Agenda

Overview

Ground 1: Pedrotti, Jang, and Begault Render The Challenged Claims Obvious

Ground 2: McCulloch, Pedrotti, and Flaks Render The Challenged Claims Obvious

Overview Of McCulloch

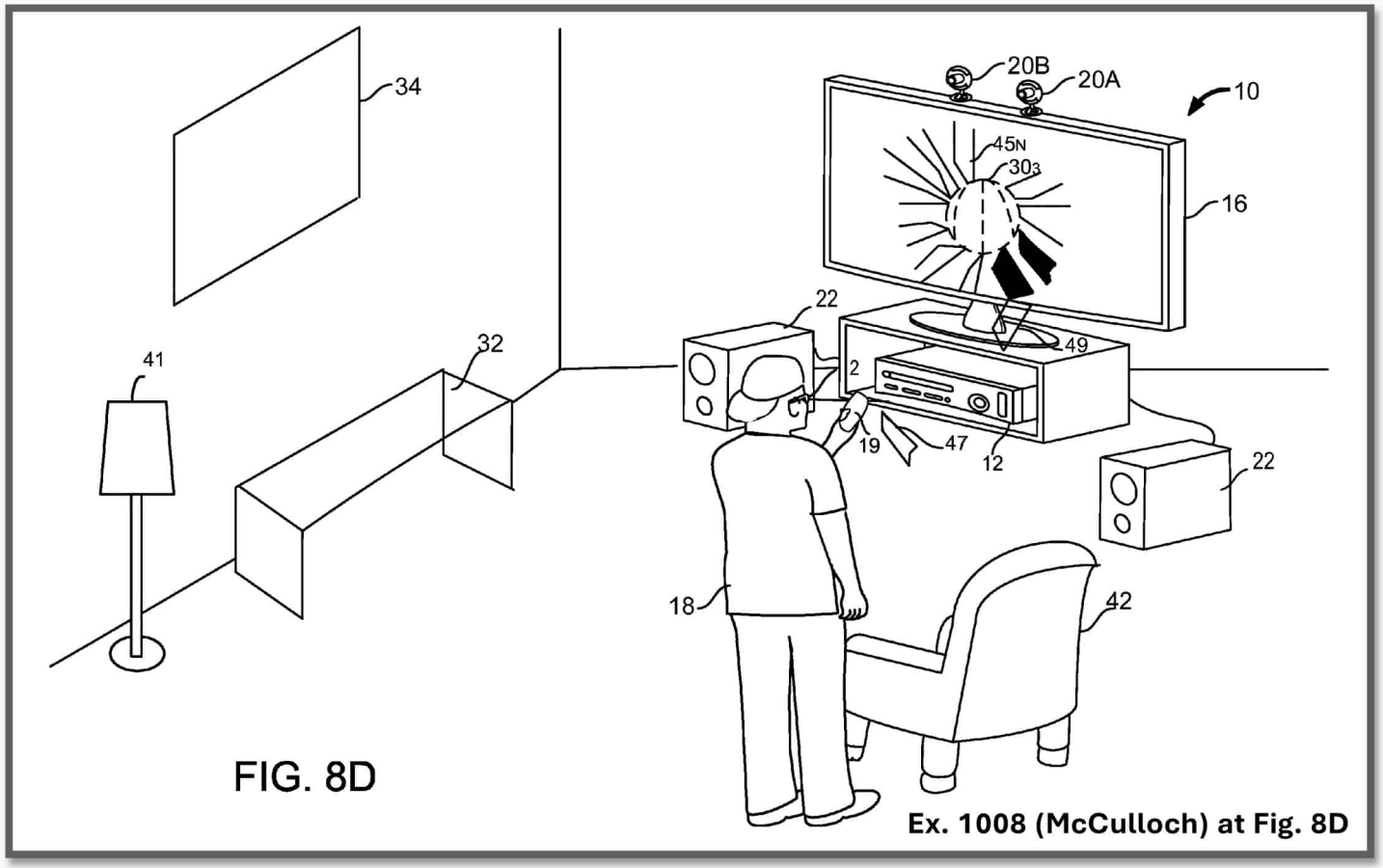


FIG. 8D

Ex. 1008 (McCulloch) at Fig. 8D

Overview Of McCulloch

McCulloch

FIG. **2A** is a side view of an eyeglass temple **102** of the frame **115** in an embodiment of the optical see-through, augmented reality display device **2** embodied as eyeglasses providing support for hardware and software components. At the front of frame **115** is depicted one of at least two physical environment facing capture devices **113**, e.g. cameras, that can capture image data like video and still images, typically in color, of the real world to map real objects in the display field of view of the see-through display, and hence, in the field of view of the user.

In some examples, the capture devices **113** may also be depth sensitive, for example, they may be depth sensitive cameras which transmit and detect infrared light from which depth data may be determined. In other examples, a separate depth sensor (not shown) on the front of the frame **115** may also capture and provide depth data to objects and other surfaces in the field of view. The depth data and image data form a depth map of the captured field of view of the capture devices **113** which are calibrated to include the display field of view. A three dimensional (3D) mapping of the display field of view can be generated based on the depth map. Some examples of depth sensing technologies that may be included on the head mounted display device **2** without limitation, are SONAR, LIDAR, Structured Light, and/or Time of Flight.

Ex. 1008 (McCulloch) at 7:24-47

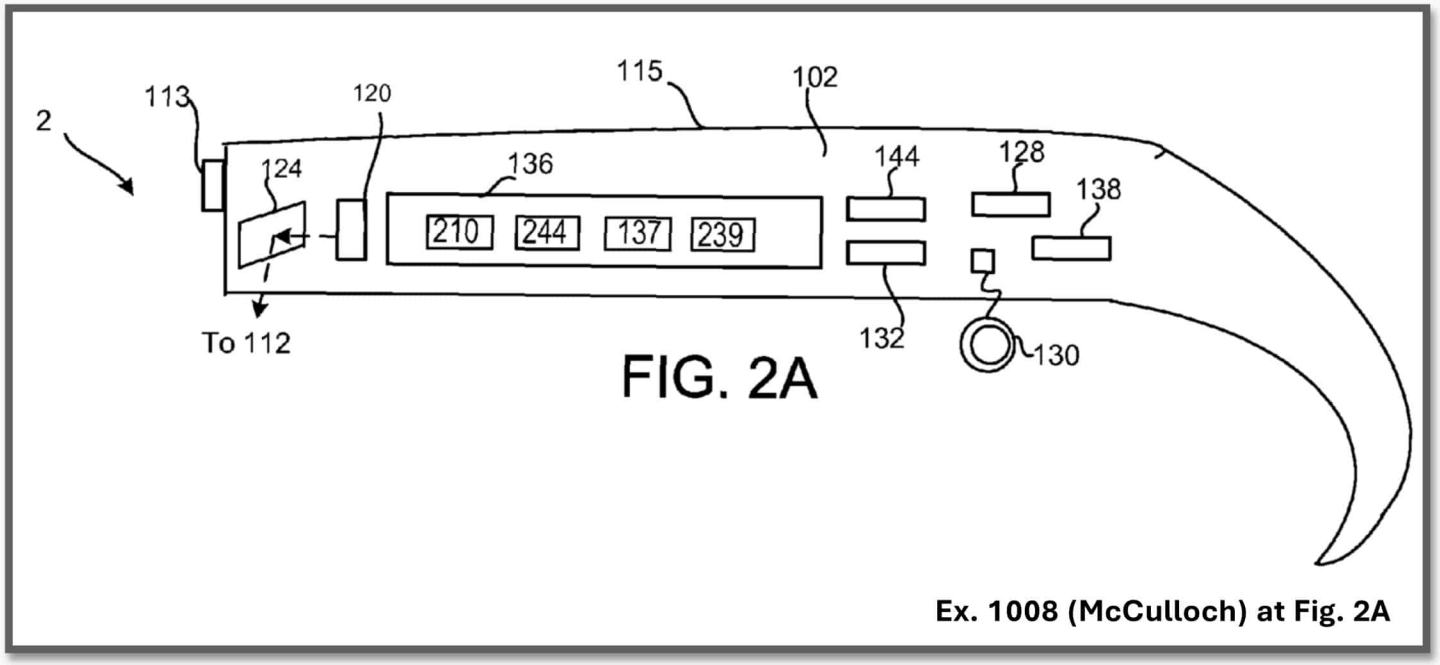


FIG. 2A

Ex. 1008 (McCulloch) at Fig. 2A

Overview Of McCulloch

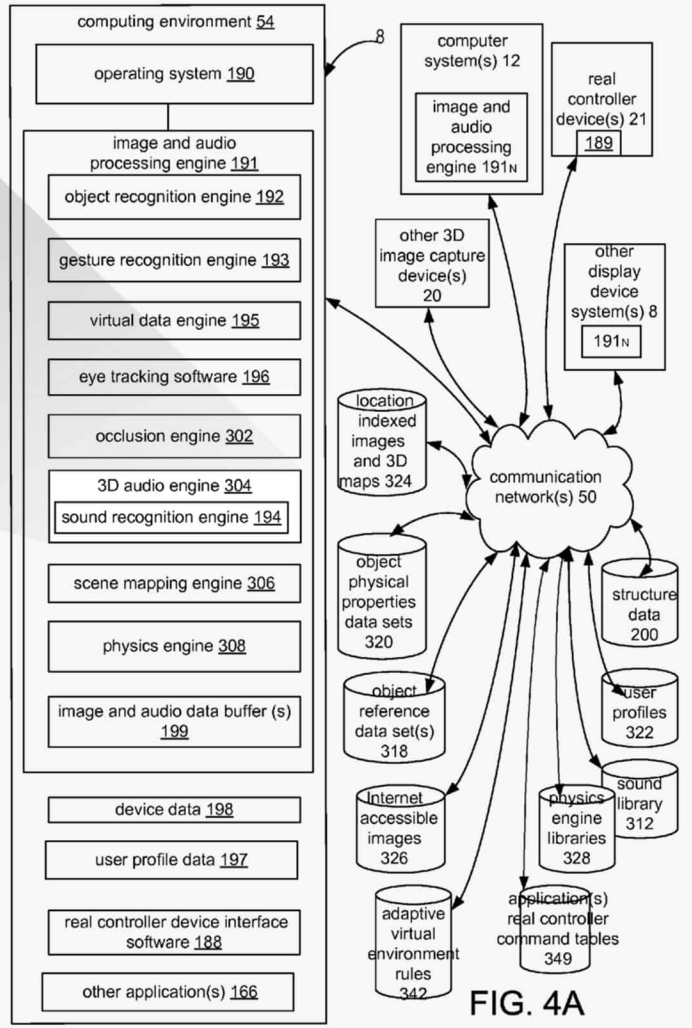
McCulloch

nism. Additionally, in optional step **416**, the 3D audio engine **304** plays audio data for the virtual object projected from a 3D space position of the virtual object relative to a 3D space position and orientation identified for the display device which is used to approximate the position and orientation of the user's head supporting the display device. In the helicopter examples, a flight path of the virtual helicopter currently has it on course to fly into a wall behind the user. The user gets distracted and does not change the path via user input. The virtual helicopter is no longer displayed in the display field of view, but the 3D audio engine **304** plays the audio of the virtual crash to project from a position of the wall behind the user.

Ex. 1008 (McCulloch) at 26:7-19

3D audio engine 304

sound recognition engine 194



Ex. 1008 (McCulloch) at Fig. 4A

Overview Of Pedrotti

Pedrotti

In still another embodiment, an irregularly shaped area is defined, as shown in FIG. **14**. A boundary **1404** around an irregularly shaped area, which is not circular, can be defined, for example, by having the user walk around a perimeter chosen by the user with one of the trackers to define the outer boundary of a selected area, for example, one in which there are no obstacles. The processor determines the position of the tracker at a number of sampling points as the user moves around the chosen perimeter, and from those points determines the boundary **1404**. This approach may be desirable

Ex. 1005 (Pedrotti) at 14:56-65

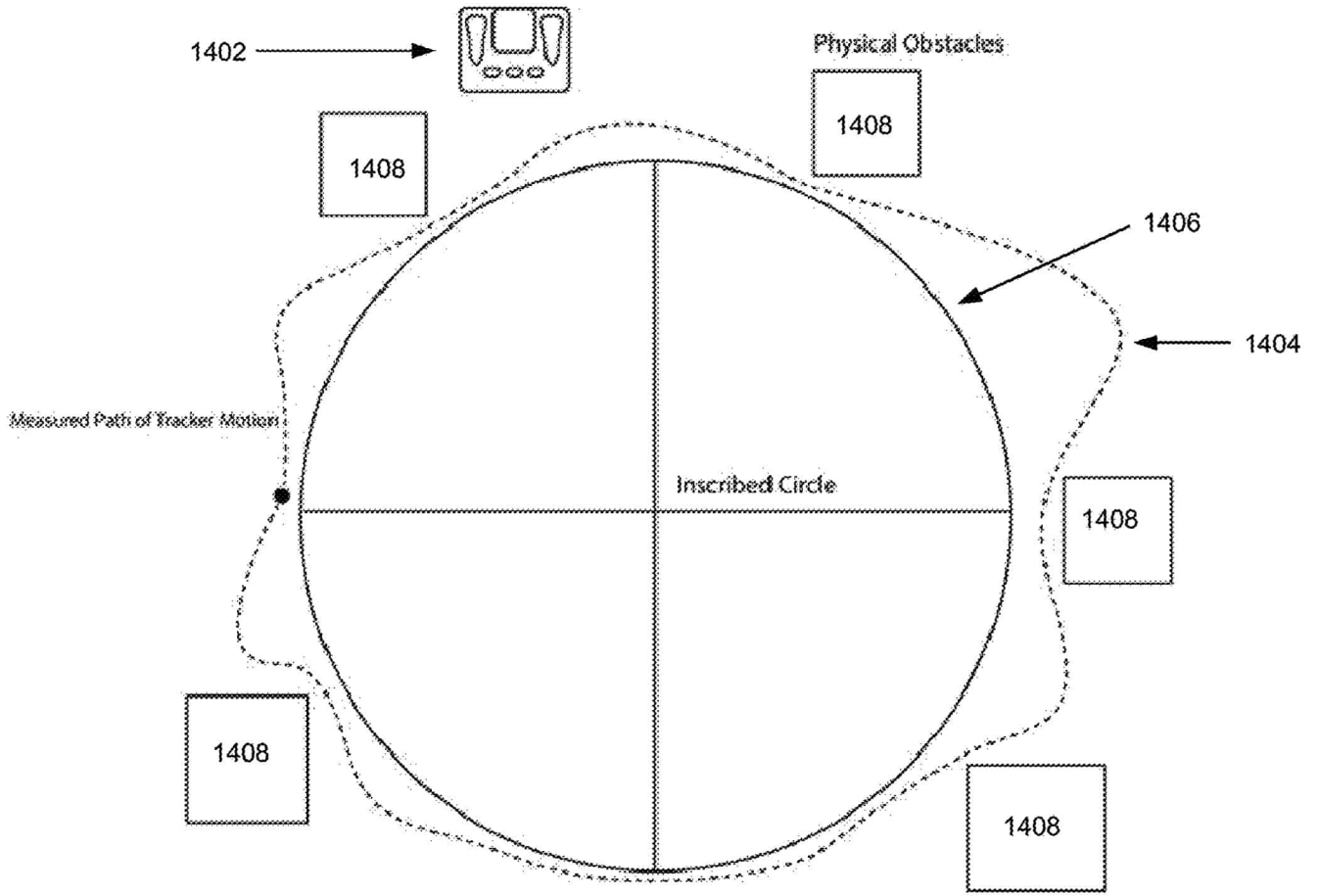


Figure 14

Ex. 1005 (Pedrotti) at Fig. 14

Overview Of Pedrotti

Pedrotti

FIG. **11** shows one such form of visual warning. In FIG. **11** it is assumed that the user **1002** is holding a controller with a tracker in the hand corresponding to virtual hand **1012**, and that the user **1002** has extended that hand to a point within the preselected distance from the boundary of the selected area. The display in FIG. **11** is similar to that of FIG. **10**, except that since the user **1002** has extended his hand holding the controller, the virtual hand **1012** now extends further in front of the user **1002**.

In addition, since the hand of the user **1002** is within the preselected distance of the boundary of the selected area, the processor generates instructions to the HMD to generate the visual warning. As illustrated in this embodiment, this visual warning is in the form of a grid of lines or a "virtual fence" located at the boundary, as indicated in FIG. **11** by the dashed lines **1114**. The grid can be glowing or colored if desired to be more visible to the user. In other embodiments, other shapes than a grid-shaped virtual fence can be displayed to the user. For example, the developer of a particular

Ex. 1005 (Pedrotti) at 12:51-13:2

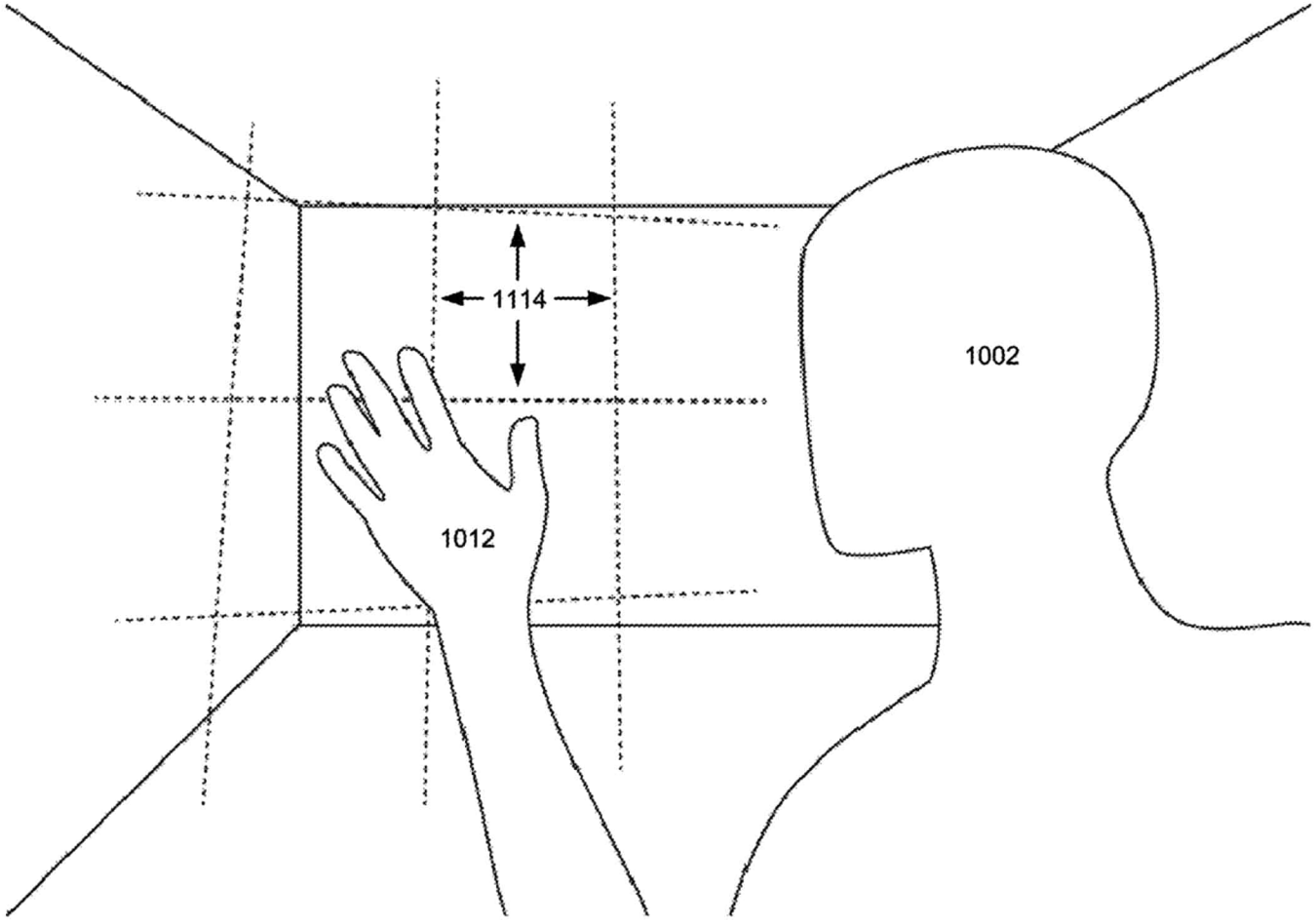


Figure 11

Ex. 1005 (Pedrotti) at Fig. 11

Motivations To Combine: McCulloch And Safety Boundaries

McCulloch

environment as a factor in the execution of a game. Some applications store adaptive virtual environment rules **342** for effecting the placement and display of one or more virtual objects in a 3D mapping of an environment during their execution. For example, a gaming application may receive user input identifying boundaries for a playspace in which virtual objects can be positioned. For example, the user input data may be image and depth data from a capture device on the display device captured while a user is turning his head, gaze data captured while the user is gazing at boundary points and perhaps audio data captured by the microphone of the user speaking a command like "boundary". In other examples, an application automatically determines a play-space or operation space for the application based on a 3D mapping of the user environment or location. A 3D mesh may be used to represent the mapping of the environment. The adaptive virtual environment rules are flexible in that they provide fallback rules or alternative rules based on the real objects and real features mapped in the user environment. An example of a real feature is lighting. Another example is size dimensions.

Ex. 1008 (McCulloch) at 20:7-27

Pedrotti

Thus, it is desirable to provide a means by which the user may be made aware that the user is approaching a boundary of a selected area in which the user desires to remain, to avoid physical objects or for any other reason, without distracting the user from the immersive virtual world. In one

Ex. 1005 (Pedrotti) at 11:66-12:3

game consoles. As above, various embodiments may be applicable to HMDs that block the user's view of all or only part of the physical world. Even some uses of a device such as Google Glass, which obscures only a small portion of the user's field of vision of the physical world, may benefit from some embodiments described herein.

Ex. 1005 (Pedrotti) at 16:14-19

A POSA Would Have Been Motivated To Use Boundaries Even In AR

Sabelman

It's ironic, really. You buy an AR device to make you more able, yet you're likely to experience some of the same problems faced by visually impaired individuals: reduced depth of focus, distance and speed perception, and reaction time. Indeed, AR users may be at more risk than someone with a permanent vision problem, because they have developed no compensatory strategies for lost vision.

* * *

the projected image. But our innate neural wiring prefers images of people to objects–and that is the case even if the people are virtual and the objects are real. So if you're looking at something not human in the real world, but the AR image includes people (or even simple shapes resembling the human form) AR will win the struggle for attention.

Ex. 1088 (Sabelman) at 51-52

Dr. Welch, Decl.

410. Even as an Augmented Reality (AR) system, McCulloch's system is susceptible to safety issues stemming from the user's impeded ability to sense the real, physical environment, which necessitates Pedrotti's "safe area" or boundaries. Persons of ordinary skill in the art would have known and understood that virtual objects and effects in an AR paradigm can occlude the user's view of the real world—indeed such occlusions are intentional. For example, in his widely cited and well-known article titled "A Survey of Augmented Reality," Ron Azuma defines AR as "allow[ing] the user to see the real world, with virtual objects superimposed upon or composited with the real world." Azuma, *A Survey of Augmented Reality* (1997) ("Azuma") (Ex.1112) at 356.

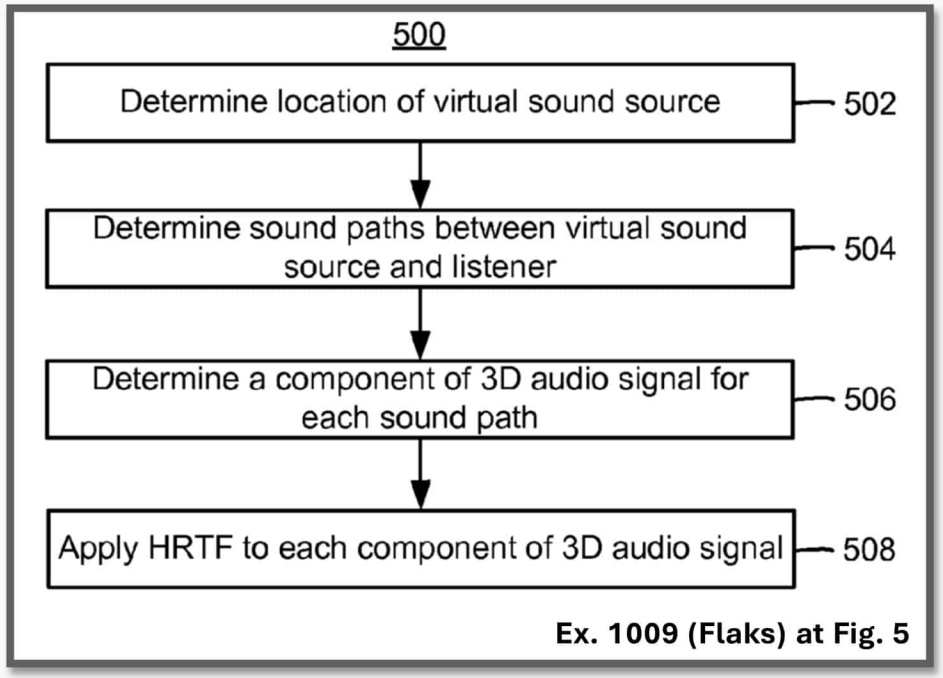
Ex. 1003 (Welch Decl.) ¶ 410

Overview Of Flaks

Flaks

It is well known that humans have the ability to recognize the source of a sound using their ears even without any visual cues. Humans estimate the location of a source by taking cues derived from one ear, and by comparing cues received at both ears (difference cues or binaural cues). Among the difference

Ex. 1009 (Flaks) at 1:7-11



Ex. 1009 (Flaks) at Fig. 5

Flaks

FIG. **5**A is a flowchart of one embodiment of a process **500** of determining components for a 3D audio signal. Process **500** is one embodiment of step **306** of process **300**. In step **502**, the location of a virtual sound source **29** is determined. For example, if a user is interacting with a virtual world depicted on a display **196**, then the virtual sound source **29** could be some object being displayed in that virtual world. However, the virtual sound source **29** could be an actual or virtual object in the user's room. For example, the user could place an object at a desired location in the room. Then, the system could identify the location of the object. As specific

* * *

In step **504**, sound paths between the virtual sound source **29** and the listener **8** are determined. This may include deter-

* * *

In step **506**, a component of the 3D audio signal is determined for each sound path. These different components may be joined to form the 3D audio signal. The information about

* * *

In step **508**, an HRTF for the listener is applied to each audio component. Further details of determine a suitable HRTF for the listener are discussed below. After applying the

Ex. 1009 (Flaks) at 9:4-14, 9:27-28, 9:49-51, 9:65-67

Motivations To Combine: McCulloch Incorporates Flaks By Reference

McCulloch

The 3D audio engine **304** is a positional 3D audio engine which receives input audio data and outputs audio data for the earphones **130** or other output audio devices like speakers in other embodiments. The received input audio data may be for a virtual object or be that generated by a real object. Audio data for virtual objects generated by an application can be output to the earphones to sound as if coming from the direction of the virtual object projected into the display field of view. An example of a positional 3D audio engine which may be used with an augmented reality system is disclosed in U.S. patent application Ser. No. 12/903,610 entitled "System and Method for High-Precision 3-Dimensional Audio for Augmented Reality," to Flaks et al., and filed Oct. 13, 2010, which is hereby incorporated by reference. Audio data from a sound library **312** may be associated with one or more collisions or actions for a particular physics model by an application or a user so that the 3D audio engine **304** will play the audio data during display of one or more collisions or actions.

Ex. 1008 (McCulloch) at 21:21-38

Flaks

In a real-world situation the sound actually emanates from a particular location. It can be desirable to enable the listener to perceive that sound produced by audio-speakers appears to come from a particular location in 3-dimensional space. One possible technique involves having the user wear "headphones," also referred to as a "headset." That is, one audio-speaker is placed over or near each ear. This technique may employ creating an audio signal using a "head-related transfer function" (HRTF) to create the illusion that sound is originating from a location in 3D space. Herein, an audio signal that creates the illusion that sound is coming from a location in 3D space is referred to as a 3D audio signal.

Ex. 1009 (Flaks) at 1:17-28

'509 Patent, Limitation 9[pre] (Ground 2)

[9pre]	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.

McCulloch Discloses A Non-Transitory Computer Readable Storage Medium

McCulloch

Control circuitry **136** provide various electronics that support the other components of head mounted display device **2**. In this example, the right temple **102***r* includes control circuitry **136** for the display device **2** which includes a processing unit **210**, a memory **244** accessible to the processing unit **210** for storing processor readable instructions and data, a wireless interface **137** communicatively coupled to the processing unit **210**, and a power supply **239** providing power for the components of the control circuitry **136** and the other components of the display **2** like the capture devices **113**, the microphone **110** and the sensing units discussed below. The processing unit **210** may comprise one or more processors including a central processing unit (CPU) and a graphics processing unit (GPU), particularly in embodiments without a separate companion processing module **4**, which contains at least one graphics processing unit (GPU).

Ex. 1008 (McCulloch) at 8:1-16

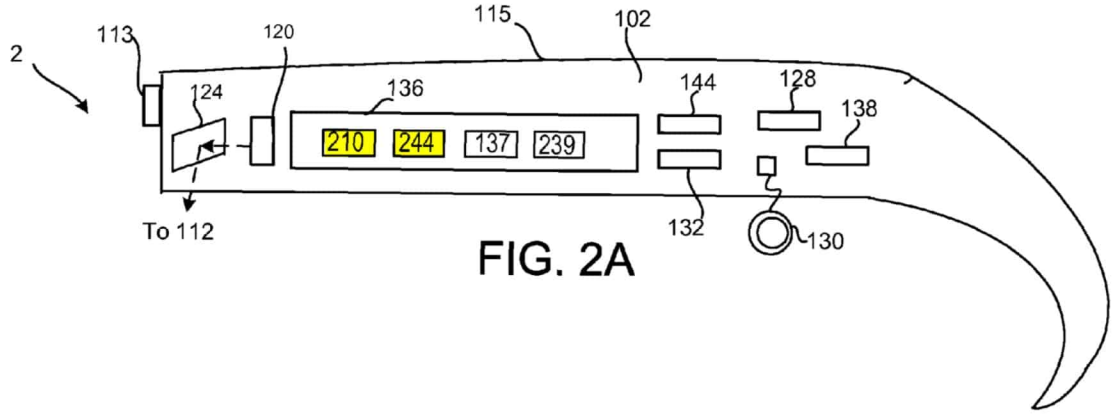


FIG. 2A

Ex. 1008 (McCulloch) at Fig. 2A

McCulloch Discloses A Non-Transitory Computer Readable Storage Medium

McCulloch

FIG. **9** is a block diagram of one embodiment of a computing system that can be used to implement one or more network accessible computer systems **12** or a companion processing module **4** which may host at least some of the software components of computing environment **54** or other elements depicted in FIG. **4**A. With reference to FIG. **9**, an exemplary system includes a computing device, such as computing device **900**. In its most basic configuration, computing device **900** typically includes one or more processing units **902** including one or more central processing units (CPU) and one or more graphics processing units (GPU). Computing device **900** also includes memory **904**. Depending on the exact configuration and type of computing device, memory **904** may include volatile memory **905** (such as RAM), non-volatile memory **907** (such as ROM, flash memory, etc.) or some combination of the two. This most basic configuration

Ex. 1008 (McCulloch) at 30:4-19

'509 Patent, Limitation 9[a] (Ground 2)

[9pre]	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.

Pedrotti Discloses Dividing, With A PED, An Area Around The User Into A Zone

Pedrotti

As above the processor is tracking the position and orientation of the user's head from the tracker of the HMD, and possibly tracking the position and orientation of the user's hand if the user is holding a controller with a tracker. Thus, the processor knows where the user's head and hands are located; if the processor has been provided with information about the boundary of the selected area then the processor can also determine when the user's head and/or hand approaches the boundary.

* * *

In still another embodiment, an irregularly shaped area is defined, as shown in FIG. **14**. A boundary **1404** around an irregularly shaped area, which is not circular, can be defined, for example, by having the user walk around a perimeter chosen by the user with one of the trackers to define the outer boundary of a selected area, for example, one in which there are no obstacles. The processor determines the position of the tracker at a number of sampling points as the user moves around the chosen perimeter, and from those points determines the boundary **1404**. This approach may be desirable

Ex. 1005 (Pedrotti) at 12:31-39, 14:56-65

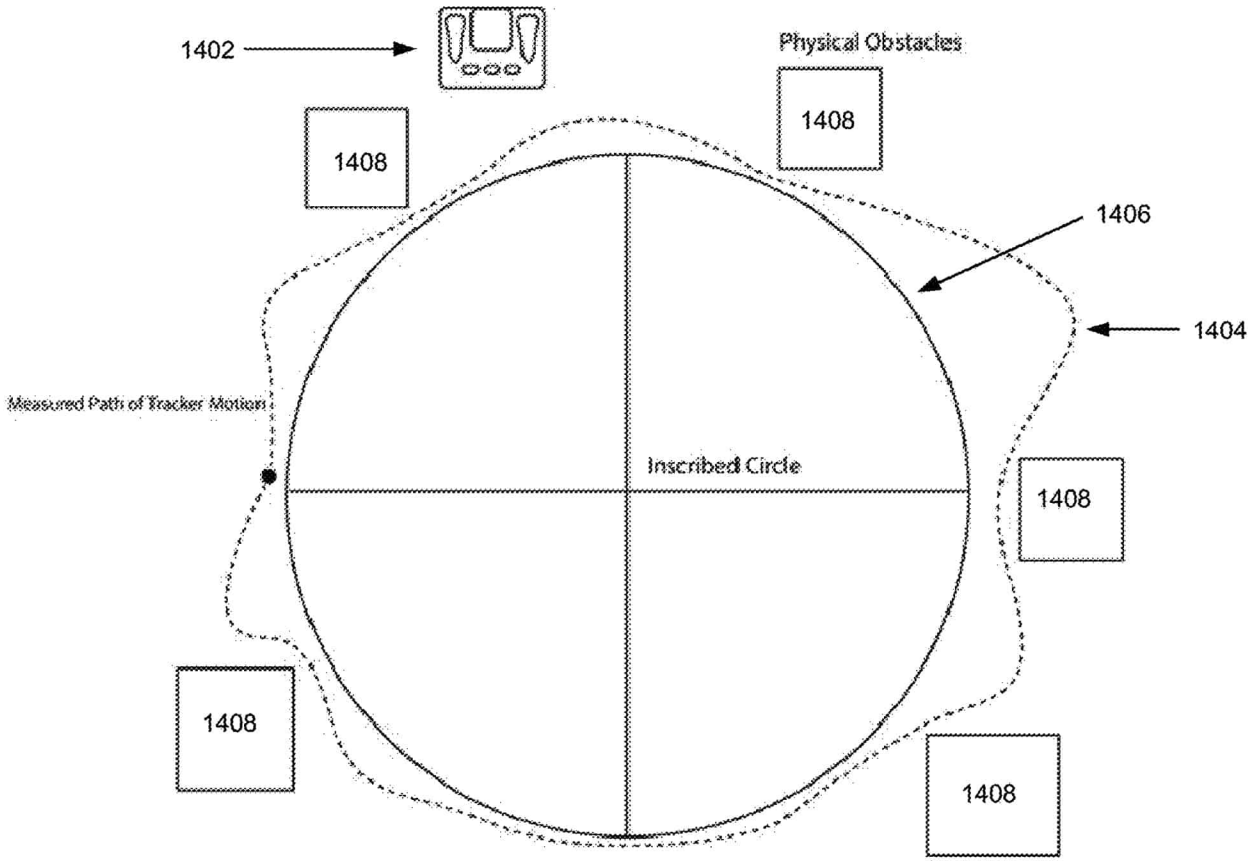


Figure 14

Ex. 1005 (Pedrotti) at Fig. 14

McCulloch's System, Like Pedrotti's, Defines Boundaries Around Users

McCulloch

environment as a factor in the execution of a game. Some applications store adaptive virtual environment rules **342** for effecting the placement and display of one or more virtual objects in a 3D mapping of an environment during their execution. For example, a gaming application may receive user input identifying boundaries for a playspace in which virtual objects can be positioned. For example, the user input data may be image and depth data from a capture device on the display device captured while a user is turning his head, gaze data captured while the user is gazing at boundary points and perhaps audio data captured by the microphone of the user speaking a command like "boundary". In other examples, an application automatically determines a play-space or operation space for the application based on a 3D mapping of the user environment or location. A 3D mesh may be used to represent the mapping of the environment. The adaptive virtual environment rules are flexible in that they provide fallback rules or alternative rules based on the real objects and real features mapped in the user environment. An example of a real feature is lighting. Another example is size dimensions.

Ex. 1008 (McCulloch) at 20:7-27

Dr. Welch, Decl.

427. The computing environment also receives inertial and positional data from "handheld IMU controller[s]," which are PEDs held in the hands of the user. McCulloch (Ex.1008) at 4:25-31 (describing variants of controllers), 28:63-66 ("Joe is holding a handheld IMU real controller device 19 in this example"). "[C]hanges in position and orientation of [a] handheld controller cause 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 [a] virtual object," such as a virtual basketball. McCulloch (Ex.1008) at 29:4-11. And as I

Ex. 1003 (Welch Decl.) ¶ 427

McCulloch And Flaks Render Obvious The Existence Of SLPs In Empty Space

McCulloch

The 3D audio engine **304** is a positional 3D audio engine which receives input audio data and outputs audio data for the earphones **130** or other output audio devices like speakers in other embodiments. The received input audio data may be for a virtual object or be that generated by a real object. Audio data for virtual objects generated by an application can be output to the earphones to sound as if coming from the direction of the virtual object projected into the display field of view. An example of a positional 3D audio engine which may be used with an augmented reality system is disclosed in U.S. patent application Ser. No. 12/903,610 entitled "System and Method for High-Precision 3-Dimensional Audio for Augmented Reality," to Flaks et al., and filed Oct. 13, 2010, which is hereby incorporated by reference. Audio data from a sound library **312** may be associated with one or more collisions or actions for a particular physics model by an application or a user so that the 3D audio engine **304** will play the audio data during display of one or more collisions or actions.

Ex. 1008 (McCulloch) at 21:21-38

Flaks

originating from a location in 3D space. Herein, an audio signal that creates the illusion that sound is coming from a location in 3D space is referred to as a 3D audio signal.

* * *

requires accurate 3-D audio. For example, a user should be able to accurately localize a sound as coming from a virtual sound source.

Ex. 1009 (Flaks) at 1:26-28, 44-46

McCulloch Discloses Zones Including SLPs In Empty Space

McCulloch

environment as a factor in the execution of a game. Some applications store adaptive virtual environment rules **342** for effecting the placement and display of one or more virtual objects in a 3D mapping of an environment during their execution. For example, a gaming application may receive user input identifying boundaries for a playspace in which virtual objects can be positioned. For example, the user input

Ex. 1008 (McCulloch) at 20:7-27

McCulloch

nism. Additionally, in optional step **416**, the 3D audio engine **304** plays audio data for the virtual object projected from a 3D space position of the virtual object relative to a 3D space position and orientation identified for the display device which is used to approximate the position and orientation of the user's head supporting the display device. In the helicopter examples, a flight path of the virtual helicopter currently has it on course to fly into a wall behind the user. The user gets distracted and does not change the path via user input. The virtual helicopter is no longer displayed in the display field of view, but the 3D audio engine **304** plays the audio of the virtual crash to project from a position of the wall behind the user.

Ex. 1008 (McCulloch) at 26:7-19

'509 Patent, Limitation 9[b] (Ground 2)

[9pre]	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.

Patent Owner Challenges Only Limitation 9[b]

Patent Owner Response

3. The proposed combination does not render obvious Claims 9-16.

Petitioner's proposed combination does not teach or render obvious limitation 9[b]. As explained in §II.A.4, limitation 9[b] requires that the processor responsible for making the determination is located in the WED.

Petitioner advances the exact same argument as it raises for limitation 1[b] in Ground 2. Pet. 65. For limitation 1[b], Petitioner refers back to its argument for Ground 1. *Id.* at 53. For the reasons discussed in §II.A.4, Petitioner's argument fails. Additionally, Petitioner references portions of McCulloch that discloses sensors in the HMD. *Id.* But these cites portions do not teach that the act of determination is performed by a processor in the HMD.

For the forgoing reasons, Petitioner's obviousness analysis under Ground 1 fails as to 9 as well as Claims 10-14 depending from Claim 9.

POR at 46

Icon Health & Fitness, Inc. v. Strava, Inc.

"Attorney argument is not evidence."

***Icon Health & Fitness, Inc. v. Strava, Inc.*, 849 F.3d 1034, 1043 (Fed. Cir. 2017)**

Pedrotti Discloses Determining The User Is Located Inside The Zone With The WED

Pedrotti

As above the processor is tracking the position and orientation of the user's head from the tracker of the HMD, and possibly tracking the position and orientation of the user's hand if the user is holding a controller with a tracker. Thus, the processor knows where the user's head and hands are located; if the processor has been provided with information about the boundary of the selected area then the processor can also determine when the user's head and/or hand approaches the boundary.

* * *

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 station, 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 (Pedrotti) at 12:35-39, 16:20-26

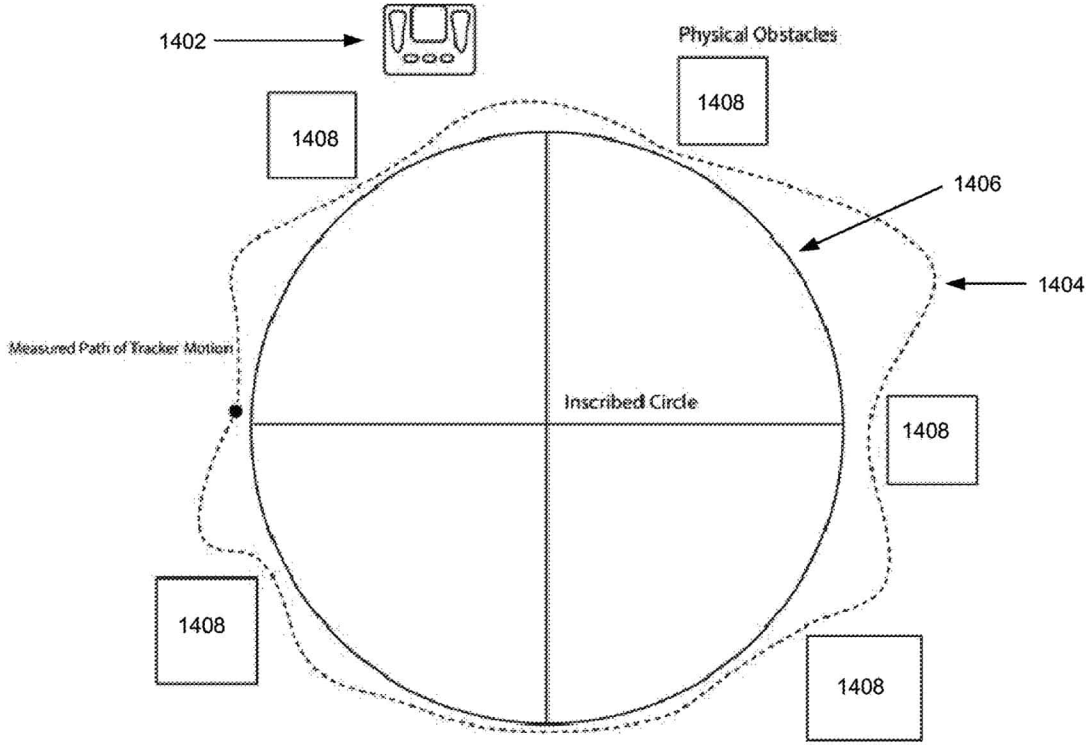


Figure 14

Ex. 1005 (Pedrotti) at Fig. 14

McCulloch Renders Obvious Determining The User Is Located Inside The Zone With The WED

McCulloch

Inside, or mounted to temple **102**, are an earphone of a set of earphones **130**, an inertial sensing unit **132** including one or more inertial sensors, a location sensing unit **144** including one or more location or proximity sensors, some examples of which are a GPS transceiver, an infrared (IR) transceiver, or a radio frequency transceiver for processing RFID data. Optional electrical impulse sensing unit **128** detects commands via eye movements. In one embodiment, 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

Ex. 1008 (McCulloch) at 8:17-28

McCulloch

In some examples, virtual objects are tracked in the display field of view and real objects are ignored. Data such as from the inertial sensing unit **132** may identify position changes of the head mounted display device **2**, and hence, the user's eyes and perspective. For example, the inertial sensing unit **132** may identify rotation of the user's eyes and therefore rotation of the user's perspective of the virtual object. The display of

Ex. 1008 (McCulloch) at 12:4-9

McCulloch's HMD Includes Processors And A Computing Environment Capable Of Determining User's Location

210: processing unit, which "may comprise one or more processors including a central processing unit (CPU) and a graphics processing unit (GPU)" and "memory 244"

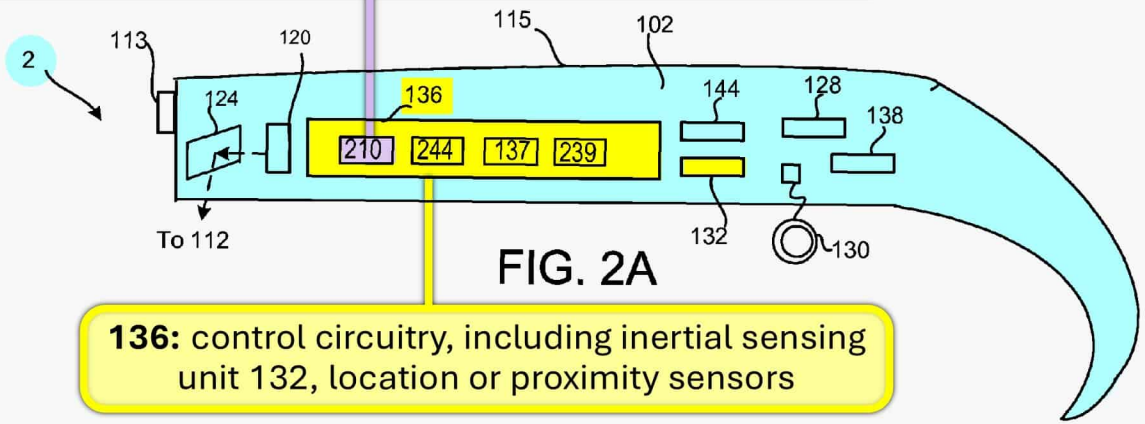


FIG. 2A

136: control circuitry, including inertial sensing unit 132, location or proximity sensors

McCulloch's HMD Includes Processors And A Computing Environment Capable Of Determining User's Location

210: processing unit, which "may comprise one or more processors including a central processing unit (CPU) and a graphics processing unit (GPU)" and "memory 244"

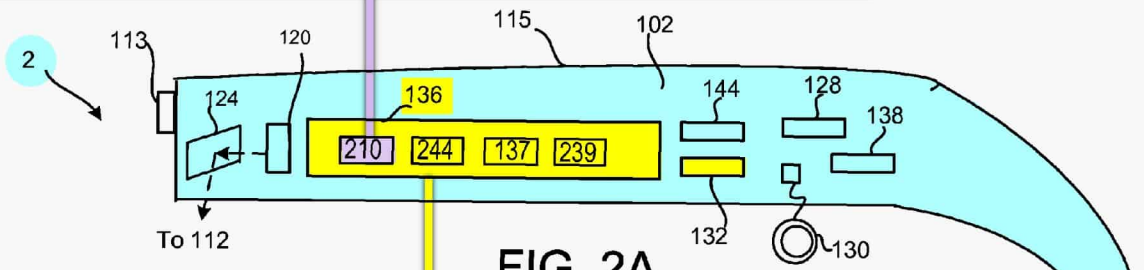


FIG. 2A

136: control circuitry, including inertial sensing unit 132, location or proximity sensors

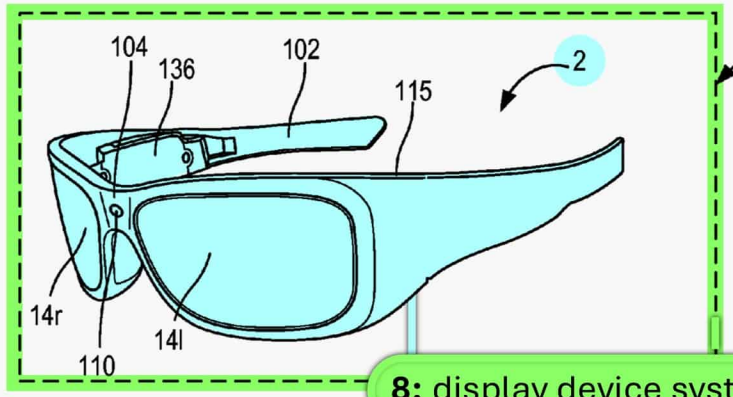
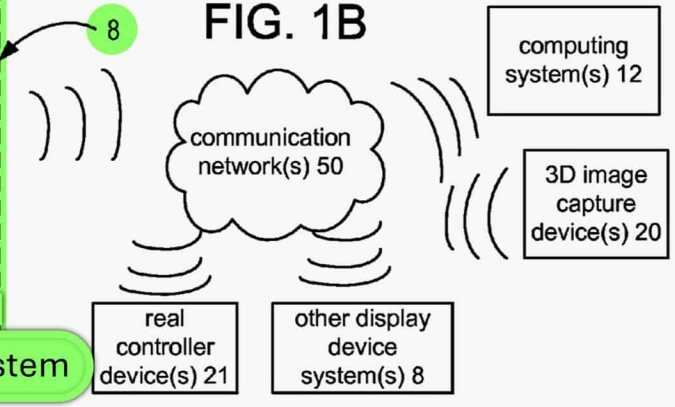


FIG. 1B



8: display device system

2: head mounted display device

McCulloch's HMD Includes Processors And A Computing Environment Capable Of Determining User's Location

210: processing unit, which "may comprise one or more processors including a central processing unit (CPU) and a graphics processing unit (GPU)" and "memory 244"

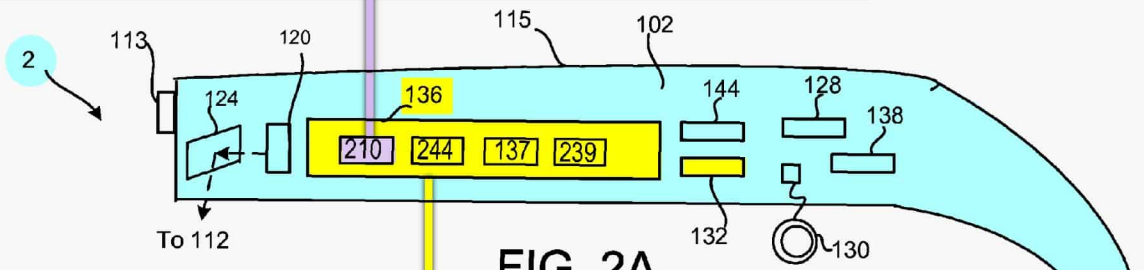
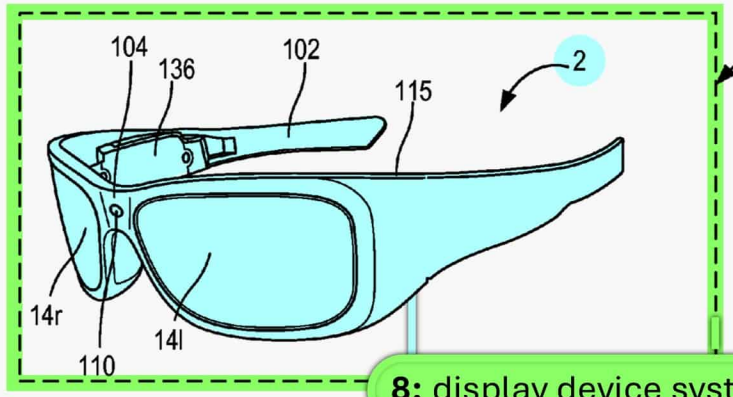


FIG. 2A

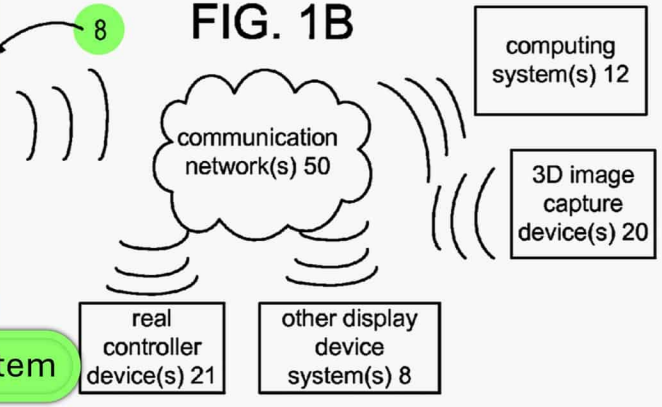
136: control circuitry, including inertial sensing unit 132, location or proximity sensors



8: display device system

2: head mounted display device

FIG. 1B



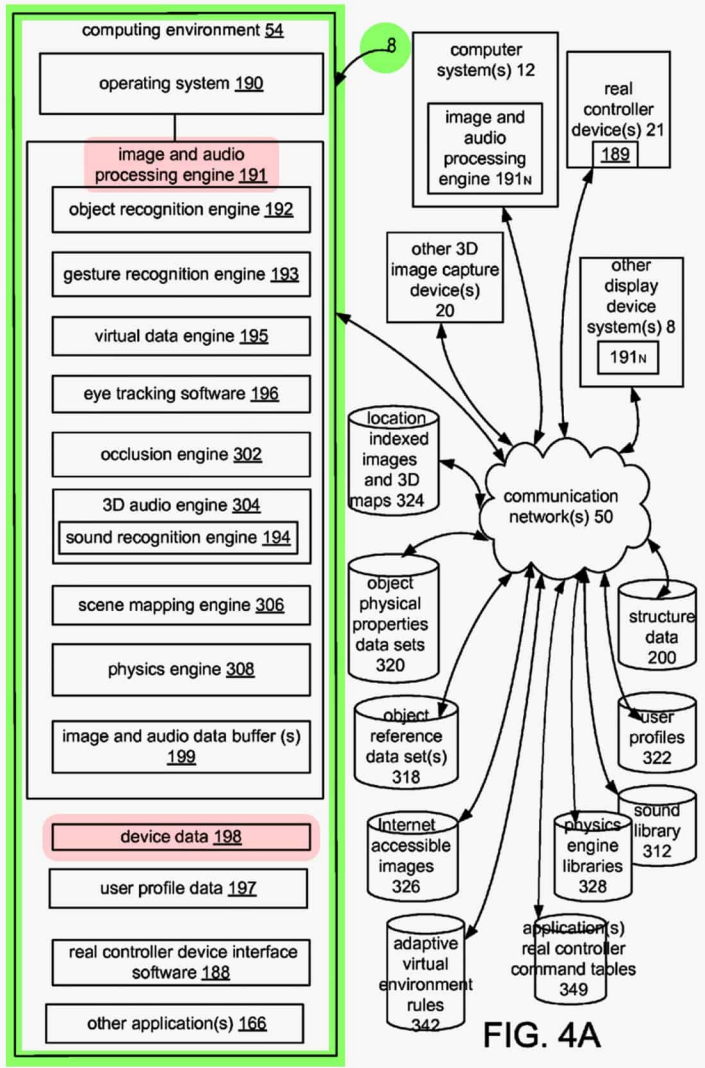


FIG. 4A

Ex. 1008 (McCulloch) at 8:1-46, Figs. 1B, 2A, 4A

Flaks Renders Obvious Determining The User Is Located Inside The Zone With The WED

Flaks

might change over time. Since the listener's location might change quite frequently, it might be carefully tracked.

* * *

gnome on a desk. The system then determines the location of the object by, for example, using the depth camera system. As discussed earlier, the system may track the physical location of the user. Therefore, the system is able to determine that the user has placed the gnome on the desk, by tracking the user's movements. Other techniques could be used for the system to

* * *

In step **610**, inertial sensors on the user collect data. In one embodiment, at least one inertial sensor is located on the user's head to allow tracking of the user's head.

Ex. 1009 (Flaks) at 7:33-34, 9:17-22, 11:25-27

'509 Patent, Limitation 9[c] (Ground 2)

[9pre]	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.

Pedrotti Discloses Determining When The User Is Leaving The Zone With The WED

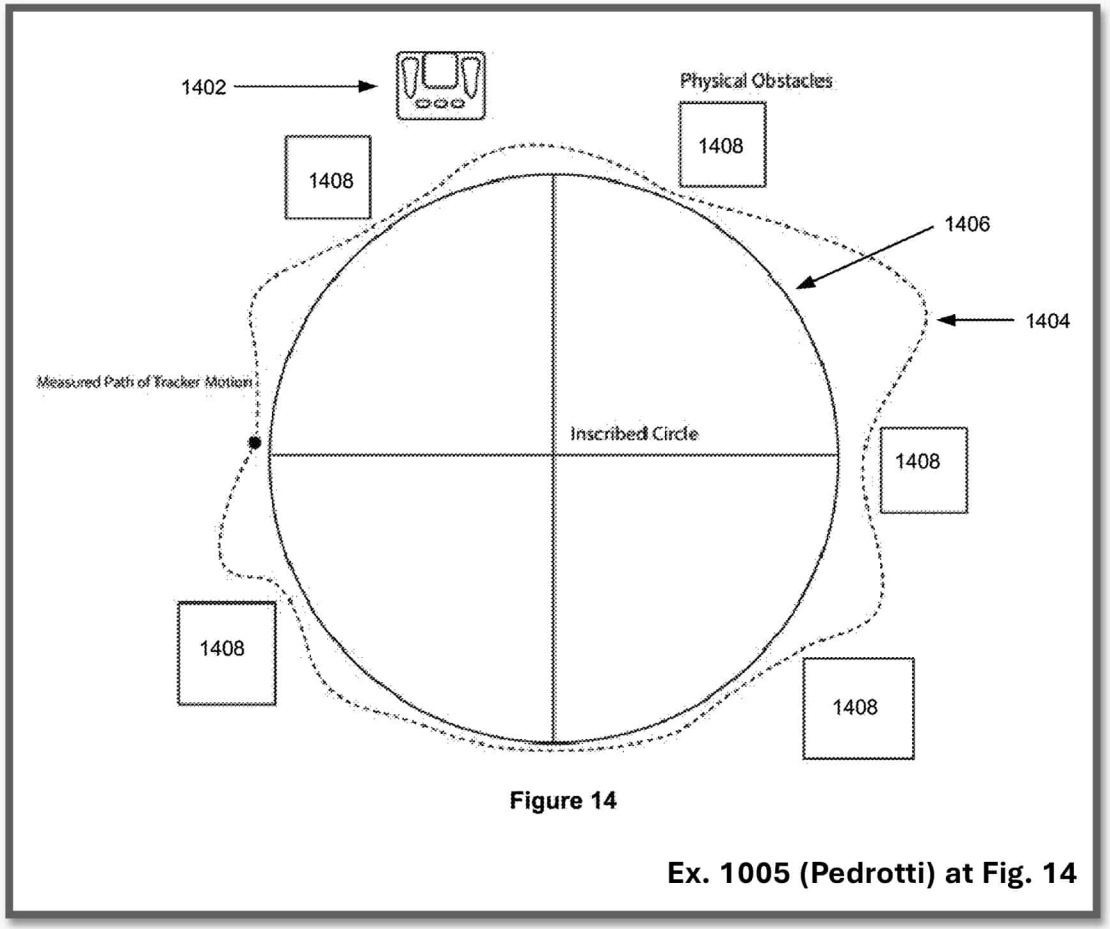


Figure 14

Ex. 1005 (Pedrotti) at Fig. 14

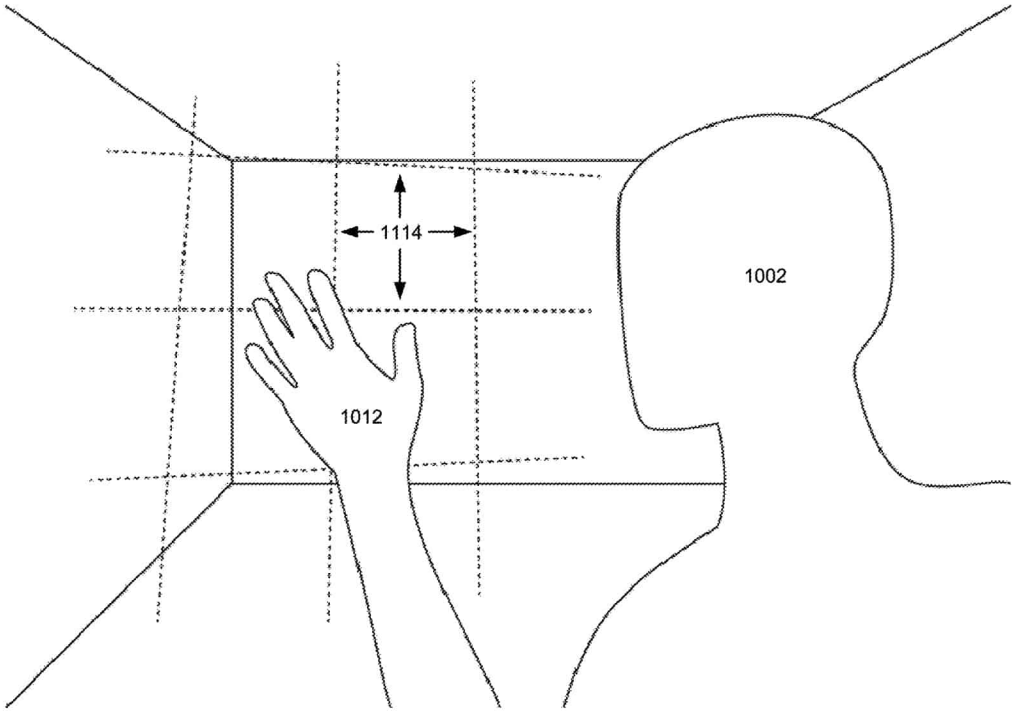


Figure 11

Ex. 1005 (Pedrotti) at Fig. 11

'509 Patent, Limitation 9[d] (Ground 2)

[9pre]	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.

Pedrotti Discloses Displaying A Virtual Fence In Response To The WED Determining The User Leaving The Zone

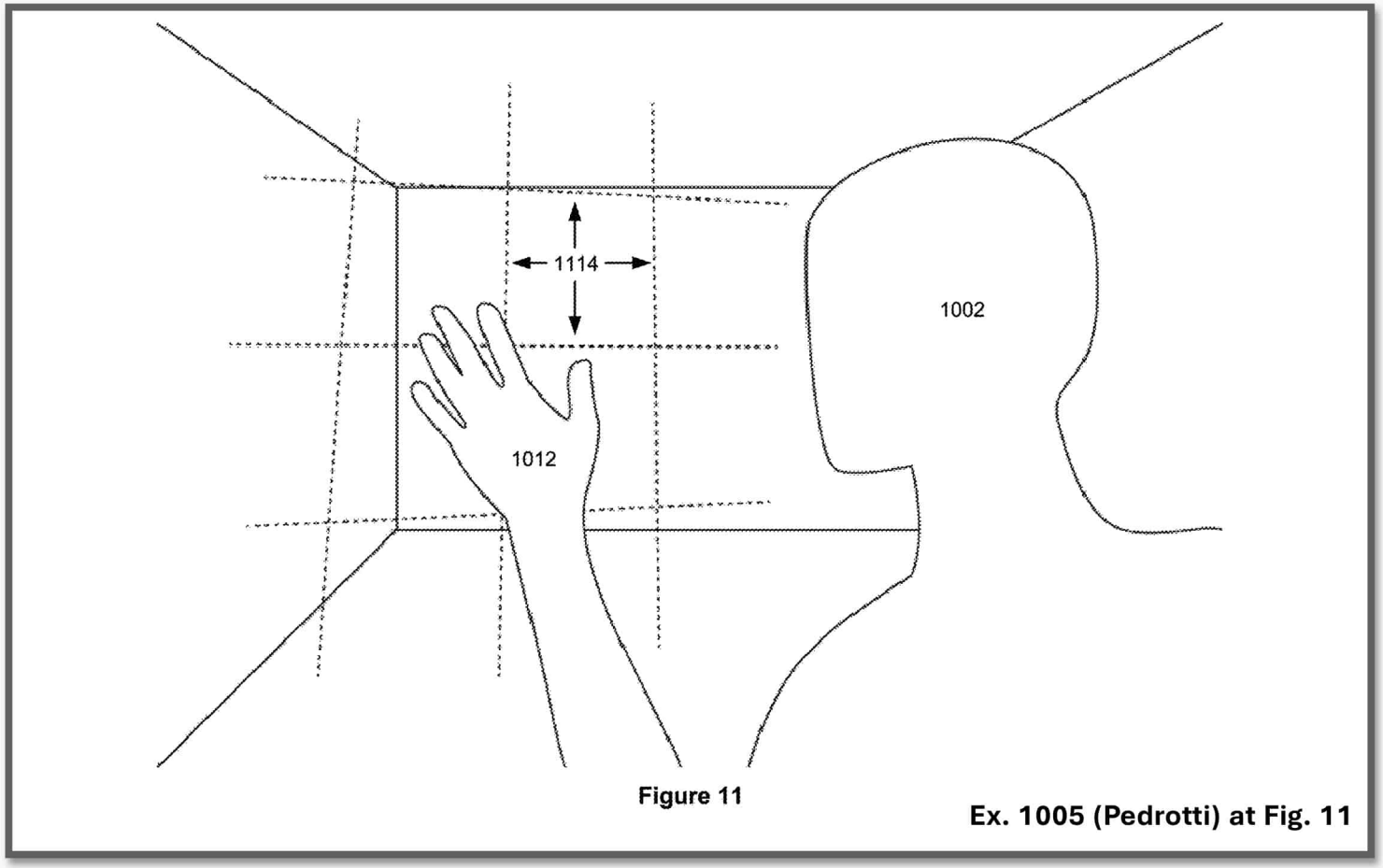


Figure 11

Ex. 1005 (Pedrotti) at Fig. 11

McCulloch Discloses Displaying Virtual Images Using Its WED

McCulloch

Mounted to or inside temple **102** is an image source or image generation unit **120** which produces visible light representing images. The image generation unit **120** can display a virtual object to appear at a designated depth location in a field of view to provide a realistic, in-focus three dimensional display of a virtual object and which can interact with one or more real objects. Some examples of embodiments of image

Ex. 1008 (McCulloch) at 8:40-46, Fig. 8B

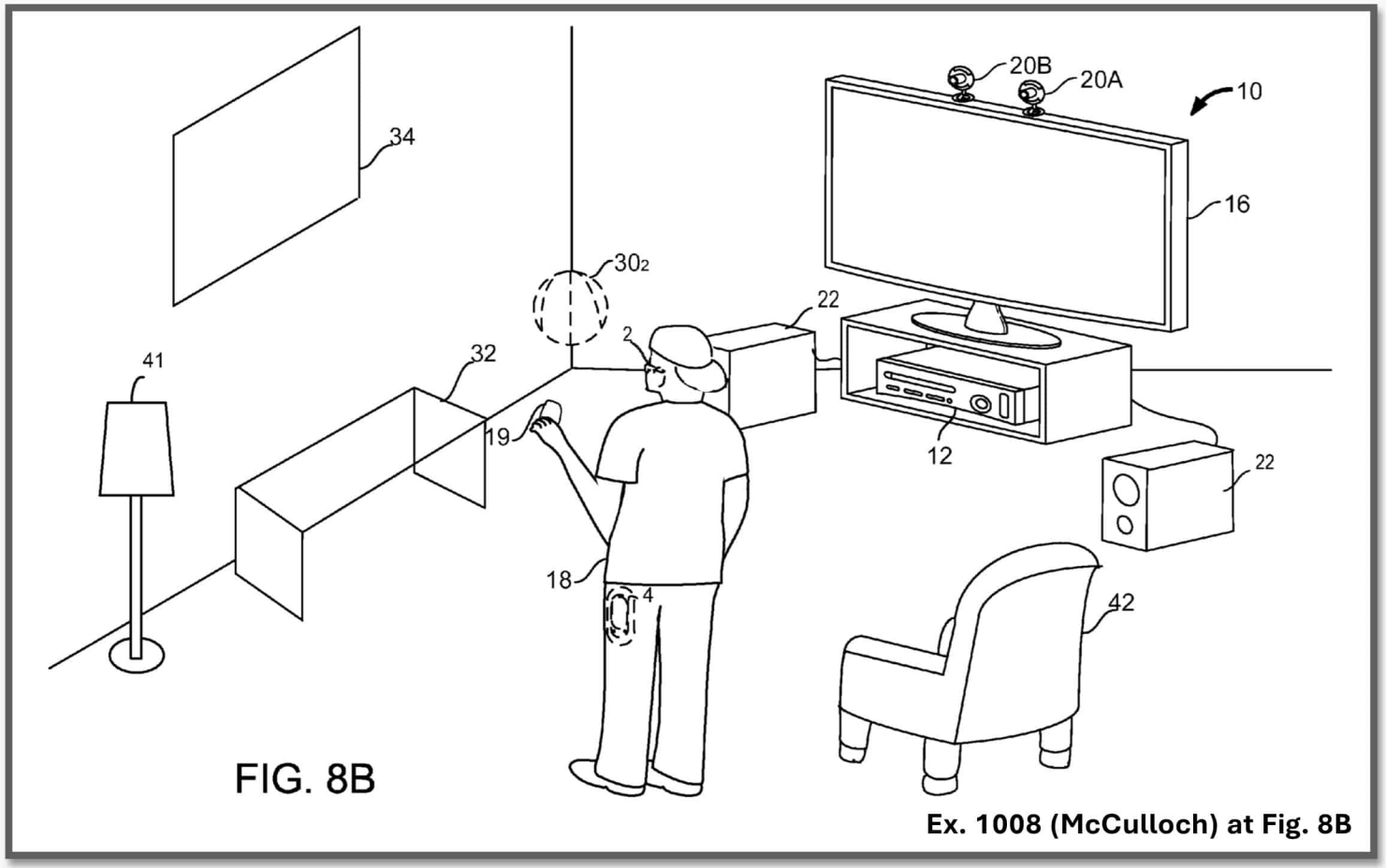


FIG. 8B

Ex. 1008 (McCulloch) at Fig. 8B

McCulloch Renders Obvious Displaying With The WED The Pedrotti-Type Zone

McCulloch

environment. A mesh may comprise a detailed geometric representation of various features including real and virtual objects and surfaces thereof within a particular environment or region of an environment. A 3D point cloud representing the surfaces of objects including things like walls and floors in a space can be generated based on captured image data and depth data of the user environment. A 3D mesh of the surfaces in the environment can then be generated from the point cloud. More information regarding the generation of 3-D maps can be found in U.S. patent application Ser. No. 13/017,690, "Three-Dimensional Environment Reconstruction," incorporated herein by reference in its entirety. 3D mesh representations of virtual objects can be added.

* * *

Virtual data engine **195** processes virtual objects and registers the 3D position and orientation of virtual objects or imagery in relation to one or more coordinate systems, for example in display field of view coordinates or in the view independent 3D map coordinates. The virtual data engine **195** determines the position of image data of a virtual object or imagery in display coordinates for each display optical system **14**. Additionally, the virtual data engine **195** performs

Ex. 1008 (McCulloch) at 17:19-31; 23:25-29

Pedrotti

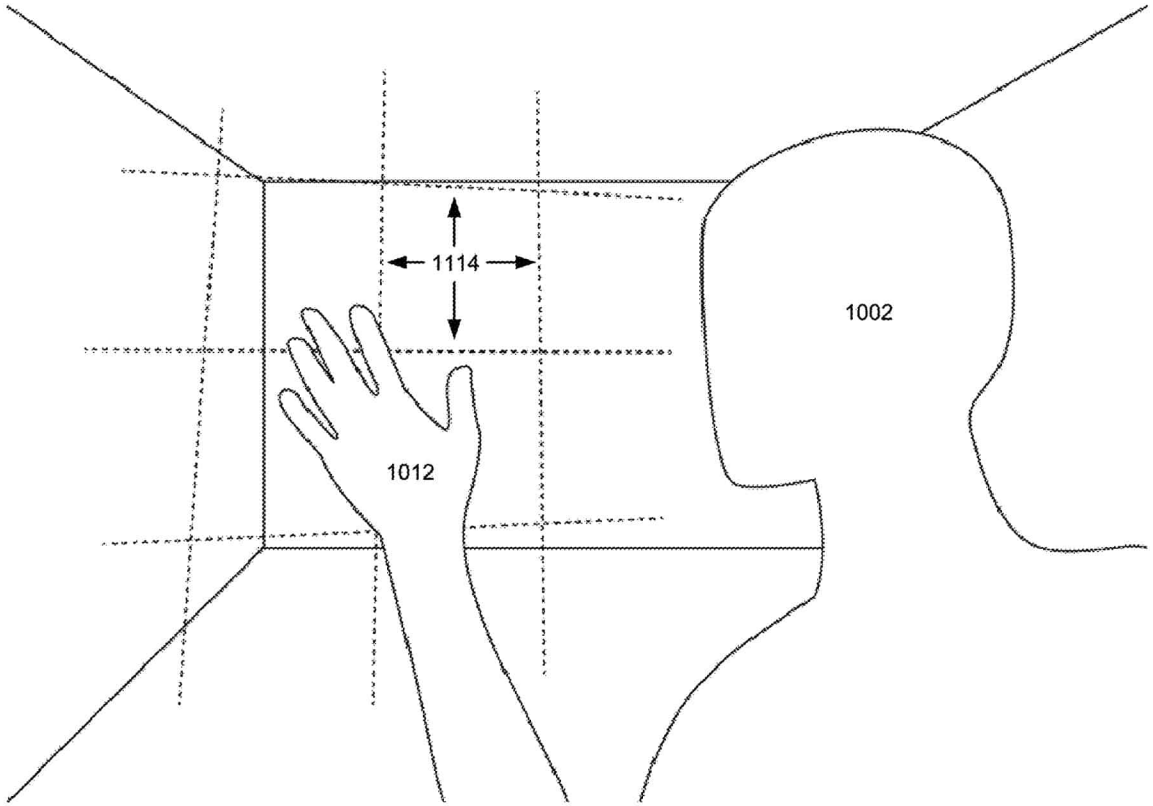


Figure 11

Ex. 1005 (Pedrotti) at Fig. 11

'509 Patent, Limitation 10[a] (Ground 2)

[10pre]	The non-transitory computer readable storage medium of claim 9 in which the method further comprises:
[10a]	determining, with the WED, when the PED is pointed at one of the SLPs while the user is located in the zone; and
[10b]	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.

McCulloch Discloses PEDs Used To Point, Select, And Control Objects

McCulloch

Some examples of the real controller device are a joystick, a steering wheel, a touch pad, a gamepad, a pointing device (e.g. mouse), a trackball assembly, a handheld inertial motion unit (IMU), a touch display (e.g. a touch pad or a multi-point touch pad) or other types of controllers, for example, other types of real controllers typically associated with gaming consoles or game applications. An application with which the real controller device may be providing user input data for the selected object can be other than a game application though.

Ex. 1008 (McCulloch) at 4:25-33

McCulloch

both systems **8** and **12**. A real controller device **21** relates one or more physical actions with respect to one or more touch activated parts, e.g. joystick, button, touchscreen, of the controller device to electrical signals which are translated into user input data which is sent to the display device system **8** for controlling an object. A real controller device **21** may also

* * *

In other examples, non-NUI input like moving a displayed selection arrow with the real controller device may be used to identify a user selected object for control or force feedback as discussed below.

Ex. 1008 (McCulloch) at 6:61-66, 25:25-28

McCulloch Discloses Determining, With The WED, Where The PED Is Pointed

McCulloch

FIG. **8B** illustrates an example of a virtual object representation of the user selected real object being controlled with the real controller device. 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 $\mathbf{30_2}$ representing the real basketball based on the user perspective. In this example, the movement of the real controller device **19** up by the user has translated into an up action to be applied to the basketball virtual object $\mathbf{30_2}$ which the user sees from his perspective as he is looking straight at the virtual basketball $\mathbf{30_2}$. The real basketball **30** has been erased in this example.

Ex. 1008 (McCulloch) at 29:4-17 , Fig. 8B

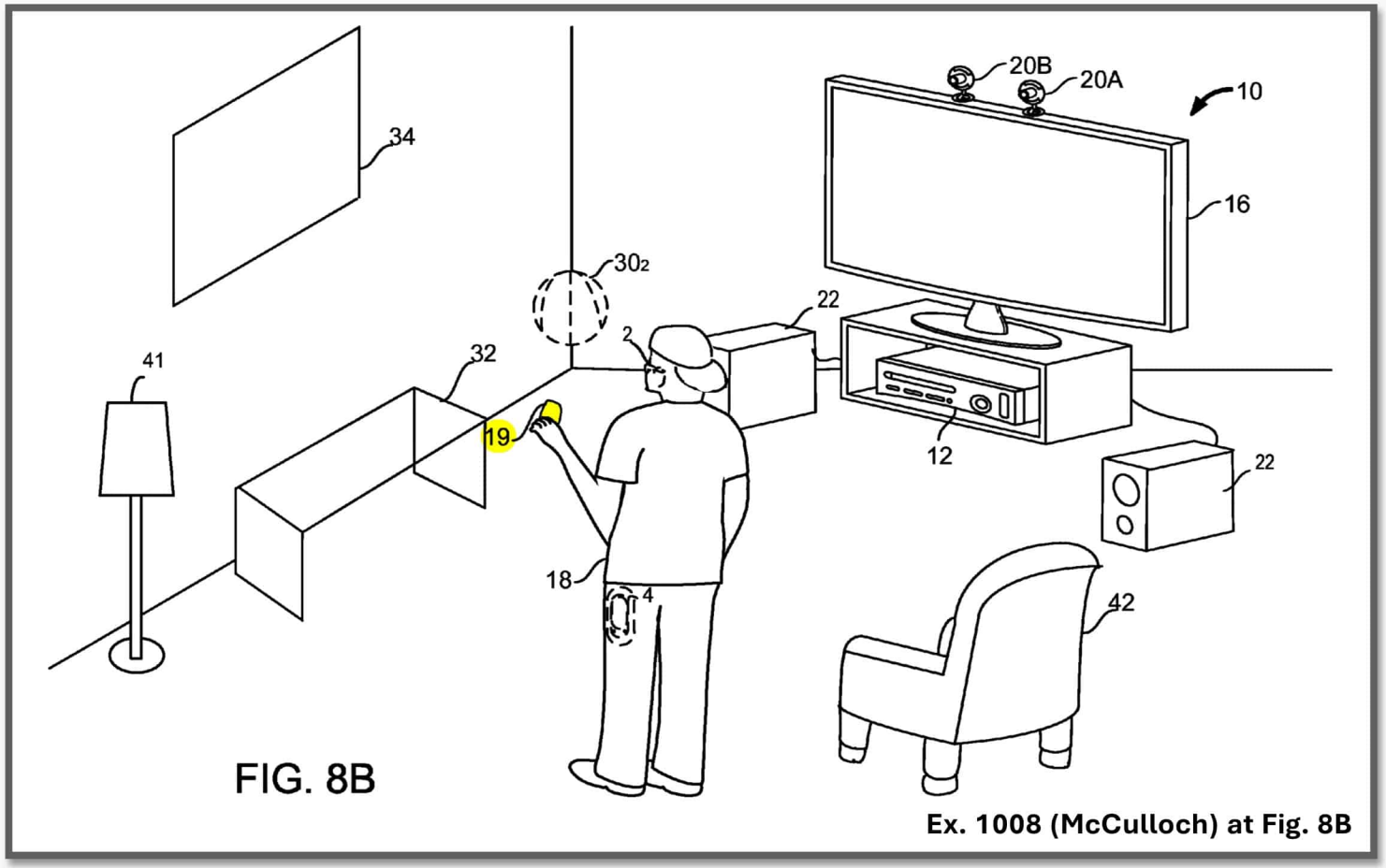


FIG. 8B

Ex. 1008 (McCulloch) at Fig. 8B

McCulloch Discloses Determining, With The WED, Where The PED Is Pointed

McCulloch

FIG. **8**D illustrates an example of a simulated effect on a physical state of the user selected force feedback object due to a collision with the virtual object representation of the user selected control real object in the continuing example of FIGS. **8**A, **8**B and **8**C. 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**. Joe has moved the handheld IMU device with such an intensity in the direction of the television **16** that the virtual basketball **303** collides with the display of the television. The physics engine **308** models the collision and the virtual data engine **195** displays a collision effect selected by the physics engine **308** based on the properties of the real basketball **30** and the real television **16** in which the display of television **16** not only cracks, as illustrated by cracks like path representative crack **45**N, but breaks resulting in glass pieces **49** and **47** separating from the display and falling to the ground, with the assistance of a gravity force component, from the vertical surface of television display. The cracking and breaking of the display is based on its physics model which is based on realistic physical properties of the display of television **16**. As the television

Ex. 1008 (McCulloch) at 29:36-57, Fig. 8D

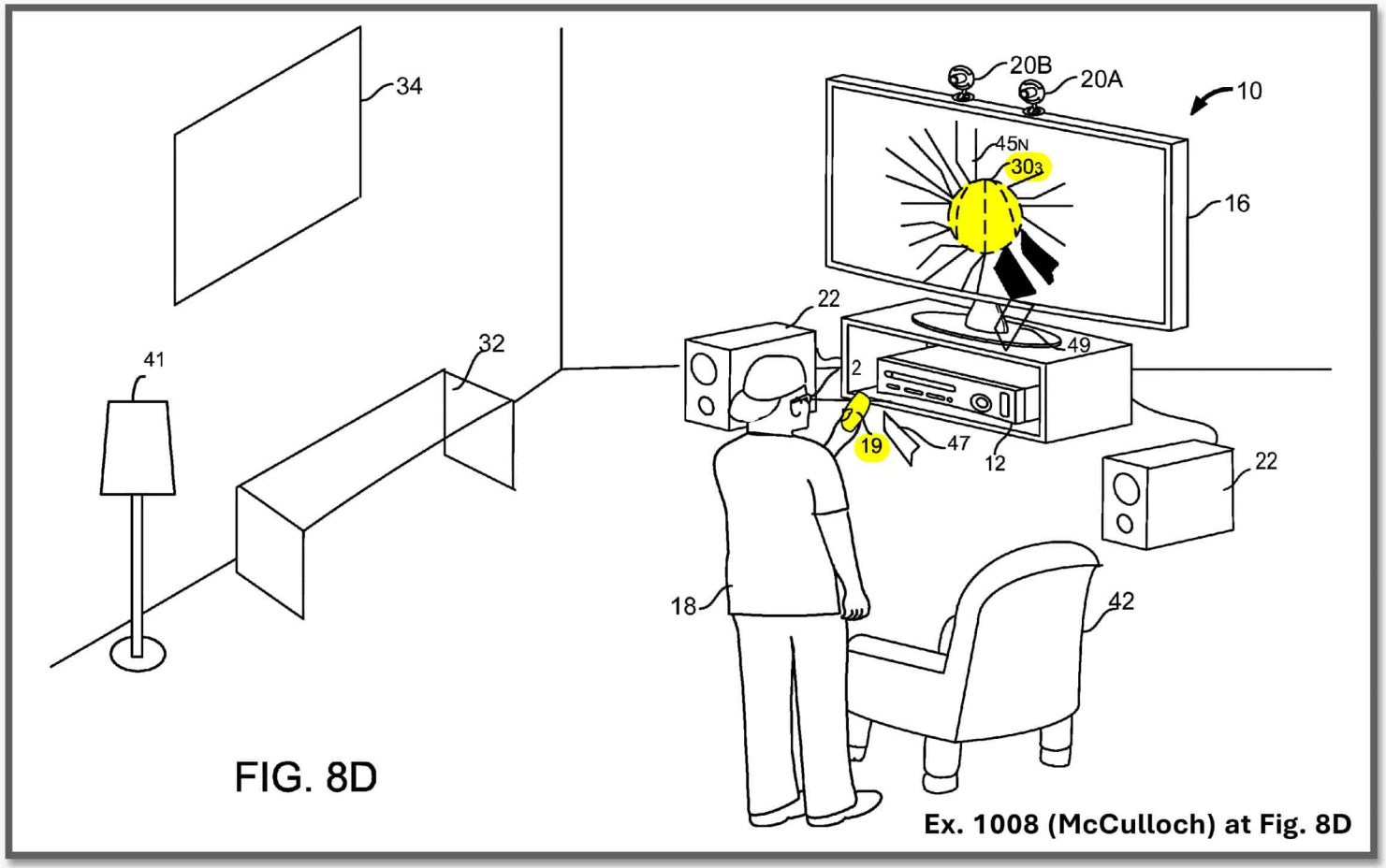


FIG. 8D

Ex. 1008 (McCulloch) at Fig. 8D

McCulloch Discloses Determining, With The WED, Where The PED Is Pointed

McCulloch

The 3D audio engine **304** is a positional 3D audio engine which receives input audio data and outputs audio data for the earphones **130** or other output audio devices like speakers in other embodiments. The received input audio data may be for a virtual object or be that generated by a real object. Audio data for virtual objects generated by an application can be output to the earphones to sound as if coming from the direction of the virtual object projected into the display field of view. An example of a positional 3D audio engine which may be used with an augmented reality system is disclosed in U.S. patent application Ser. No. 12/903,610 entitled "System and Method for High-Precision 3-Dimensional Audio for Augmented Reality," to Flaks et al., and filed Oct. 13, 2010, which is hereby incorporated by reference. Audio data from a sound library **312** may be associated with one or more collisions or actions for a particular physics model by an application or a user so that the 3D audio engine **304** will play the audio data during display of one or more collisions or actions.

Ex. 1008 (McCulloch) at 21:21-38, Fig. 8D

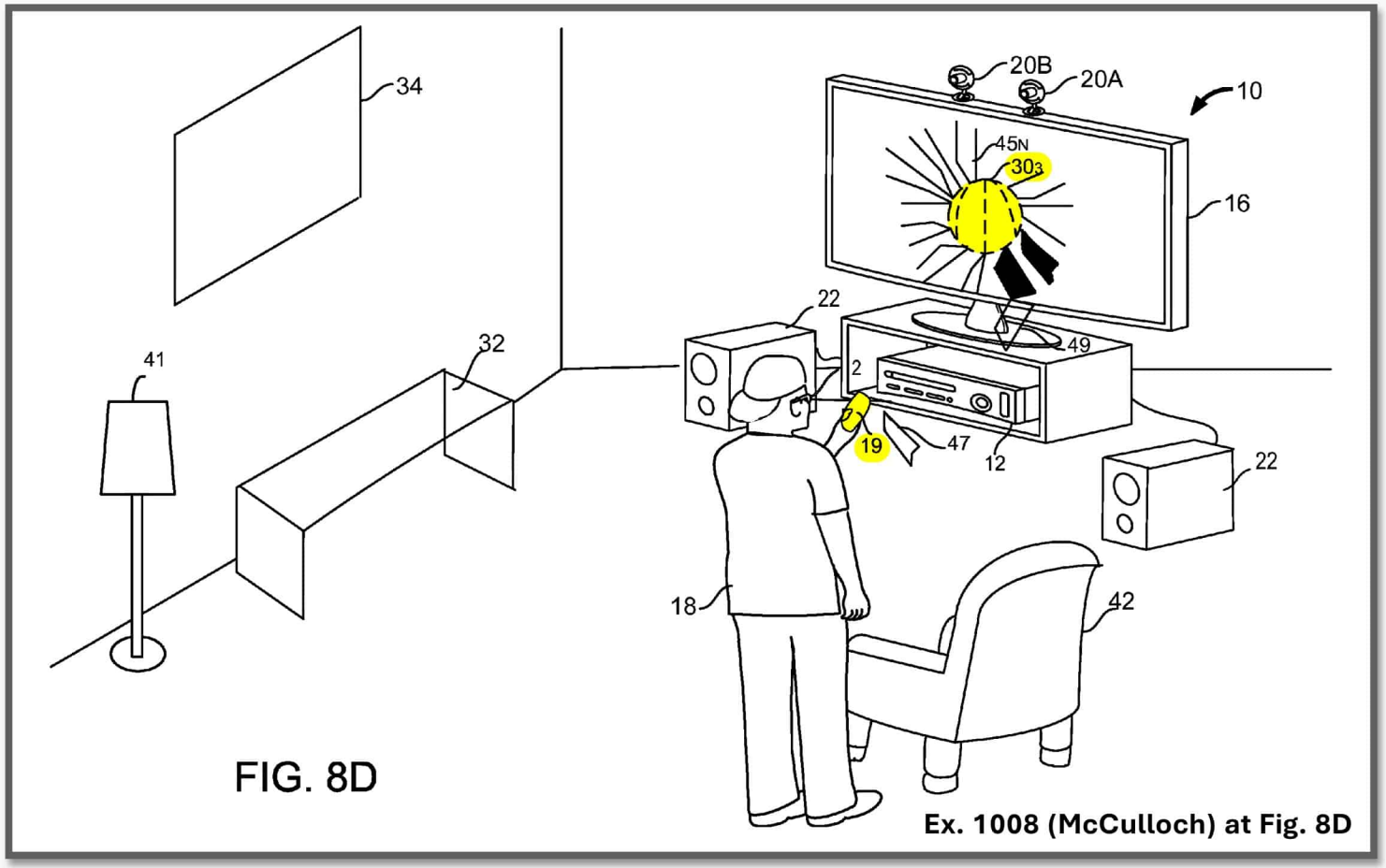


FIG. 8D

Ex. 1008 (McCulloch) at Fig. 8D

McCulloch Discloses Determining, With The WED, Where The PED Is Pointed

McCulloch

FIG. **5** is a flowchart of an embodiment of a method for controlling a virtual object displayed by a near-eye, augmented reality display with a real controller device. In some applications, for example a game for the helicopter in FIGS. **3**A through **3**E, an application designates a virtual object to be controlled by the real controller device **21**. In other examples, the user selects an object to be controlled by the real controller device. In optional step **402**, the real controller device interface software **188** or an application **166** identifies a user selected object in a display field of view of the near-eye AR display as the virtual object for control by the real controller device **21**. The identification may be based on NUI input data. For example, a selection gesture like pointing one's finger may be identified by the gesture recognition engine **193** and a notification sent to the operating system identifying the selection gesture and the object to which it is related. In another example, a gaze duration period and the real or virtual object which is the point of gaze in the display field of view for the duration may be identified by the eye tracking software **196**. In other examples, non-NUI input like moving a displayed selection arrow with the real controller device may be used to identify a user selected object for control or force feedback as discussed below.

Ex. 1008 (McCulloch) at 25:6-28, Fig. 3A

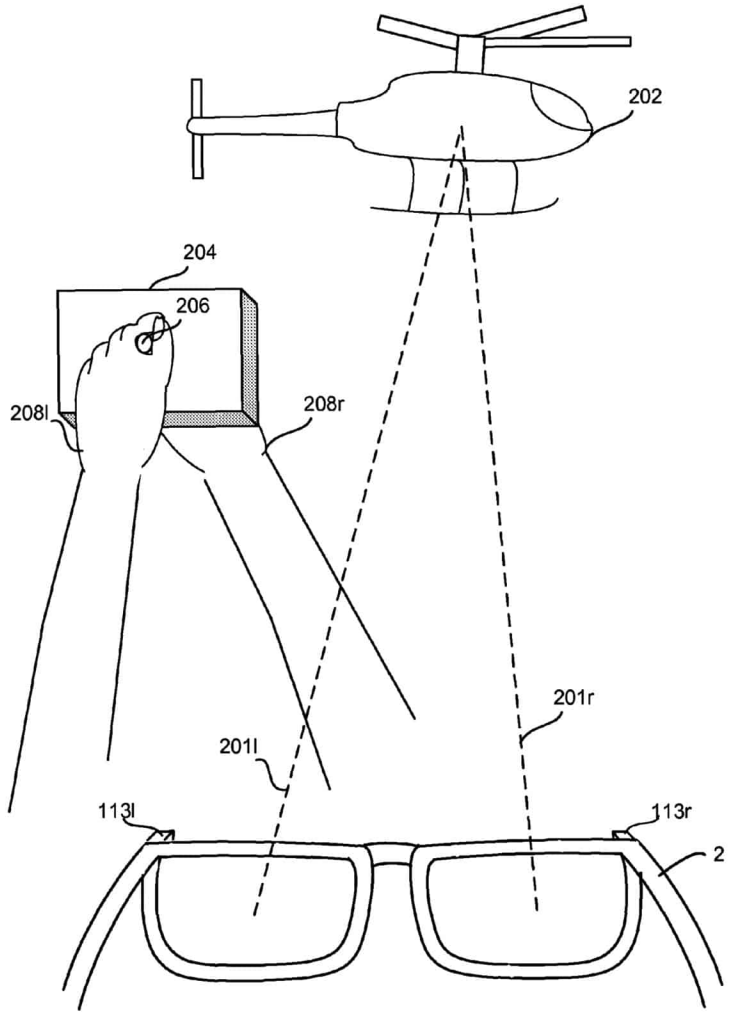


FIG. 3A

'509 Patent, Limitation 10[b] (Ground 2)

[10pre] The non-transitory computer readable storage medium of claim 9 in which the method further comprises:

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

[10b] 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.

McCulloch Renders Obvious Playing Binaural Sound In Response To The WED Determining The PED Is Pointed At An SLP

McCulloch

FIG. **8**D illustrates an example of a simulated effect on a physical state of the user selected force feedback object due to a collision with the virtual object representation of the user selected control real object in the continuing example of FIGS. **8**A, **8**B and **8**C. 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**. Joe has moved the handheld IMU device with such an intensity in the direction of the television **16** that the virtual basketball **303** collides with the display of the television. The physics engine **308** models the collision and the virtual data engine **195** displays a collision effect selected by the physics engine **308** based on the properties of the real basketball **30** and the real television **16** in which the display of television **16** not only cracks, as illustrated by cracks like path representative crack **45**N, but breaks resulting in glass pieces **49** and **47** separating from the display and falling to the ground, with the assistance of a gravity force component, from the vertical surface of television display. The cracking and breaking of the display is based on its physics model which is based on realistic physical properties of the display of television **16**. As the television

Ex. 1008 (McCulloch) at 29:36-57, Fig. 8D

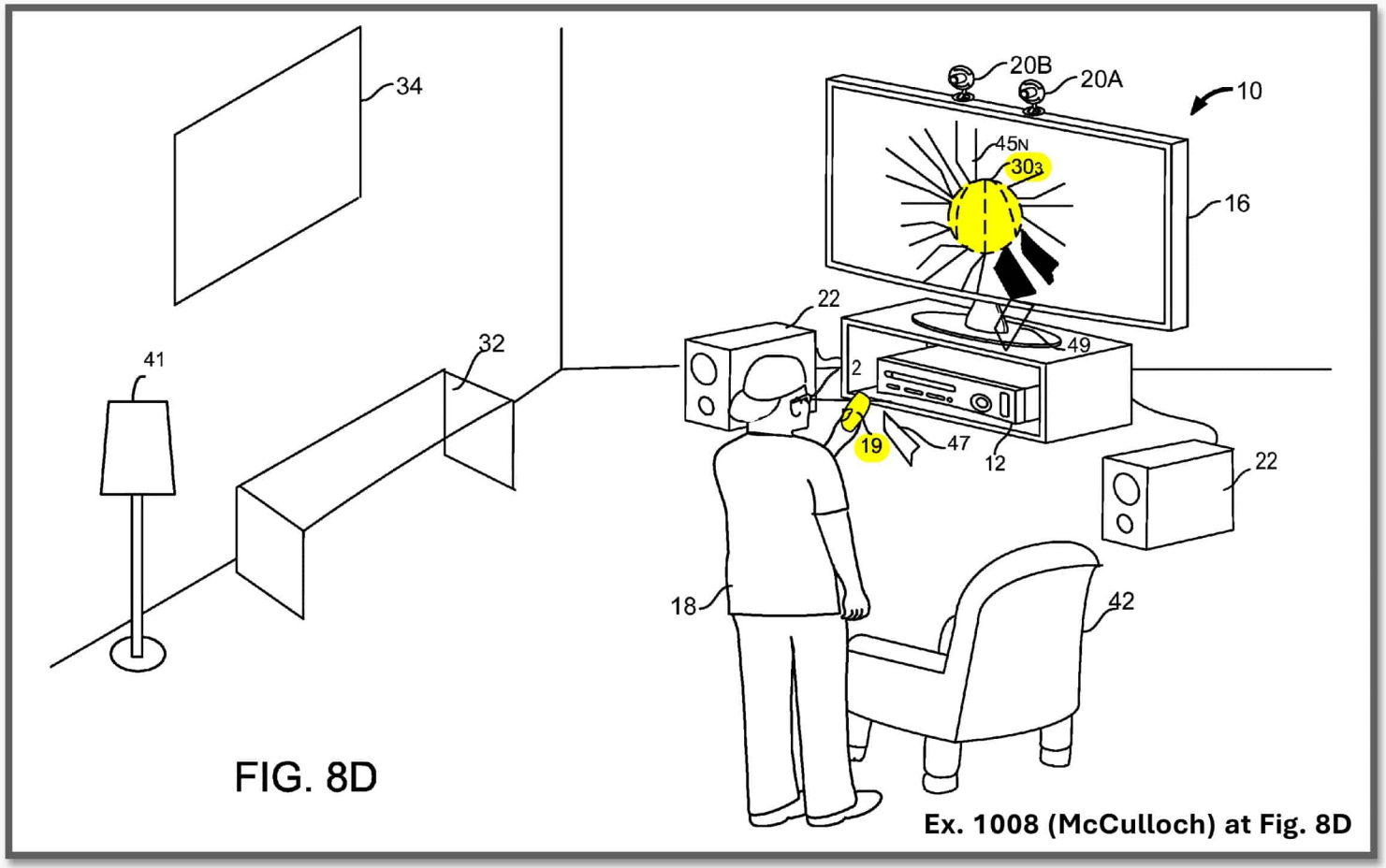


FIG. 8D

Ex. 1008 (McCulloch) at Fig. 8D

McCulloch's 3D Audio Engine Causes Binaural Sound To Play In Response To Pointing

McCulloch

The 3D audio engine **304** is a positional 3D audio engine which receives input audio data and outputs audio data for the earphones **130** or other output audio devices like speakers in other embodiments. The received input audio data may be for a virtual object or be that generated by a real object. Audio data for virtual objects generated by an application can be output to the earphones to sound as if coming from the direction of the virtual object projected into the display field of view. An example of a positional 3D audio engine which may be used with an augmented reality system is disclosed in U.S. patent application Ser. No. 12/903,610 entitled "System and Method for High-Precision 3-Dimensional Audio for Augmented Reality," to Flaks et al., and filed Oct. 13, 2010, which is hereby incorporated by reference. Audio data from a sound library **312** may be associated with one or more collisions or actions for a particular physics model by an application or a user so that the 3D audio engine **304** will play the audio data during display of one or more collisions or actions.

Ex. 1008 (McCulloch) at 21:21-38, Fig. 8D

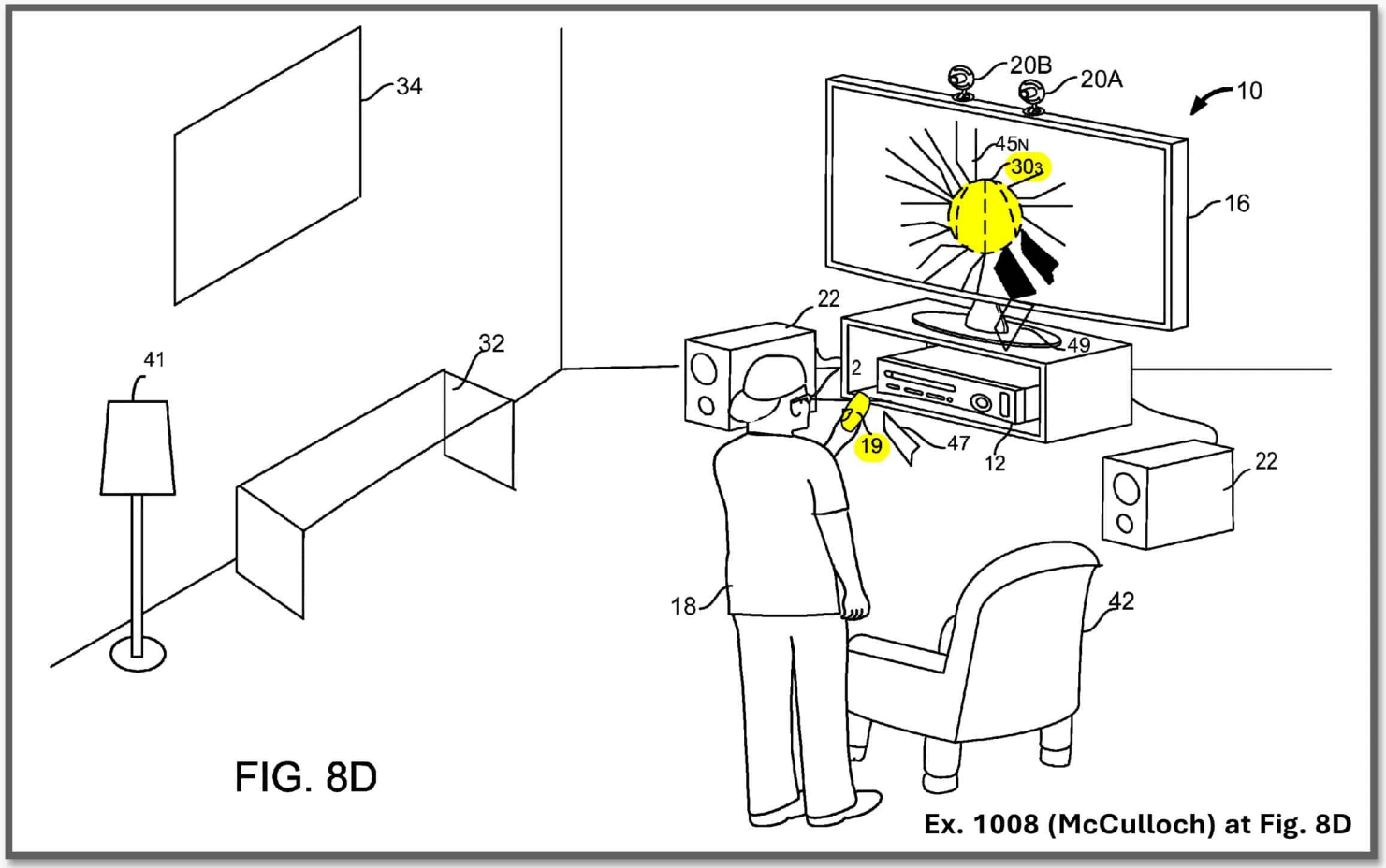


FIG. 8D

Ex. 1008 (McCulloch) at Fig. 8D

'509 Patent, Limitation 11[a] (Ground 2)

[11pre] The non-transitory computer readable storage medium of claim 9 in which the method further comprises:

[11a] highlighting, while the user is located in the zone and with a display of the WED, a virtual image at one of the 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.

McCulloch Discloses Highlighting As A Visual Effect

McCulloch

material in different orientations. The sound library **312**, 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 which may be linked with different simulated actions, pre-collision events and collision effects. Similarly, 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. The

Ex. 1008 (McCulloch) at 22:66-23:7

Patent Owner Mischaracterizes The Petition

Patent Owner Sur-Reply

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…" And,

POSR at 6

Petition

Accordingly, POSAs 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. These were well-known techniques. McCulloch, 12:51-52, 29:45; Welch¶¶269-275, 467-468. Also, 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. McCulloch, 7:34-59, 8:17-30, 12:18-21, 22:4-8, 28:5-11; §V.D.2; Welch¶469.

Pet. at 55

McCulloch Teaches Highlighting Sound-Producing, Virtual Objects

McCulloch

FIG. **8**D illustrates an example of a simulated effect on a physical state of the user selected force feedback object due to a collision with the virtual object representation of the user selected control real object in the continuing example of FIGS. **8**A, **8**B and **8**C. 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**. Joe has moved the handheld IMU device with such an intensity in the direction of the television **16** that the virtual basketball **303** collides with the display of the television. The physics engine **308** models the collision and the virtual data engine **195** displays a collision effect selected by the physics engine **308** based on the properties of the real basketball **30** and the real television **16** in which the display of television **16** not only cracks, as illustrated by cracks like path representative crack **45**N, but breaks resulting in glass pieces **49** and **47** separating from the display and falling to the ground, with the assistance of a gravity force component, from the vertical surface of television display. The cracking and breaking of the display is based on its physics model which is based on realistic physical properties of the display of television **16**. As the television

Ex. 1008 (McCulloch) at 29:36-57, Fig. 8D

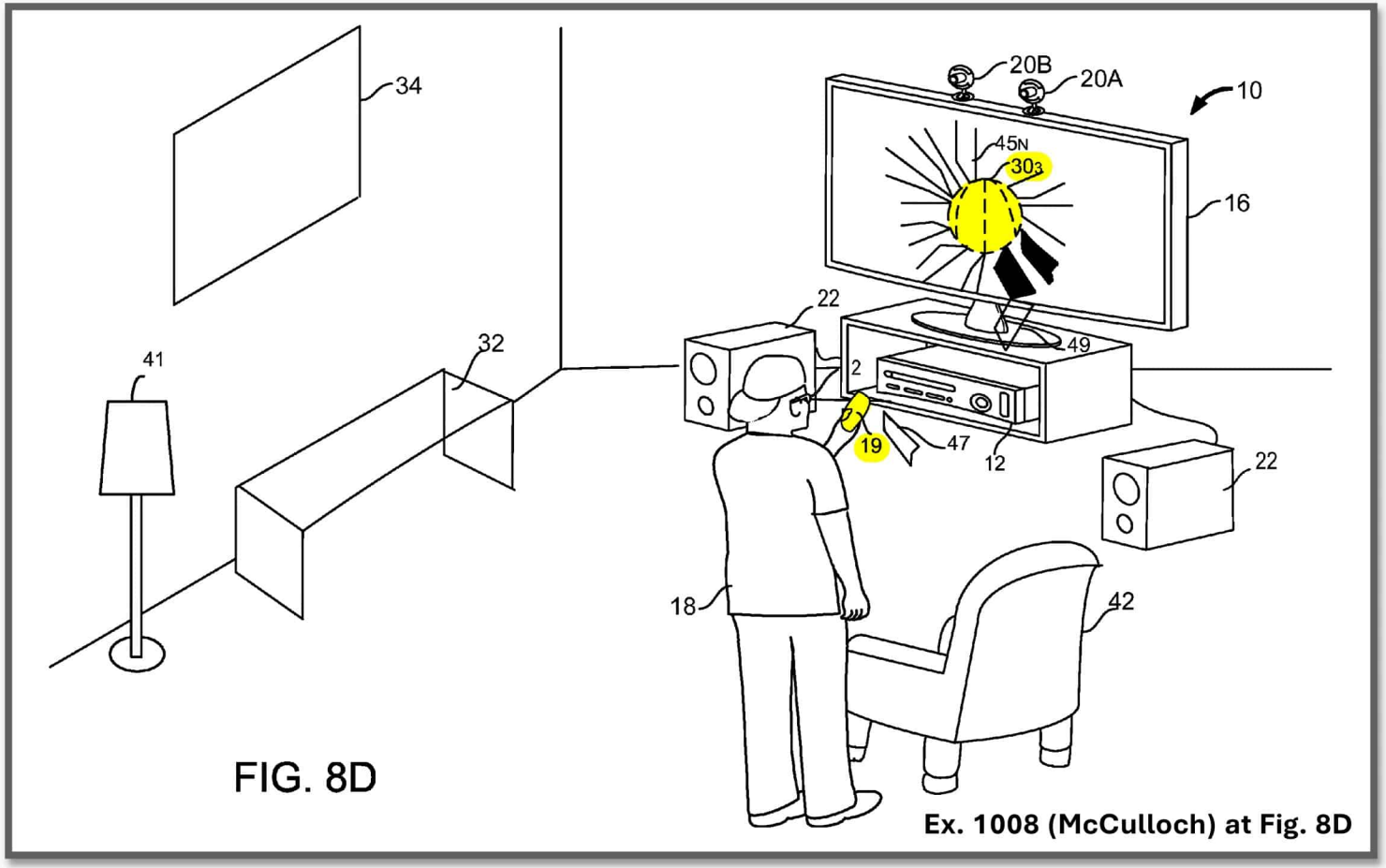


FIG. 8D

Ex. 1008 (McCulloch) at Fig. 8D

McCulloch Teaches Highlighting Sound-Producing, Virtual Objects

McCulloch

nism. Additionally, in optional step **416**, the 3D audio engine **304** plays audio data for the virtual object projected from a 3D space position of the virtual object relative to a 3D space position and orientation identified for the display device which is used to approximate the position and orientation of the user's head supporting the display device. In the helicopter examples, a flight path of the virtual helicopter currently has it on course to fly into a wall behind the user. The user gets distracted and does not change the path via user input. The virtual helicopter is no longer displayed in the display field of view, but the 3D audio engine **304** plays the audio of the virtual crash to project from a position of the wall behind the user.

Ex. 1008 (McCulloch) at 26:7-19, Fig. 3A

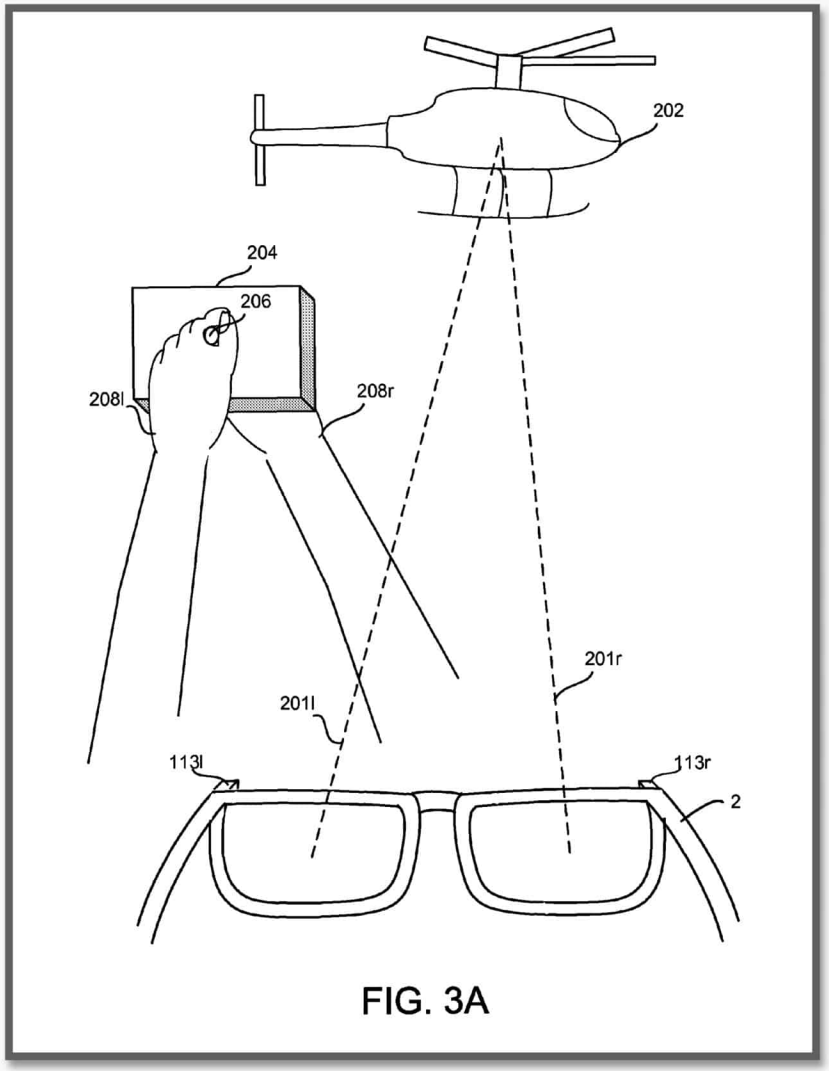


FIG. 3A

Same Disputed Limitations Present In Independent Claim 1

'509 Patent

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

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;

determining, with a wearable electronic device (WED) worn on a head of the user, when the user is located inside the zone;

determining, with the WED worn on the head of the user, when the user is leaving the zone; and

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 ('509 patent) at Claim 9

1. A method comprising:

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;

determining, with a wearable electronic device (WED) worn on a head of the user, when the user is located inside the zone;

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

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 ('509 patent) at Claim 1

Same Disputed Limitations Present In Independent Claim 1

'509 Patent

11. The non-transitory computer readable storage medium of claim **9** in which the method further comprises:

highlighting, while the user is located in the zone and with a display of the WED, a virtual image at one of the 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.

Ex. 1001 ('509 patent) at Claim 11

1. A method comprising:

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;

determining, with a wearable electronic device (WED) worn on a head of the user, when the user is located inside the zone;

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

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 ('509 patent) at Claim 1

Same Disputed Limitations Present In Independent Claim 1

'509 Patent

10. The non-transitory computer readable storage medium of claim **9** in which the method further comprises:

determining, with the WED, when the PED is pointed at one of the SLPs while the user is located in the zone; and

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 ('509 patent) at Claim 10

1. A method comprising:

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;

determining, with a wearable electronic device (WED) worn on a head of the user, when the user is located inside the zone;

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

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 ('509 patent) at Claim 1

'509 Patent, Limitation 2[a] (Ground 2)

[2pre]	The method of claim 1 further comprising:
[2a]	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; and
[2b]	displaying, with the WED worn on the head of the user, a three dimensional (3D) virtual image that shows a size and a shape of the zone in response to the WED determining that the PED moved outside the zone

McCulloch Teaches Tracking With Sensors In The WED The PED

McCulloch

FIG. **2A** is a side view of an eyeglass temple **102** of the frame **115** in an embodiment of the optical see-through, augmented reality display device **2** embodied as eyeglasses providing support for hardware and software components. At the front of frame **115** is depicted one of at least two physical environment facing capture devices **113**, e.g. cameras, that can capture image data like video and still images, typically in color, of the real world to map real objects in the display field of view of the see-through display, and hence, in the field of view of the user.

Ex. 1008 (McCulloch) at 7:24-33, Fig. 2A

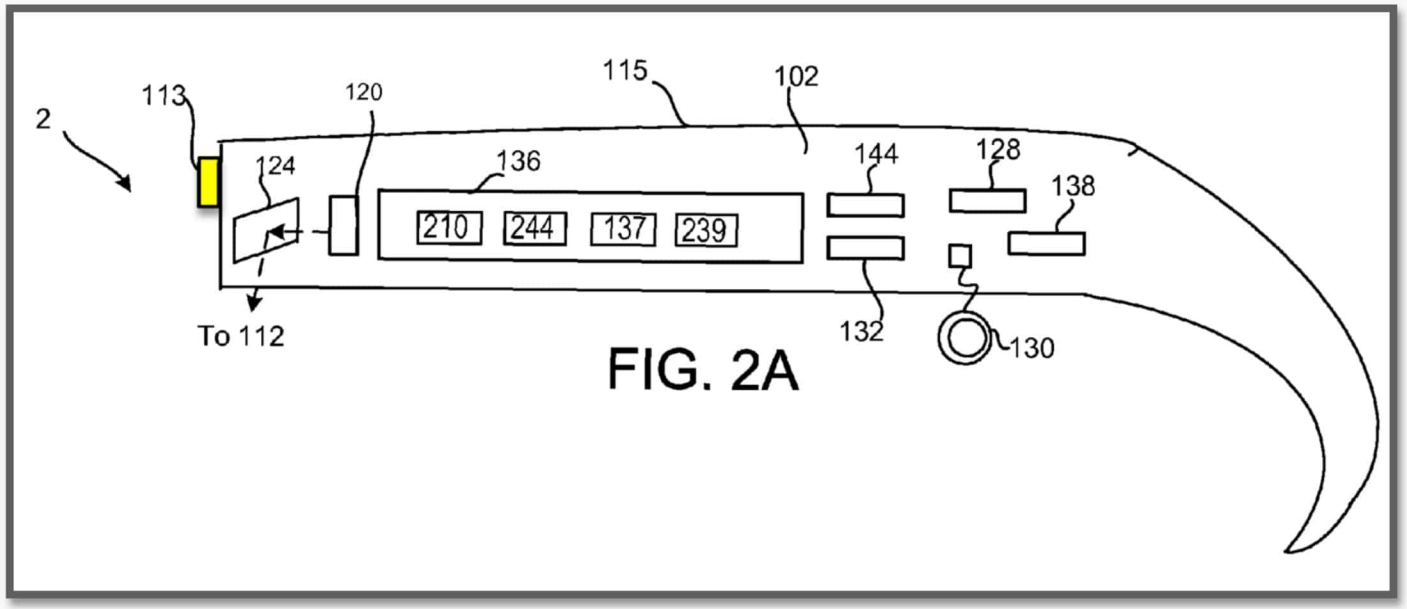


FIG. 2A

McCulloch Discloses A WED That Includes Sensors, As Patent Owner Admits

McCulloch

In some examples, the capture devices **113** may also be depth sensitive, for example, they may be depth sensitive cameras which transmit and detect infrared light from which depth data may be determined. In other examples, a separate depth sensor (not shown) on the front of the frame **115** may also capture and provide depth data to objects and other surfaces in the field of view. The depth data and image data form a depth map of the captured field of view of the capture devices **113** which are calibrated to include the display field of view. A three dimensional (3D) mapping of the display field of view can be generated based on the depth map. Some examples of depth sensing technologies that may be included on the head mounted display device **2** without limitation, are SONAR, LIDAR, Structured Light, and/or Time of Flight.

* * *

verts analog signals, for its respective device. Some examples of devices which process analog signals are the sensing units **144**, **132**, **128** and earphones **130** as well as the microphone **110**, capture devices **113** and an IR illuminator **134**A, and an IR detector or camera **134**B discussed below,

Ex. 1008 (McCulloch) at 7:34-47, 8:35-39

Patent Owner Response

Petitioner advances the exact same argument as it raises for limitation 1[b] in Ground 2. Pet. 65. For limitation 1[b], Petitioner refers back to its argument for Ground 1. *Id.* at 53. For the reasons discussed in §II.A.4, Petitioner's argument fails. Additionally, Petitioner references portions of McCulloch that discloses sensors in the HMD. *Id.* But these cites portions do not teach that the act of determination is performed by a processor in the HMD.

POR at 46

McCulloch Teaches That The WED's Sensors "Track" The PED

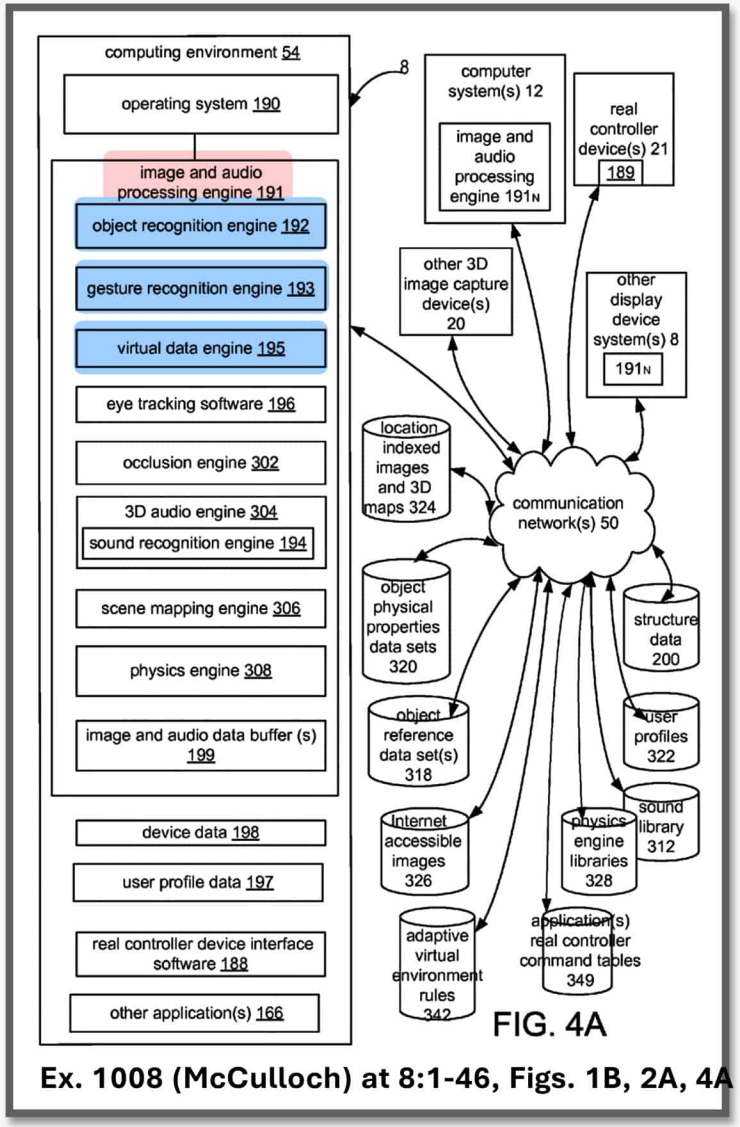
McCulloch

device system 8. Image and audio processing engine **191** includes object recognition engine **192**, gesture recognition engine **193**, virtual data engine **195**, eye tracking software **196** if eye tracking is in use, an occlusion engine **302**, a 3D positional audio engine **304** with a sound recognition engine **194**, a scene mapping engine **306**, and a physics engine **308** which may communicate with each other.

* * *

The object recognition engine **192** of the image and audio processing engine **191** detects, tracks and identifies real objects in the display field of view and the 3D environment of the user based on captured image data and depth data if available or determined depth positions from stereopsis. The object recognition engine **192** distinguishes real objects from each other by marking object boundaries and comparing the object boundaries with structural data. One example of mark-

Ex. 1008 (McCulloch) at 14:5-11, 17:32-39



Ex. 1008 (McCulloch) at 8:1-46, Figs. 1B, 2A, 4A

McCulloch Teaches That The WED's Sensors "Track" The PED

Dr. Welch, Decl.

476. Further, McCulloch discloses that its HMD contains capture devices, including cameras and infrared transceivers (sensors) that detect and track infrared light that may be emitted by a controller (i.e., one or more sensors in the WED). McCulloch (Ex.1008) at 7:34-67 (describing capture devices), 8:7-39 (describing multiple types of "sensors" in the HMD, including transceivers), 5:19-36 (describing "companion processing module 4," which "may be integrated in" "display device 2," that communicates with the "controller devices 21" through infrared light). And McCulloch's processor stores the information needed compare the PED's or HMD's location with the zone's boundaries in view of McCulloch's shared coordinate system. McCulloch (Ex.1008) at 15:48-54, 16:18-21. Further, methods of using

Ex. 1003 (Welch Decl.) ¶ 476

McCulloch

(e.g. smartphone). The companion processing module **4** may communicate wired or wirelessly (e.g., WiFi, Bluetooth, infrared, RFID transmission, wireless Universal Serial Bus (WUSB), cellular, 3G, 4G or other wireless communication means) over one or more communication networks **50** to one or more computer systems **12** whether located nearby or at a remote location, one or more real controller devices **21**, other display device systems **8** in a location or environment and, if available, one or more 3D image capture devices **20** in the environment. In other embodiments, the functionality of the companion processing module **4** may be integrated in software and hardware components of the display device **2** as in FIG. **1**B. Some examples of hardware components of the

Ex. 1008 (McCulloch) at 5:19-36

Dr. Welch's Testimony Regarding McCulloch's Sensors Is Unrebutted

Dr. Welch, Decl.

430. Additionally, McCulloch's HMD includes front-facing cameras to develop image and depth data to track objects in front of the user, including the user's hands and controllers held in the user's hands. McCulloch at (Ex.1008) 12:18-21 ("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"), 7:57-59 ("capture devices 113 are also referred to as outward facing capture devices meaning facing outward from the user's head"), 7:34-37 ("the capture devices 113 may also be depth sensitive, for example, they may be depth sensitive cameras which transmit and detect infrared light from which depth data may be determined"), 22:4-8 ("gesture recognition engine 193 can identify actions performed by a user indicating a control or command to an executing application," including actions "performed by a body part of a user, e.g. a hand or finger"), 28:5-11 ("the capture devices 113 can capture data of the user's hand and finger pointing to different objects and identifying them as a control object or a force feedback object or both, and the image and depth data is processed by the gesture recognition engine 193 for identifying a pointing selection gesture").

Ex. 1003 (Welch Decl.) ¶ 430

Dr. Welch, Decl.

432. Persons of ordinary skill in the art also would have understood that the camera-based absolute position and orientation of the handheld IMU real controller device 19 (held in the user's hand) supplements the IMU information about velocities and accelerations received from the IMU real controller device. As I discussed above, a "hybrid method of integrating multiple technologies together (sensor fusion)" can "provide both high precision and accuracy." Jerald, THE VR BOOK (Ex.1063) at 315. As such, persons of ordinary skill in the art would have known, or at minimum found it obvious, to use sensor fusion methods to combine the camera-based absolute position and orientation of the handheld IMU real controller device 19 (held in the user's hand) with the IMU-based derivative signals (e.g., velocities and accelerations) from the IMU real controller device 19.

Ex. 1003 (Welch Decl.) ¶ 432

Patent Owner's Framing Of Limitation 2[a] Is Inaccurate

Patent Owner Response

To teach limitation 2[a], Petitioner must show that McCulloch disclosing three elements—all of which are required by the express language of the limitation: (1) the WED includes one or more sensors; (2) these sensors track the PED; and (3) a determination is made based on this tracking to ascertain when the PED leaves the zone. *See* §II.A.3. To meet its burden, Petitioner presents several superficial

POR at 36

2. The method of claim 1 further comprising:

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; and

displaying, with the WED worn on the head of the user, a three dimensional (3D) virtual image that shows a size and a shape of the zone in response to the WED determining that the PED moved outside the zone.

Ex. 1001 ('509 patent) at Claim 2

Dr. Welch Testified That Sensors Sense And Are Used To Track

Dr. Welch, Supp. Decl.

84. First, limitation 2[a] does not require "that the WED's sensors track" anything (POR 15, 18); this limitation recites "tracking, ***with*** one or more sensors in the WED worn on the head of the user, the PED." The sensors need not track. Rather, the ***system*** tracks using sensors. Indeed, sensors do not track. Sensors ***sense*** and other components of VR and AR systems track with information sensed by the sensors. And the '509 patent itself shows that Patent Owner's argument is misplaced.

Ex. 1173 (Welch Supp. Decl.) ¶ 84

Pedrotti

Such trackers, and the processors which determine the position and orientation of such trackers, are well known to those of skill in the art. One such example, U.S. Pat. No. 4,737,794, teaches a "method and apparatus for determining remote object orientation and position with an electromagnetic coupling." It shows a plurality of radiating antennas located at a source to provide a plurality of electromagnetic fields spanning three dimensional space and defining a source reference coordinate frame, and a plurality of receiving antennas located on an object to be tracked for receiving that field. A processor receives the outputs from the receiving antennas and converts the received components of the transmitted electromagnetic fields into remote object position and orientation relative to the source reference coordinate frame. The antennas may be, for example, dipole antennas, loop antennas, or coil antennas.

Ex. 1005 (Pedrotti) at 4:59-5:7

Dr. Welch Testified That Sensors Sense And Are Used To Track

Dr. Welch, Supp. Decl.

85. For example, claim 17 recites a WED that includes "***sensors that sense***." '509 patent (Ex.1001-509) at cl. 17. And the '509 patent's specification is consistent with what a skilled artisan would know—a combination of hardware, including a processor in addition to sensors, is required to perform tracking like that claimed. The specification discloses that the WED includes "a processor or processing unit 1574," and "a motion or location tracker 1582," both of which are separate from "one or more sensors 1580." '509 patent (Ex.1001-509) at 34:20-29; Fig. 15:

Ex. 1173 (Welch Supp. Decl.) ¶ 85

17. An electronic system comprising:
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
a wearable electronic device (WED) that is worn on a head of the user, wirelessly communicates with the PED, includes speakers that play the binaural sound to the user that emanates from the SLPs in empty space, includes one or more sensors that sense when the PED leaves the zone, and includes a display that displays a 3D virtual image of the zone in response to sensing that the PED leaves the zone, wherein the display displays the 3D virtual image of the zone to warn the user that the user is leaving the zone.

Ex. 1001 ('509 patent) at Claim 17

Patent Owner Ignored The Petition's Discussion Of McCulloch's Teachings Regarding Tracking

Patent Owner Response

As explained in §II.A.3, Petitioner interprets limitations 17[e] and 2[a] as equivalent, and as such it advances identical argument ***based exclusively on Pedrotti*** for them. *Id.* at 68 ("Limitation 17[e] … would have been obvious for the same reasons as limitation 2[a]."). Considering the disparate meanings and scopes of these

POR at 35

Patent Owner Ignored The Petition's Discussion Of McCulloch's Teachings Regarding Tracking

Petition

McCulloch disclosed, or at a minimum rendered obvious, "tracking, with one or more sensors in the WED worn on the head of the user, [a] PED." McCulloch's HMD (WED) tracks handheld controllers (PEDs). §§V.D.2-V.D.4; Welch¶¶474-475. Further, 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. McCulloch, 7:34-67 (capture devices), 8:7-39 (multiple types of "sensors" in the HMD, including transceivers), 5:19-36 ("companion processing module 4," which "may be integrated in" "display device 2," i.e., McCulloch's HMD, communicates with the "controller devices 21" via, among other things, infrared); Welch¶476. Moreover, techniques using sensors on HMDs to track controllers, e.g., controllers emitting infrared light, were well known and widely used due to their accuracy advantages. Welch¶¶88-98, 295-296; VR Book, 315 ("Hand-held tracked devices typically use inertial, electromagnetic, ultrasonic, or optical (camera) technologies.").

Additionally, 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. §IV.F.1.a; Welch¶477.

Pet. at 57-58

Patent Owner Ignores The Combined Teachings Of Pedrotti And McCulloch

Patent Owner Response

device." This 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 limitations 2[a] and 17[e]. Petitioner fails to explain how identifying an object and estimating its position with respect to the HMD are the same as tracking an object held by the user's hands relative to boundaries of a virtual 3D zone defined by the user.

POR at 39

Bradium Techs. v. Iancu

"[O]bviousness… cannot be overcome by attacking references individually where the rejection is based upon the teachings of a combination of references."

***Bradium Techs. v. Iancu*, 923 F.3d 1032, 1050 (Fed. Cir. 2019)**
(citations and quotations omitted)

McCulloch's Express Disclosures Contradict Patent Owner's Arguments About Perspective

Patent Owner Sur-Reply

McCulloch focuses on controlling virtual object features within a display field of view or a display portion of what a user looks through and is seen from the user's perspective. Ex. 1008, 4:4-13; 11:56-12:17 and 15:1-62 (showing that the display field of view is defined in terms of a coordinate system that may be acquired using 3D mapping techniques with image data and depth data, which as a PHOSITA would know reflects a first-person perspective and teaches away from the user leaving the zone). A person of skill in the art would understand that this first-person perspective makes it impossible for a user to leave the zone. POPR, 42-45.

POSR at 14-15

McCulloch

environment as a factor in the execution of a game. Some applications store adaptive virtual environment rules **342** for effecting the placement and display of one or more virtual objects in a 3D mapping of an environment during their execution. For example, a gaming application may receive user input identifying boundaries for a playspace in which virtual objects can be positioned. For example, the user input data may be image and depth data from a capture device on the display device captured while a user is turning his head, gaze data captured while the user is gazing at boundary points and perhaps audio data captured by the microphone of the user speaking a command like "boundary". In other examples, an application automatically determines a play-space or operation space for the application based on a 3D mapping of the user environment or location. A 3D mesh may be used to represent the mapping of the environment. The adaptive virtual environment rules are flexible in that they provide fallback rules or alternative rules based on the real objects and real features mapped in the user environment. An

* * *

Virtual data engine **195** processes virtual objects and registers the 3D position and orientation of virtual objects or imagery in relation to one or more coordinate systems, for example in display field of view coordinates or in the view independent 3D map coordinates. The virtual data engine **195**

Ex. 1008 (McCulloch) at 20:7-25, 23:25-29

Patent Owner Selectively Quotes Dr. Welch's Testimony

Patent Owner Sur-Reply

At his deposition, Petitioner's expert Dr. Welch was unable to identify any disclosure from McCulloch of an HMD that tracks controllers. *See, e.g.*, Ex. 2012, at 268:10-14 (Q: Dr. Welch … would you please show me exactly where it is in those lines it says that HMD tracks the controller? A: So I did not say that.). *See also id. at* 272:3-8, 275:20-276:18.

POSR at 15

Dr. Welch

Q. Dr. Welch, you mentioned Column 7, Line 34 and you read a few lines down, Line 34, would you please show me exactly where in those lines it says that HMD tracks the controller?

A. **So I did not say that. That's not what I head, what it said was it would have at least been obvious to do it for all sorts of reasons, and McCulloch provides just examples of all sorts of sensors that would be helpful, useful to do that. Some of them are also listed in Column 8, lines 17 through 39 where it talks about at the very end like 39 IR detector camera these are all common things people used for doing that and there are really good reasons to do the head tracking, handheld controllers with respect to the head. It makes the most sense, it's most commonly done. A person of ordinary skill would know that and would do it because there's really good reason to do it. It might be disclosed here somewhere in McCulloch.** Sitting here right now I am unable to identify that for you. It's a long, long, long patent. I would have to sit here and read the entire patent to try and make a more definitive statement about that.

Ex. 2012 (Welch Dep. Tr.) at 268:10-269:11

Patent Owner Takes Dr. Welch's Testimony Out Of Context

Patent Owner Response

In fact, Dr. Welch made it clear during the deposition that "a person of ordinary skill would – it's probably pretty hopeless" to track when both sensors and trackers are moving. Ex. 2012, 227:5-228:13. Specifically, when Dr. Welch was questioned whether it is possible to track a tracker attached to a part of the user's body by sensors mounted on the user's head, he testified 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.* 233:17-235:10.

POR at 24

Dr. Welch

Q. And -- remove the landmarks from the ceiling and put it on the chest of the user and then I asked you did that system where the landmark was placed on the chest of the user would that system be capable of tracking the user as the user moves in the room?

* * *

A. So I think you're trying to get me to say some hypothetical sweeping statement about inability to track position with sensors on the head or something like that which -- in a head mount are on the head which is in my world that's a completely unrealistic world. Nobody -- it's hard for me to understand why anybody would even discuss that because it doesn't make any sense. If you want to ask me if you put a camera on your head and it's looking down at your chest and it only sees your chest, can you track where you are in the world or in the room, probably not. I mean, if that's all you have, but nobody would -- 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. It just doesn't make sense.

Ex. 2012 (Welch Dep. Tr.) at 233:17-235:10

Dr. Welch Addressed Patent Owner's Flawed Hypothetical

Welch 2001

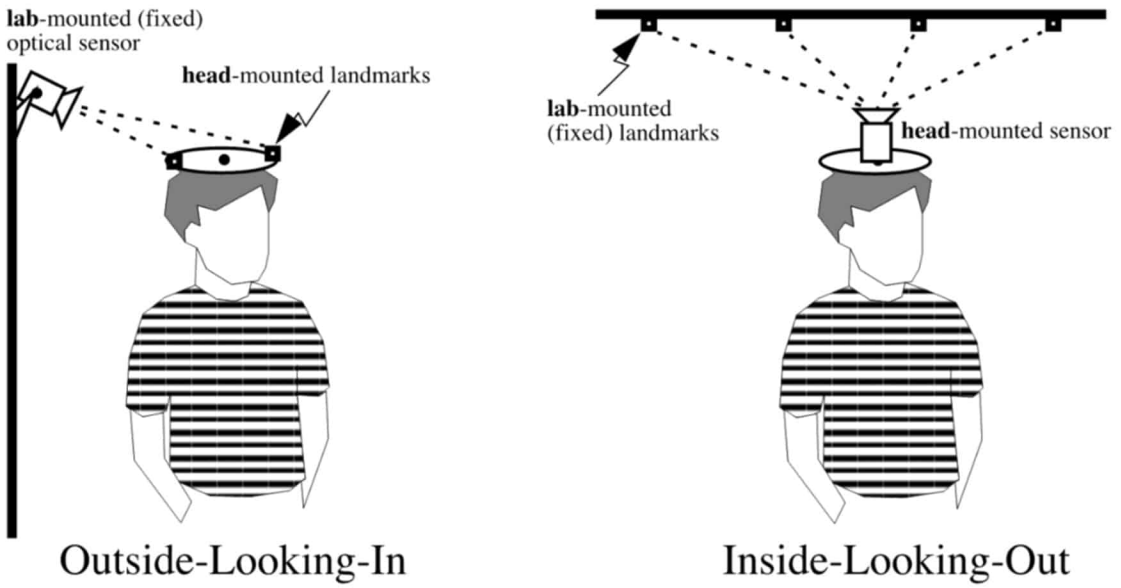


Figure 5

Ex. 1103 (Welch 2001) at Fig. 5

Dr. Welch

A. First of all, I'm the one who created the figure so I know what the purpose of the figure was. I know where the figure came from. I know what the context of the figure was I know what it's intent was. For example, this is not a schematic that's meant to describe some mechanical design or some design of a system.

Ex. 2012 (Welch Dep. Tr.) at 233:1-8

Dr. Welch Testified That A POSA Had The Skill To Track With Sensors

Dr. Welch

A. ...You have to think about which sensors you would use. It's all within the realm of a person of ordinary skill, but it's not as simple as saying, oh, I'm going to have some sensors. And sensors are very broad. They, again, could be magnet, could be acoustic, some use different references, some don't. You might have two or three of time, you might have five of them, you might have one of them, one dimensional, two dimensional, three dimensional, all of these different characteristics, where they're mounted with respect each other. All of this matters and it's pretty standard to a person of ordinary skill who works in tracking to sort of figure this out, but to just say sensors on your head, nobody can draw any conclusion from that. So I'm not what you're looking for. That would be like saying if I put sensors on my car, can I determine where my car is? It would depend on the sensors and where they are and what they're sensing and lots of other information.

Ex. 2012 (Welch Dep. Tr.) at 231:3-232:1

'509 Patent, Limitation 2[b] (Ground 2)

[2pre]	The method of claim 1 further comprising:
[2a]	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; and
[2b]	displaying, with the WED worn on the head of the user, a three dimensional (3D) virtual image that shows a size and a shape of the zone in response to the WED determining that the PED moved outside the zone

McCulloch Renders Obvious Displaying With The WED The Pedrotti-Type Zone

McCulloch

environment. A mesh may comprise a detailed geometric representation of various features including real and virtual objects and surfaces thereof within a particular environment or region of an environment. A 3D point cloud representing the surfaces of objects including things like walls and floors in a space can be generated based on captured image data and depth data of the user environment. A 3D mesh of the surfaces in the environment can then be generated from the point cloud. More information regarding the generation of 3-D maps can be found in U.S. patent application Ser. No. 13/017,690, "Three-Dimensional Environment Reconstruction," incorporated herein by reference in its entirety. 3D mesh representations of virtual objects can be added.

* * *

Virtual data engine **195** processes virtual objects and registers the 3D position and orientation of virtual objects or imagery in relation to one or more coordinate systems, for example in display field of view coordinates or in the view independent 3D map coordinates. The virtual data engine **195** determines the position of image data of a virtual object or imagery in display coordinates for each display optical system **14**. Additionally, the virtual data engine **195** performs

Ex. 1008 (McCulloch) at 17:19-31; 23:25-29

Pedrotti

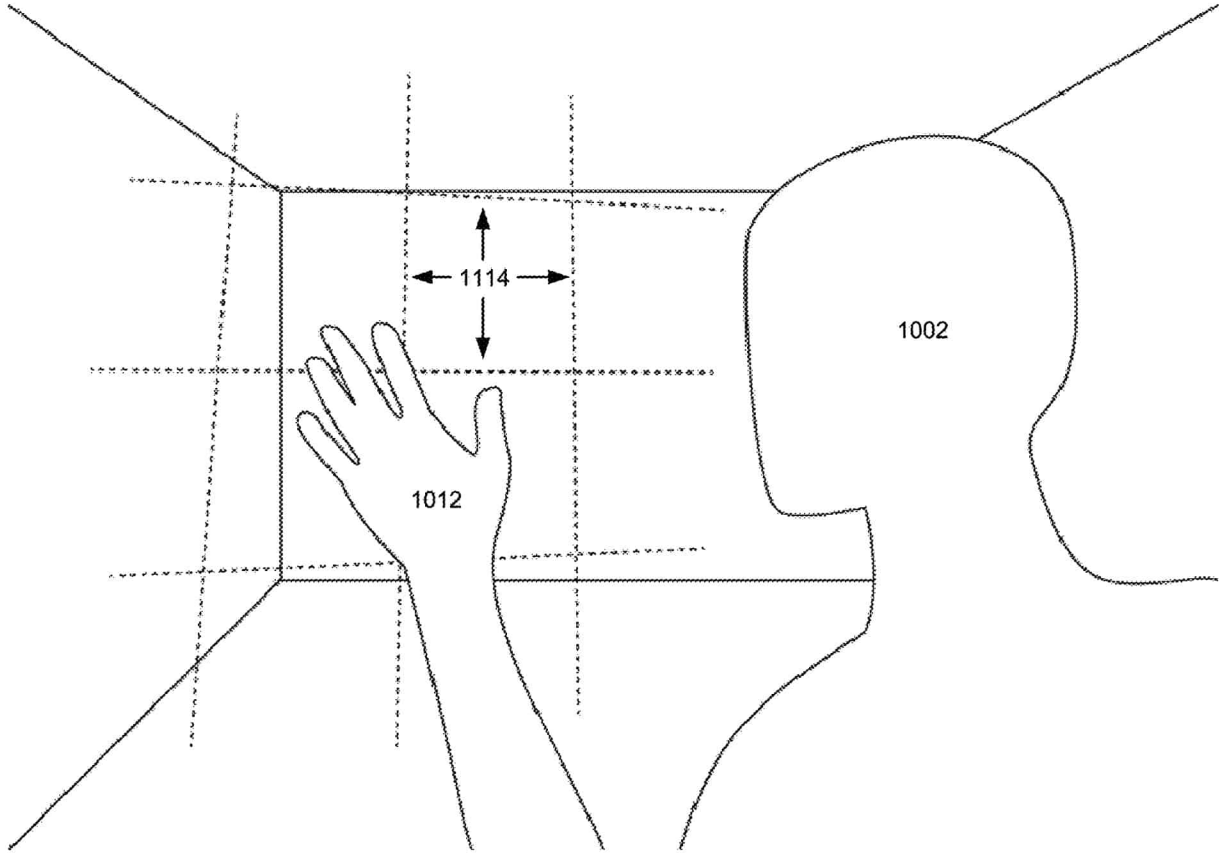


Figure 11

Ex. 1005 (Pedrotti) at Fig. 11

No Meaningful Differences Between Limitations 2[a] and 17[e]

'509 Patent

2. The method of claim **1** further comprising:

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; and

displaying, with the WED worn on the head of the user, a three dimensional (3D) virtual image that shows a size and a shape of the zone in response to the WED determining that the PED moved outside the zone.

Ex. 1001 ('509 patent) at Claim 2

17. An electronic system comprising:

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

a wearable electronic device (WED) that is worn on a head of the user, wirelessly communicates with the PED, includes speakers that play the binaural sound to the user that emanates from the SLPs in empty space, includes one or more sensors that sense when the PED leaves the zone, and includes a display that displays a 3D virtual image of the zone in response to sensing that the PED leaves the zone, wherein the display displays the 3D virtual image of the zone to warn the user that the user is leaving the zone.

Ex. 1001 ('509 patent) at Claim 17

Same Disputed Limitations Present In Independent Claim 17

'509 Patent

10. The non-transitory computer readable storage medium of claim **9** in which the method further comprises:

determining, with the WED, when the PED is pointed at one of the SLPs while the user is located in the zone; and

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 ('509 patent) at Claim 10

17. An electronic system comprising:

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

a wearable electronic device (WED) that is worn on a head of the user, wirelessly communicates with the PED, includes speakers that play the binaural sound to the user that emanates from the SLPs in empty space, includes one or more sensors that sense when the PED leaves the zone, and includes a display that displays a 3D virtual image of the zone in response to sensing that the PED leaves the zone, wherein the display displays the 3D virtual image of the zone to warn the user that the user is leaving the zone.

Ex. 1001 ('509 patent) at Claim 17

Same Disputed Limitations Present In Independent Claim 17

'509 Patent

2. The method of claim **1** further comprising:

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; and

displaying, with the WED worn on the head of the user, a three dimensional (3D) virtual image that shows a size and a shape of the zone in response to the WED determining that the PED moved outside the zone.

Ex. 1001 ('509 patent) at Claim 2

17. An electronic system comprising:

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

a wearable electronic device (WED) that is worn on a head of the user, wirelessly communicates with the PED, includes speakers that play the binaural sound to the user that emanates from the SLPs in empty space, includes one or more sensors that sense when the PED leaves the zone, and includes a display that displays a 3D virtual image of the zone in response to sensing that the PED leaves the zone, wherein the display displays the 3D virtual image of the zone to warn the user that the user is leaving the zone.

Ex. 1001 ('509 patent) at Claim 17

Same Disputed Limitations Present In Independent Claim 17

'509 Patent

2. The method of claim **1** further comprising:
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; and
displaying, with the WED worn on the head of the user, a three dimensional (3D) virtual image that shows a size and a shape of the zone in response to the WED determining that the PED moved outside the zone.

Ex. 1001 ('509 patent) at Claim 2

17. An electronic system comprising:
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
a wearable electronic device (WED) that is worn on a head of the user, wirelessly communicates with the PED, includes speakers that play the binaural sound to the user that emanates from the SLPs in empty space, includes one or more sensors that sense when the PED leaves the zone, and includes a display that displays a 3D virtual image of the zone in response to sensing that the PED leaves the zone, wherein the display displays the 3D virtual image of the zone to warn the user that the user is leaving the zone.

Ex. 1001 ('509 patent) at Claim 17

Same Disputed Limitations Present In Independent Claim 17

'509 Patent

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

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;

determining, with a wearable electronic device (WED) worn on a head of the user, when the user is located inside the zone;

determining, with the WED worn on the head of the user, when the user is leaving the zone; and

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 ('509 patent) at Claim 9

17. An electronic system comprising:

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

a wearable electronic device (WED) that is worn on a head of the user, wirelessly communicates with the PED, includes speakers that play the binaural sound to the user that emanates from the SLPs in empty space, includes one or more sensors that sense when the PED leaves the zone, and includes a display that displays a 3D virtual image of the zone in response to sensing that the PED leaves the zone, wherein the display displays the 3D virtual image of the zone to warn the user that the user is leaving the zone.

Ex. 1001 ('509 patent) at Claim 17

Patent Owner Disclaimed Its Expert, Leaving Only Attorney Argument

Patent Owner Response

D. PHOSITA

For this proceeding, Patent Owner accepts Petitioner's definition of PHOSITA. Patent Owner chooses not to rely on an expert for this proceeding; nor does Patent Owner rely on the expert declaration and C.V. submitted with its preliminary response. Accordingly, Patent Owner hereby affirmatively withdraws the expert declaration and C.V. submitted with Patent Owner's preliminary response.

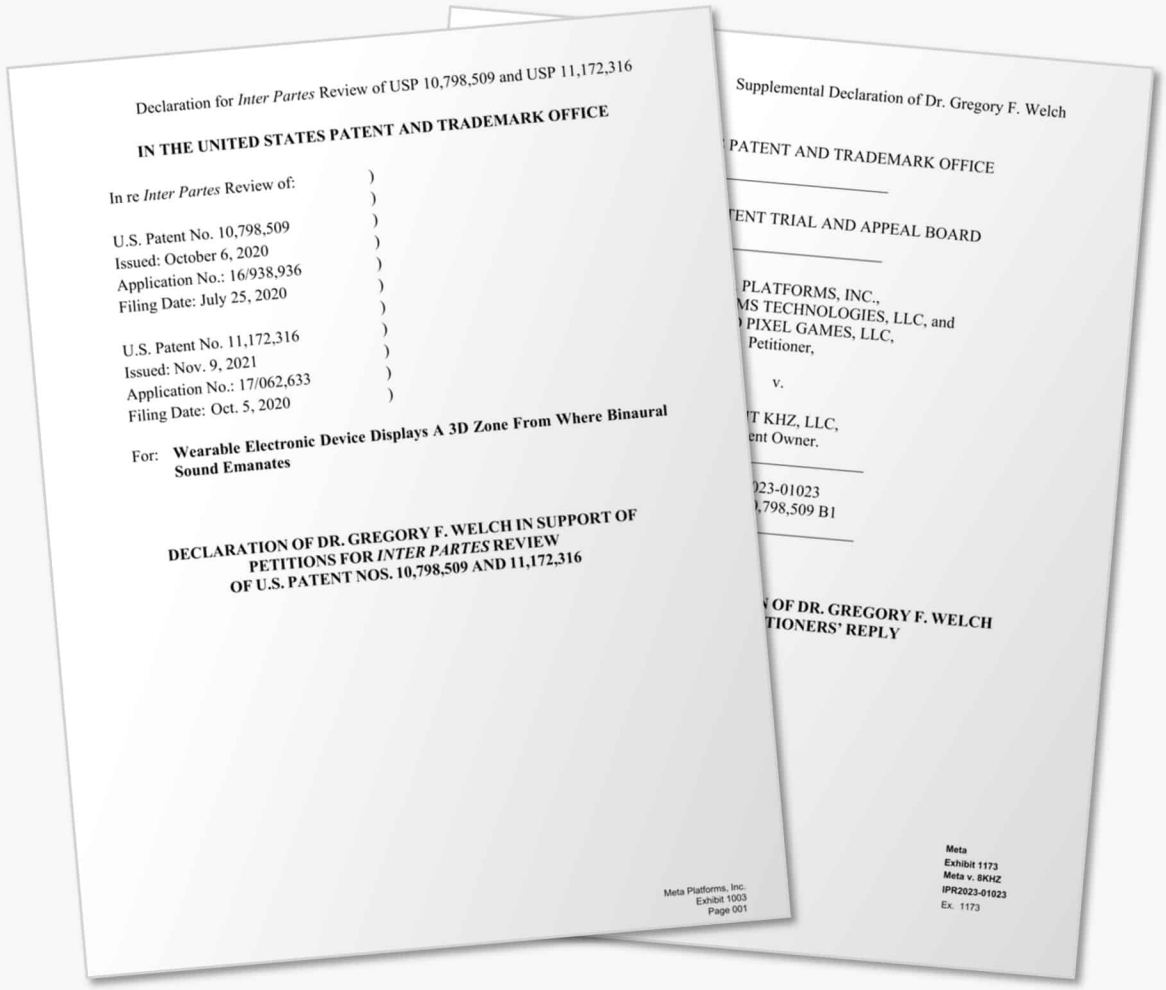
POR at 2

Icon Health & Fitness, Inc. v. Strava, Inc.

"Attorney argument is not evidence."

***Icon Health & Fitness, Inc. v. Strava, Inc.*, 849 F.3d 1034, 1043 (Fed. Cir. 2017)**

Unrebutted, Well-Reasoned Expert Testimony From Dr. Welch



Declaration for *Inter Partes* Review of USP 10,798,509 and USP 11,172,316

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re *Inter Partes* Review of:

U.S. Patent No. 10,798,509
Issued: October 6, 2020
Application No.: 16/938,936
Filing Date: July 25, 2020

U.S. Patent No. 11,172,316
Issued: Nov. 9, 2021
Application No.: 17/062,633
Filing Date: Oct. 5, 2020

For: **Wearable Electronic Device Displays A 3D Zone From Where Binaural Sound Emanates**

DECLARATION OF DR. GREGORY F. WELCH IN SUPPORT OF PETITIONS FOR *INTER PARTES* REVIEW OF U.S. PATENT NOS. 10,798,509 AND 11,172,316

Meta Platforms, Inc.
Exhibit 1003
Page 001

Supplemental Declaration of Dr. Gregory F. Welch

PATENT AND TRADEMARK OFFICE

TENT TRIAL AND APPEAL BOARD

PLATFORMS, INC.,
MS TECHNOLOGIES, LLC, and
PIXEL GAMES, LLC,
Petitioner,

v.

T KHZ, LLC,
ent Owner.

023-01023
,798,509 B1

OF DR. GREGORY F. WELCH
TIONERS' REPLY

Meta
Exhibit 1173
Meta v. 8KHZ
IPR2023-01023
Ex. 1173

Ex. 1003 (Welch Decl.); Ex. 1173 (Welch Decl. Supp.)

Dr. Welch

Q. So did you analyze the claims to understand the meaning and scope of each claim?

A. **Certainly the scope. I don't know what you mean exactly by meaning. I analyzed the claims looking at how a person of ordinary skill as I defined in my declarations would read those claims, what they would read the claims to claim so the scope of those claims based on the words of the claim. That is not the same thing as picking out elements and explaining -- doing some analysis on what the meaning of those elements are. I don't think I ever did that, and I don't think I would need to do that or want to do that as part of this -- the analysis I did.**

Ex. 2012 (Welch Dep. Tr.) at 192:13-193:4

Case Law Supports Reliance On POSA Knowledge Involving Predictable Application Of Known Technology

B/E Aerospace, Inc. v. C&D Zodiac, Inc.

"First, we affirm the Board's conclusion that the challenged claims would have been obvious because modifying the Admitted Prior Art/Betts combination to include a second recess **was nothing more than the predictable application of known technology**. The prior art **yields a predictable result** …."

B/E Aerospace, Inc. v. C&D Zodiac, Inc., 962 F.3d 1373, 1379-80 (Fed. Cir. 2020) (emphasis added) (internal citations removed)

Koninklijke Philips N.V. v. Google LLC

"[I]t does not follow that we ignore the skilled artisan's knowledge when determining whether it would have been obvious to modify the prior art."

Koninklijke Philips N.V. v. Google LLC, 948 F.3d 1330, 1337-38 (Fed. Cir. 2020) (emphasis added)

Pointing At, Highlighting, And Selecting Sound-Producing Virtual Objects Was Well Known

Lovitt

[0038] In the illustrated example of FIG. **2**, the interactive digital environment of game **208** includes virtual space sound source **238** (e.g., weapon muzzle brake of a user-controlled weapon) and virtual space sound source **242** (e.g., tank muzzle brake). As used herein, the term "virtual space sound source" refers to any element (e.g., scenery, user-controlled characters, non-user-controlled characters, etc.) generated by gaming console **212** with which sound is programmatically associated (e.g., "originates" from). In other words, each virtual space sound source includes one or more associated sounds such that, during interaction with the virtual environment, one or more of the associated sounds are programmed to be "output" from a particular virtual space sound source.

Ex. 1021 (Lovitt) at [0038]

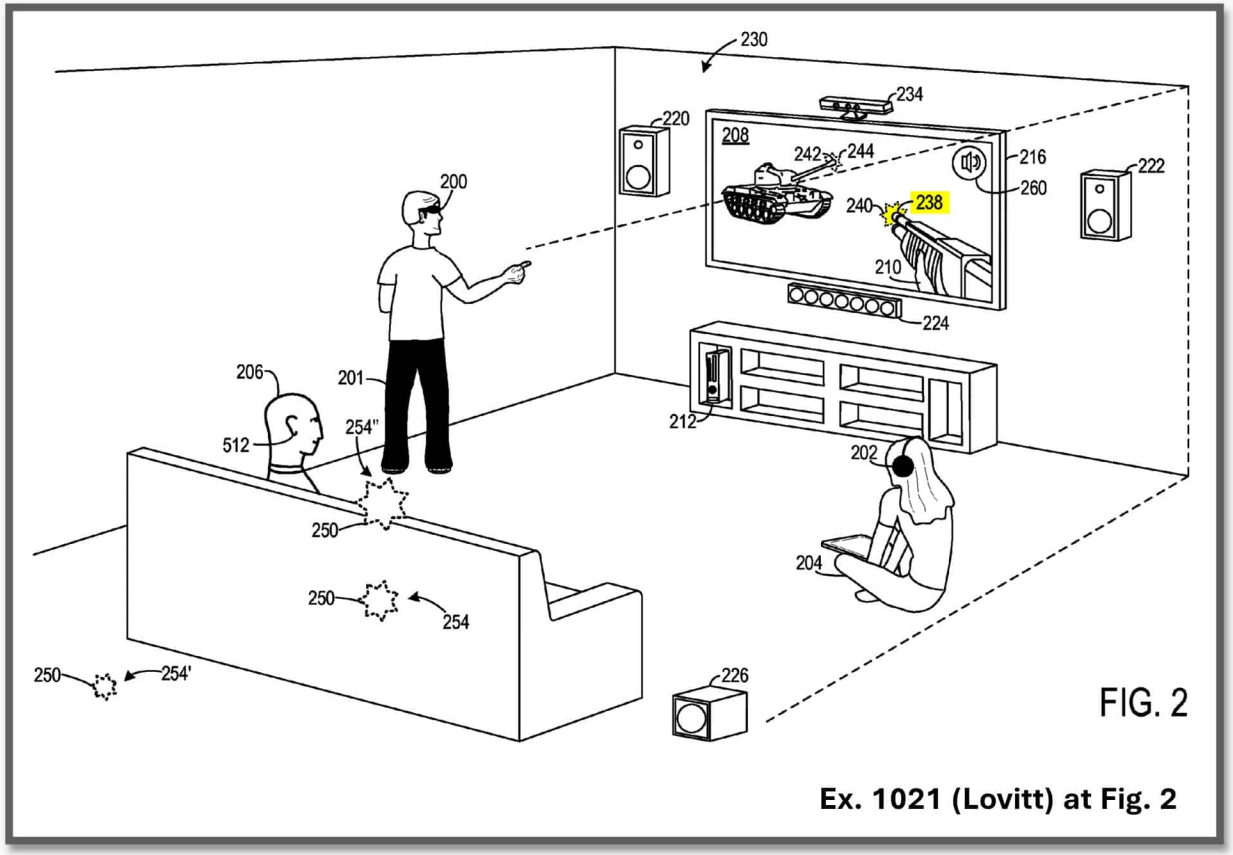


FIG. 2

Ex. 1021 (Lovitt) at Fig. 2

Pointing At, Highlighting, And Selecting Sound-Producing Virtual Objects Was Well Known

Osman

In one embodiment, game console **422** tracks the location of the ears of player **406***a*. When sounds are generated in the game (e.g., the sound of a helicopter flying) game console **422** determines the coordinates in the virtual space of the sound origin. Once the location of the ears and the location of the sound origin are known, the game console **422** determines the relative location between the sound origin and the ears perceiving the sound. Game console **422** also has information regarding the location of speakers **420** in the room. The HRTF of the user is used to convert the sound into a localized sound that appears to the user as coming from the sound origin. The localized sound, which is transmitted to speakers **420**, includes different acoustic signals for each of the speakers **420** in order to simulate the location of the sound origin.

Ex. 1031 (Osman) at 10:3-15

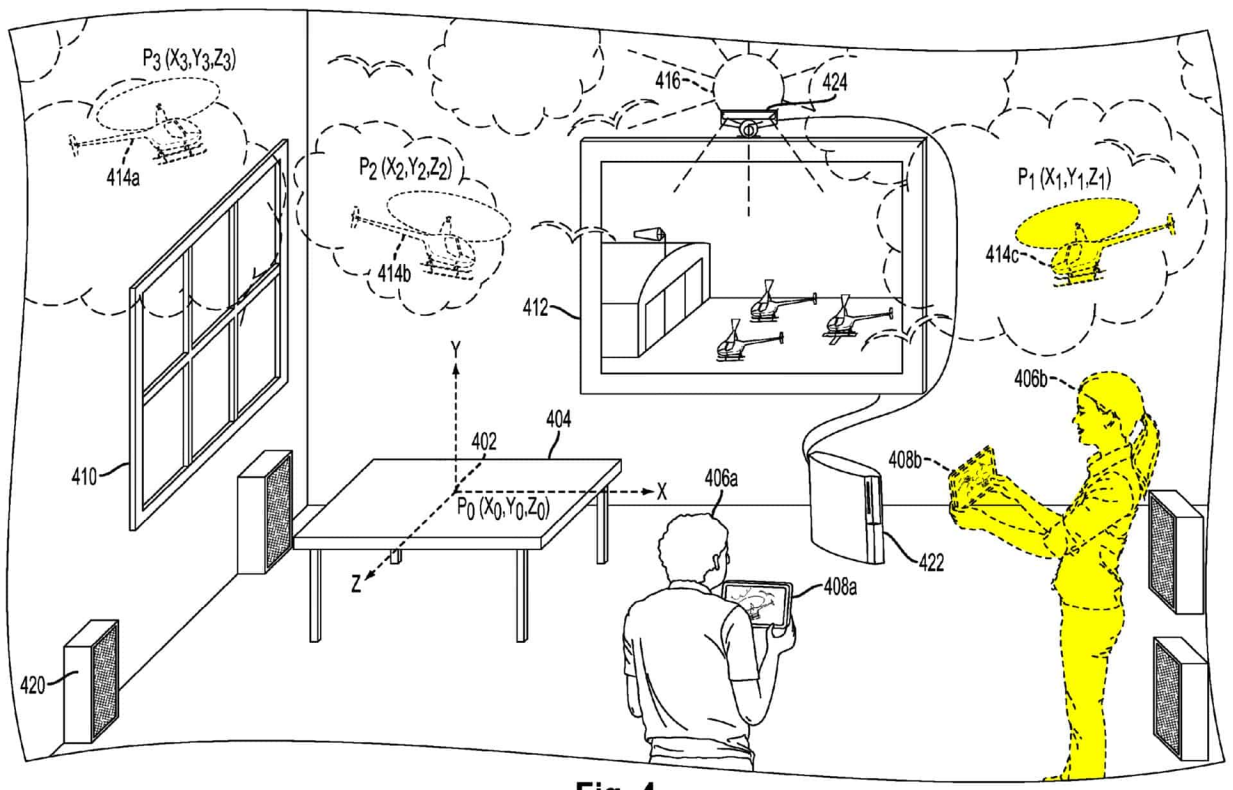


Fig. 4

Ex. 1031 (Osman) at 10:3-15, Fig. 4

Pointing At, Highlighting, And Selecting Sound-Producing Virtual Objects Was Well Known

McCulloch

nism. Additionally, in optional step **416**, the 3D audio engine **304** plays audio data for the virtual object projected from a 3D space position of the virtual object relative to a 3D space position and orientation identified for the display device which is used to approximate the position and orientation of the user's head supporting the display device. In the helicopter examples, a flight path of the virtual helicopter currently has it on course to fly into a wall behind the user. The user gets distracted and does not change the path via user input. The virtual helicopter is no longer displayed in the display field of view, but the 3D audio engine **304** plays the audio of the virtual crash to project from a position of the wall behind the user.

Ex. 1008 (McCulloch) at 26:7-19, Fig. 3A

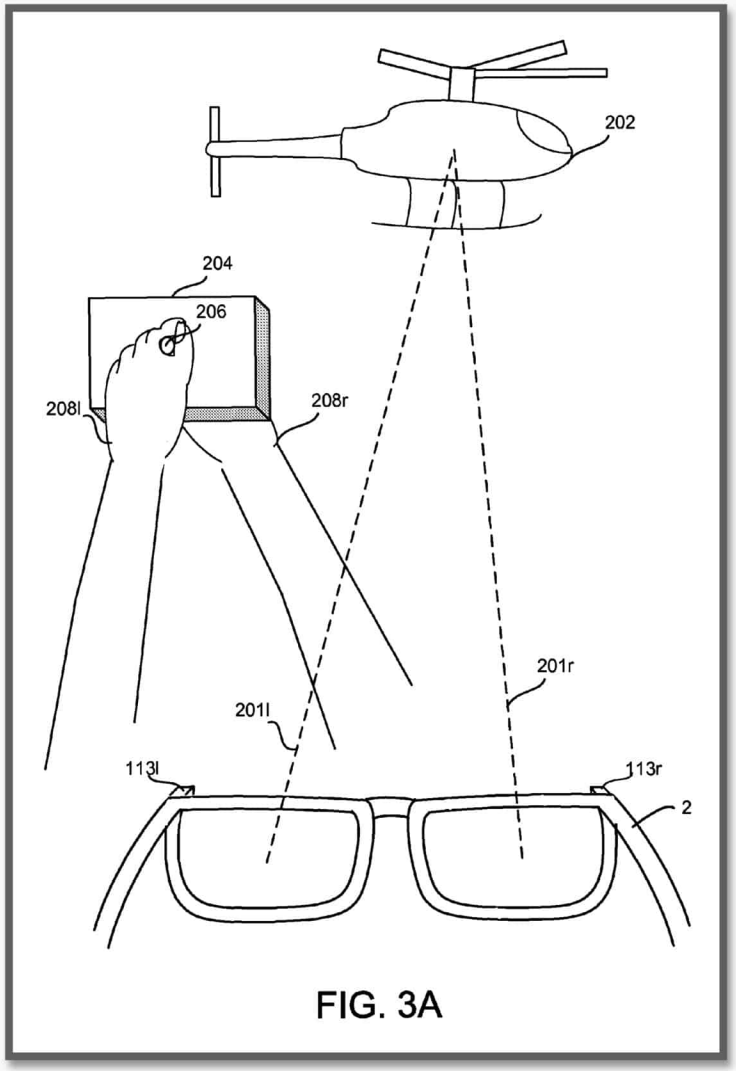


FIG. 3A

Arendi, Citing *K/S Himpp*, Focuses On Documentary Evidence



K/S Himpp v. Hear-Wear Techs., LLC

"[I]t is about **whether the Board declined to accept a conclusory assertion from a third party about general knowledge in the art without evidence on the record**, particularly where it is an important structural limitation that is not evidently and indisputably within the common knowledge of those skilled in the art. … The Board's decision was correct because an assessment of basic knowledge and common sense as a replacement for documentary evidence for core factual findings lacks substantial evidence support."

K/S Himpp v. Hear-Wear Techs., LLC, **751 F.3d 1362, 1365-66 (Fed. Cir. 2014) (emphasis added)**

Arguments In Petitioners' Reply Are Proper

Apple Inc. v. Andrea Elecs. Corp.

"Apple's legal ground did not change in its reply—its reply still asserted that claims 6–9 would have been obvious over Hirsch and Martin. Moreover, Apple's **reply relies on the same algorithm from the same prior art reference to support the same legal argument**."

***Apple Inc. v. Andrea Elecs. Corp.*, 949 F.3d 697, 706 (Fed. Cir. 2020) (emphasis added)**

Summary of Disputed Limitations

Exemplary Claim Language	Limitations	Impacted Claims
• "determining, with a wearable electronic device (WED) …"	1[b], 9[b], 9[c]	Independent Claims 1 and 9 Dependent Claims 2-8, 10-14
• "determining … when the PED is pointed at one of the SLPs" • "highlighting … one of the multiple SLPs in the zone"	1[c], 10[a], 11[a]	Independent Claim 1 Dependent Claims 2-8,10-11
• "playing the binaural sound … in response to the WED determining that the PED is pointed at the one of the SLPs"	1[d], 10[b]	Independent Claim 1 Dependent Claims 2-8, 10
• "tracking, with one or more sensors in the WED … the PED to determine when the PED moves outside the zone"	2[a], 17[e]	Independent Claim 17 Dependent Claims 2, 18-20

Appendix of Challenged Claims

U.S. 10,798,509 – Claim 1

1. A method comprising:
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;
determining, with a wearable electronic device (WED) worn on a head of the user, when the user is located inside the zone;
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
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 ('509 patent) at Claim 1

U.S. 10,798,509 – Claim 2

2. The method of claim **1** further comprising:

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; and

displaying, with the WED worn on the head of the user, a three dimensional (3D) virtual image that shows a size and a shape of the zone in response to the WED determining that the PED moved outside the zone.

Ex. 1001 ('509 patent) at Claim 2

U.S. 10,798,509 – Claim 3

3. The method of claim 1 further comprising:

tracking, with the WED worn on the head of the user, the user to determine when the user moves outside the zone; and

displaying, with the WED worn on the head of the user, a three dimensional (3D) virtual image that shows a size and a shape of the zone in response to the WED determining that the user moved outside the zone.

Ex. 1001 ('509 patent) at Claim 3

U.S. 10,798,509 – Claim 4

4. The method of claim **1** further comprising:

storing, in memory of the WED, a location of the zone, a size and a shape of the zone, and locations of the multiple SLPs in the zone from where the binaural sound originates to the user; and

displaying, with the WED, a virtual image having the size and the shape of the zone in response to the WED determining that the user is located in the zone.

Ex. 1001 ('509 patent) at Claim 4

U.S. 10,798,509 – Claim 5

5. The method of claim **1** further comprising:

designating, with the PED held in the hand of the user, locations of the multiple SLPs in the zone from where the binaural sound originates to the user; and

displaying, with the WED, virtual images at the location of the multiple SLPs in the zone.

Ex. 1001 ('509 patent) at Claim 5

U.S. 10,798,509 – Claim 6

6. The method of claim **1** further comprising:

selecting the 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

displaying, with the WED worn on the head of the user, a virtual image at 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 ('509 patent) at Claim 6

U.S. 10,798,509 – Claim 7

7. The method of claim **1**, wherein the zone has one of a three-dimensional (3D) shape of a cylinder and a 3D shape of a rectangle, and the user is centered in the zone.

Ex. 1001 ('509 patent) at Claim 7

U.S. 10,798,509 – Claim 8

8. The method of claim **1** further comprising:
playing, with speakers in the WED worn on the head of the user, a verbal instruction indicating the user should move back into the zone in response to the WED determining that the user moved outside the zone.

Ex. 1001 ('509 patent) at Claim 8

U.S. 10,798,509 – Claim 9

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

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;

determining, with a wearable electronic device (WED) worn on a head of the user, when the user is located inside the zone;

determining, with the WED worn on the head of the user, when the user is leaving the zone; and

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 ('509 patent) at Claim 9

U.S. 10,798,509 – Claim 10

10. The non-transitory computer readable storage medium of claim **9** in which the method further comprises:

determining, with the WED, when the PED is pointed at one of the SLPs while the user is located in the zone; and

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 ('509 patent) at Claim 10

U.S. 10,798,509 – Claim 11

11. The non-transitory computer readable storage medium of claim **9** in which the method further comprises:

highlighting, while the user is located in the zone and with a display of the WED, a virtual image at one of the 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.

Ex. 1001 ('509 patent) at Claim 11

U.S. 10,798,509 – Claim 12

12. The non-transitory computer readable storage medium of claim **9**, wherein the 3D virtual image of the zone is shaped as a cylinder with the user being centered in the cylinder, and the WED is one of a head mounted display and electronic glasses.

Ex. 1001 ('509 patent) at Claim 12

U.S. 10,798,509 – Claim 13

13. The non-transitory computer readable storage medium of claim **9**, wherein the 3D virtual image of the zone is shaped as a rectangle with the user being centered in the rectangle, and the WED is one of a head mounted display and electronic glasses.

Ex. 1001 ('509 patent) at Claim 13

U.S. 10,798,509 – Claim 14

14. The non-transitory computer readable storage medium of claim **9** in which the method further comprises:

playing, with the WED worn on the head of the user, a verbal instruction indicating the user should move back into the zone in response to the WED determining that the user moved outside the zone.

Ex. 1001 ('509 patent) at Claim 14

U.S. 10,798,509 – Claim 17

17. An electronic system comprising:

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

a wearable electronic device (WED) that is worn on a head of the user, wirelessly communicates with the PED, includes speakers that play the binaural sound to the user that emanates from the SLPs in empty space, includes one or more sensors that sense when the PED leaves the zone, and includes a display that displays a 3D virtual image of the zone in response to sensing that the PED leaves the zone, wherein the display displays the 3D virtual image of the zone to warn the user that the user is leaving the zone.

Ex. 1001 ('509 patent) at Claim 17

U.S. 10,798,509 – Claim 18

18. The electronic system of claim **17**, wherein the display of the WED highlights a virtual image at one of the SLPs in response to the WED determining that the PED is pointing to the one of the SLPs.

Ex. 1001 ('509 patent) at Claim 18

U.S. 10,798,509 – Claim 19

19. The electronic system of claim **17**, wherein the WED tracks a location of the user with respect to the SLPs, and automatically display a virtual image at a location of one of the SLPs in response to determining that the user is proximate to the location of the one of the SLPs.

Ex. 1001 ('509 patent) at Claim 19

U.S. 10,798,509 – Claim 20

20. The electronic system of claim **17**, wherein the speakers in the WED play the binaural sound that emanates from one of the SLPs in empty space in response to the WED determining that the PED is pointed to the one of the SLPs in empty space.

Ex. 1001 ('509 patent) at Claim 20

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6(e), I certify that on this 16th day of October, 2024, a true and correct copy of the foregoing **Petitioners' Demonstratives** was served by electronic mail on Patent Owner's lead and backup counsel at the following email addresses:

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