preceding sections, Petitioner demonstrates that the combined teachings of Pedrotti, Jang, and Begault would have rendered claim 9 obvious to one skilled in the art.

8. Claims 10 and 11

a) Claim 10

Claim 10 is similar to limitation 1[d] in that it requires "playing the binaural sound that originates from the one of the SLPs in the zone in response to the WED determining that the PED is pointed at the one of the SLPs." Ex. 1001, 42:11–13. Patent Owner contends that "the proposed combination does not disclose playing the binaural sound that emanates from the pointed to SLP, in response to such pointing," for the same reasons it does not disclose limitation 1[d]. PO Resp. 32. We agree with Patent Owner for the reasons discussed in Section II.D.5.b above.

b) Claim 11

Claim 11 is similar to limitation 1[c] in that it requires highlighting when the PED is pointed at one of the SLPs. Ex. 1001, 42:16–20. Patent Owner contends that "the proposed combination does not disclose this limitation" for the same reasons as with limitation 1[c]. PO Resp. 32–33. We agree with Patent Owner for the reasons discussed in Section II.D.5.a above.

c) Conclusion for Claims 10 and 11

For the reasons discussed in the preceding sections, Petitioner does not demonstrate that the combined teachings of Pedrotti, Jang, and Begault would have rendered claims 10 and 11 obvious to one skilled in the art.

9. Claims 12–14

Patent Owner does not separately address claims 12–14. PO Resp. 32. We have reviewed Petitioner's arguments and evidence, as well as Dr. Welch's testimony in support thereof, and determine that Petitioner demonstrates that the combined teachings of Pedrotti, Jang, and Begault would have rendered claims 12–14 obvious to one skilled in the art. *See* Pet. 40 (citing *id.* at 34–36; Ex. 1003 ¶¶ 348–360, 382–384).

10. Independent Claim 17

Petitioner asserts that the combined teachings of Pedrotti, Jang, and Begault disclose or suggest all of the limitations of claim 17. Pet. 40–43. Patent Owner disagrees, contending that Petitioner's proposed combination does not teach or render obvious limitation 17[e]. PO Resp. 11–13. Limitation 17[e] requires a WED that "includes one or more sensors that sense when the PED leaves the zone." Ex. 1001, 42:63–64. For the reasons discussed below, we agree with Patent Owner.

a) Petitioner's Assertions

Petitioner asserts that persons of skill in the art "would have considered equally obvious sensing that a PED 'moves outside the zone' (2[a]) and sensing that a PED 'leaves the zone' (17[e])." Pet. 42.

b) Patent Owner's Response

Patent Owner responds that "Petitioner uses its analysis of limitation 2[a] as a shorthand for another limitation that uses different language and pertain[s] to a different claim, without any further explanation," and that "[t]his approach is insufficient to meet Petitioner's burden." PO Resp. 11–12. Patent Owner asserts further that limitation 17[e] is narrower that limitation 2[a] in that "[i]t requires that the WED 'includes one or more sensors that sense when the PED leaves the zone'" and that "Petitioner and Dr. Welch fail to offer any analysis regarding the meaning and scope of" limitation 17[e]. *Id.* at 13.

c) Petitioner's Reply

In reply, Petitioner reiterates its position that "[f]or the same reasons limitation 2[a] would have been obvious over the Ground 1 art, limitation 17[e] would have been obvious." Pet. Reply 19 (citing *id.* at 14–19; Pet. 42; Ex. 1003 ¶ 392).

d) Patent Owner's Sur-reply

Patent Owner replies that "Pedrotti does not disclose sensing 'when the PED leaves the zone.'" PO Sur-reply 14.

e) Discussion

We agree with Patent Owner that Petitioner has not adequately explained how Pedrotti teaches or suggests limitation 17[e], and thus has not shown sufficiently that the combined teachings of Pedrotti, Jang, and

Begault would have rendered claim 17 obvious to one of skill in the art. Petitioner's reference to a different limitation of a different claim without further explanation does not satisfy Petitioner's burden with respect to limitation 17[e].

f) Conclusion for Claim 17

For the reasons discussed in the preceding sections, Petitioner does not demonstrate that the combined teachings of Pedrotti, Jang, and Begault would have rendered claim 17 obvious to one skilled in the art.

11. Dependent Claims 18–20

Claims 18–20 depend from claim 17. Ex. 1001, 43:3–16. Petitioner's challenge to these claims based on the combined teachings of Pedrotti, Jang, and Begault suffers from the same deficiencies as its challenge to claim 17. Accordingly, we determine that Petitioner fails to demonstrate by a preponderance of the evidence that the combined teachings of Pedrotti, Jang, and Begault would have rendered claims 18–20 obvious to one of ordinary skill in the art.

12. Conclusion For Ground One

Based on our review of the entire record of this proceeding, we determine that Petitioner has shown, by a preponderance of the evidence, that claims 9 and 12–14 are unpatentable over the combined teachings of Pedrotti, Jang, and Begault. We further determine that Petitioner has not shown, by a preponderance of the evidence, that claims 1–8, 10, 11, and 17–20 are unpatentable over the combined teachings of Pedrotti, Jang, and Begault.

E. Ground Two: Alleged Obviousness of Claims 1–14 and 17–20 in View of the Combined Teachings of McCulloch, Pedrotti, and Flaks

1. McCulloch (Ex. 1008)

McCulloch is a U.S. Patent for "Controlling a Virtual Object with a Real Controller Device" and relates to the use of a real controller device that controls an object displayed by a near-eye, augmented reality display. Ex. 1008, code (54), 1:19–20. Figure 8B, reproduced below, is a perspective view of a user controlling a virtual object with a real controller device.

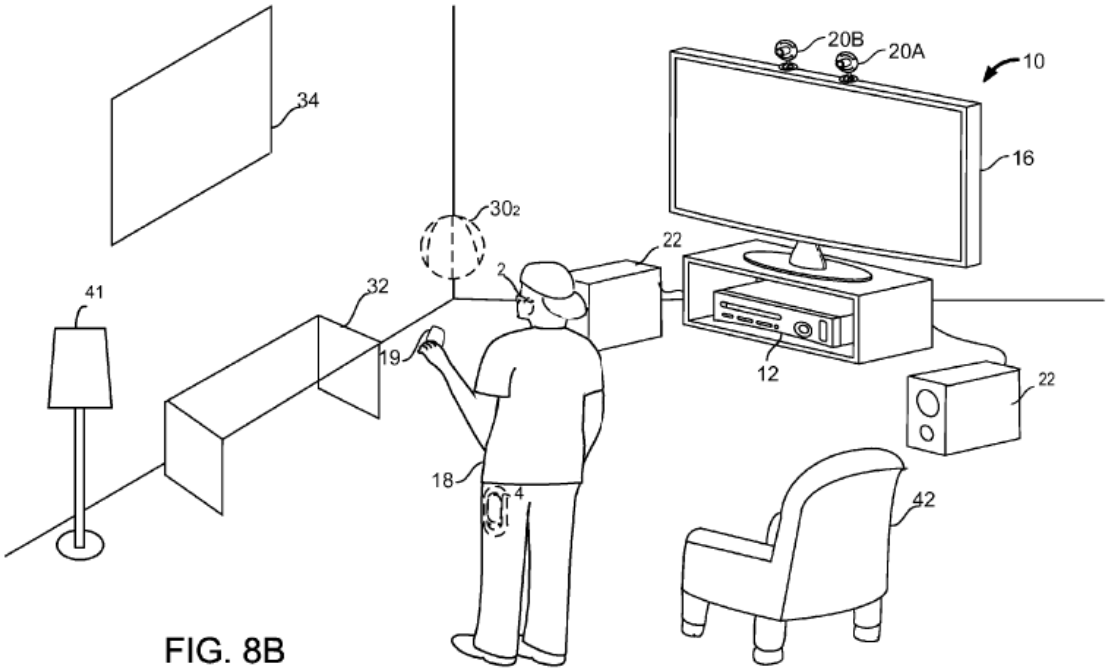

FIG. 8B

Figure 8B shows user 18 in his living room which includes lamp 41, table 32, wall hanging 34, basketball 30, chair 42 and home entertainment system 10 including 3D image capture devices 20A and 20B, television 16, speakers 22, and game console 12. Ex. 1008, 28:55–60. User 18 wears head mounted display device 2, has companion processing module 4 in his pocket, and holds real controller device 19 in his left hand. *Id.* at 28:63–66, Fig. 8B.

As further shown in Figure 8B, virtual object 30_2 is controlled with real controller device 19. Ex. 1008, 29:4–6. "The changes in position and orientation of the handheld controller causes its inertial motion unit to generate one or more signals which are converted by the handheld IMU real controller device 19 to be user input requesting display of an action by the virtual object 30_2." *Id.* at 29:6–10.

2. Flaks (Ex. 1009)

Flaks is a U.S. Patent for a "System and Method for High-Precision 3-Dimensional Audio for Augmented Reality." Ex. 1009, code (54). Flaks collects data from sensors, including a listener's location within a room and the room's characteristics, in order to generate a three-dimensional ("3D") audio signal. *Id.* at code (57). Flaks further discloses that "[i]n some embodiments, sensor data may be used to collect physical characteristics of the listener such that a suitable HRTF may be determined from a library of HRTFs." *Id.*

3. Rationale to combine McCulloch, Pedrotti, and Flaks

Petitioner asserts that "McCulloch incorporates, and thus includes as part of its own disclosures, Flaks's '3D audio engine.'" Pet. 46 (citing Ex. 1008, 21:21–38). Based on this assertion, Petitioner reasons that a person of ordinary skill in the art "would have known to combine McCulloch's system with Flaks' 3D audio engine because McCulloch says to do so, and to enhance the VR immersive experience using 3D audio." *Id.* at 46–47 (citing *id.* at 45–46; Ex. 1003 ¶¶ 418–419). Petitioner reasons further that a person of ordinary skill in the art "would have been motivated to combine McCulloch's system (including Flaks's 3D audio engine) with Pedrotti's method for assisting a user in remaining within a selected area" because

"McCulloch taught 'identifying boundaries for a playspace.'" *Id.* at 47 (citing Ex. 1008, 20:11–13). In addition, Petitioner asserts that a person of ordinary skill in the art "would have recognized that Pedrotti describes an advantageous method for defining boundaries for virtual environments, including to protect users." *Id.* (citing *id.* at 5–7).

In addition, Petitioner opines that "[i]n AR and VR environments, immersivity is key, and users risk personal injury and property damage due to collisions and tripping hazards" and that "Pedrotti's methods help users stay within boundaries and avoid such collisions, without disrupting immersive experiences." Pet. 47 (citing *id.* at 5–7; Ex. 1003 ¶¶ 409–415; Ex. 1005, 11:66–12:3; Ex. 1008, 26:35–48, 20:28–29, 23:39-51). Petitioner also asserts that McCulloch, Flaks, and Pedrotti are analogous to each other in that they are all "directed to systems and methods for providing immersive, interactive virtual experiences and use motion-tracked HMDs and controllers." *Id.* at 48 (citing *id.* at 5–7, 45–46; Ex. 1003 ¶¶ 407–408).

In conclusion, Petitioner reasons that a person of ordinary skill in the art "combining the teachings of McCulloch (including with Flaks) with Pedrotti's methods would have had a reasonable expectation of success" as "[t]hese references disclosed hardware that was well known before June 2016, such as HMDs, controllers, and processors, and common methods of using such hardware, e.g., to set boundaries and process sound with HRTFs." *Id.* (citing *id.* at 5–7, 45–46). Petitioner reasons further that "combining the teachings of McCulloch, Flaks, and Pedrotti to implement Pedrotti's 'safe area' system would have been obvious to try and well within common sense, and would have been routine, requiring no more than

combining known elements with known functions, to improve similar devices in known ways." *Id.* (citing Ex. 1003 ¶¶ 416–417).

4. Independent Claim 1

Petitioner asserts that the combined teachings of McCulloch, Pedrotti, and Flaks disclose or suggest all of the limitations of claim 1. Pet. 49–57. Patent Owner disagrees, contending that "Petitioner's proposed combination does not teach or render obvious limitations 1[c] and 1[d]." PO Resp. 33. For the reasons discussed below, we agree with Petitioner.[10]

a) Limitation 1[c]: highlighting, while the user is located in the zone and with a display of the WED, one of the multiple SLPs in the zone when the PED held in the hand of the user is pointed at the one of the multiple SLPs in the zone;

(1) Petitioner's Assertions

Petitioner asserts that "McCulloch (including with Flaks) and Pedrotti render obvious limitation 1[c]'s (i) user in a zone with a WED that displays images and (ii) highlighting an SLP when a handheld PED is pointed at it." Pet. 53. Specifically, Petitioner asserts that "limitation 1[c]'s 'pointed' PED would have been obvious over McCulloch" because "McCulloch, like Pedrotti, taught that its handheld controllers are used to manipulate and control virtual objects." *Id.* at 54. According to Petitioner, McCulloch discloses "multiple examples of controllers for controlling virtual objects, including 'a joystick,' 'a pointing device,' and [a] 'handheld inertial motion

[10] Patent Owner does not contest Petitioner's assertions with respect to the other limitations of claim 1. Although we do not reproduce Petitioner's assertions challenging the other limitations, we have reviewed these assertions, as well as the evidence and testimony in support thereof. Pet. 49–53.

unit (IMU)' . . . which obviously could be pointed." *Id.* (citing *id.* at 19–22; Ex. 1008, code (54), 4:25–33, 6:55–66; 33:14–23; Ex. 1003 ¶¶ 460–463).

Petitioner asserts further that "[l]imitation 1[c]'s 'highlighting' also would have been obvious over McCulloch" because "McCulloch's system uses a 'visual effects library' comprising 'routines for animations, ***highlighting***, and other types of visual enhancements which may also be associated with particular actions.'" Pet. 54–55 (citing Ex. 1008, 23:4–7). Petitioner reasons that a person of ordinary skill in the art "would have known and understood that McCulloch's handheld controllers (PEDs) could and would point at virtual objects (e.g., a 'virtual basketball' or a 'virtual remote control helicopter') to select them, e.g., to move them, and that selected virtual objects could and would be highlighted to facilitate user selection" because "[t]hese were well-known techniques." *Id.* at 55 (citing Ex. 1008, 12:51–52, 29:45; Ex. 1003 ¶¶ 269–275, 467–468). Petitioner also asserts that "McCulloch's system could and would highlight an SLP's image 'when the PED . . . is pointed at' the SLP because McCulloch's HMD tracks its own position and uses image and depth data to track objects, e.g., controllers, in front of the user." *Id.* (citing *id.* at 49–53; Ex. 1008, 7:34–59, 8:17–30, 12:18–21, 22:4–8, 28:5–11; Ex. 1003 ¶ 469).

(2) Patent Owner's Response

Patent Owner responds that McCulloch does not discuss pointing a PED at an SLP or highlighting an SLP as claimed. PO Resp. 33.

(3) Petitioner's Reply

Petitioner replies that "McCulloch renders obvious the claimed highlighting and binaural sound playback." Pet. Reply 21 (citing Pet. 54–56). Petitioner reasons that persons of skill in the art "would have known

that with a McCulloch system, a user would point a controller at an SLP, e.g., a sound-producing virtual image." *Id.* As an example, Petitioner asserts that "McCulloch depicts and describes a virtual basketball that is controlled by a user, including when the user points his controller at the basketball, as shown in Figure 8B, and when the user points the controller at a virtual television into which the basketball collides, as shown in Figure 8D." *Id.* (citing Ex. 1008, Figs. 8A–8D, 28:51–29:63; Ex. 1003 ¶¶ 460–463). Based on this example, Petitioner reasons that persons of skill in the art "would have known that virtual images at which the user points (e.g., the basketball, the television, a helicopter), could and would be highlighted" because "McCulloch discloses a 'visual effects library' that stores 'routines for . . . highlighting' for 'actions, pre-collision events and collision events.'" *Id.* at 21–22 (citing Pet. 55–56; Ex. 1008, 23:4–7; Ex. 1003 ¶¶ 464–468).

In addition, Petitioner reasons that persons of skill in the art "would have known that a user's pointing would trigger binaural sound playback." Pet. Reply 22 (citing Pet. 56–57). As an example, Petitioner asserts that "as Figure 8D shows, a virtual basketball collides with a virtual television as a result of a user pointing a controller at the television" and "[w]hen that happens, the user's pointing will (or at a minimum obviously will) result in binaural sound—the collision sound—playing from the location (the SLP) pointed at." *Id.* (citing Ex. 1008, 21:34–38, 22:66–23:7, Fig. 8D; Ex. 1003 ¶¶ 470–471; Ex. 1173 ¶¶ 117–122).

(4) Patent Owner's Sur-reply

Patent Owner replies that "[n]one of the prior art references cited in . . . Ground 2 teach or suggest pointing to virtual objects with a PED, let alone pointing to one SLP of multiple SLPs in the zone to highlight that

particular SLP, as required by limitation 1[c]." PO Sur-reply 2–3. According to Patent Owner, "Petitioner cites to no disclosure of McCulloch, Flaks, or Pedrotti that discloses 'highlighting . . . one of the multiple SLPs in the zone when the PED held in the hand of the user is pointed at one of the multiple SLPs in the zone.'" *Id.* at 5–6.

According to Patent Owner, "Petitioner's Ground 2 position regarding McCulloch relies entirely on McCulloch's *controllers* which are the objects with which the user is pointing, not the things pointed at, and thus do not 'highlight[] . . . one of the multiple SLPs when the PED held in the hand of the user is pointed at one of the multiple SLPs.'" PO Resp. 6. Patent Owner contends further that "with respect to the requirement that the PED is pointed a[t] 'one of multiple SLPs,' Petitioner argues that all of the 'virtual objects' of McCulloch are SLPs, relying solely on its expert Dr. Welch to fill the gaps in the prior art." *Id.* (citing Pet, 56). This, according to Patent Owner, "is improper — expert testimony cannot 'fill the gaps' of the prior art." *Id.* (citing *Arendi S.A.R.L. v. Apple Inc.*, 832 F.3d 1355, 1366 (Fed. Cir. 2016)).

(5) Discussion

As an initial matter, we note that we do not reproduce Petitioner's assertions regarding the VR Book (Ex. 1063) or rely on them in making our determination regarding limitation 1[c]. As Petitioner pointed out, it does not rely "on the VR Book 'to cure . . . deficiencies.'" Pet. Reply 22.

We agree with Petitioner that McCulloch suggests limitation 1[c]. McCulloch teaches that "a visual effects library may store routines for animations, *highlighting*, and other types of visual enhancements which may also be associated with particular *actions, pre-collision events and collision*

effects." Ex. 1008, 23:4–7 (emphasis added). Figures 8B–8D, relied upon by Petitioner, clearly show a PED (real controller device 19) held in the user's hand that is pointed at a virtual object (i.e., a virtual basketball) while the user is located in a zone. *Id.* at 29:4–63, Figs. 8B, 8D; *see* Pet. 45–46, 50, 54, 56. Figure 8B depicts real controller device 19 pointing at virtual object 30_2. McCulloch discloses that "[t]he changes in position and orientation of the handheld controller" cause it to generate signals corresponding to "user input requesting display of an action by the virtual object 30_2 representing the real basketball based on the user perspective." Ex. 1008, 29:6–11. Then, after the user makes an "Impact on TV" command (depicted in Figure 8C), Figure 8D depicts real controller device 19 pointing at virtual object 30_3, displayed to the user as impacting television 16. McCulloch describes this as the "simulated effect" on the physical state of the television from a "collision" with the virtual basketball. *Id.* at 29:36–40. "Inertial motion sensors (not shown) in the handheld real controller device 19 identify parameters like speed, acceleration and direction of motion of the device 19," "physics engine 308 models the collision," and "virtual data engine 195 displays a collision effect" where the display of television 16 cracks and breaks. *Id.* at 29:40–55.

Given these disclosures, we credit Dr. Welch's testimony and conclude that McCulloch suggests limitation 1[c]. *See* Ex. 1003 ¶¶ 459, 461, 462, 464, 466–469. As Dr. Welch correctly points out, McCulloch disclose highlighting associated with actions and collision effects, and depicts in Figures 8B–8D a user "pointing the handheld IMU real controller device at the virtual basketball, which is a virtual object associated with an SLP," and "select[ing] and mov[ing] the virtual object and its associated

SLP." *Id.* ¶¶ 461, 464, 467–468. For example, the highlighted SLP would be the location of the virtual basketball itself in Figure 8B and the location of the virtual basketball impacting the television screen in Figure 8D. Pet. 56 (citing Figure 8D and arguing that "the selected and highlighted sound source could be moved from its location (SLP) to a different location in the virtual environment (a different SLP)").

Accordingly, we agree with Petitioner that a person of ordinary skill in the art considering McCulloch's teachings about highlighting associated with actions and collision effects, together with its disclosure of pointing at a virtual basketball and causing a virtual collision between the virtual basketball and a television, would have understood McCulloch to suggest the use of highlighting as required by limitation 1[c].

b) Limitation 1[d]: playing, with the WED worn on the head of the user, the binaural sound that emanates from the one of the multiple SLPs in response to the one of the multiple SLPs being pointed at by the PED held in the hand of the user.

(1) Petitioner's Assertions

Petitioner asserts that "McCulloch's HMD plays binaural sounds from SLPs, through its earphones." Pet. 56–57 (citing *id.* at 49–52; Ex. 1008, 8:17–18, 21:21–29; Fig. 2A). Petitioner asserts further that "it was well known that playing sounds, such as McCulloch's binaural sounds, could, like highlighting, facilitate user selection." *Id.* at 57 (citing Ex. 1003 ¶¶ 470–471).

(2) Patent Owner's Response

Patent Owner responds that "Pedrotti does not teach or suggest 'playing, with the WED worn on the head of the user, the binaural sound that emanates from the one of the multiple SLPs in response to the one of the

multiple SLPs being pointed at by the PED held in the hand of the user,' as described in limitation 1[d]" and that "McCulloch does not teach or suggest this feature." PO Resp. 34. Patent Owner responds further that "[t]here is no teaching or suggestion in Pedrotti or McCulloch of such trigger in playing an SLP's binaural sound." *Id.*

(3) Petitioner's Reply

Petitioner replies that it is "not relying on 'playing [sound] based upon selection.'" Pet. Reply 22 (citing PO Resp. 34). Petitioner replies further that "the collision sound . . . plays in response to pointing, not selection." *Id.*

(4) Patent Owner's Sur-reply

Patent Owner does not discuss limitation 1[d] as challenged in Ground Two in its Sur-reply. *See generally* PO Sur-reply.

(5) Discussion

For this limitation, as with limitation 1[c] discussed above, we do not reproduce Petitioner's assertions regarding the VR Book or rely on them in making our determination.

We agree with Petitioner that McCulloch suggests limitation 1[d]. McCulloch teaches a "sound library 312 [that] besides being a resource for command and object recognition based on sound, may also store audio data for sound effects to be played by the 3D audio engine 304 and . . . may be linked with different simulated actions, pre-collision events and collision effects." Ex. 1008, 22:66–23:4. Given this disclosure, which is very similar to the "highlighting" disclosure discussed above in connection with limitation 1[c], we credit Dr. Welch's testimony that "[p]ersons of ordinary skill in the art would have found it obvious to trigger an action based on pointing the PED at an SLP (e.g., playing a binaural sound with

McCulloch's HMD that includes 'a set of earphones')." Ex. 1003 ¶ 471 (citing Ex. 1008, 8:17–22, 11:42–46, 21:21–38). In other words, a person of ordinary skill in the art considering McCulloch's teachings about its sound library together with McCulloch's disclosure of pointing the controller at a virtual basketball and causing a virtual collision between a virtual basketball and a television would have understood these actions and effects to be of the type where sound effects such as the playing of binaural sound would be used and that the playing of such sound would occur in response to the user pointing the PED to initiate the collision effect. Accordingly, McCulloch suggests the playing of binaural sound as required by this limitation.

c) Conclusion For Claim 1

For the reasons discussed in the preceding sections, Petitioner demonstrates that the combined teachings of McCulloch, Pedrotti, and Flaks would have rendered claim 1 obvious to one skilled in the art.

5. Dependent Claim 2

Petitioner asserts that the combined teachings of McCulloch, Pedrotti, and Flaks disclose or suggest all of the limitations of claim 2. Pet. 57–59. Patent Owner disagrees, contending that Petitioner's proposed combination does not teach or suggest limitation 2[a]. PO Resp. 36. Limitation 2[a] requires "tracking, with one or more sensors in the WED worn on the head of the user, the PED to determine when the PED moves outside the zone." Ex. 1001, 41:9–11.

a) Petitioner's Assertions

Petitioner asserts that "McCulloch disclosed capture devices such as cameras and infrared transceivers (sensors) in its HMD for detecting and tracking infrared light, which may be emitted by a controller." Pet. 57–58

(citing Ex. 1008, 5:19–36, 7:34–67, 8:7–39; Ex. 1003 ¶ 476). Petitioner reasons that "McCulloch's system with its HMD-tracked controllers and using Pedrotti's safe area method would render obvious limitation 2[a]'s 'determin[ing] when the PED moves outside the zone' in view of the Pedrotti disclosures discussed for this limitation in Ground 1." *Id.* at 58 (citing *id.* at 24–26; Ex. 1003 ¶ 477).

b) Patent Owner's Response

Patent Owner responds that McCulloch does not track the controllers with sensors located in its WED. *See* PO Resp. 36–37. Specifically, Patent Owner contends that "[t]here is no discussion of sensors for the purpose of tracking a PED held in hands of the user. The only tracking described in this portion of McCulloch [(i.e., Ex. 1008, 13:52–19:7)] is limited to 'an eye tracking software 134' that uses an 'eye tracking software 196' to capture and process eye data via an eye tracking camera." *Id.* at 38 (citing Ex. 1008, 14:15–17, 14:57–60).

Patent Owner responds further that in McCulloch, "inertial motion sensors (not shown) in the handheld real controller device 19 identify parameters like speed, acceleration and direction of motion ***of the device 19*** which is sent as data to the display device system 8." PO Resp. 38 (quoting Ex. 1008, 29:40–43; citing Ex. 1008, 29:4–63). Thus, according to Patent Owner, "Petitioner omits the [emphasized] segment that makes it clear that in McCulloch the sensors are in the controller not in the HMD as expressly required by limitations 2[a]." *Id.*; *see also id.* at 40.

In addition, Patent Owner asserts that none of the citations Petitioner provides support its position that limitation 2[a] is rendered obvious by McCulloch. PO Resp. 38–39. As an example, Patent Owner contends that

"McCulloch makes it clear that the 'inertial sensors are for sensing position, orientation, and sudden accelerations of head mounted display device 2'" and "they are not used for sensing the controllers in the hands of the user." *Id.* at 39 (citing Ex. 1008, 8:17–30). As another example, Patent Owner contends that in McCulloch "'the front facing capture devices 113 capture and provide image and depth data from which real objects are identified as well as their positions and often orientations relative to the display portion of the device'" and that "[t]his passage does not disclose that capture devices '***track***[] . . . the PED to determine ***when the PED moves outside the zone***' or '***sense when the PED leaves the zone***,' which are expressly required by limitation[] 2[a]." *Id.*

Patent Owner responds further that "Dr. Welch cannot say McCulloch 7:34–67 discloses an HMD tracking a controller with sensors located at the HMD, because McCulloch 7:34–67 simply does not disclose the same." PO Resp. 42. According to Patent Owner, "[t]he cited passage merely discloses depth sensitive cameras that can be used to determine 'depth data,'" such that "McCulloch's capture devices are not used to '***track***[] . . . the PED to determine ***when the PED moves outside the zone***' or '***sense when the PED leaves the zone***.'" *Id.* at 42–43.

In addition, Patent Owner responds that "'companion processing module 4' cannot be a sensor—it is a processing unit, nor does it include a sensor" and that "none of the examples outlined in the cited paragraphs of Dr. Welch's declaration stands for a proposition that 'techniques using sensors on HMDs to track controllers . . . were well-known.'" PO Resp. 43–45.

c) Petitioner's Reply

Petitioner asserts that "the Petition explained why McCulloch . . . renders limitation 2[a] obvious, including through its disclosure of capture devices in its HMD, such as cameras and infrared transceivers (sensors), for detecting and tracking infrared light, which may be emitted by a controller." Pet. Reply 23 (citing Pet. 57–58; Ex. 1008, 7:24–67, 8:7–39, 5:19–36).

In addition, Petitioner replies that Patent Owner "attacks '13 paragraphs from Dr. Welch's declaration' ([Ex. 1003] ¶¶ 130–142) cited in the Petition's discussion of limitation 1[b]—not limitation 2[a]." Pet. Reply 16 (citing PO Resp. 16). Petitioner asserts that "Dr. Welch discussed multiple references demonstrating that sensors on HMDs for sensing user and controller locations were well-known and known to be beneficial, confirming limitation 2[a]'s obviousness." *Id.* (citing Ex. 1003 ¶¶ 88–98, 292–296).

d) Patent Owner's Sur-reply

Patent Owner replies that "Petitioner's own expert testified that a [POSITA] would not have located sensors on a WED to track a PED and determine when it leaves the zone." PO Sur-reply 9. According to Patent Owner, "Dr. Welch testifies that 'no sane person of ordinary skill or sane person in general who knows something about sensors and system like this would ever attempt to do that.'" *Id.* at 10 (citing Ex. 2012, 233:17–235:10).

e) Discussion

We agree with Patent Owner, that Petitioner has not adequately explained how the combined teachings of McCulloch, Pedrotti, and Flaks suggest "tracking, with one or more sensors in the WED worn on the head of the user, the PED to determine when the PED moves outside the zone" as

required by limitation 2[a]. Petitioner cites several portions of McCulloch to support its reasoning. Pet. 57–58 (citing Ex. 1008, 7:34–67, 8:7–39, 5:19–36). Petitioner's first citation (Ex. 1008, 7:34–67) describes capture devices 113 and indicates that they may be depth sensitive cameras. *Id.* at 7:34–36. This portion goes on to describe how depth data is determined and how, ultimately, the position of a real object can be determined. *Id.* at 7:36–56. McCulloch also indicates that the capture devices 113 can be mounted in McCulloch's HMD (WED). *Id.* at 7:24–33. Notably, this cited portion of McCulloch does not describe how the position of its handheld controllers (PEDs) can be determined.

Petitioner's second citation (Ex. 1008, 8:7–39) describes a wireless interface 137 communicatively coupled to capture devices 113 and other components of device 2. *Id.* at 8:7–16. This portion also describes a sensing unit 132 including inertial sensors and a location sensing unit 144. *Id.* at 8:18–22. McCulloch states that "[t]he inertial sensors are for sensing position, orientation, and sudden accelerations of the head mounted display device 2." *Id.* at 8:26–28. In this portion, McCulloch also describes processing of analog signals by various devices. *Id.* at 8:22–39. Notably, this cited portion of McCulloch does not describe determining the location of its handheld controllers (PEDs) or tracking them.

Petitioner's third citation (Ex. 1008, 5:19–36) describes a companion processing module 4 and indicates that "the functionality of the companion processing module 4 may be integrated in software and hardware components of the display device 2." *Id.* at 5:32–35. Notably, this portion of McCulloch does not describe what the functions of companion processing module 4 are. *See id.* at 5:19–36.

We do not agree with Petitioner that a person of skill in the art considering these teachings would conclude that it would have been obvious to track, "with one or more sensors in the WED worn on the head of the user, the PED to determine when the PED moves outside the zone" as required by limitation 2[a]. Nor do we credit Dr. Welch's conclusory testimony in this regard. Ex. 1003 ¶ 476.

f) Conclusion for Claim 2

For the reasons discussed in the preceding sections, we agree with Patent Owner that Petitioner has not demonstrated that the combined teachings of McCulloch, Pedrotti, and Flaks would have rendered claim 2 obvious to one skilled in the art.

6. Dependent Claims 3–8

Petitioner sets forth its challenge, based on the combined teachings of McCulloch, Pedrotti, and Flaks, to claims 3–8 on pages 59–64 of the Petition. Patent Owner does not separately address Petitioner's assertions for claims 3–8 on this ground. *See* PO Resp. 34. We have reviewed Petitioner's arguments and evidence, as well as Dr. Welch's testimony in support thereof, and determine that Petitioner demonstrates that the combined teachings of McCulloch, Pedrotti, and Flaks would have rendered claims 3–8 obvious to one skilled in the art.

7. Independent Claim 9

Petitioner asserts that the combined teachings of McCulloch, Pedrotti, and Flaks disclose or suggest all of the limitations of claim 9. Pet. 64–66. Patent Owner disagrees, contending that "Petitioner's proposed combination does not teach or render obvious limitation 9[b]." PO Resp. 46. For the

reasons discussed below, we agree with Petitioner.[11] Limitation 9[b] requires "determining, with a wearable electronic device (WED) worn on a head of the user, when the user is located inside the zone." Ex. 1001, 41:63–65.

a) Petitioner's Assertions

Petitioner asserts that "[l]imitation 9[b] would have been obvious for the same reasons as limitation 1[b]." Pet. 65 (citing *id.* at 53; Ex. 1003 ¶ 530). For limitation 1[b], Petitioner asserts that "McCulloch's system with its 'head mounted display' (WED) ([Ex. 1008], 4:49–50) and implementing Pedrotti's safe area method would render limitation 9[b] obvious in view of the Pedrotti disclosures discussed for this limitation in Ground 1." *Id.* at 53. Petitioner asserts further that "McCulloch's HMD includes 'an inertial sensing unit 132' and 'a location sensing unit 144,' and its 'inertial sensors are for sensing position, orientation, and sudden accelerations of head mounted display device 2.'" *Id.* (citing Ex. 1008, 8:17–28). Based on these assertions, Petitioner reasons that persons of ordinary skill in the art "would have known that McCulloch's HMD, like Pedrotti's HMD, could and would 'determin[e] . . . when the user is located inside the zone' as claimed." *Id.* (citing Ex. 1003 ¶¶ 450–454; Ex. 1008, 12:4–7). In addition, Petitioner asserts that "Flaks taught tracking a user to update localized (i.e., binaural) sound" and that "chaperone systems that determined user locations in virtual

[11] Patent Owner does not contest Petitioner's assertions with respect to the other limitations of claim 9. Although we do not reproduce Petitioner's assertions challenging the other limitations, we have reviewed these assertions, as well as the evidence and testimony in support thereof, and find them persuasive. Pet. 64–66.

environments to help users stay within boundaries were known." *Id.* (citing Ex. 1009, 9:18–20, 11:25–43; Ex. 1003 ¶¶130–142, 455–457).

b) Patent Owner's Response

Patent Owner responds that "limitation 9[b] requires that the processor responsible for making the determination is located in the WED." PO Resp. 46. Patent Owner responds further that "Petitioner advances the exact same argument as it raises for limitation 1[b] in Ground 2," that [f]or limitation 1[b], Petitioner refers back to its argument for Ground 1," and that "[f]or the reasons discussed" for limitation 1[b], "Petitioner's argument fails." *Id.* (citing Pet. 53, 65). In addition, Patent Owner contends that the portions of McCulloch that Petitioner references (portions of McCulloch that disclose sensors in the HMD) "do not teach that the act of determination is performed by a processor in the HMD." *Id.*

c) Petitioner's Reply

In reply, Petitioner argues that Patent Owner's arguments are "conclusory attorney argument that McCulloch's disclosures are insufficient" that do not "rebut the Petition's and Dr. Welch's explanations of how McCulloch and Flaks, like Pedrotti, render limitation 9[b] obvious." Pet. Reply 20–21 (citing Pet. 53, 65; Ex. 1003 ¶¶ 110–113).[12]

d) Patent Owner's Sur-reply

Patent Owner does not address this limitation in its Sur-reply. *See generally* PO Sur-reply.

[12] We do not reproduce Petitioner's arguments regarding the testimony of Patent Owner's expert that has been withdrawn from this proceeding.

e) Discussion

We agree with Petitioner that McCulloch discloses limitation 9[b]. McCulloch discloses a WED (head mounted display device 2) including "an inertial sensing unit 132 including one or more inertial sensors [and] a location sensing unit 144 including one or more location or proximity sensors." Ex. 1008, 8:18–20, Fig. 2B. McCulloch further discloses that its WED includes "control circuitry 136 for the display device 2 which includes a processing unit 210" and that

> inertial sensing unit 132 includes as sensors a three axis magnetometer, a three axis gyro, and a three axis accelerometer. The inertial sensors are for sensing position, orientation, and sudden accelerations of head mounted display device 2. From these movements, head position, and thus orientation of the display device, may also be determined. In this embodiment, each of the devices processing an analog signal in its operation include control circuitry which interfaces digitally with the digital processing unit 210 and memory 244 and which produces or converts analog signals, or both produces and converts analog signals, for its respective device.

Ex. 1008, 8:3–5, 8:24–35. Given these disclosures, we credit Dr. Welch's testimony that "persons of ordinary skill in the art would have found it obvious for McCulloch, alone or with Flaks, in view of Pedrotti, to determine, with a wearable electronic device (WED) worn on a head of the user, when the user is located inside the zone." Ex. 1003 ¶ 457.

f) Conclusion for Claim 9

For these reasons, we determine that Petitioner demonstrates that the combined teachings of McCulloch, Pedrotti, and Flaks would have rendered claim 9 obvious to one skilled in the art.

8. Dependent Claim 10

Petitioner asserts that that the combined teachings of McCulloch, Pedrotti, and Flaks disclose or suggest all of the limitations of claim 10. Pet. 66–67. Patent Owner disagrees, contending that Petitioner's proposed combination does not teach or render obvious limitation 10[a]. PO Resp. 47. For the reasons discussed below, we agree with Patent Owner.

a) Limitation 10[a]: determining, with the WED, when the PED is pointed at one of the SLPs while the user is located in the zone;

(1) Petitioner's Assertions

Petitioner asserts that "McCulloch's HMD receives position and orientation data from its controller, e.g., handheld IMU, and it would have been obvious to store SLP locations in McCulloch's HMD's memory" and that "it would have been obvious to use this information to determine when the PED is pointed at an SLP while the user is in the zone." Pet. 66 (citing *id.* at 38; Ex. 1003 ¶¶ 535–537).

(2) Patent Owner's Response

Patent Owner responds that Petitioner's arguments are conclusory. PO Resp. 47. Patent Owner responds further that "even if McCulloch's controllers communicate information about their location to the HMD, that does not necessarily mean that the HMD can determine 'when the PED is pointed at one of the SLPs while the user is located in the zone' as claimed." *Id.*

(3) Petitioner's Reply

Petitioner replies that Patent Owner's "attorney argument about McCulloch's disclosures, including [Patent Owner's] assertion that those disclosures do not '***necessarily***' disclose what is claimed, does not (and

cannot) rebut the Petition's and Dr. Welch's explanations of how McCulloch renders this limitation obvious." Pet. Reply 22–23 (citing Pet. 66; Ex. 1003 ¶¶ 535–537; Ex. 1008, Figs. 2A, 8B, 8D, 8:1–16; Ex. 1003 ¶¶ 123–129).

(4) Patent Owner's Sur-reply

Patent Owner does not address limitation 10[a] in its Sur-reply. *See generally* PO Sur-reply.

(5) Discussion

In Section II.E.5 above, we explained that McCulloch discloses inertial sensors and a location sensing unit that determine the location of the WED, not the PED. As limitation 10[a] also requires determining the location (i.e., the PED pointed at an SLP) with the WED, Petitioner's assertions regarding limitation 10[a] suffer from the same deficiencies as its assertions for claim 2.

b) Limitation 10[b]: playing the binaural sound that originates from the one of the SLPs in the zone in response to the WED determining that the PED is pointed at the one of the SLPs.

(1) Petitioner's Assertions

Petitioner asserts that "[l]imitation 10[b] would have been obvious for the same reasons as limitations 1[c], 1[d], and 10[a]." Pet. 66 (citing *id.* at 53–56; Ex. 1003 ¶¶ 538–539).

(2) Patent Owner's Response

Patent Owner responds that "Petitioner's argument for limitation 10[b] suffers from [the] same deficiencies as its argument in Ground 1" in that "the proposed combination does not disclose playing the binaural sound that emanates from the pointed to SLP, in response to such pointing." PO Resp. 47.

(3) Petitioner's Reply

Petitioner replies that persons of ordinary skill in the art "would have known that a user's pointing would trigger binaural sound playback." Pet. Reply 22 (citing Pet. 56–57). Petitioner replies further that, for example, when the "virtual basketball collides with a virtual television as a result of a user pointing a controller," the collision sound (binaural sound) will play from the location (SLP) that the user is pointing at. *Id.* (citing Ex. 1008, 21:34–38, 22:66–23:7, Fig. 8D; Ex. 1003 ¶¶ 117–122, 470–471).

(4) Patent Owner's Sur-reply

Patent Owner does not address limitation 10[b] in its Sur-reply. *See generally* PO Sur-reply.

(5) Discussion

Petitioner does not show that the combined teachings of McCulloch, Pedrotti, and Flaks render limitation 10[b] obvious because Petitioner does not address the requirement that playing of the sound is in response to the WED determining that the PED is pointed at the SLP. Although McCulloch clearly shows a PED pointed at a virtual object and suggests the playing of sound in response to a collision event, Petitioner has not shown that the playing of the sound is in response to a determination by the WED.

c) Conclusion for Claim 10

For these reasons, discussed in the preceding sections, Petitioner does not demonstrate that the combined teachings of McCulloch, Pedrotti, and Flaks would have rendered claim 10 obvious to one skilled in the art.

9. Dependent Claim 11

Petitioner asserts that "[c]laim 11 would have been obvious for the same reasons as limitation[] 1[c]." Pet. 67 (citing *id.* 53–56, 63; Ex. 1003

¶ 540. Patent Owner responds that "[c]laim 11 is not rendered obvious by the proposed combination." PO Resp. 47. We agree with Petitioner that claim 11 is similar to limitation 1[c] with the only difference between the two limitations being that claim 11 specifies that the highlighting that occurs at the SLP is of a virtual image. Ex. 1001, 42:16–20. As discussed in Section II.E.4.a above, McCulloch suggests highlighting associated with collision events and we agree with Petitioner and Dr. Welch that McCulloch suggests highlighting of the virtual object as required by claim 11. For these reasons, Petitioner demonstrates that the combined teachings of McCulloch, Pedrotti, and Flaks would have rendered claim 11 obvious to one skilled in the art.

10. Dependent Claims 12–14

Petitioner sets forth its challenge, based on the combined teachings of McCulloch, Pedrotti, and Flaks, to claims 12–14 on page 67 of the Petition. Patent Owner does not separately address Petitioner's assertions for claims 12–14 on this ground. *See* PO Resp. 46. We have reviewed Petitioner's arguments and evidence, as well as Dr. Welch's testimony in support thereof, and determine that Petitioner demonstrates that the combined teachings of McCulloch, Pedrotti, and Flaks would have rendered claims 12–14 obvious to one skilled in the art.

11. Independent Claim 17

Petitioner asserts that the combined teachings of McCulloch, Pedrotti, and Flaks disclose or suggest all of the limitations of claim 17. Pet. 67–69. Patent Owner disagrees, contending that Petitioner's proposed combination does not teach or render obvious limitation 17[e]. PO Resp. 35.

For limitation 17[e], Petitioner asserts that "[l]imitation 17[e] would have been obvious for the same reasons as limitation 2[a], and as explained for limitation 17[e] in Ground 1." Pet. 68 (citing *id.* at 42, 57; Ex. 1003 ¶ 552). Patent Owner groups limitation 17[e] and limitation 2[a] together in its Response. PO Resp. 35–46. In reply, Petitioner likewise groups limitation 17[e] and limitation 2[a] together. Pet. Reply 27. In its Sur-reply, Patent Owner also groups limitations 17[e] and 2[a] together. PO Sur-reply 13–16.

We have discussed Petitioner's and Patent Owner's positions regarding limitation 2[a] in Section II.E.5 above. For the same reasons, we determine that Petitioner has not demonstrated that the combined teachings of McCulloch, Pedrotti, and Flaks suggest limitation 17[e], and thus, would have rendered claim 17 obvious to one of skill in the art.

12. Dependent Claims 18–20

Claims 18–20 depend from claim 17. Ex. 1001, 43:3–16. Petitioner's challenge to these claims based on the combined teachings of McCulloch, Pedrotti, and Flaks suffers from the same deficiencies as its challenge to claim 17. Accordingly, we determine that Petitioner fails to demonstrate by a preponderance of the evidence that the combined teachings of McCulloch, Pedrotti, and Flaks would have rendered claims 18–20 obvious to one of ordinary skill in the art.

13. Conclusion For Ground Two

Based on our review of the entire record of this proceeding, we determine that Petitioner has shown, by a preponderance of the evidence, that claims 1, 3–9, and 11–14 are unpatentable over the combined teachings of McCulloch, Pedrotti, and Flaks. We further determine that Petitioner has

not shown, by a preponderance of the evidence, that claims 2, 10, and 17–20 are unpatentable over the combined teachings of McCulloch, Pedrotti, and Flaks.

III. CONCLUSION

For the reasons discussed above, we determine that Petitioner has demonstrated, by a preponderance of the evidence, that claims 1, 3–9, and 11–14 are unpatentable on the bases set forth in the table below.[13] We further determine that Petitioner has not demonstrated, by a preponderance of the evidence, that claims 2, 10, and 17–20 are unpatentable on the bases set forth in the following table.

Claim(s)	35 U.S.C. §	Reference(s)/ Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1–14, 17–20	103	Pedrotti, Jang, Begault	9, 12–14	1–8, 10, 11, 17–20
1–14, 17–20	103	McCulloch, Pedrotti, Flaks	1, 3–9, 11–14	2, 10, 17–20
Overall Outcome			1, 3–9, 11–14	2, 10, 17–20

[13] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this Final 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, Petitioner has demonstrated by a preponderance of the evidence that claims 1, 3–9, and 11–14 of U.S. Patent No. 10,798,509 B1 are unpatentable;

FURTHER ORDERED that, Petitioner has not demonstrated by a preponderance of the evidence that claims 2, 10, and 17–20 of U.S. Patent No. 10,798,509 B1 are unpatentable; and

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

FOR PETITIONER:

Inge Osman
Christopher Henry
Linfong Tzeng
Steven Peters
LATHAM & WATKINS LLP
inge.osman@lw.com
christopher.henry@lw.com
linfong.tzeng@lw.com
steven.peters@lw.com

FOR PATENT OWNER:

Erick Robinson
Patrick Dunn
Jayme Partridge
Homayoon Rafatijo
Jayne Piana
BOCHNER PLLC
erobinson@bochner.law
patdunn64@gmail.com
jpartridge@spencerfane.com
hrafatijo@bochner.law
jpiana@bochner.law