

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*.

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

Meta Platforms, Inc., Meta Platforms Technologies, LLC, and Twisted Pixel Games, LLC (“Petitioner”) filed a Petition (Paper 2 (“Pet.”)), seeking *inter partes* review of claims 1–14 and 17–20 (the “challenged claims”) of U.S. Patent No. 10,798,509 B1 (Ex. 1001 (“the ’509 patent”)). See Pet. 2. Eight KHZ, LLC (“Patent Owner”) filed a Preliminary Response. Paper 7 (“Prelim. Resp.”). With our prior authorization (Ex. 1144), Petitioner filed a Preliminary Reply (Paper 8, “Prelim. Reply”) and Patent Owner filed a Preliminary Sur-Reply (Paper 9, “Prelim. Sur-reply”).

Institution of an *inter partes* review is authorized by statute when “the information presented in the petition . . . and any response . . . shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” 35 U.S.C. § 314(a); see 37 C.F.R. § 42.108 (2022). Upon consideration of the Petition and Preliminary Response we conclude that the information presented shows that there is a reasonable likelihood that Petitioner would prevail in establishing the unpatentability of at least one challenged claim of the ’509 patent.

A. 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) (“the related District Court litigation”). 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,

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15/944,796, 16/162,416, 16/445,268, 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).

B. The '509 Patent (Ex. 1001)

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.

Accordingly, 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).

C. 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.

D. The Alleged Grounds of Unpatentability

Petitioner asserts the following grounds of unpatentability (Pet. 2–3):¹

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–14, 17–20	103	Pedrotti, ² Jang, ³ Begault ⁴
1–14, 17–20	103	McCulloch, ⁵ Pedrotti, Flaks ⁶

E. Evidence

In support of its proposed grounds, Petitioner relies on the Declaration of Gregory F. Welch, Ph.D. (“Dr. Welch”). In support of its Preliminary

¹ Petitioner supports its challenge with the Declaration of Dr. Gregory F. Welch. Ex. 1003.

² U.S. Patent No. 9,851,786 B2, filed July 7, 2015, issued December 26, 2017 (Ex. 1005, “Pedrotti”).

³ U.S. Patent No. 8,520,872 B2, issued August 27, 2013 (Ex. 1006, “Jang”).

⁴ DURAND R. BEGAULT, NAT’L AERONAUTICS AND SPACE ADMIN., 3D SOUND FOR VIRTUAL REALITY AND MULTIMEDIA (2000) (Ex. 1007, “Begault”).

⁵ U.S. Patent No. 9,041,622 B2, issued May 26, 2015 (Ex. 1008, “McCulloch”).

⁶ U.S. Patent No. 8,767,968 B2, issued July 1, 2014 (Ex. 1009, “Flaks”).

Response, Patent Owner relies on the Declaration of John C. Hart, Ph.D. (“Dr. Hart”). In our analysis below, we consider Dr. Welch’s and Dr. Hart’s testimony.

II. ANALYSIS

A. Discretion under 35 U.S.C. § 314(a)

Patent Owner argues that we should exercise discretion under § 314(a) to deny institution in light of the related District Court litigation. Prelim. Resp. 52–60.

We consider the following factors when determining whether to deny institution under § 314(a) based on a parallel district court proceeding:

1. whether the court granted a stay or evidence exists that one may be granted if a proceeding is instituted;
2. proximity of the court’s trial date to the Board's projected statutory deadline for a final written decision;
3. investment in the parallel proceeding by the court and the parties;
4. overlap between issues raised in the petition and in the parallel proceeding;
5. whether the petitioner and the defendant in the parallel proceeding are the same party; and
6. other circumstances that impact the Board's exercise of discretion, including the merits.

Apple Inc. v. Fintiv, Inc., IPR2020-00019, Paper 11 at 5–6 (PTAB Mar. 20, 2020) (precedential) (“*Fintiv*”). We also consider “several clarifications” made by the Director of the United States Patent and Trademark Office (“USPTO”). See USPTO Memorandum, Interim Procedure for

Discretionary Denials in AIA Post Grant Proceedings with Parallel District Court Litigation, 2 (June 21, 2022) (“Director’s Memo”).⁷

The Director’s Memo provides that “[c]onsistent with *Sotera Wireless, Inc.*,^[8] the PTAB will not discretionarily deny institution in view of parallel district court litigation where a petitioner presents a stipulation not to pursue in a parallel proceeding the same grounds or any grounds that could have reasonably been raised before the PTAB.” Director’s Memo 3. With our authorization, Petitioner has filed a stipulation which stipulates that

If the PTAB institutes the pending IPR in IPR2023-01023 challenging the patentability of claims 1-14 and 17-20 of the ’509 patent, then [Defendants Meta Platforms, Inc., Meta Platforms Technologies, LLC, and Twisted Pixel Games, LLC] will not pursue as to the challenged claims any ground raised or that could have been reasonably raised in the IPR in the above-captioned district court litigation (No. 6:22-cv-00575-ADA).

Ex. 1141, 3.

Patent Owner concedes that Petitioner has filed a “*Sotera*-like stipulation” but argues that it is insufficient because it “leaves the door open to a duplication of efforts and the possibility of conflicting decisions.” Prelim. Sur-reply 2 (citing Ex. 1141, 4 (“This stipulation is not intended . . . to limit Meta’s ability to assert . . . invalidity under 35 U.S.C. §§ 102 and 103 not available in IPR and under 35 U.S.C. §§ 101 and 112[], regardless of whether IPRs are instituted.” (emphasis omitted))). Namely, Patent Owner argues that Petitioner’s stipulation carves out “the right to assert

⁷ Available at https://www.uspto.gov/sites/default/files/documents/interim_proc_discretionary_denials_aia_parallel_district_court_litigation_memo_20220621_.pdf.

⁸ *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 at 18–19 (PTAB Dec. 1, 2020) (precedential).

overlapping system art in the parallel district court proceeding,” such that institution here would not address the risk of “inconsistent outcomes between the PTAB and the district court.” *Id.* at 4–5.

We disagree with Patent Owner, as Petitioner’s stipulation sufficiently comports with the language of the Director’s Memo, consistent with *Sotera Wireless, Inc.* See Director’s Memo 3. Patent Owner’s argument invites us to disagree with the reasoning of *Sotera* itself and the Director’s Memo, which we are bound to follow. Accordingly, Patent Owner’s argument is unavailing.

Patent Owner also urges us not to accept a “late” *Sotera* stipulation. Prelim. Sur-reply 5. We disagree that Petitioner’s *Sotera* stipulation is late. It is within our discretion to permit Petitioner to file a stipulation prior to institution. See *NXP USA, Inc. v. Impinj, Inc.*, IPR2021-01556, Paper 13 (PTAB Sept. 7, 2022) (precedential).

We therefore decline to discretionarily deny institution in view of the related District Court litigation.

B. Legal Standards

Petitioner bears the burden to demonstrate unpatentability, and that burden never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

A claim is unpatentable for obviousness if “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” 35 U.S.C. § 103; see also *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 ordinary skill in the art; and (4) when in evidence, objective evidence of nonobviousness.⁹ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

C. Level of Ordinary Skill in the Art

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 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 “applies Petitioner’s characterization of a person of ordinary skill in the art.” Prelim. 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).

D. 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).

⁹ The parties have not directed our attention to any objective evidence of obviousness or non-obviousness.

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 disagrees with Petitioner’s contention that we should apply “any reasonable construction,” and instead argues that “[t]he claim terms should be given their ‘ordinary and customary meaning’ as understood by a POSITA in view of the patent claims, specification[,], and prosecution history.” Prelim. Resp. 3 (citations omitted). Patent Owner further argues that “[h]ere, no express constructions of the claims are necessary.” *Id.*

We agree with Patent Owner that at this point in this proceeding, “no express constructions of the claims are necessary.” Prelim. Resp. 3.

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

Petitioner contend that claims 1–14 and 17–20 are unpatentable over the combined teachings of Pedrotti, Jang, and Begault. Pet. 5–45. For the reasons discussed below, Petitioner demonstrates a reasonable likelihood of

prevailing for some claims on this ground.

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 1:42–45. 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).

Patent Owner does not explicitly contest Petitioner’s reasoning in support of the proposed combination. *See* Prelim. Resp. 5–35. To the extent that Patent Owner’s arguments regarding Ground 1 implicitly contest this reasoning, we address Patent Owner’s arguments in conjunction with the contested limitations below.

5. 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. As Petitioner has demonstrated a reasonable likelihood of prevailing for claim

9, we begin our discussion of Ground 1 with this claim.

- a. 9[pre]: A non-transitory computer readable storage medium storing instructions that one or more electronic devices execute as a method, the method comprising:*

Petitioner asserts that “Pedrotti disclosed ‘a non-transitory computer-readable medium having embodied thereon a program . . . executable by a processor to perform’ its ‘method of assisting a user’ to ‘remain[] within a selected area of the physical world’” and that “Jang similarly disclosed that its ‘features and/or utilities’ ‘may be realized by a computer-readable medium having stored thereon a computer program to execute [its] method.’” Pet. 36 (citing *id.* at 11; Ex. 1005, 2:60–3:12; Ex. 1006, 4:45–55, 3:16–19, 6:5–20, 12:57–63; Ex. 1003 ¶¶ 361–363). Patent Owner does not dispute Petitioner’s assertions. *See generally* Prelim. Resp.

- b. 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;*

For limitation 9[a], Petitioner refers to its assertions for limitation 1[a]. Pet. 37. Regarding limitation 1[a], Petitioner asserts that “[a] user of Pedrotti’s system ‘wear[s] a head-mounted display (HMD)’ and ‘hold[s] a handheld controller’ (PED) comprising a ‘tracker,’ which ‘provides information regarding a position of the handheld controller.’” *Id.* at 11 (citing Ex. 1005, 2:44–57, 15:7–120, 4:49–5:24). Petitioner asserts further that in Pedrotti’s method “[a] processor tracks the controller’s movement (*id.* 12:31–39), including to determine ‘a boundary of a selected area,’ so a user ‘may move freely’ without hitting ‘obstacles.’” *Id.* at 11–12 (citing Ex. 1005, 2:49–51; 4:32–36). According to Petitioner, “[t]hat boundary can be defined ‘by having the user walk around a perimeter chosen by the user with

one of the trackers,’ e.g., a controller tracker, ‘to define the outer boundary of [the] selected area.’” *Id.* (citing Ex. 1005, 14:56–65, 15:13–22).

In addition, Petitioner asserts that

After Pedrotti’s boundary is defined, e.g., by the “measured path of tracker motion” (*id.* Fig. 14), and a user is in “the virtual world,” when “the processor determines from the position of the handheld controller that the handheld controller is within a preselected distance of the boundary,” it instructs the HMD to display “a visual warning to the user,” which can be in the form of grid lines such as a virtual fence.”

Pet. 12 (citing Ex. 1005, 11:43–55, 15:30–37, Figs. 11, 14–15). Thus, according to Petitioner, “Pedrotti’s handheld controller (PED) divides an area around a user into a zone—Pedrotti’s ‘selected’ or ‘safe’ area, bound by Pedrotti’s boundary and its virtual fence.” *Id.* (citing Ex. 1003 ¶¶ 229–236).

Petitioner also asserts that “Pedrotti’s controller-divided zone will (or at a minimum will obviously) include SLPs from which binaural sound will originate, for example, when a user plays a VR game” and that “[a]ssociating and moving sounds with virtual images were ‘extremely important’ features of VR well before February 2016.” Pet. 13–14 (citing Ex. 1003 ¶¶ 238–239, 272–275; Ex. 1005, 1:19–20; Ex. 1125, 17:22–18:35). Based on these assertions, Petitioner reasons that a person of ordinary skill in the art “would have known that virtual objects (e.g., Pedrotti’s sword or another ‘virtual weapon’) could and would have associated binaural sounds that move with them to multiple locations (multiple SLPs).” *Id.*

In addition, Petitioner asserts that “Jang confirms the obviousness of using, in zones around users (like Pedrotti’s), ‘multiple[] sound localization points (SLPs) from where binaural sound originates to the user,’ e.g., during VR game play” as “Jang’s sound processing system ‘check[s] sound source

information’ on ‘characters and other objects’ and provides localized audio (i.e., binaural sound) for ‘sound sources’ ‘according to the[ir] relative locations’ (SLPs), including in ‘sound areas’ around a user.” Pet. 14 (citing Ex. 1006, 7:24–59, 1:28–2:11, 5:35–37, 8:18–49, 8:65–9:3, Fig. 2; Ex. 1003 ¶¶ 240–241, 101–129).

Regarding limitation 9[a] specifically, Petitioner asserts that a person of ordinary skill in the art “would have known that SLPs in Jang’s sound areas in Pedrotti’s zone could and would be in ‘empty space,’ i.e., space not occupied by a physical object.” Pet. 37 (citing Ex. 1001, 6:1–5; Ex. 1003 ¶¶ 364–365; Ex. 1006, 4:19, 4:45–55).

Patent Owner does not dispute Petitioner’s assertions regarding limitation 1[a] or its additional assertion and reasoning regarding limitation 9[a]. See Prelim. Resp. 5–31.

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

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

Patent Owner contends that Pedrotti does not disclose “determining, *with a wearable electronic device (WED) worn on the head of the user*, when the user is located inside the zone – that is, an integrated tracking system in the HMD – but instead relies on a stationary base station that is external to the HMD.” Prelim. Resp. 15, 28. Patent Owner asserts further that “[a]ll of Pedrotti’s teachings on tracking involve the stationary base station. Pedrotti teaches that whether by electromagnetic fields, light emitting trackers, or other forms, the HMD and handheld controller is tracked in relation to their distance from a base station.” *Id.* at 15 (citing Ex. 1005, 4:49–58, 5:7–24; Ex. 2001 ¶ 36).

Patent Owner contends further that “tracking the handheld controller with the HMD while worn on the head to define a safe area with the system disclosed by Pedrotti is directly contrary to Pedrotti’s teachings emphasizing the safety of the user by avoiding collisions with physical obstacles in the safe area.” Prelim. Resp. 17 (citing Ex. 2001 ¶ 37). According to Patent Owner, “the Pedrotti system does not envision and, indeed, cannot provide controller tracking via a processor of the HMD and thus, does not teach or suggest handheld controller tracking by an HMD (WED) worn on the head of the user.” *Id.* at 17–18 (citing Ex. 2001 ¶ 37).

In addition, Patent Owner contends that

Petitioner’s assertion that Pedrotti’s light-emitting trackers in the controller are used by a camera mounted on the HMD to track the position of the controller, even if true, would not track the position of the controller in relation to the ‘safe area,’ but instead would merely track the position of the controller relative to the HMD.

Prelim. Resp. 18 (citing Ex. 2001 ¶ 37). Patent Owner asserts further that “the only component [in Pedrotti] that could be practically employed to track

a boundary using relative position data would be a stationary device, such as the base station as described throughout Pedrotti.” *Id.* at 18–19 (citing Ex. 1005, 4:49–57, 5:7–11, 6:3–10, 7:66–8:2, 10:20–27, 14:7–10, 14:13–23).

Patent Owner’s arguments are unavailing as they are based on the assumption that Petitioner’s proposed combination eliminates Pedrotti’s base station and that limitation 9[b] precludes the use of a base station with the WED. Neither of these assumptions is correct. Nothing in Petitioner’s challenge indicates that the proposed combination eliminates the use of Pedrotti’s base station. Moreover, nothing in claim 9 precludes the use of a base station in conjunction with the WED to track the user. Claim 9 merely recites a non-transitory computer readable storage medium storing instructions executed as a method “comprising” determining, “with” the WED, when the user is located inside the zone and leaving the zone, but does not expressly preclude other devices from being involved in those determinations.

d. 9[c]: determining, with the WED worn on the head of the user, when the user is leaving the zone; and

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).

Patent Owner does not contest Petitioner’s assertions regarding claims 2 and 3. Prelim. Resp. 35. For limitation 9[c], Patent Owner contends that “Pedrotti does not teach that the tracking processor may be in the HMD and, indeed, such possibility is incompatible with the boundary determination and HMD techniques disclosed by Pedrotti.” *Id.* at 28 (citing *id.* at 15–22). For the reasons discussed in Section II.E.5.c above, we disagree with Patent Owner.

e. 9[d]: displaying, with the WED worn on the head of the user, a three dimensional (3D) virtual image of the zone to warn the user that the user is leaving the zone.

Petitioner asserts that “[l]imitation 9[d] would have been obvious for the same reasons as limitations 2[b], 3[b], and 9[c].” Pet. 38 (citing *id.* at 24–26, 28, 37–38. Limitation 9[c] is discussed above. For limitation 2[b] Petitioner asserts that “Pedrotti disclosed or at a minimum rendered obvious a WED (Pedrotti’s HMD with its processor) that determines that a PED (Pedrotti’s controller) moves outside a zone, and Pedrotti taught that, based on this determination, its HMD displays ‘a visual warning such as a grid or virtual fence.’” Pet. 26 (citing *id.* at 24–26; Ex. 1005, 4:37–44, 13:17–27, Fig. 11; Ex. 1003 ¶¶ 303–306). Petitioner asserts further that “Pedrotti’s ‘grid or virtual fence’ is, or at a minimum obviously could be, a 3D virtual image appearing at Pedrotti’s zone boundary showing a size and a shape of Pedrotti’s zone” in that “[i]t is a virtual image presented in a 3D VR environment—i.e., a 3D virtual image.” *Id.* at 27 (citing Ex. 1005, 12:51–

13:11; Ex. 1003 ¶ 306). In addition, Petitioner asserts that “Pedrotti taught that ‘other shapes other than a grid-shaped virtual fence can be displayed to the user. For example, the developer of a particular application may choose some other design to provide contrast with, or maintain thematic correctness with, the particular virtual world being displayed.’” *Id.* (citing Ex. 1005, 12:60–13:11; Ex. 1003 ¶¶ 308–309).

For limitation 3[b], Petitioner asserts that “[t]his limitation would have been obvious for reasons explained for limitations 1[b], 2[a]–[b], and 3[a].” Pet. 28 (citing *id.* at 18–19, 24–28; Ex. 1003 ¶¶ 315–318). Limitations 1[b], 2[a], 2[b], and 3[a] are discussed above.

Patent Owner does not contest Petitioner’s assertions regard limitations 2[b] and 3[b]. Prelim. Resp. 35. Regarding limitation 9[d], Patent Owner contends that “[i]n contrast to providing a virtual fence ‘in response to the WED determining that the user is *leaving the zone*,” “Pedrotti teaches providing the virtual fence ‘in an area around the point in the virtual world at which the user’s head or hand *has approached the boundary of the selected area*.’” *Id.* at 29 (citing Ex. 1005, 13:14–17; Ex. 2001 ¶¶ 42–43). Patent Owner contends further that “Pedrotti suggests alternative actions to displaying the virtual fence when the ‘user’s head or hands go beyond the boundary.’” *Id.* at 30 (citing Ex. 1005, 13:63). Specifically, according to Patent Owner, “Pedrotti teaches that ‘the processor can provide additional messaging or warning, such as text or auditory warnings, or an additional visual warning that persists until the user returns to the selected area within the boundary.’” *Id.* (citing Ex. 1005, 13:63–66; Ex. 2001 ¶ 44). In addition, Patent Owner contends that “Pedrotti actually suggests that ‘the processor can cause the HMD to fade to black,

and present, for example, only a warning message and/or a beacon for arrows directing the user to move in the direction of the boundary and the selected area.” *Id.* (citing Ex. 1005, 13:63–14:5; Ex. 2001 ¶ 44). Based on these contentions, Patent Owner argues that “Pedrotti actually teaches away from displaying a three-dimensional virtual image of the zone in response to determining that the user is leaving the zone.” *Id.* (citing Ex. 2001 ¶ 44).

We disagree with Patent Owner’s contentions on this record. Claim 9 merely requires displaying the “virtual image of the zone in response to the WED determining that the user is leaving the zone.” Ex. 1001, 42:1–4. It does not preclude displaying of that image as the user approaches the boundary. Moreover, although Pedrotti discloses an alternative embodiment where the display of the zone fades to black when the user leaves the zone, this embodiment is an alternative to the first disclosed embodiment where the display of the zone is maintained. Ex. 1005, 13:63–14:5. Thus, rather than teach away from display of the virtual image of the zone when the WED determines that the user is leaving the zone, Pedrotti explicitly discloses such display of the boundary.

f. Conclusion regarding Claim 9

For claim 9, we have reviewed Petitioner’s assertions and the evidence in support thereof including the testimony of Dr. Welch. We have also reviewed Patent Owner’s contentions and Dr. Hart’s testimony in support thereof. On this record and for the reasons discussed above, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing for claim 9.

6. Dependent Claims 10–14

Petitioner asserts that the combined teachings of Pedrotti, Jang, and

Begault disclose or suggest all of the limitations of claims 10–14. Pet. 38–40. Patent Owner does not contest Petitioner’s assertions for these claims. Prelim. Resp. 35. Rather, Patent Owner contends that “based at least upon the virtue of their dependency, Petitioner fails to carry its burden with respect to dependent . . . dependent claims 10–14.” *Id.*

As we have determined that Petitioner has demonstrated a reasonable likelihood of prevailing for independent claim 9 (from which claims 10–14) depend, Patent Owner’s argument is unavailing. We have reviewed Petitioner’s assertions regarding claims 10–14 and Dr. Welch’s testimony in support thereon. On this record, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing for claims 12–14. For the reasons discussed below with respect to independent claim 1, at this stage, we question whether Petitioner has met its burden for limitations pertaining to pointing of the PED, highlighting of the SLPs, and playing of binaural sound when the PED is pointed at an SLP such as those limitations set forth in claims 10 and 11.

7. Independent Claim 17

Petitioner asserts that the combined teachings of Pedrotti, Jang, and Begault disclose or suggest all of the limitations of claim 9. Pet. 40–43. Petitioner has demonstrated a reasonable likelihood of prevailing for claim 17 for the reasons discussed below.

a. 17[pre]: An electronic system comprising:

Petitioner asserts that “Pedrotti taught an electronic system comprising an HMD and controllers” and that “Jang’s HMD, ‘sound processing unit,’ and ‘control unit’ also are an electronic system.” Pet. 40–41 (citing *id.* at 11, 36; Ex. 1005, 2:44–59; Ex. 1006, 2:26–47; Ex. 1003

¶ 385).

- b. 17[a]: a portable electronic device (PED) held in a hand of a user that divides an area around the user into a three-dimensional (3D) zone that includes sound localization points (SLPs) in empty space from where binaural sound originates to the user; and*

Petitioner asserts that limitation 17[a] “would have been obvious for the same reasons as limitations 1[a], 2[b], and 9[a].” Pet. 41 (citing *id.* at 11–18, 26–27, 37). Petitioner’s assertions regarding limitations 1[a], 2[b], and 9[a] are discussed in Section II.E.5 above.

Petitioner asserts further that “Pedrotti’s safe area is a three-dimensional zone because it is the zone in a 3D virtual environment in which the user plays a game, and is bound by Pedrotti’s boundary and virtual fence, which extend (or at a minimum obviously extend) around the user.” Pet. 41 (citing Ex. 1005, Figs. 11, 14; Ex. 1003 ¶ 386).

Patent Owner does not contest Petitioner’s assertions regarding limitation 17[a]. See Prelim. Resp. 31–35.

- c. 17[b]: a wearable electronic device (WED) that is worn on a head of the user,*

Petitioner asserts that “Pedrotti’s system comprises an HMD (WED worn on the head of a user).” Pet. 41 (citing Ex. 1005, 2:44–47; Ex. 1003 ¶ 387. Patent Owner does not contest this assertion. Prelim. Resp. 31–35.

- d. 17[c]: wirelessly communicates with the PED,*

Petitioner asserts that “Pedrotti taught, or at a minimum rendered obvious, an HMD (WED) communicating wirelessly with handheld controllers (PEDs) because Pedrotti disclosed multiple controller tracking methods that [persons of ordinary skill] would understand are or could be implemented wirelessly, including ‘magnetic, optical, electrical, sonar,

radar, [and] ultrasonic’ tracking.” Pet. 41–42 (citing Ex. 1005, 4:49–5:26; Ex. 1006, 7:35–37; Ex. 1003 ¶¶ 388–389).

Patent Owner contends that “Pedrotti does not disclose a tracking processor in the head-worn WED” because “Pedrotti teaches a stationary tracker outside that HMD that is used to track the tracker inside the HMD.” Prelim. Resp. 31 (citing Ex. 1005, 10:42–44). Patent Owner contends further that “there is no teaching or suggestion in Pedrotti of wireless communication between the HMD and controllers.” *Id.* at 31–32. Patent Owner also contends that “Jang does not obviate this deficiency of Pedrotti.” *Id.* at 32.

Patent Owner’s argument is unconvincing. Pedrotti discloses wireless tracking of a tracker in its HMD (WED) and controllers by a processor in a base station. Ex. 1005, 4:37–39. Pedrotti also discloses other embodiments with the processor located elsewhere such as “in a separate location, or even in the HMD.” *Id.* at 5:64–6:1, 16:22–23. Given these express teachings in Pedrotti, we agree with Petitioner based on the current record that Pedrotti suggests tracking of the PED by the HMD and that such tracking would occur wirelessly.

Further, to the extent that Patent Owner is arguing that Pedrotti does not meet this limitation because it requires a base station, this argument is unavailing as claim 17 does not preclude another component, such as a base station, from being involved in the recited tracking.

e. 17[d]: includes speakers that play the binaural sound to the user that emanates from the SLPs in empty space,

Petitioner asserts that limitation 7[d] “would have been obvious for the same reasons as limitations 1[d] (binaural sound) and 9[a] (empty space) and claim 8 (speakers).” Pet. 42 (citing *id.* at 22–24, 35, 37); Ex. 1003

¶¶ 390–391). Limitations 1[d] and 9[a] are discussed in Section II.E.5 above.

For the limitation of claim 8 requiring speakers, Petitioner asserts that a person of ordinary skill in the art “would have known that Pedrotti’s HMD could and would have speakers, e.g., to generate ‘audio warnings’” and that “[s]peakers were routinely used in HMDs before February 2016, as Jang shows.” Pet. 35–36 (citing Ex. 1006, 1:44–45, 7:5–6; Ex. 1003 ¶¶ 358–360).

Patent Owner does not contest Petitioner’s assertions regarding limitation 17[d]. See Prelim. Resp. 31–35.

f. 17[e]: includes one or more sensors that sense when the PED leaves the zone, and

Petitioner asserts that “[l]imitation 17[e], which requires that the WED ‘includes one or more sensors that sense when the PED leaves the zone,’ would have been obvious for the same reasons as limitation 2[a].” Pet. 42 (citing *id.* at 24–26). Petitioner reasons that a person of ordinary 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]).” *Id.* (citing Ex. 1003 ¶ 392). Limitation 2[a] is discussed in Section II.E.5.d above.

In response, Patent Owner reiterates its arguments that “Pedrotti does not teach or suggest a tracking system on the HMD, let alone one that receives PED location information from the PED; but instead teaches a tracker that provides information to the tracking system to track the HMD.” Prelim. Resp. 33 (citing *id.* at 15–28). These arguments are unavailing for the reason discussed in Section II.E.5.d above.

- g. 17[f]: includes a display that displays a 3D virtual image of the zone in response to sensing that the PED leaves the zone,*

Petitioner asserts that this limitation “would have been obvious for the same reasons as limitation 2[b] and 17[e].” Pet. 42 (citing *id.* at 26–27, 42); Ex. 1003 ¶ 393). Petitioner’s assertions regarding limitations 2[b] and 17[e] are discussed above.

Patent Owner contends that “the cited references do not teach or suggest displaying a 3D virtual image of the zone in response to determin[ing] that the user is leaving the zone.” Prelim. Resp. 34 (citing *id.* at 29–31). Patent Owner’s contentions are discussed in Section II.E.5.e above and are unconvincing.

- h. 17[g]: wherein the display displays the 3D virtual image of the zone to warn the user that the user is leaving the zone.*

Petitioner contends limitation 17[g] “would have been obvious for the same reasons as limitation 3[b].” Pet. 43 (citing *id.* at 28–29, 35; Ex. 1005, 12:40–50; Ex. 1003 ¶ 394). Petitioner’s assertions regarding limitation 3[b] are discussed in Section II.E.5.e above.

Patent Owner contends that Pedrotti teaches “removing the virtual fence when the user is leaving the zone.” Prelim. Resp. 35. We disagree with Patent Owner’s contention. Although Pedrotti discloses an embodiment where the HMD fades to black and only a warning message, beacon, or arrows are displayed when the user leaves the boundary (zone), Pedrotti first discloses an embodiment where an additional message or warning is displayed when the user leaves the boundary. Ex. 1005, 13:46–14:5.

- i. Conclusion regarding Claim 17*

For claim 17, we have reviewed Petitioner's assertions and the evidence in support thereof including the testimony of Dr. Welch. We have also reviewed Patent Owner's contentions and Dr. Hart's testimony in support thereof. On this record and for the reasons discussed above, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing for claim 17.

8. Dependent Claims 18–20

Petitioner asserts that the combined teachings of Pedrotti, Jang, and Begault disclose or suggest all of the limitations of claims 18–20. Pet. 43–45. Patent Owner does not contest Petitioner's assertions for these claims. Prelim. Resp. 35. Rather, Patent Owner contends that “based at least upon the virtue of their dependency, Petitioner fails to carry its burden with respect to . . . dependent claims 18–20.” *Id.*

As we have determined that Petitioner has demonstrated a reasonable likelihood of prevailing for independent claim 17 (from which claims 18–20) depend, Patent Owner's argument is unavailing. We have reviewed Petitioner's assertions regarding claims 18–20 and Dr. Welch's testimony in support thereon. On this record, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing for claims 19 and 20. For the reasons discussed below with respect to independent claim 1, at this stage, we question whether Petitioner has met its burden for claim 18, which recites highlighting.

9. 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. As explained above, we are persuaded, based on the current record, that

Petitioner has shown a reasonable likelihood of prevailing on certain claims on this ground. Accordingly, we institute review “on all of the challenged claims and on all grounds of unpatentability asserted for each claim.” *See* 37 C.F.R. § 42.108(a).

To provide guidance to the parties regarding the Petitioner’s challenge to claims 1–8, however, we note the following regarding limitations 1[c] and 1[d].

- a. 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*

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; Ex. 1063, 327).

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. 1063. 305, 281, 361, Fig. 26.5; 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; Ex. 1063, 327).

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).

Patent Owner contends 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.” Prelim. Resp. 22. First, Patent Owner contends that “Pedrotti’s virtual fence is not a sound localization point and thus does not teach or suggest ‘highlighting . . . one of the multiple SLPs’” and that “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.* at 22–23 (citing Ex. 2001 ¶ 46). Thus, according to Patent Owner, “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.* at 23.

Second, Patent Owner contends that Pedrotti's teachings regarding its controllers manipulating and controlling virtual objects and the use of a pointing pattern for selection do not teach selection of SLPs. Prelim. Resp. 23 (citing Ex. 2001 ¶ 47). Patent Owner contends further that "Pedrotti's 'virtual object' is a virtual representation *of the controller*, not an SLP that the controller can point to" and that "as a virtual representation of the controller, it is impossible to point the controller to the virtual object, which is itself." *Id.* Thus, according to Patent Owner, "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." *Id.* at 24 (citing Ex. 2001 ¶ 48).

At this stage, we question whether Petitioner has sufficiently demonstrated that Pedrotti, Jang, or Begault disclose or suggest highlighting a SLP in a zone or pointing of the PED at a SLP, as required by claim 1. For example, we agree with Patent Owner on this record that "Pedrotti's virtual fence is not a sound localization point and thus does not teach or suggest 'highlighting . . . one of the multiple SLPs'" and that Jang does not cure this deficiency in Pedrotti. Prelim. Resp. 22 (citing Ex. 2001 ¶ 46).

We further note that several of Petitioner's assertions are supported only by VR Book (Ex. 1063), which is not relied upon as the basis for this challenge, or Dr. Begault's deposition testimony, which does not qualify as prior art in this proceeding. Pet. 20–21.

- b. 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.*

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. 1063, 281, 356; 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).

In response, Patent Owner reiterates its contention that “the cited references do not disclose pointing to an SLP with a PED held in the hand of the user.” Prelim. Resp. 26. Thus, according to Patent Owner, “the references clearly do not disclose playing the binaural sound that emanates from the pointed to SLP, in response to such pointing.” *Id.* Patent Owner also reiterates its position that Petitioner’s challenge relies upon a reference, VR Book, which is not part of the cited combination. *Id.*

For the reasons discussed above regarding limitation 1[c], we question whether Petitioner has sufficiently demonstrated that the combined teachings of Pedrotti, Jang, and Begault would have rendered this limitation obvious.

c. Conclusion For Claim 1

We have reviewed Petitioner's assertions regarding claim 1 and the evidence supporting these assertions, as well as Patent Owner's contentions regarding those assertions and the evidence support these contentions. On the record before us for the reasons discussed above, we question whether Petitioner has made a sufficient showing for claim 1 on this ground.

10. Claims 2–8

Petitioner asserts that the combined teachings of Pedrotti, Jang, and Begault disclose or suggest all of the limitations of claims 2–8. Pet. 24–36. As claims 2–8 depend from independent claim 1, and we question whether Petitioner has made a sufficient showing for claim 1, we likewise question the sufficiency of Petitioner's showing for dependent claims 2–8.

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

Petitioner contend that claims 1–14 and 17–20 are unpatentable over the combined teachings of McCulloch, Pedrotti, and Flaks. Pet. 45–70. For the reasons discussed below, Petitioner demonstrates a reasonable likelihood for some claims on this ground.

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.

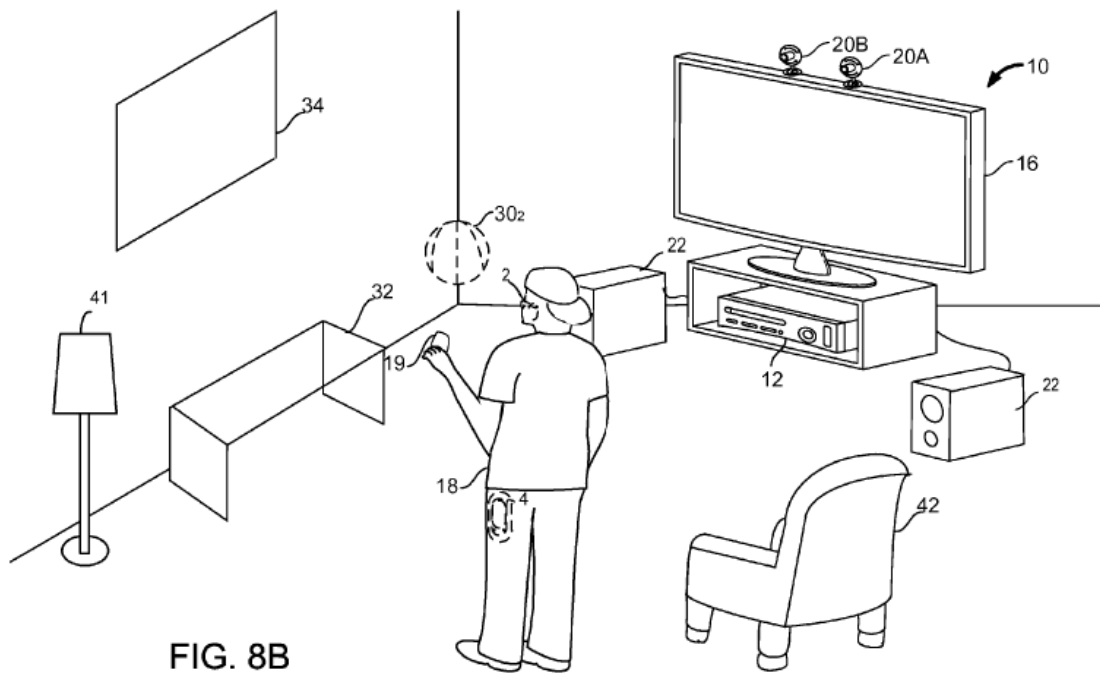


Figure 8B shows user 18 in his living room which includes lamp 41, table 32, wall hanging 34, basketball 30, chair 42 and home entertainment system 10 including 3D image capture devices 20A and 20B, television 16, speakers 22, and game console 12. Ex. 1008, 28:55–60. User 18 wears head mounted display 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 30₂ 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 30₂.” *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).

Patent Owner contends that a person of ordinary skill in the art “would not be motivated to combine McCulloch’s system with Pedrotti’s method for assisting a user in remaining within a selected area” because “[t]he motive in McCulloch for defining a playspace with boundaries is

unrelated to user safety as within Pedrotti.” Prelim. Resp. 39 (citing Ex. 2001 ¶ 59). According to Patent Owner, “[t]he critical difference between Pedrotti’s and McCulloch’s motivation is related to how a user interacts with the real world when wearing an HMD or WED.” *Id.* Based on this understanding of the prior art, Patent Owner contends that “Pedrotti is clear that the HMD it describes completely obstructs the user’s view of the real world making it hazardous to move freely in a real-world space that has obstructions and walls” whereas “the McCulloch HMD *always* permits the user to see the real world while wearing the HMD such that it replicates or does not meaningfully obstruct the user’s natural field-of-view (‘FOV’).” *Id.* at 39–40 (citing Ex. 1005, 2:25–26; 4:6; Ex. 1008, 3:54–4:3). Thus, according to Patent Owner, “there is no need for producing the safety barrier using the McCulloch device, contrary to Petitioner’s assertion.” *Id.* at 40 (citing Ex. 2001 ¶ 59). Patent Owner contends further that “the method for setting such a boundary in McCulloch is adequate and environmentally based on the user’s needs, eliminating the necessity to add Pedrotti’s invention to its system.” *Id.*

Patent Owner contends that “[t]he creation of a virtual safety fence is not only counter to the objectives of the McCulloch invention, but also unnecessary.” Prelim. Resp. 40 (citing Ex. 2001 ¶ 60). Patent Owner contends that “McCulloch describes an invention that is meant to blur the lines of reality and fiction” and if “a virtual wall [was] to suddenly appear, this would serve as [a] sudden and violent break with the immersive experience McCulloch is trying to create.” *Id.* at 40–41 (citing Ex. 1008, 29:36–63; Ex. 2001 ¶ 60). Patent Owner contends further that “beyond the fact that a user would be able to see the couch wearing the McCulloch HMD

in Petitioner’s hypothetical, McCulloch specifically teaches using depth sensors on the HMD and other parts of the system to produce a 3D map of the objects in the user’s environment” such that McCulloch’s “HMD can easily predict a potential collision with a physical object, know whether the object is seen by the user, and alert the user to the presence of the object if necessary.” *Id.* at 41 (citing Ex. 2001 ¶ 61). Thus, according to Patent Owner, a person of ordinary skill in the art “would not be motivated to combine McCulloch’s boundary setting method with the Pedrotti boundary method.” *Id.*

We do not find Patent Owner’s argument to be convincing at this stage. Although we agree with Patent Owner that McCulloch’s HMD allows the user to see their surroundings, we do not agree that this obviates the need for further safety measures such as those taught by Pedrotti. On the record before us we determine that Petitioner has articulated sufficient reasoning in support of the proposed combination.

4. *Claims 1–8*

Petitioner asserts that the combined teachings of McCulloch, Pedrotti, and Flaks disclose or suggest all of the limitations of claim 1. Pet. 48–55. Petitioner’s challenge to claim on Ground 2 raises the same questions as to the sufficiency of Petitioner’s assertions regarding limitations 1[c] and 1[d], because it relies on the same assertions regarding Pedrotti as the challenge in Ground 1. Petitioner also asserts that McCulloch teaches the “pointed at” and “highlighting” requirements of claim 1. *Id.* at 54–56. However, the cited portions of McCulloch do not discuss pointing a PED at an SLP or highlighting a SLP as claimed. As in its Ground 1 challenge discussed in Section II.E.9 above, Petitioner’s Ground 2 challenge relies on VR Book to

cure the deficiencies in its assertions regarding the “pointed at” and “highlighting” requirements of claim 1. *See* Pet. 53–57. For these reasons, we question whether Petitioner has made a sufficient showing for claim 1, and its dependent claims 2–8.

5. Claims 9 and 17

Petitioner asserts that the combined teachings of McCulloch, Pedrotti, and Flaks disclose or suggest all of the limitations of claims 9 and 17. Pet. 64–69. We do not reproduce Petitioner’s assertions for claims 9 and 17, as these assertions refer extensively to Petitioner’s assertions regarding Pedrotti for these claims as set forth in Ground 1 and Patent Owner’s arguments pertain to alleged deficiencies in these assertions, as opposed to alleged deficiencies with respect to Petitioner’s assertions regarding McCulloch.

For claim 9, Patent Owner contends that McCulloch does not cure the alleged deficiencies in Petitioner’s assertions that Pedrotti discloses or suggests limitations 9[b]–9[d]. Prelim. Resp. 46–48. As discussed in Section II.E.5 above, we find no such deficiencies based on the current record. Thus, Patent Owner’s arguments are unavailing.

For claim 17, Patent Owner contends that McCulloch does not cure the alleged deficiencies in Petitioner’s assertions that Pedrotti discloses or suggests limitations 17[e]–17[g]. Prelim. Resp. 48–51. As discussed in Section II.E.6 above, we find no such deficiencies based on the current record. Thus, Patent Owner’s assertions are unavailing.

For claims 9 and 17, we have reviewed Petitioner’s assertions and the evidence in support thereof including the testimony of Dr. Welch. We have also reviewed Patent Owner’s contentions and Dr. Hart’s testimony in support thereof. On this record and for the reasons discussed above, we

determine that Petitioner has demonstrated a reasonable likelihood of prevailing for claims 9 and 17.

6. *Claims 10–14 and 18–20*

Patent Owner does not present separate arguments for claims 10–14 and 18–20. We have reviewed Petitioner’s assertions regarding these claims and the evidence in support of those assertions including the testimony of Dr. Welch. On this record, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing for claims 12–14, 19, and 20. For the reasons discussed above with respect to independent claim 1, at this stage, we question whether Petitioner has met its burden for limitations pertaining to pointing of the PED, highlighting of the SLPs, and playing of binaural sound when the PED is pointed at an SLP such as those limitations set forth in claims 10, 11, and 18.

III. CONCLUSION

Based on the current record, we determine Petitioner has shown a reasonable likelihood of prevailing with respect to at least one claim of the ’509 patent. Accordingly, we institute *inter partes* review of all claims challenged on all of the grounds in the Petition. *See Consolidated Trial Practice Guide* (Nov. 2019), 64.¹⁰

IV. ORDER

Accordingly, it is:

ORDERED that pursuant to 35 U.S.C. § 314, an *inter partes* review is hereby instituted as to claims 1–14 and 17–20 of the ’509 patent based on the unpatentability challenges presented in the Petition; and

¹⁰ Available at www.uspto.gov/sites/default/files/documents/tpgnov.pdf.

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FURTHER ORDERED that pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial commencing on the entry date of this decision.

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