

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VALVE CORPORATION,
Petitioner,

v.

IMMERSION CORPORATION,
Patent Owner.

Case No. IPR2024-00557
Patent No. 10,665,067

PETITION FOR *INTER PARTES* REVIEW
UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 42.1 *et seq.*

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Exhibit	Description
1001	U.S. Patent No. 10,665,067
1002	Prosecution History of U.S. Patent No. 10,665,067
1003	Declaration of Gregory Welch
1004	CV of Gregory Welch
1005	Plaintiff’s Preliminary Infringement Contentions, <i>Immersion Corp. v. Valve Corp.</i> , 2:23-cv-00712 (W.D. Wash.) (served Oct. 20, 2023)
1006	Exhibit F to Plaintiff’s Preliminary Infringement Contentions, <i>Immersion Corp. v. Valve Corp.</i> , 2:23-cv-00712 (W.D. Wash.) (served Oct. 20, 2023)
1007	Amended Joint Status Report and Discovery Plan, <i>Immersion Corp. v. Valve Corp.</i> , 2:23-cv-00712, Dkt No. 42 (W.D. Wash) (filed Oct. 18, 2023)
1008	U.S. Patent Appl. Publ. No. 2018/0144549 (“Gonzales”)
1009	U.S. Patent Appl. Publ. No. 2016/0274662 (“Rimon”)
1010	U.S. Patent Appl. Publ. No. 2017/0354864 (“Rogers”)
1011	U.S. Patent Appl. Publ. No. 2017/0108930 (“Banerjee”)
1012	U.S. Patent Appl. Publ. No. 2012/0045742 (“Meglan”)
1013	Ronald T. Azuma, “A survey of augmented reality,” <i>Presence: Teleoperators and Virtual Environments</i> , vol. 6, no.4, pp.355 –385, August, 1997 (“Azuma”)
1014	Carmigniani <i>et al.</i> , “Augmented reality technologies, systems and applications,” <i>Multimedia Tools and Applications</i> (2011) 51:341–377, (“Carmigniani”)
1015	Araujo <i>et al.</i> , “An haptic-based immersive environment for shape analysis and modelling,” <i>Journal of Real-Time Image Processing</i> (2010) 5:73–90 (“Araujo”)
1016	U.S. Patent No. 7,812,815 (“Banerjee-815”)
1017	U.S. Patent No. 6,417,638 (“Guy”)

1018	U.S. Patent No. 7,411,576 (“Massie-576”)
1019	U.S. Patent Appl. Publ. No. 2010/0291505 (“Rawley”)
1020	Ronald T. Azuma, “A survey of augmented reality,” <i>Presence: Teleoperators and Virtual Environments</i> , vol. 6, no.4, pp.355-385, August, 1997 (“Azuma-Stamped-Copy”)
1021	U.S. Patent No. 9,563,266 (“Banerjee-266”)
1022	U.S. Patent Appl. Publ. No. 2002/0097223 (“Rosenburg”)
1023	U.S. Patent No. 5,587,937 (“Massie-937”)
1024	U.S. Patent No. 11,127,306 (“Goel”)
1025	U.S. Patent No. 10,172,676 (“Ecabert”)
1026	U.S. Patent Appl. Publ. No. 2018/0335841 (“Rubin”)
1027	U.S. Patent No. 9,881,520 (“Ullrich-520”)
1028	U.S. Patent No. 10,146,335 (“Balan”)
1029	Federal Court Management Statistics (September 2023)
1030	<i>Immersion Corp. v. Valve Corp.</i> , 2:23-cv-00712-TL, Dkt. No. 15 (W.D. Wash. May 18, 2023) (Proof of Service)
1031	<i>Immersion Corp. v. Valve Corp.</i> , 2:23-cv-00712-TL, Dkt. No. 46 (W.D. Wash. Nov. 11, 2023)
1032	U.S. Patent Appl. Publ. No. 2009/0263775 (“Ullrich-775”)
1033	U.S. Patent Appl. Publ. No. 2019/0179426 (“Ojala”)
1034	U.S. Patent No. 10,701,318 (“Valli”)
1035	U.S. Patent Appl. Publ. No. 2018/0050268 (“Jones”)
1036	U.S. Patent No. 10,319,109 (“Murrish”)
1037	U.S. Patent No. 10,803,761 (“Welch”)

I. MANDATORY NOTICES

A. Real Party-In-Interest – §42.8(b)(1)

Petitioner Valve Corporation is the Real Party-in-Interest.

B. Related Matters – §42.8(b)(2)

1. United States Patent & Trademark Office

U.S. Patent No. 10,665,067 (“the ’067 patent”) was filed on June 14, 2018, as U.S. Patent Application No. 16/010,230.

2. United States Patent Trial and Appeal Board

Valve Corporation v. Immersion Corporation, Case Nos. IPR2024-00477, IPR2024-00478, IPR2024-00508.

3. District Court Matters

The ’067 patent is asserted in the following case: *Immersion Corp. v. Valve Corp.*, 2:23-cv-00712-TL (W.D. Wash.).

C. Counsel and Service Information – §42.8(b)(3) and (b)(4)

Lead Counsel	Elisabeth H. Hunt, Reg. No. 67,336	
Backup Counsel	Marc S. Johannes, Reg. No. 64,978 Nathan R. Speed (<i>pro hac vice</i> application forthcoming)	
Service Information	<u>E-Mail:</u>	EHunt-PTAB@wolfgreenfield.com MJohannes-PTAB@wolfgreenfield.com nspeed@wolfgreenfield.com
	<u>Post & Hand-Delivery:</u>	Wolf, Greenfield & Sacks, P.C. 600 Atlantic Avenue Boston, MA 02210-2206

	<u>Telephone:</u>	617-646-8000
	<u>Facsimile:</u>	617-646-8646

A power of attorney is submitted with this Petition. Counsel for Petitioner consents to service of all documents via electronic mail.

Petitioner requests *inter partes* review of claims 1-8, 11-12, and 15-21 (“challenged claims”) of the ’067 patent.

II. INTRODUCTION

The ’067 patent is directed to “integrating haptics” into “augmented reality” (AR) applications. EX1001, 1:9. In AR systems, aspects of both a virtual environment and the physical environment are perceived by the user, in contrast to “virtual reality” (VR) systems that display only a virtual environment. EX1003 (“Welch”), ¶¶41-45.

Two primary AR techniques are: (1) optical see-through (OST) where the user sees the real environment directly (EX1013, Figure 11, below left), and (2) video see-through (VST) where the user sees the real environment indirectly via video capture, (EX1013, Figure 13, below right). EX1013, 361-363; Welch, ¶¶46, 53.

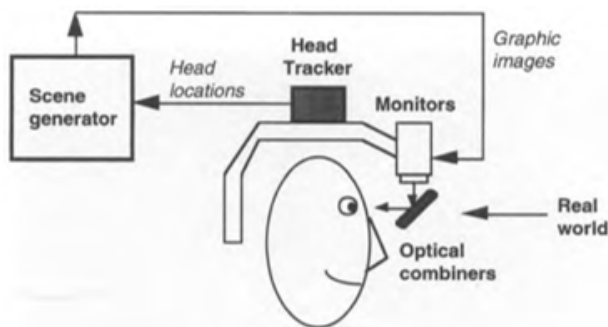


Figure 11. Optical see-through HMD conceptual diagram.

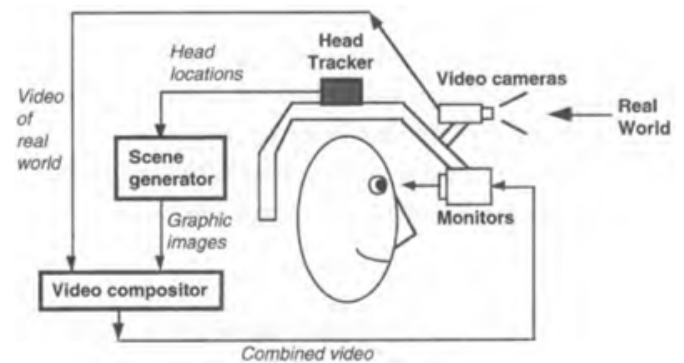
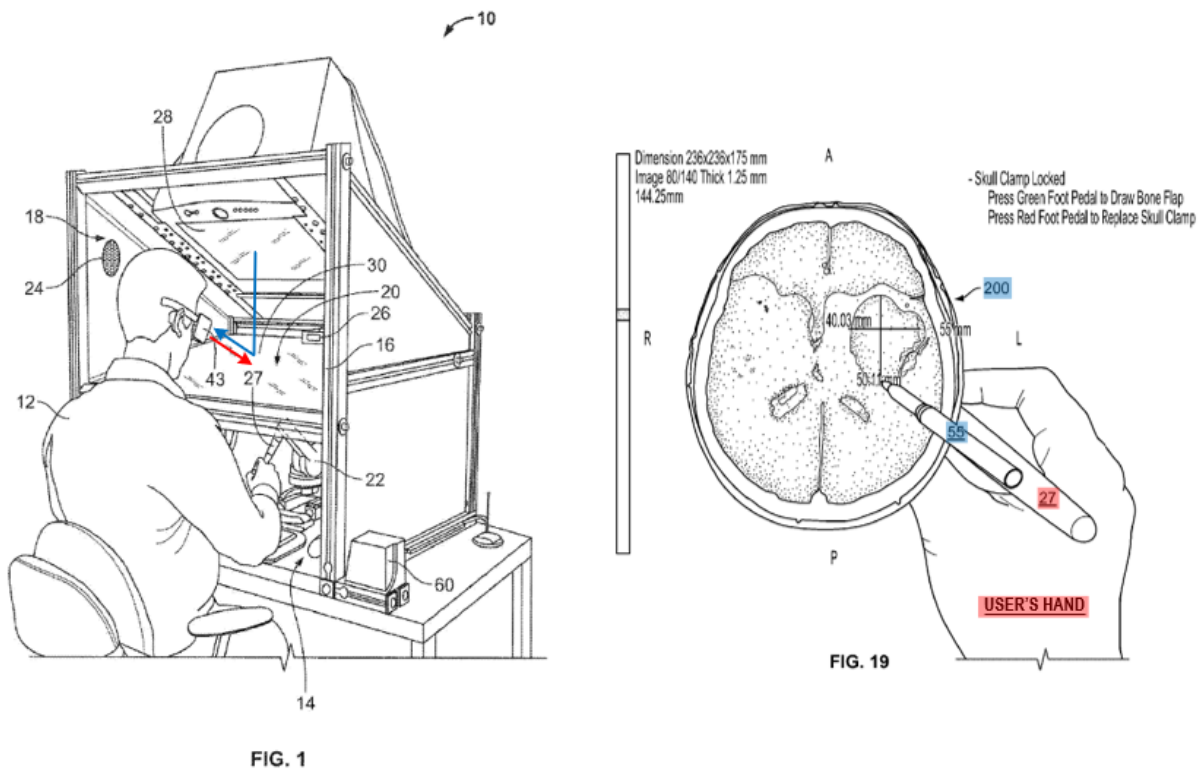


Figure 13. Video see-through HMD conceptual diagram.

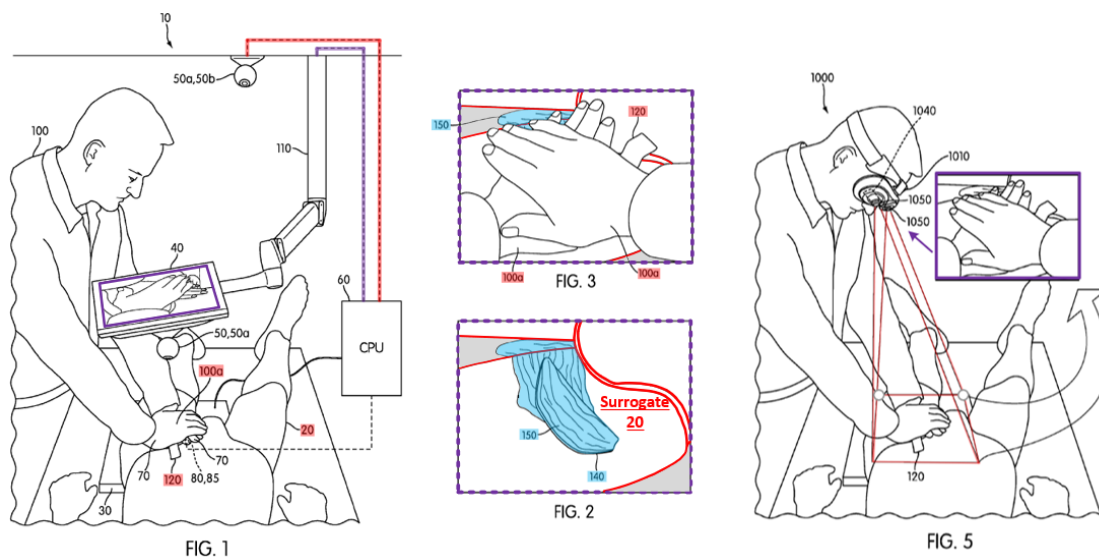
In OST AR, the user sees the real world through an optical combiner, and virtual objects projected onto the optical combiner are reflected into the user’s vision as if superimposed on the real world. EX1013, 361-362; Welch, ¶¶47-50. Banerjee

(EX1011) discloses an OST surgical simulation system (see Banerjee's FIGS. 1 and 19, annotated below) where user 12 simultaneously sees real-world objects through partially-transparent mirror 30 (**red** annotations) and virtual objects projected by screen 28 and reflected by the mirror (**blue** annotations). EX1011, [0029], [0035], [0052]-[0054]; Welch, ¶¶51-52.



In VST AR, the user views real-time video of the real world with virtual aspects overlaid thereon. EX1013, 362; Welch, ¶¶54-56. Meglan (EX1012) discloses a VST trauma simulator (see Meglan's FIGS. 1-3 and 5, annotated below) where trainee 100 sees composite video (**purple** annotations) in which a virtual wound (shaded **blue**) is overlaid on real-time video of a mannequin (**red**

annotations) with which trainee 100 interacts. EX1012, [0066], [0070]-[0072], [0082]-[0083], [0094]; *see also* EX1010, [0063]; Welch, ¶¶57-58.



The '067 patent acknowledges that conventional *virtual* reality (VR) applications integrated haptics—e.g., by causing VR game controllers to provide “touch sensation[s]” to users’ hands to make it feel like the user is shooting a gun. EX1001, 1:14-20. But the patent alleges that “[i]n [the] *AR* space, it is difficult to provide a haptic effect to the user,” and therefore techniques “for integrating haptics overlay in augmented reality are needed.” EX1001, 1:19-23.¹

But conventional AR systems already integrated haptics using the same conventional AR displays and haptic devices disclosed in the '067 patent. Welch,

¹ ***Bold italic*** emphases added unless otherwise specified. *Plain italics* indicate claim language.

¶42. Both Banerjee and Meglan integrate haptics into their respective AR systems (and additionally VR systems), providing touch sensations that the user can feel as part of the surgical/trauma simulation. Banerjee is the basis of **Ground 1** and Meglan is the basis of **Ground 2**. Rogers (EX1010) also integrates haptics in both VR and AR systems and is the basis of **Ground 3**.

III. CERTIFICATION OF STANDING

The '067 patent is available for IPR and Petitioner is not barred or estopped from requesting IPR of the challenged claims. 37 C.F.R. §42.104(a).

IV. TABLE OF GROUNDS

Ground	Reference(s)	Claim(s)	Basis
1	Banerjee	1-8, 11-12, 15-21	102/103
2	Meglan	1-8, 11-12, 15-21	102/103
3	Rogers	1-8, 11-12, 15-21	102/103

The above-identified references are prior art (at least) under AIA 35 U.S.C. §§102(a)(1)-(2) based on the following filing and publication dates:

Reference	Filing Date	Publication Date
Banerjee	2012-09-27	2017-04-20
Meglan	2010-06-16	2012-02-23
Rogers	2016-09-30	2017-12-14

None of the above-identified references were cited during prosecution.

V. THE '067 PATENT²

The '067 patent discusses techniques that “allow a user to see and feel a texture on a real world object using a haptics overlay on that object.” 2:31-33. Figure 2 (below) illustrates a system “for integrating haptics overlay in augmented reality.” 5:23-24.

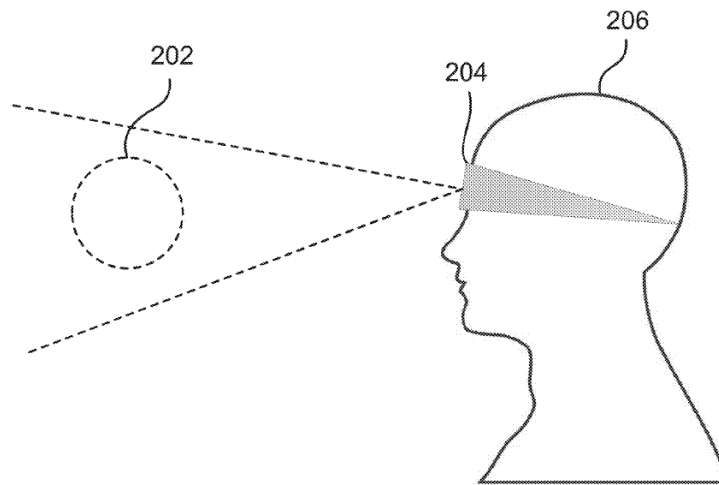


Figure 2

The real-world object is called a “proxy object 202” and can be in “the form of any object,” including “a shoe,” “an electronic device,” or “an interface object.” 5:34-37. User 206 may choose a texture/color for proxy object 202 (e.g., “red leather”) and “an augmented reality visual effect will modify the appearance of the proxy object” as viewed through AR device 204, such that “user 206 will be able to view the proxy object with the chosen texture.” 5:45-65. Additionally, a “haptic

² Unless otherwise noted, citations in Section V are to EX1001.

effect associated with the selected texture” is output by “haptic output device(s) 118 contained in proxy object 202.” 5:66-6:14; Welch, ¶¶63-70.

Despite the specification’s focus on simulating textures of materials (“leather, plastic, rubber,” 5:34-50), the challenged claims are not so limited. Only dependent claims 9-10 and 13-14 (not challenged herein) recite modifying texture. The challenged claims more broadly recite components/techniques that modify a visual effect displayed on a proxy object’s surface and output a haptic effect. All of the ’067 patent’s disclosed components/techniques were conventional and routinely used in AR systems. Welch, ¶¶71-72.

A. Level of Ordinary Skill in the Art

A person of ordinary skill in the art (“POSA”) would have a bachelor’s degree in electrical engineering, computer science, or a related field, plus at least two years of industry experience or graduate-level experience with human-computer interaction. More education could substitute for experience, and *vice versa*. Welch, ¶39.

B. Prosecution History

As originally filed, claim 1 recited a system comprising “a haptic output device,” “a display configured to output a visual effect,” “a sensor for tracking a position of a proxy object,” and a “processor” configured to, *inter alia*, cause a modified visual effect to be displayed and a haptic effect to be output. EX1002, 30.

That initial claim, and others, were rejected as obvious over Gonzalez (EX1008) and Rimon (EX1009). EX1002, 75-103.

In response, applicant amended claim 1 to require that the “haptic device” be “mechanically coupled to the proxy object” and that the display output a visual effect “onto a surface of the proxy object.” EX1002, 124. The examiner made final the Gonzalez-Rimon rejection. EX1002, 135-170). Applicant’s after-final amendment (EX1002, 257-264) was not entered (EX1002, 271-272).

Applicant requested continued examination and amended the claims to require that the “proxy object” comprises “one or more haptic output devices,” that a “modified visual effect [] be displayed on the proxy object via the display,” and deleted “a haptic device mechanically coupled to the proxy object.” EX1002, 280-283. The claims were subsequently allowed. EX1002, 295-299.

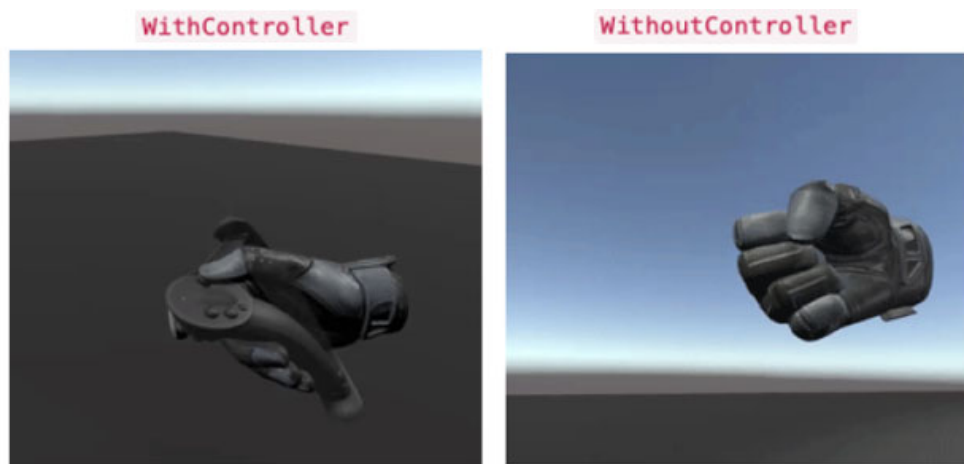
VI. CLAIM INTERPRETATION

Claim terms are construed herein according to their ordinary meaning in light of the specification and prosecution history. 37 C.F.R. §42.100(b).

In co-pending litigation, Patent Owner (“Immersion”) asserts that the claims can cover virtual-only displays, despite the specification disclosing AR systems as opposed to VR systems. Immersion contends that the “*visual effect*” displayed “*onto a surface of the proxy object*” in each independent claim can be met by a wholly

virtual display without any view of the physical environment. EX1006, 4-5; Welch, ¶77.

Specifically, with reference to the below image capture of a display (EX1006, 5), Immersion contends that a physical video-game controller is the claimed “*proxy object*” and that displaying “*a visual effect onto a surface of the proxy object*” is met either by displaying a virtual hand (the alleged “*visual effect*”) grasping a ***virtual representation*** of a controller (“WithController”) or by displaying the virtual hand ***alone*** (“WithoutController”). EX1006, 4-5; Welch, ¶78-80.



Petitioner disputes this overly broad interpretation as inconsistent with the intrinsic evidence which uniformly confines the claimed “*proxy object*” to a real-world object seen through an “augmented reality” device with a visual effect on its surface. EX1001, 3:1-4, 5:60-62.

But the Board need not resolve this dispute, as at least Grounds 1 and 2 demonstrate unpatentability under ***both*** Immersion’s VR-encompassing

interpretation and the proper AR interpretation. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Ltd.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017); *10X Genomics, Inc. v. Bio-Rad Labs*, IPR2020-00086, Paper 8 at 19 (Apr. 27, 2020) (“[J]udicial efficiency will be enhanced by allowing Petitioner to rely upon a claim construction that Patent Owner is relying upon in the related district court litigation to asserted infringement of the challenged patent.”).

VII. GROUND 1: CLAIMS 1-8, 11-12, 15-21 ARE ANTICIPATED BY, OR ALTERNATIVELY OBVIOUS OVER, BANERJEE

A. Banerjee (EX1011)³

Banerjee discloses “haptic augmented and virtual reality” systems for “performing simulated surgical procedures” on virtual patient anatomy. [0027]. Banerjee’s system includes: an AR “open surgery station” that displays “virtual reality aspects superimposed over real reality” ([0029]); and a VR “microsurgery station” whose visual display “consists of virtual aspects” such that “the user does not see aspects of real reality” ([0030]). Welch, ¶83.

1. Open Surgery Station (“OSS”)

Banerjee’s OSS allows a user to interact with virtual patient anatomy using a haptic-enabled physical stylus “as a proxy” for a “simulated surgical instrument.” [0029]. In the user’s view, the appearance of the simulated surgical instrument is

³ Unless otherwise noted, citations in Section VII are to Banerjee.

superimposed on the physical stylus, to make the physical object held in the user's hands look like the particular surgical instrument. [0029]. In this manner, the user sees "aspects of real reality in addition to the superimposed virtual reality aspects" while performing a surgical simulation. [0029]; Welch, ¶¶84-85.

As shown by annotated FIG. 1 (below left), OSS 10 implements this OST-type AR effect using a display screen 28 angled towards partially transparent (half-silvered) mirror 30 so that user 12 simultaneously sees physical objects through the mirror (**red** arrow) and 3D-stereoscopic images of virtual objects from display screen 28 reflected by the mirror (**blue** arrow). [0035]; Welch, ¶86.

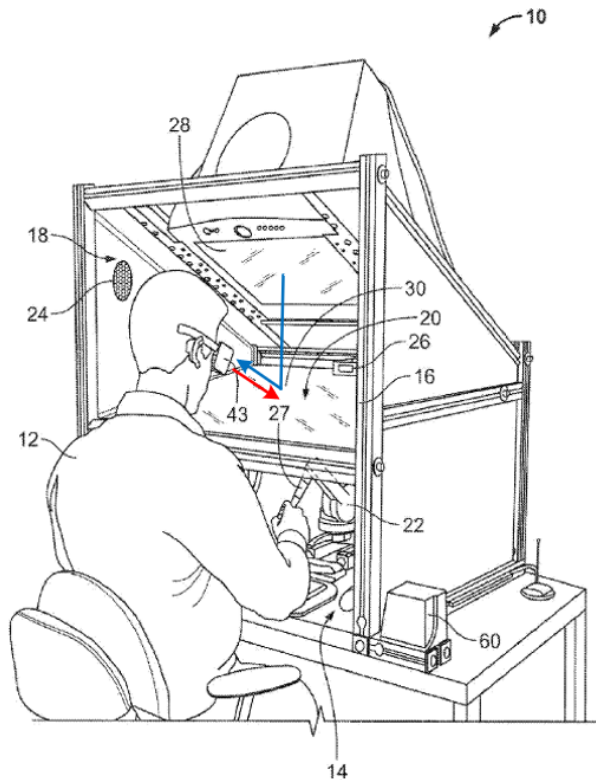


FIG. 1

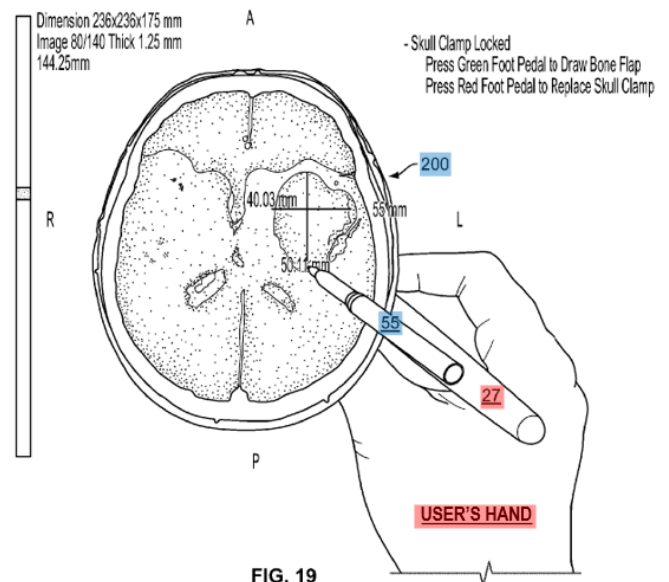


FIG. 19

FIG. 19 (annotated above right), for example, depicts the view seen by user 12 having selected “virtual marker 55” as the simulated instrument to “mark and measure a planned craniotomy on the simulated radiology scan 200.” [0053]. User 12 simultaneously sees his/her actual hand holding physical stylus 27 (shaded **red**) through mirror 30, as well as virtual marker 55 and radiology scan 200 (annotated with **blue**), which are virtual objects reflected by mirror 30. [0053]. Thus, OSS 10 “automatically superimpose[s] an image of the surgical marker over the real haptic stylus 27 visible through partially transparent mirror 30,” making the stylus look like a marker to the user. [0053]; Welch, ¶¶87-88.

2. Microsurgery Station (“MSS”)

Banerjee’s MSS (FIG. 4, below) likewise “uses a haptic stylus as a proxy for the [surgical] instrument” to allow interaction with virtual patient anatomy, but “the user does not see aspects of real reality” and instead sees only “computer generated graphics” of the 3D virtual environment ([0030]) via display screen 28 viewed through eyepiece 31 ([0035])—i.e., as the user manipulates haptic stylus 27 to control a selected virtual tool, the user does not see the actual stylus or the user’s actual hands, but only computer-generated objects whose virtual movements are controlled using stylus 27. [0030]; Welch, ¶89.

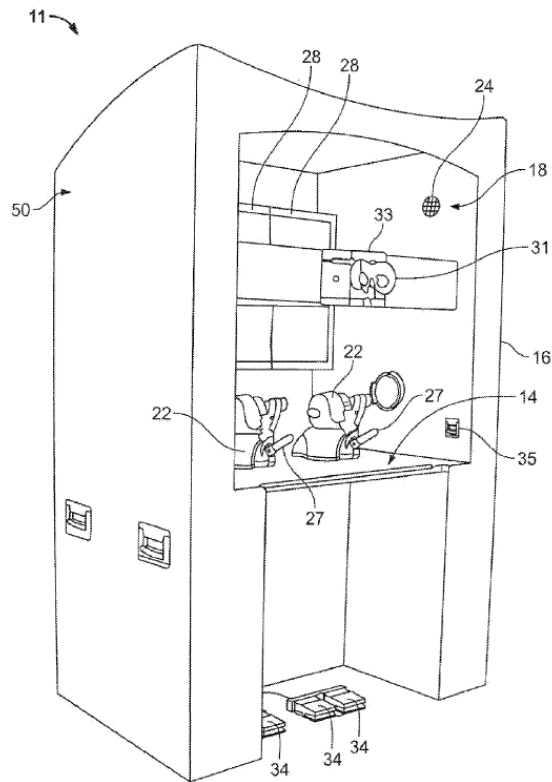


FIG. 4

3. Banerjee's Haptics and Graphics Rendering

Banerjee's OSS and MSS use the same haptics and graphics software 44, 46 (annotated FIG. 2, below) to provide real-time haptic and visual feedback as the user manipulates a virtual tool via haptic device 22's haptic stylus 27 to interact with virtual objects in a virtual environment and receive corresponding haptic feedback. [0032]-[0033], [0041]-[0045]; Welch, ¶90.

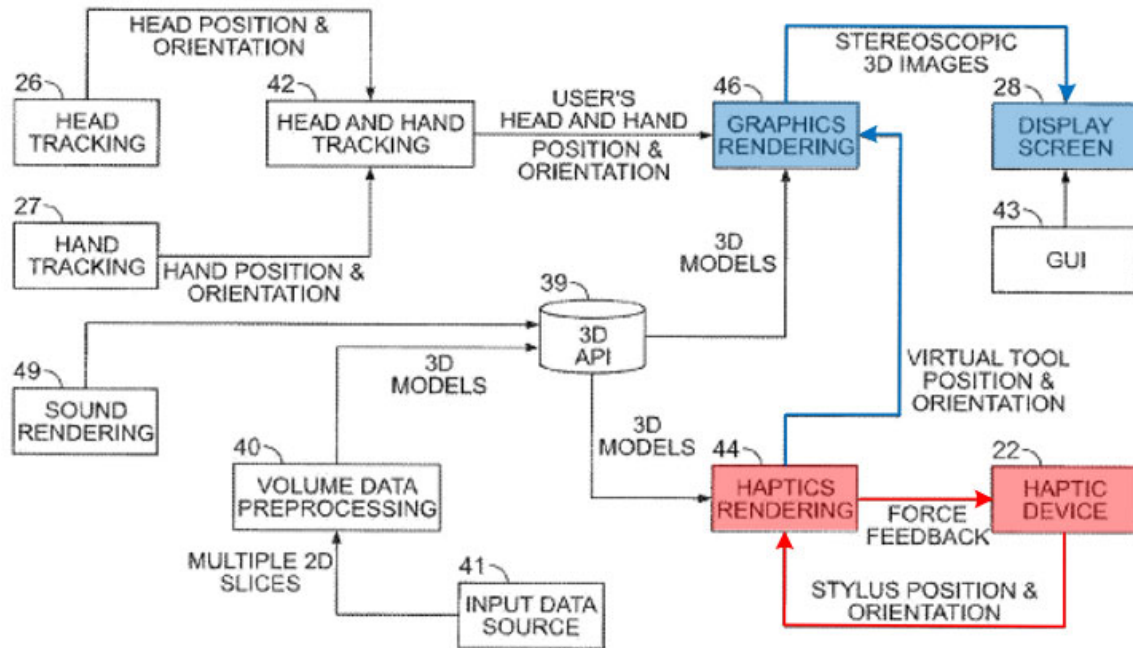


FIG. 2

In the haptics update path (annotated **red** in FIG. 2, above), haptics rendering software 44 reads the current position and orientation of stylus 27 from haptic device 22 and updates the location of the virtual tool in the virtual environment to match the physical location of the stylus in the real world. [0029]-[0030], [0042]. Haptics rendering 44 calculates interactions between the virtual tool at that location and other objects in the virtual environment (e.g., virtual anatomy) and determines appropriate force feedback to simulate the “feel characteristics” of the computed interactions. [0042]. Haptic device 22 generates the force feedback to provide “tactile sensations” ([0044]) of the computed interactions to the user holding stylus 27—e.g., the “different sensations when touching skin, bone, and internal organs” ([0043]). [0042]-[0044]; Welch, ¶91.

In the graphics update path (annotated **blue** in FIG. 2, above), graphics rendering software 46 receives the updated virtual-tool position and orientation from haptics rendering software 44 and “generates and continuously updates, in real time, the stereoscopic 3D display that is displayed by a display screen 28” ([0044]). [0035]-[0036], [0044]; Welch, ¶92.

B. Claim 1

1. [1PRE]: “A system comprising:”

Banerjee discloses “haptic augmented and virtual reality [] **systems**” ([0027]), including the OSS and MSS discussed *supra* §VII.A. [0027]-[0031]. OSS 10 and MSS 11 are thus each a system. OSS and MSS also share computer 32 and are used together to perform different steps in a simulated surgical procedure, thus forming a combined system. [0031], [0037], [0053]-[0068]. The combined OSS/MSS system and/or either system individually, meets [1PRE]. *Id.*; Welch, ¶100.

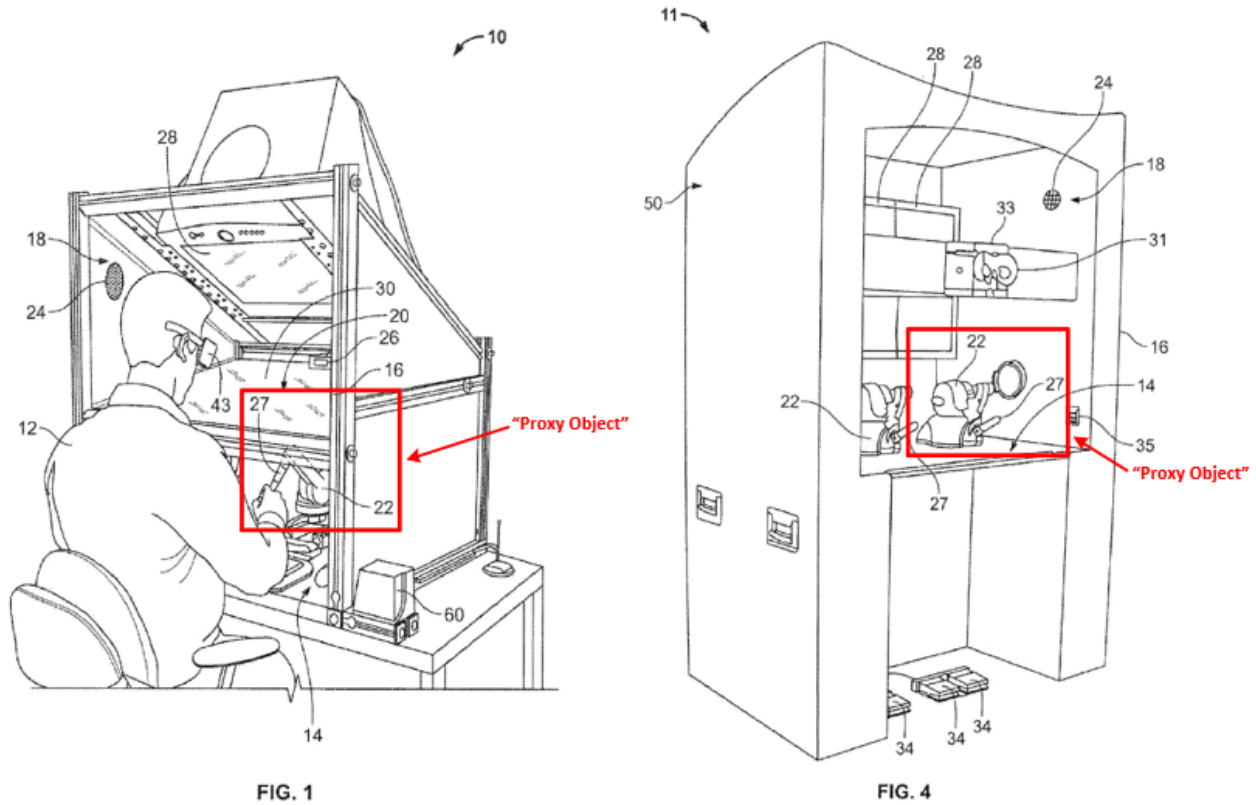
2. [1A]: “a proxy object comprising one or more haptic output devices;”

Banerjee’s haptic device 22 (or its component, haptic stylus 27) is used “as a proxy” for a virtual tool and meets [1A]. [0029]-[0030]; Welch, ¶101.

a. Haptic Device 22 Meets [1A]

As boxed in **red** in annotated FIGS. 1 and 4 (below), haptic device 22 in both OSS 10 and MSS 11 includes haptic stylus 27 and tracks the position and orientation of the user’s hand as it moves the stylus. This tracking allows a virtual tool to be

“collocated with [] haptic device 22” in views shown to the user. [0032]-[0034]; Welch, ¶102.



Thus, the user holds and manipulates haptic device 22’s stylus 27 “as a proxy” for the virtual tool that the user is controlling in the simulation ([0029]-[0030]). [0029]-[0034], [0042], [0053]-[0070]. Thus, Banerjee’s haptic device 22 is a real-world object that Banerjee explicitly teaches is a “proxy,” and that the user manipulates to control a corresponding virtual tool, and therefore is “*a proxy object*” as claimed. [0029]-[0030], [0034], [0042]; EX1001, 5:34-47 (proxy object “may take the form of *any* object”); Welch, ¶¶59-60 (citing EX1032, [0027], [0045]-

[0047], [0072]; EX1033, [0024]-[0030], [0046]-[0047], [0069]; EX1036, 7:20-8:13; EX1034, 7:54-60), 61-62, 103-105.

Haptic device 22 “*compris[es] one or more haptic output devices*” for three reasons. First, haptic device 22 is a haptic output device because it is explicitly described as a “haptic device” and it outputs “force feedback” to simulate the “feel characteristics” of virtual objects contacted by the virtual tool. [0042]; Welch, ¶106. Second, haptic device 22 comprises haptic stylus 27, which is a haptic output device because the user feels the haptic device’s output “tactile sensations” through stylus 27. [0044]. Indeed, Banerjee discloses that the simulation “outputs the force result” computed for different haptic effects “to the haptic stylus 27” (*see infra* §VII.B.5.b). [0057]-[0059], [0062]-[0063], [0068]; Welch, ¶107.

Third, POSAs understood that Banerjee’s haptic device 22 that generates “force feedback” includes actuators (e.g., motors) to produce the disclosed “force feedback” (or that would have been the obvious way to implement what Banerjee discloses) and thus comprises “haptic output devices” for this additional reason. EX1001, 2:53-55, 4:23-33 (disclosing that “actuators” and “motors” are haptic output devices); Welch, ¶¶93-99 (citing EX1017, 1:18-65, 4:26-59, 12:64-13:10; EX1018, 1:12-57, 3:38-6:36, 12:54-13:29; Banerjee, [0032], EX1016, 9:15-31, EX1010, [0020], FIG. 3), 108-109.

b. Haptic Stylus 27 Meets [1A]

Haptic device 22's haptic stylus 27 also meets [1A]'s "*proxy object*" because it is a real-world object used "as a proxy" to control a virtual tool. [0029]-[0030]; Welch, ¶¶59-62, 110. Haptic stylus 27 "*comprises one or more haptic output devices*" because it is itself a "*haptic output device*" through which "tactile sensations" are felt ([0044], *supra* §VII.B.2.a), and because POSAs understood that haptic stylus 27 comprises the actuators ("*haptic output devices*") (*see supra* §VII.B.2.a that cause the disclosed force feedback felt by the user. [0042]-[0044]; Welch, ¶¶110-111 (citing EX1017, 1:18-65, 4:26-59; EX1018, 1:12-57, 5:54-6:36, 12:54-13:29).

3. [1B]: "a display configured to output a visual effect onto a surface of the proxy object"

a. OSS 10 Meets [1B]

OSS 10 displays "virtual reality aspects superimposed over real reality," meeting [1B]. [0029]; Welch, ¶¶112-113. This is done using "display screen 28" (shaded **blue** in annotated FIG. 1, below) that displays stereoscopic images of virtual aspects of the environment and "half-silvered mirror 30" (shaded **purple**) "to reflect the image of the display screen" to the user. [0035]. Because mirror 30 is "partially transparent," the user also sees the physical environment (i.e., "the user's hands" and "haptic device 22 with its stylus 27") through mirror 30 to provide "an augmented reality environment." [0035]; Welch, ¶113.

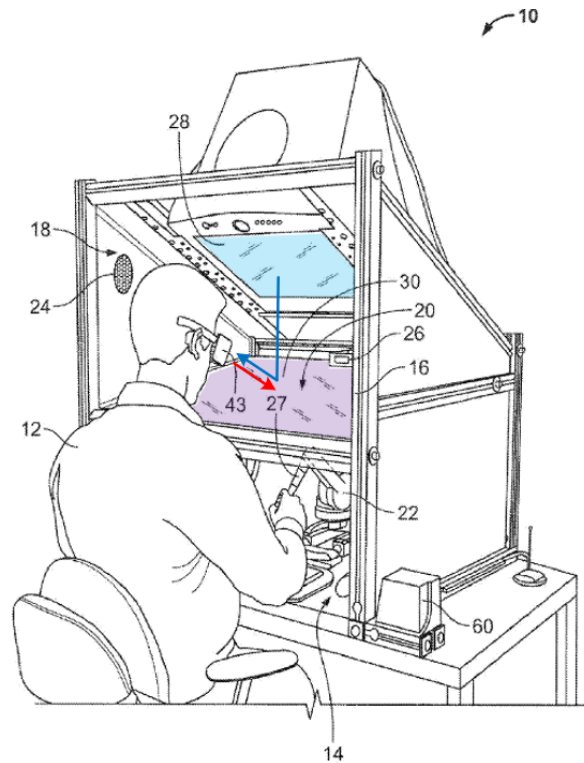
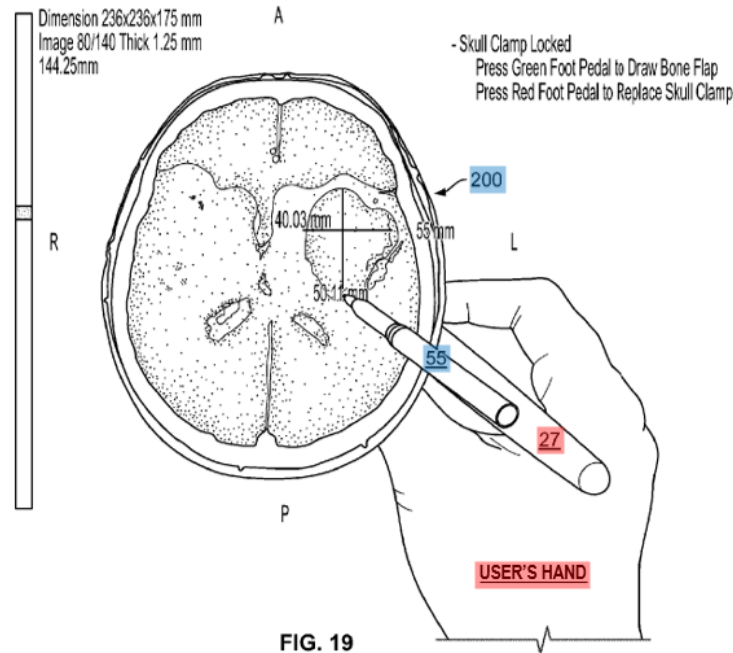


FIG. 1

The “virtual reality display” from screen 28 includes a 3D image of a virtual tool that is collocated with haptic device 22’s physical stylus 27 so that the 3D image of the virtual tool reflected by mirror 30 is superimposed on the user’s view of the physical stylus and appears to be held in the user’s actual hand visible through mirror 30. [0029], [0034]-[0035], [0042]-[0044], [0053]-[0059], [0063], FIGS. 7-18; Welch, ¶114. FIG. 19 illustrates an example of this visual effect where the user has selected surgical marker 55 as the virtual tool to “mark and measure a planned craniotomy.” [0053].



As shown by FIG. 19, above (annotated with virtual object labels shaded **blue** and real object labels shaded **red**), user 12 simultaneously sees the virtual objects (i.e., “simulated radiology scan 200” and “virtual marker 55”) as reflected by mirror 30 from display screen 28, and the real environment through mirror 30 (i.e., the user’s hand (label added) and haptic stylus 27 on which virtual marker 55 is superimposed). [0053]; Welch, ¶115.

Thus, OSS 10’s display system is “*configured to output a visual effect onto a surface of the proxy object*” because the image of the virtual tool (“*a visual effect*”) is “superimpose[d] over the real haptic stylus 27 visible through partially transparent mirror 30” ([0053], [0057]-[0059], [0062]-[0063]), like the ’067 patent’s embodiments where visual effects are seen on the proxy object “through” the AR display (EX1001, 2:49-52, 5:60-62, 8:19-24). [0029], [0035], [0044], [0053]-[0059];

Welch, ¶116. This also meets Immersion’s broader interpretation that encompasses both AR and VR displays by displaying the virtual tool. Welch, ¶117; EX1006, 4-5; *supra* §VI.

POSAs understood that OSS 10’s “display system” ([0035]), including display screen 28 and mirror 30, meets [1B]’s “*display*” at least because the ’067 patent explicitly says that one type of “display” is conventional “AR headsets” (EX1001, 3:40-41), which POSAs understood commonly included the same elements as OSS 10’s display system, e.g., EX1013’s head-mounted OST display (EX1013, 364-365, Figures 11-12) or the Hololens AR headset ([0072]; EX1028, 2:25-26, 5:16-35, FIG. 2) discussed *supra* §II. *See also* EX1001, 5:60-62, 8:19-24 (disclosing that the “wearable AR device” shown as a headset in FIGS. 2-4 is an “augmented reality display”); Welch, ¶118.

Thus, POSAs understood that “*a display*” encompasses multi-element AR displays for at least the above reasons. This understanding is reinforced by the ’067 patent’s disclosure that while Fig. 2 “shows the user wearing a wearable AR device 204, any type of AR display system may be used.” EX1001, 5:26-28; Welch, ¶119.

Moreover, Banerjee discloses that the OSS’s display system can be implemented using the “Microsoft Hololens” ([0072]) head-mounted display (HMD)—i.e., an AR headset that the ’067 patent explicitly says is a display. EX1001, 3:40-41, 8:19-24; Welch, ¶119. A “perspective rendering” of the

“Microsoft Hololens” is illustrated in FIG. 2 of EX1028 below (EX1028, 2:25-26).
EX1028, 5:16-22 (corroborating that Hololens is an OST HMD);

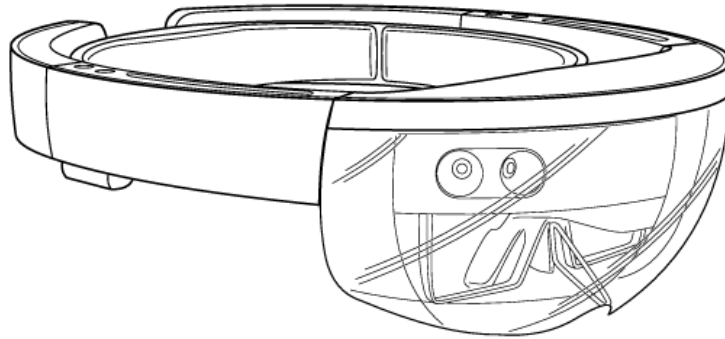


FIG. 2

POSAs understood that in Banerjee’s disclosed Hololens implementation of OSS 10’s display system, the functionality of Banerjee’s display screen 28 and mirror 30 would be performed by the Hololens HMD’s OST components. EX1028, 5:16-22 (describing HMD’s “see-through holographic lenses” and “advanced optical projection system”), 5:24-6:44; Welch, ¶¶88, 120-121.

Thus, OSS 10’s display system of FIG. 1, or its implementation using the Hololens AR HMD, meets “*a display configured to output a visual effect onto a surface of the proxy object.*” Welch, ¶122; *supra* §II.

Alternatively, display screen 28 alone meets [1B]’s “*display*” because it is “*configured*” to output the “*visual effect onto a surface of the proxy object*” by being angled towards mirror 30, thus causing virtual tools to appear superimposed on the surface of the physical stylus. [0035], [0053], [0057]-[0059], [0062]-[0063], [0066],

[0068]; Welch, ¶123. Similarly, Banerjee’s mirror 30 also meets [1B]’s “*display*” because it displays to the user the “*visual effect*” by reflection and the real world via transmission. [0035]; Welch, ¶123.

b. MSS 11 Meets [1B] Under Immersion’s Interpretation

Additionally, MSS 11 meets [1B] because display screen 28 (shaded blue in FIG. 4, below) is “a display” that is “*configured to output a visual effect onto a surface of the proxy object,*” under Immersion’s broader interpretation that encompasses MSS 11’s VR display. [0030], [0035], [0042]-[0044]; Welch, ¶¶124-125; EX1006, 4-5; *supra* §VI.

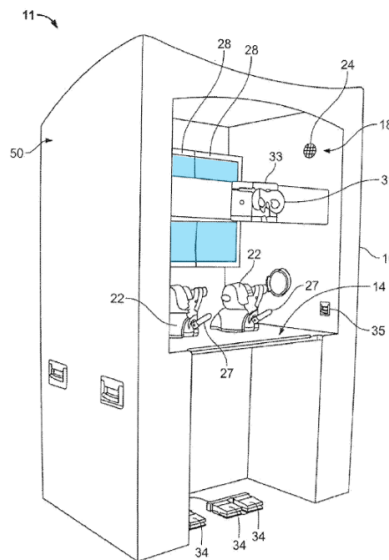


FIG. 4

4. [1C]: “a sensor for tracking a position of the proxy object”

Banerjee’s system meets [1C] because haptic device 22 tracks the position of haptic stylus 27, in both OSS 10 and MSS 11. Welch, ¶126.

Haptic device 22 “track[s] the user’s hand position and orientation” ([0034]) by tracking stylus 27 held by user 12. [0029]-[0034], [0042]. As shown in FIG. 2, below with **red** emphasis, haptics rendering block 44 reads the current position and orientation of stylus 27 from haptic device 22 to collocate the virtual tool with haptic device 22 in real time. [0042]-[0044]; Welch, ¶127.

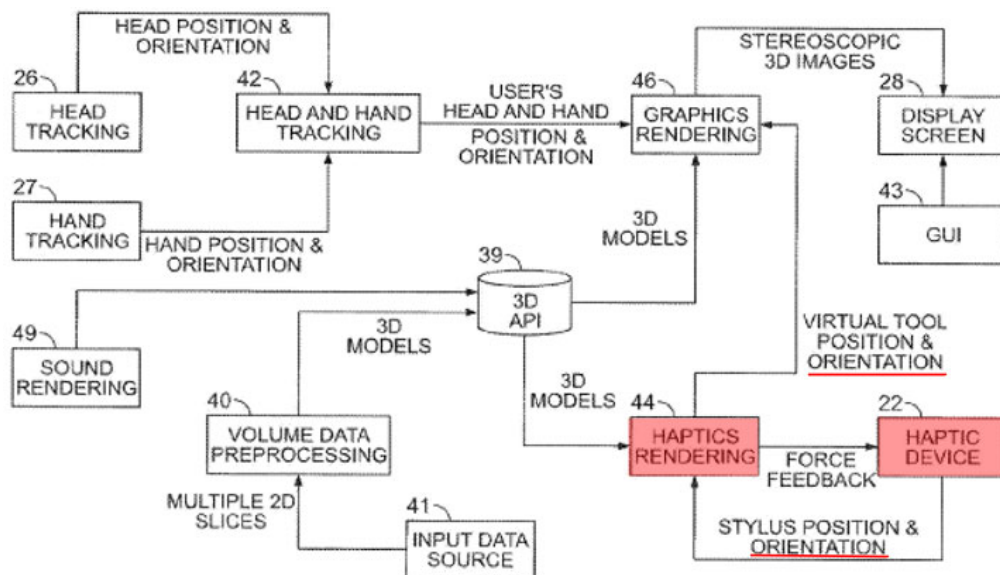


FIG. 2

POSAs therefore understood that Banerjee’s haptic device 22 that continuously measures the position and orientation of its stylus is or includes a “sensor,” which the ’067 patent uses broadly to cover a range of devices (e.g., cameras, lasers, radars, etc.), including “tracking sensors” that perform the same tracking function as Banerjee’s haptic device 22. EX1001, 4:2-8; Welch, ¶128. For example, the ’067 patent discloses that “detection module 124 may sample sensor 108 in order to track [] the location [] of haptic output device 118 over time”

(EX1001, 4:52-55), just like Banerjee’s haptic rendering block 44 samples haptic device 22 (e.g., at 1000 Hz) to track the position and orientation of haptic stylus 27 in real time. [0042]-[0044]; Welch, ¶128; *see also* EX1001, 3:49-51 (sensors track user’s hands).

Haptic device 22 tracks “*a position of the proxy object*” for multiple reasons. First, the tracked position/orientation of haptic stylus 27 is “*a position*” of haptic device 22 (a claimed “*proxy object*”—*supra* §VII.B.2.a) of which the stylus is a part—i.e., “haptics rendering software 44 can read the position and orientation of each haptic device 22, for example a stylus 27” ([0042]). Welch, ¶129.

Second, haptic stylus 27 itself meets [1A]’s “*proxy object*” (*see supra* §VII.B.2.b); thus haptic device 22 “*track[s] a position of the proxy object*” by tracking the current position and orientation of its stylus. [0032]-[0034], [0042]; Welch, ¶129.

Additionally, Banerjee’s system meets [1C] because POSAs understood that haptic device 22 includes sensors (e.g., optical encoders) that track movement of each articulating joint defining the stylus’s location in space (or alternatively that would have been an obvious way to implement what Banerjee discloses). Welch, ¶¶94-98, 130 (citing EX1017, 1:18-56, 2:66-3:5, 12:64-13:46; EX1018, 1:12-49, 3:51-55, 12:54-13:12). Each is a “*sensor*” that tracks “*a position*” of the haptic device 22 (a claimed “*proxy object*”—*supra* §VII.B.2.a) at the corresponding

joint, thereby also tracking “*a position*” of the stylus 27 (a claimed “*proxy object*”—*supra* §VII.B.2.b) in space. Welch, ¶131.

5. [1D]: “a processor configured to”

Banerjee’s computer 32 that executes the haptics and graphics rendering software for both the OSS and MSS includes “*a processor*” as claimed. [0037]-[0040], [0043].

Computer 32 (boxed in **red** in FIG. 3, below) is “operatively connected” to both OSS 10 and MSS 11 and includes the software that “controls and operates” both OSS 10 and MSS 11 ([0037]), including the haptics and graphics rendering software modules 44, 46, discussed *supra* §VII.A.3. [0037]-[0040], [0042]-[0044]; Welch, ¶¶132-134.

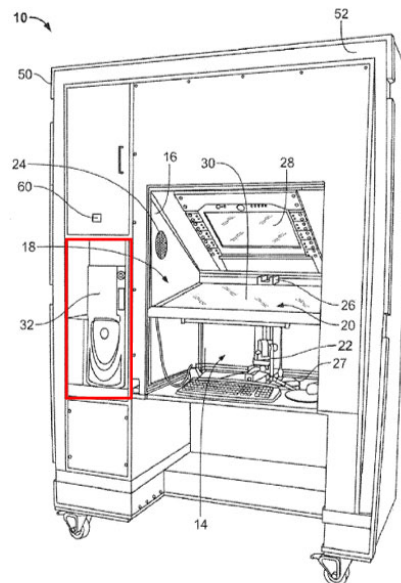


FIG. 3

POSAs understood that computer 32 includes “*a processor*” as claimed, in order to be able to execute the haptics and graphics (and other) software modules as

Banerjee discloses. [0037]-[0040], [0043]; Welch, ¶135. As one example, Banerjee discloses that in “a preferred embodiment, the graphics and haptics can be on two separate threads, which can be implemented, e.g., with a dual processor computer.” [0043]. Banerjee’s example dual processor is “*a processor*,” as claimed. *Convolve, Inc. v. Compaq Computer Corp.*, 812 F.3d 1313, 1321 (Fed. Cir. 2016) (“[A]bsent a clear intent in the claims themselves, the specification, or the prosecution history, we interpret “a processor” as “one or more processors.”).

The '067 patent explicitly says that multiple processors can be used. EX1001, 9:54-58 (disclosing implementation using “a computer” that comprises “a processor or processors”); FIG. 1 (illustrating “processor(s) 102”). Further, the '067 patent explains that “[t]he processor, and the processing, described may be in one *or more* structures, and may be dispersed through one or more structures” (EX1001, 10:24-26), reinforcing that the claim term “*a processor*” encompasses multiple processors that work together to perform the claimed functionality—e.g., in a “dispersed” manner with one processor structure performing some of the processing steps and another processor structure performing others of the processing steps, like Banerjee’s example dual-processor computer. Welch, ¶¶136-137.

Moreover, Banerjee’s dual-processor computer is described as merely one “example” way to implement the “preferred” dual-thread embodiment. [0043]. POSAs understood a dual-core processor (i.e., one processor having two cores)

commonly used for multi-threading is another example implementation for Banerjee's dual-thread embodiment. Welch, ¶138 (*citing* EX1012, [0103]). POSAs also understood that Banerjee's graphics and haptics can be executed on one thread using a single-core processor. Welch, ¶139. This understanding is reinforced by Banerjee's disclosure that the dual-thread embodiment is merely "preferred" and not the only suitable implementation. [0043].

Computer 32's processor(s), whether implemented as the example dual-processor computer or as any of the above-described obvious processor implementations, meets [1D]'s "*processor*" and performs limitations [1D1]-[1D5] when it executes Banerjee's haptics and graphics rendering software, as discussed *infra* §§VII.B.5.a-VII.B.5.e. Welch, ¶140.

a. [1D1]: "determine a modified visual effect based in part on data received from the sensor"

Banerjee's processor performs [1D1] each time graphics rendering software 46 updates in real time the display of the 3D image of the virtual tool based on the current position and orientation of stylus 27 received from haptic device 22. [0042], [0044]; Welch, ¶141; *supra* §VII.B.5.

As shown by the graphics update path annotated **blue** in FIG. 2, below, "graphics rendering 46" receives the virtual tool's current position and orientation updated by "haptic rendering 44" to coincide with stylus 27's current position and

orientation received from haptic device 22 (*see supra* §§VII.A.3, VII.B.4 and *infra* §VII.B.5.b). [0042]-[0044]; Welch, ¶142.

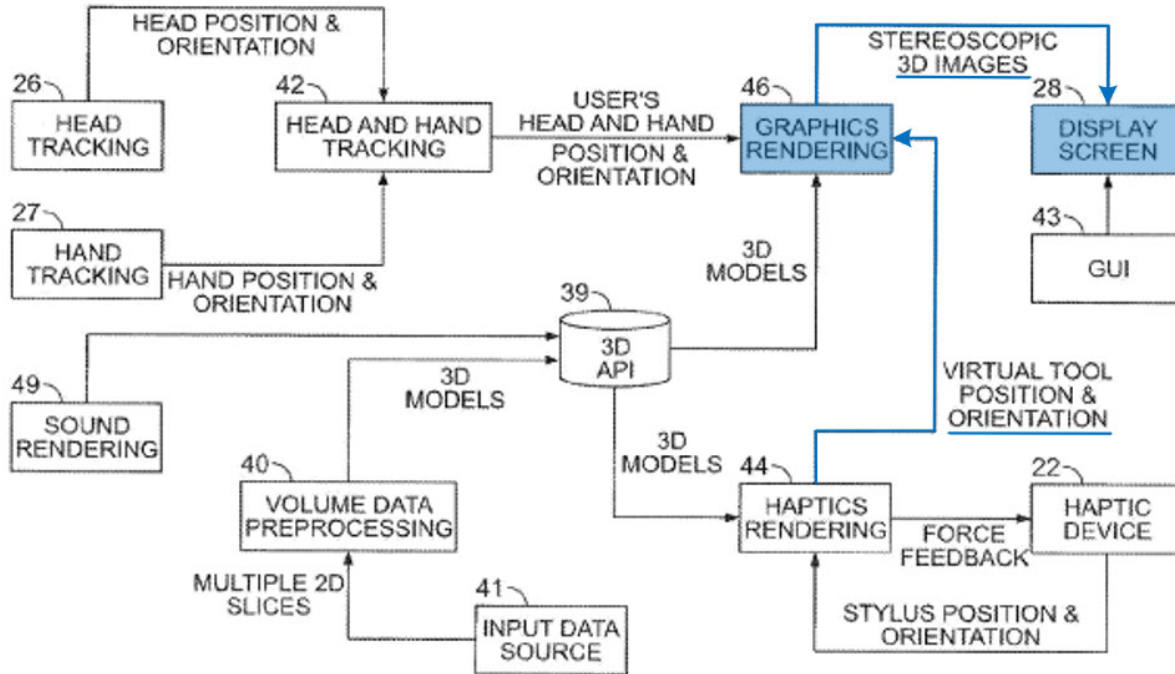
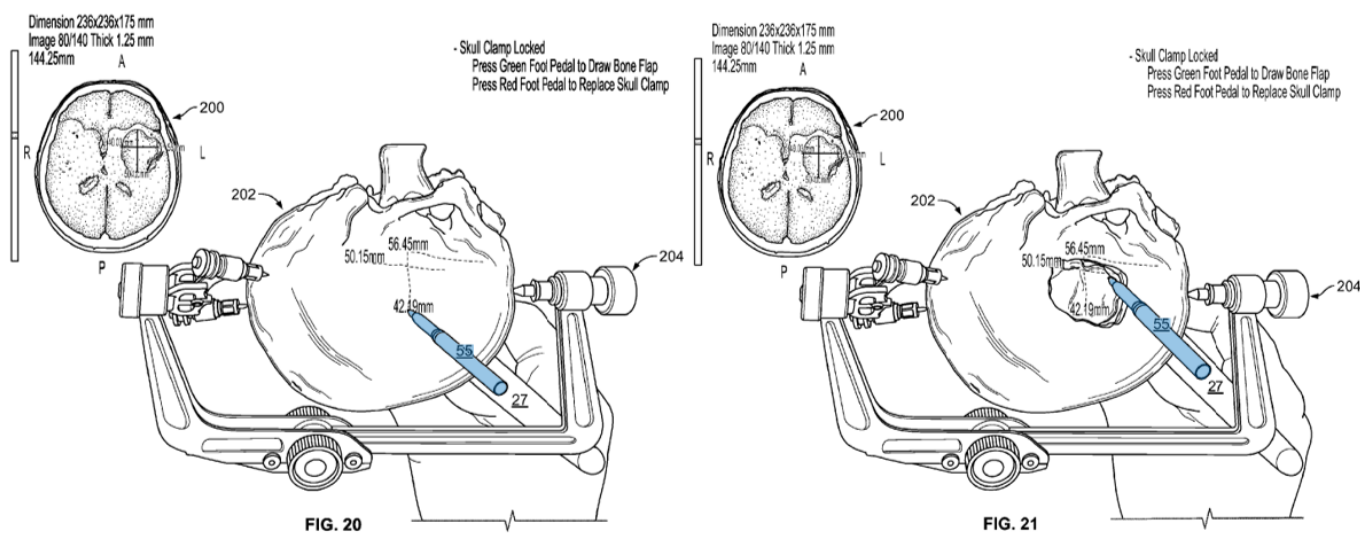


FIG. 2

Graphics rendering 46 “generates and continuously updates” ([0044]) a 3D stereoscopic image of the virtual tool at the updated position and orientation corresponding to stylus 27 for display on display 28, so that the virtual tool appears at the correct position and orientation as the user manipulates it via stylus 27. [0029], [0034]-[0035], [0042], [0044]; Welch, ¶143.

Thus, each 3D stereoscopic image of the virtual tool at an updated position/orientation is “*a modified visual effect*” determined “*based in part on data received from the sensor*”—i.e., the image is continuously modified based on the

current position/orientation of stylus 27 received from haptic device 22 (*see supra* §VII.B.4). [0029], [0034], [0042]-[0044], [0053]-[0068]; Welch, ¶144.



Computer 32's processor thus performs [1D1] by executing haptics and graphics rendering software 44, 46 (*supra* §VII.B.5). [0038], [0042]-[0044]; Welch, ¶147.

b. [1D2]: “determine a haptic effect based in part on data received from the sensor”

Haptics rendering 44 performs [1D2] by determining a “force feedback” corresponding to computed contact between virtual anatomy and the virtual tool, updated to correspond with stylus 27’s current position/orientation received from haptic device 22, as shown by the real-time haptics update emphasized in **red** in FIG. 2, below. [0042]-[0044]; Welch, ¶148.

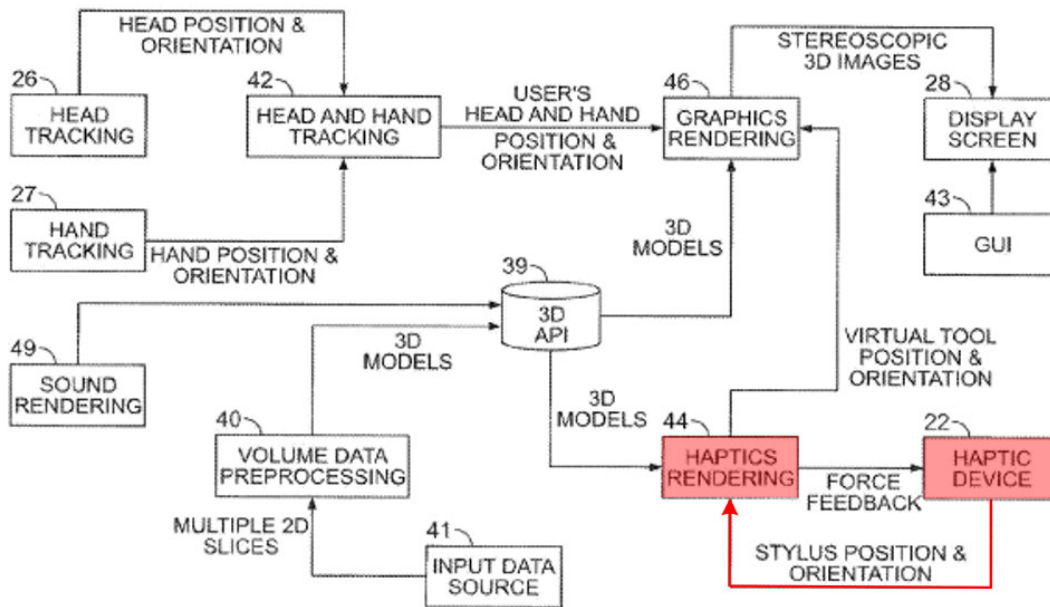


FIG. 2

Haptics rendering 44: (1) receives the current stylus position and orientation from haptic device 22 (“data received from the sensor”—see *supra* §VII.B.4); (2) updates the virtual tool’s position and orientation correspondingly; (3) computes “single or multi-point collisions” between the updated virtual tool location and virtual patient anatomy; and (4) determines the “force feedback” from “haptic

material” properties of the virtual anatomy contacted by the virtual tool (“*determine[s] a haptic effect*”). [0042]-[0044]; Welch, ¶¶149-150.

Numerous examples of haptics rendering 44 performing [1D2] are described in connection with using different tools to perform steps of a simulated aneurysm procedure illustrated in FIG. 5, below (annotated with red-shaded ovals corresponding to steps (1)-(4) above that meet [1D2]). Welch, ¶151.

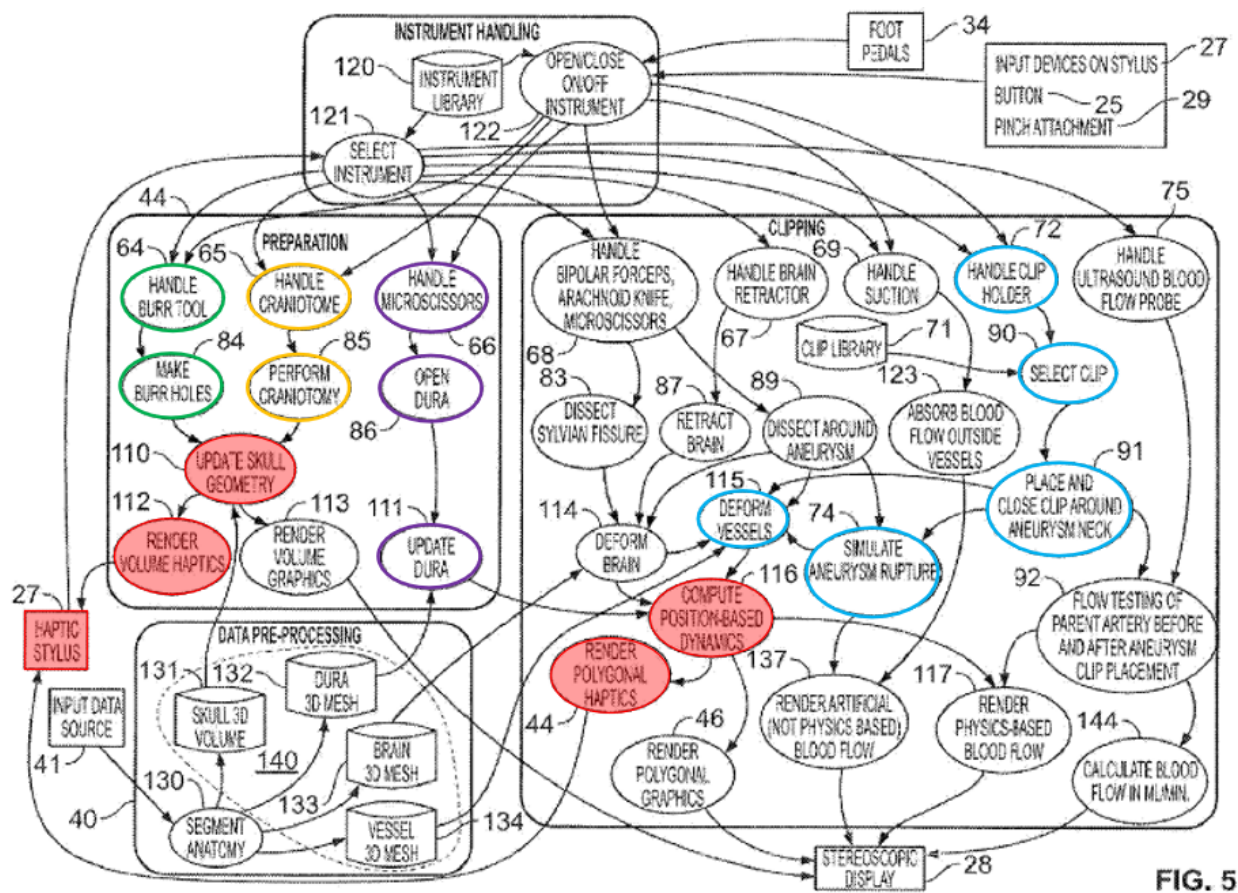


FIG. 5

For example, in simulating a brain dura cutting procedure (outlined purple), “[b]ased upon position-based dynamics” (step 116), “haptics rendering module 44 calculates the force that the user is exerting on the tool [virtual microscissors 57] to

progressively cut the dura” (step 44) and “outputs the force result to the haptic stylus 27.” [0059]. In an aneurysm clipping procedure (outlined **blue**), haptics rendering module 44 “calculates the force that the user is exerting on the virtual clip holder 72 (FIG. 8) to deform the blood vessel and aneurysm, and outputs the force result to the haptic stylus.” [0066]; *see also* [0057]-[0058] (describing “drilling” and “sawing” haptic effects for burr-hole drilling (outlined **green**) and a craniotomy (outlined **orange**), respectively); Welch, ¶¶152-154.

Thus, computer 32’s processor (§VII.B.5) performs [1D2] when haptics rendering software 44 determines any of these haptic effects based on the current position/orientation of stylus 27 output from haptic device 22. Welch, ¶155.

c. [1D3]: “transmit a display signal associated with the modified visual effect to the display, the modified visual effect to be displayed on the proxy object via the display”

As discussed *supra* §VII.B.5.a, graphics rendering 46 determines [1D1]’s “*modified visual effect*” each time it generates an updated 3D stereoscopic image of the virtual tool. Banerjee’s processor performs [1D3] when graphics rendering 46 transmits the generated 3D stereoscopic image to display screen 28 for display, as shown with **blue** emphasis in FIG. 2, below. [0042]-[0044]; Welch, ¶¶156-157.

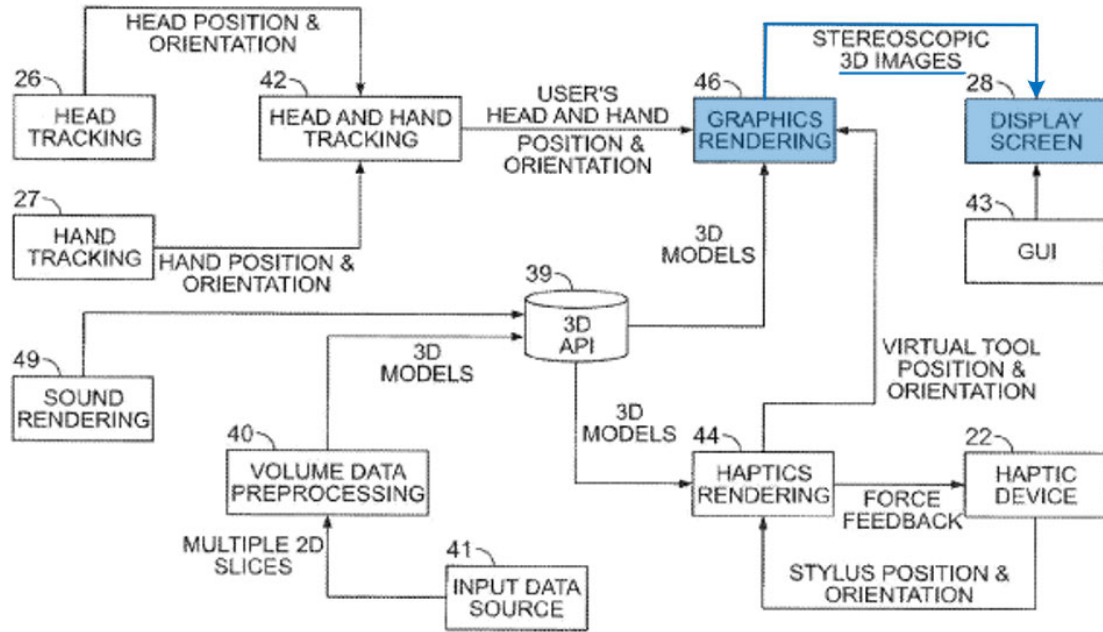


FIG. 2

POSAs understood that the way graphics rendering 46 “continuously updates” the stereographic 3D display on display screen 28 ([0044]) is by transmitting “a display signal” with updated “stereoscopic 3D images” (FIG. 2). [0038]-[0039]; Welch, ¶158. This display signal is “associated with the modified visual effect” because it includes an image of the virtual tool at the updated position/orientation. [0044], [0053]-[0070]; Welch, ¶158; *supra* §VII.B.5.a.

The “modified visual effect” of the image of the virtual tool whose position/orientation is updated as the user moves stylus 27 is “displayed on the proxy object via the display,” as discussed *supra* §VII.B.3. Specifically, Banerjee’s OSS 10 meets [1D3] because its display system “superimpose[s] an image of the tool over the real haptic stylus 27 visible through partially transparent mirror” ([0057]) such

that “a user can see aspects of real reality in addition to the superimposed virtual reality aspects” ([0029]). [0035], [0044], [0053]-[0059], [0063]; Welch, ¶159.

OSS 10’s display also meets Immersion’s broader interpretation that encompasses both AR and VR displays because OSS 10 displays the image of the updated virtual tool. Welch, ¶160; *supra* §VI; EX1006, 10 (alleging that [1D3] is met because “[t]he virtual hand is rendered differently as the controller moves.”). MSS 11’s display likewise meets [1D3] under Immersion’s interpretation—because the user sees the “*modified visual effect*” of the updated virtual tool via the display. [0030], [0042]-[0044]; Welch, ¶161; *supra* §VI; EX1006, 10.

d. [1D4]: “transmit a haptic signal associated with the haptic effect to the one or more haptic output devices”

Banerjee’s processor performs [1D4] when haptics rendering software 44 instructs haptic device 22 to generate “force feedback” that produces the haptic effect determined from the computed contact between the virtual tool and objects in the 3D environment (*see supra* §VII.B.5.b), as shown by the portion of the haptics feedback path emphasized in **red** in FIG. 2, below. [0042]-[0044]; Welch, ¶162.

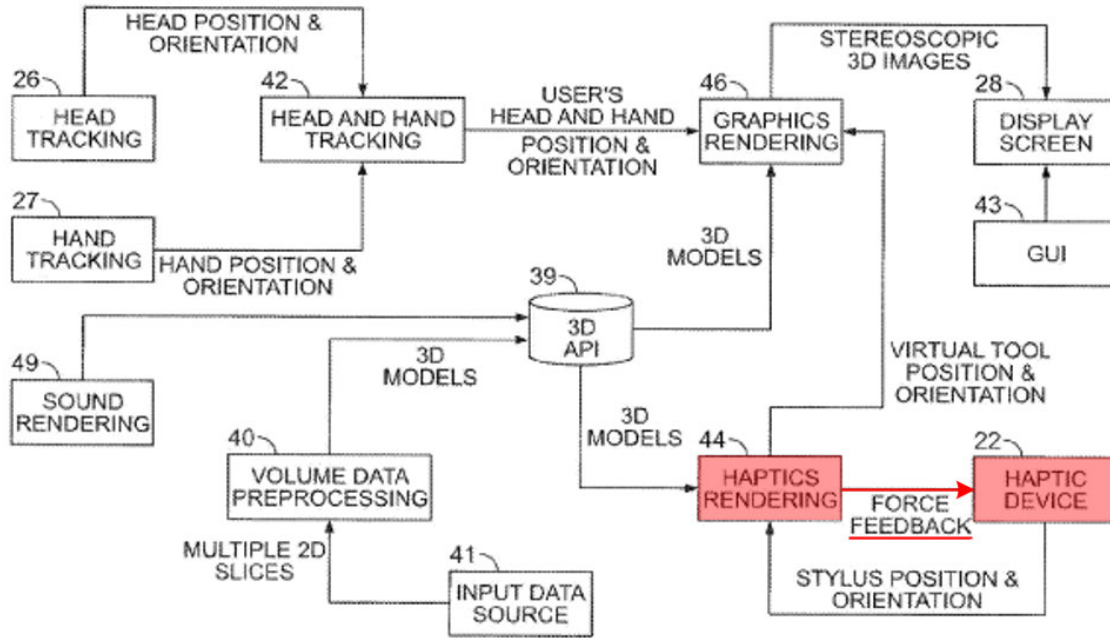


FIG. 2

Haptics rendering 44 “transmit[s] a haptic signal associated with the haptic effect” when it “direct[s] haptic device 22 to generate the corresponding force feedback” ([0042]) that produces the computed haptic effect felt by the user holding haptic stylus 27 (e.g., any of the haptic effects discussed *supra* §VII.B.5.b). [0042]-[0044], [0057]-[0068]; Welch, ¶163.

e. **[1D5]: “output the haptic effect using the one or more haptic output devices.”**

Banerjee’s processor performs [1D5] by directing haptic device 22 to generate the computed force feedback haptic (*supra* §VII.B.5.d). Directing haptic device 22 to generate the corresponding force feedback causes the user holding haptic stylus 27 to feel the corresponding “tactile sensations” ([0044]); therefore, haptics rendering software 44 is “using” haptic device 22 and its haptic stylus 27 to “output

the haptic effect” as claimed. Like a computer prints a document using a printer, the processor executing haptics rendering software 44 “drives each haptic device” to output the claimed haptic effect. [0038]-[0039], [0042]-[0044]; Welch, ¶¶164-165. Alternatively, [1D5] is met by haptic device 22 (or its actuators) that outputs via its stylus the force feedback that haptics rendering 44 directs it to generate. [0044]; Welch, ¶165; *supra* §VII.B.2.a.

C. Claim 2: “...further comprising a wearable device comprising one or more second haptic output devices.”

Banerjee discloses that both OSS 10 and MSS 11 can employ multiple haptic devices 22. [0034].

In Banerjee’s illustrated embodiments, haptic devices 22 (one for OSS 10 and two for MSS 11) are each implemented using a haptic robot stylus 27 for hand tracking. [0032]-[0034], [0042]. Banerjee discloses that “[h]and tracking is very useful because it allows users to use both hands to interact with the virtual scene,” and notes that “[w]hile the user can feel tactile sensations with a hand holding a haptic stylus 27, it is also possible to use a tracked hand to move the 3D objects, manipulate lights” ([0044]), etc. Welch, ¶¶166-167. This would be most naturally and beneficially implemented in OSS 10 by tracking the user’s free hand, for example, using “optical” hand tracking ([0056]) such as the “Leap Motion sensor” ([0072]) that Banerjee discloses can be used. Welch, ¶168.

Banerjee thus provides motivation to implement hand tracking for the user's free hand when using OSS 10 (and discloses systems capable of doing so) to "move the 3D objects, manipulate lights" or otherwise allow "both hands to interact with the virtual scene" ([0044]), e.g., to assist in performing OSS surgical steps where only one hand holds a virtual tool. [0044], [0052]-[0060], [0063]-[0068], [0072]; Welch, ¶169.

Consistent with Banerjee's teaching to provide haptic feedback regarding the user's interaction with the virtual environment, it would have been obvious and desirable to provide haptic feedback corresponding to the user's free hand interaction with virtual objects using a well-known and conventionally used wearable haptic device such as a haptic glove. Welch, ¶170 (*citing* EX1012, [0087]-[0088], [0105]-[0106], [0117], FIG. 7; EX1024, 4:17-37, 6:4-13, 7:23-31; EX1025, 2:44-49, 5:1-14, 6:25-29; EX1026, [0005], [0037], [0045]-[0047]; EX1008, [0021]-[0023], [0046], [0079]-[0085], [0124]-[0131], [0162]). A POSA would have recognized the benefit of implementing such a second haptic device 22 using known wearable haptic devices in OSS 10 to thus "allow users to use both hands to interact with the virtual scene," which Banerjee teaches is "very useful" ([0044]). Welch, ¶171.

Implementing a wearable haptic device in OSS 10 would have been no more than the obvious use of a known type of haptic device to yield the intended and

predictable result of providing haptic feedback to a user's free hand interacting with the virtual environment. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 415-421 (2007); Welch, ¶171. POSAs would have had reasonable expectation of success because Banerjee's haptics rendering software is already configured to receive location information from multiple hand-tracking devices to compute corresponding haptic feedback ([0032]-[0034], [0042]-[0044]), and Banerjee discloses using hand-tracking modes suitable for free-hand tracking ([0056], [0072]). Welch, ¶172. Implementing known hand-tracking devices and providing calculated haptic feedback to a wearable haptic device would have required only conventional and routine skill. Welch, ¶172.

This obvious and desirable use of a wearable haptic device worn on the user's free hand meets “*a wearable device comprising one or more second haptic output devices*,” as claimed. Welch, ¶173.

D. Claim 3: “...wherein the proxy object comprises...an electronic device [] an interface object”

Haptic device 22 with its haptic stylus 27 is an object that “provide[s] information regarding the user's interaction with the system” ([0032]-[0033]) both to and from the simulation—i.e., haptic device 22 and haptic stylus 27 are each a claimed “*interface object*” because they each provide an interface with the user that collects the positional information that controls the virtual tool and by which interaction with virtual anatomy is computed, and provides the corresponding haptic

feedback to the user. [0032]-[0044]; Welch, ¶¶104, 174-175. Haptic device 22 and haptic stylus 27 are each also an “*electronic device*” because their sensors and actuators are powered electronically. [0051]; Welch, ¶¶105, 175; *supra* §§VII.B.2, VII.B.4.

E. Claim 4: “...wherein the proxy object comprises neutral physical characteristics.”

As Banerjee’s FIGS. 6 and 19-21 show, haptic device 22’s stylus 27 has a neutral rod shape that can be made to look like any of many different virtual tools (e.g., FIGS. 7-18) by superimposing their images on the neutral-shaped stylus. [0053]-[0068]; *supra* §§VII.B.3, VII.B.5.a. Stylus 27 thus “*comprises neutral physical characteristics*” the same way the ’067 patent describes. EX1001, 5:34-44 (describing proxy object with “neutral physical characteristics” as one requiring “visual overlay” to make it look a particular way); Welch, ¶176.

F. Claim 5: “...wherein the modified visual effect is configured to modify an appearance of the proxy object through the display.”

Banerjee’s system meets claim 5 because the 3D image of a virtual tool is continuously updated (“*modified visual effect*”) to make haptic device 22’s stylus (both a “*proxy object*”) look like the virtual tool via the display (*see supra* §§VII.B.5.a, VII.B.5.c). Welch, ¶¶177-178; *supra* §§VII.B.2.a-VII.B.2.b.

G. Claim 6: “...wherein the display comprises at least one of: a wearable device or a mobile device.”

In Banerjee’s disclosed OSS implementation using Microsoft Hololens as

discussed *supra* §VII.B.3.a, OSS 10's display comprises the Hololens's head-mounted display—i.e., “*a wearable device*” as claimed. [0072]; EX1028, 2:25-26, 5:16-6:44; Welch, ¶¶88, 120-122, 179-180.

H. Claim 7: “...wherein the sensor comprises...a light sensor, a tracking sensor”

As discussed *supra* §VII.B.4, haptic device 22 “track[s] the user's hand position and orientation” ([0034]) by tracking the position and orientation of its stylus 27 in real time, and thus is, or includes, a “*tracking sensor*.” [0032]-[0034], [0042]-[0044]; Welch, ¶¶182-185 (explaining that haptic device's encoders are “*light sensors*”).

I. Claim 8: “...wherein the processor is further configured to receive an input signal from an input capture device and determine the haptic effect based in part on data received from the input capture device.”

FIG. 6's haptic stylus 27 (below) has multiple “input device[s]” including “toggle button 25” and/or “pinch attachment 29” ([0051]) that meet the claimed “*input capture device*” by capturing the user's pressing/pinching input that Banerjee's processor uses to control operation of different virtual tools and to calculate corresponding haptic effects. [0042], [0051], [0057]-[0059], [0063], [0065], [0068]; Welch, ¶187-188; *supra* §VII.B.5.b.

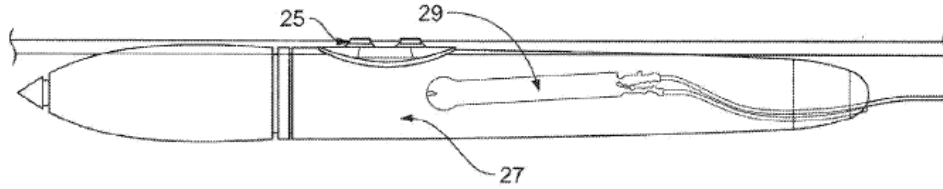


FIG. 6

For example, in steps shaded **purple** in annotated FIG. 5 (below), the user “opens and close[s] the virtual microscissors by the haptic stylus *input device 25*” (step 122) and “haptics rendering module 44 *calculates the force* that the user is exerting on the tool to progressively cut the dura and *outputs the force result* to the haptic stylus 27” ([0059])—i.e., the “*input signal*” indicating a button press is received from input device 25 by haptics rendering 44 (executed by Banerjee’s processor) and used to “*determine the haptic effect based in part on data received from the input capture device.*” [0042], [0059]; Welch, ¶189.

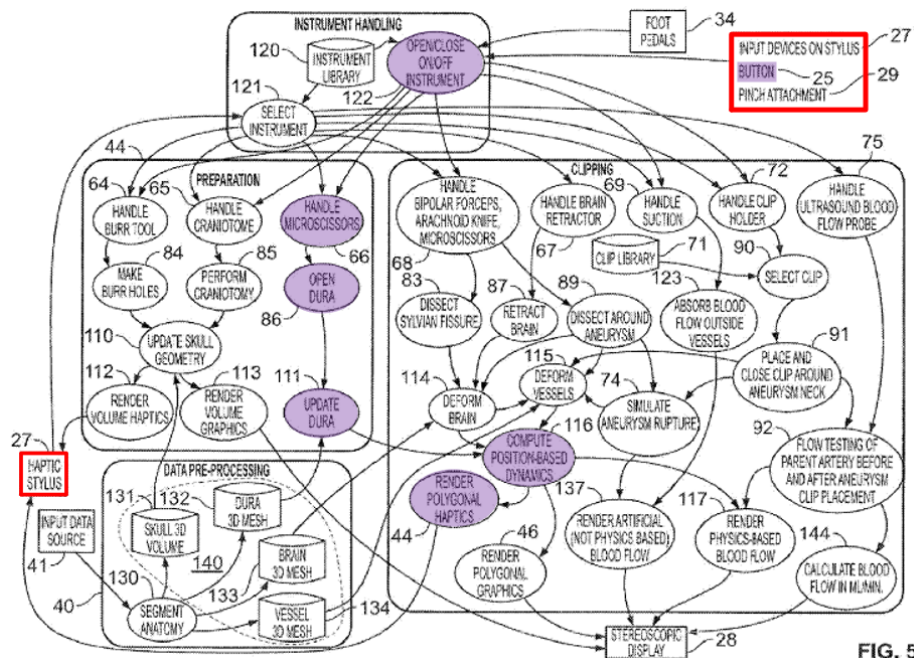


FIG. 5

Similarly, the steps shaded blue in annotated FIG. 5 (below) also meet claim 8 because user pressure applied to “pinch attachment 29” to manipulate “virtual clip holder 72” is used by haptics rendering 44 to “calculate[] the force that the user is exerting on the virtual clip holder 72” and “output[] the force result to the haptic stylus” ([0066]). [0057]-[0058]; Welch, ¶190.

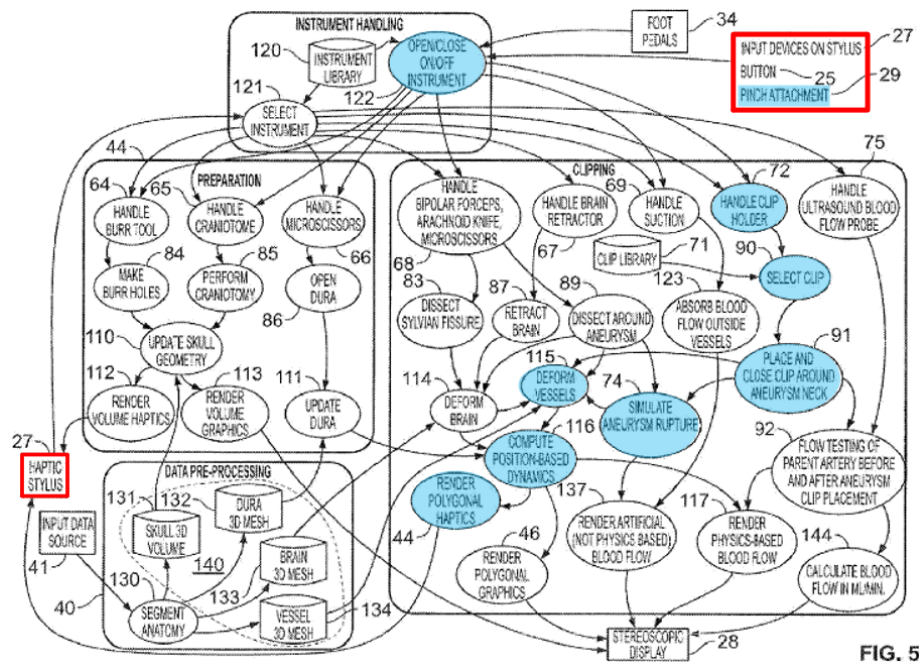


FIG. 5

Therefore, Banerjee’s processor also meets claim 8 by executing haptic rendering software 44 that receives input signals from stylus 27’s input devices to simulate tool operation and calculate a corresponding force feedback. [0042]-[0044], [0051], [0057]-[0068]; Welch, ¶191; *supra* §VII.B.5.b.

Banerjee also discloses a GUI displayed on a tablet via which the user selects a virtual tool. [0052]. Banerjee’s processor also meets claim 8 because haptics rendering software 44 will compute different haptic effects depending on the

particular virtual tool (*see supra* §VII.B.5.b) selected via the tablet. EX1001, 5:50-57 (disclosing a “touch screen” as an “input capture device” through which the user chooses a texture); Welch, ¶¶192, 193 (haptic device 22 also meets claim 8).

J. Claim 11

Claim 11 recites the method that claim 1’s processor is configured to perform. Thus, Banerjee’s system meets claim 11 for the same reasons it meets claim 1. Welch, ¶194; *supra* §VII.B.

K. Claim 12

For the reasons discussed *supra* §VII.C, it would have been obvious and desirable to implement a second haptic device 22 in OSS 10 as a wearable haptic device (e.g., a haptic glove) to provide haptic feedback to the user’s free hand interacting with the virtual environment. [0044], [0072]; Welch, ¶195.

1. [12A]: “determining a second haptic effect;”

[11B]’s “*haptic effect*” (*see supra* §VII.B.5.b for [1D2]’s same “*haptic effect*”) is a first haptic effect. Welch, ¶196. Banerjee’s free-hand tracking implementation (*supra* §VII.C) thus “*determin[es] a second haptic effect*” when haptics rendering 44 likewise determines the force feedback corresponding to the interaction between the user’s free hand and the virtual environment for a second haptic device 22 implemented by a haptic glove. [0034] (“simultaneous use of two haptic devices 22”), [0042], FIG. 2; Welch, ¶¶196-197.

2. [12B]: “transmitting a second haptic signal associated with the second haptic effect to one or more second haptic output devices;”

POSAs understood that haptic gloves provide haptic feedback via haptic actuators coupled to the portions of the glove that are sensorized. Welch, ¶198 (citing EX1012, [0087]-[0088], [0105]-[0106], [0117], FIG. 7; EX1026, [0037], [0045]-[0047], FIGS. 1a-1b; EX1008, [0130]); *supra* §VIII.C. Banerjee’s free-hand tracking implementation (*supra* §VII.C) performs [12B] when haptics rendering 44 directs the haptic glove’s actuators (i.e., “*one or more second haptic output devices*”) to generate the force feedback computed from interactions between the user’s tracked free hand and the virtual scene in the same way haptics rendering 44 does for any haptic device 22. [0042], [0057]-[0068]; Welch, ¶198; *supra* §VII.B.5.d.

3. [12C]: “outputting the second haptic effect using the one or more second haptic output devices, the one or more second haptic output devices being mechanically coupled to a wearable device.”

Banerjee’s free-hand tracking implementation (*supra* §VII.C) performs [12C] when actuators coupled to a haptic glove (*supra* §VII.K.2) worn on the user’s free hand output the force feedback computed by haptics rendering 44. [0042], [0057]-[0068]; Welch, ¶199.

L. Claim 15-20

Claims 15-20 recite identical limitations as claims 3-8, respectively, which are met by Banerjee for the reasons discussed in the corresponding Sections, listed below. Welch, ¶¶200-205.

- Claim 15: *supra* §VII.D (claim 3).
- Claim 16: *supra* §VII.E (claim 4).
- Claim 17: *supra* §VII.F (claim 5).
- Claim 18: *supra* §VII.G (claim 6).
- Claim 19: *supra* §VII.H (claim 7).
- Claim 20: *supra* §VII.I (claim 8).

M. Claim 21

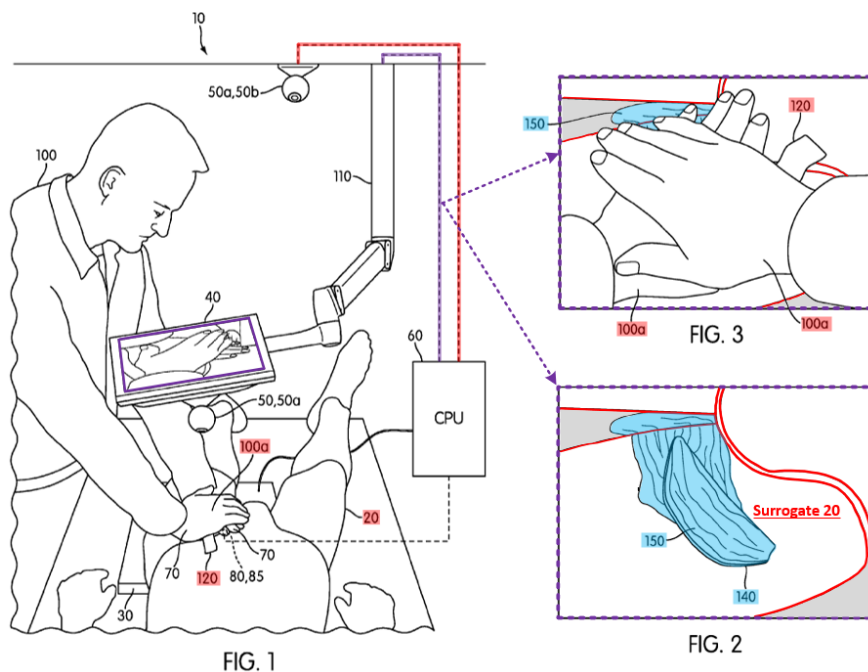
Claim 21 recites a non-transitory computer-readable medium comprising program code to cause a processor to perform the method of claim 11. Banerjee's computer 32 includes software modules, including haptics rendering software 44, graphics rendering software 46, instrument library 120, 3D API, etc. [0037]-[0041], FIGS. 2, 5. POSAs understood that this software comprises program code and would be stored on computer 32's non-volatile memory (a "*non-transitory computer readable medium*") so that the software can be accessed and executed to perform the disclosed simulations. Welch, ¶206. Thus, computer 32 includes claim 21's

computer-readable medium and meets the rest of claim 21 for the same reasons discussed *supra* §§VII.B.5.a-VII.B.5.e. Welch, ¶207.

VIII. GROUND 2: CLAIMS 1-8, 11-12 AND 15-21 ARE ANTICIPATED BY, OR ALTERNATIVELY OBVIOUS OVER, MEGLAN

A. Meglan (EX1012)⁴

Meglan's system allows a user to practice controlling a bleeding wound by interacting with a physical mannequin on which the hemorrhage (bleeding) is simulated. A video simulation of a virtual trauma is merged with the real-time video feed of the physical environment, "directly visually overlaid upon the mannequin anatomy," ([0059]) as shown in FIGS. 1-3, annotated below. [0022], [0066]-[0072], [0082]-[0083]; Welch, ¶209.



⁴ Unless otherwise noted, citations in Section VII are to Meglan.

As shown in FIG. 1, simulator 10 comprises “video camera system 50” that acquires video of real objects in the environment (highlighted **red**, above), including the user’s hands 100a interacting with mannequin 20 which is a “physical surrogate” for a trauma victim. [0066]. Processor 60 merges the camera system’s video feed (also highlighted **red**) with computer-generated video of simulated wound 140 and simulated hemorrhage 150 (shaded **blue**) and transmits the merged video feed (outlined in **purple**) to display 40 so that trainee 100 sees the simulated trauma overlaid on surrogate 20, as shown in FIG. 2’s snapshot before trainee 100 has begun treating the wound. [0066], [0069]-[0071], [0082]-[0084]; Welch, ¶210.

Processor 60 continuously updates the simulated trauma based on trainee 100’s interaction so that the trainee sees the “real time-impact on simulated wound 140 and blood flow 150” resulting from the trainee interacting with surrogate 20 to try to stop the bleeding (*see* FIG. 3, *infra* §VIII.B.3). [0082]. Haptic feedback is provided so that trainee 100 feels characteristics of the virtual trauma victim when treating the wound. [0060], [0089]-[0090], [0106]-[0107], [0113], [0117]; Welch, ¶211.

In the FIG. 5 and FIG. 8 embodiments below, camera system 50 and display 40 are both implemented via “head-mounted display 1010 (HMD)” with integrated “display 1040” and “video system 1050.” [0094]. The FIG. 8 embodiment provides haptic feedback via “sensorized substrate 2000” ([0107]) made of flexible material

that conforms to the shape of surrogate 20. [0107]-[0109], [0113]-[0117]; Welch, ¶212.

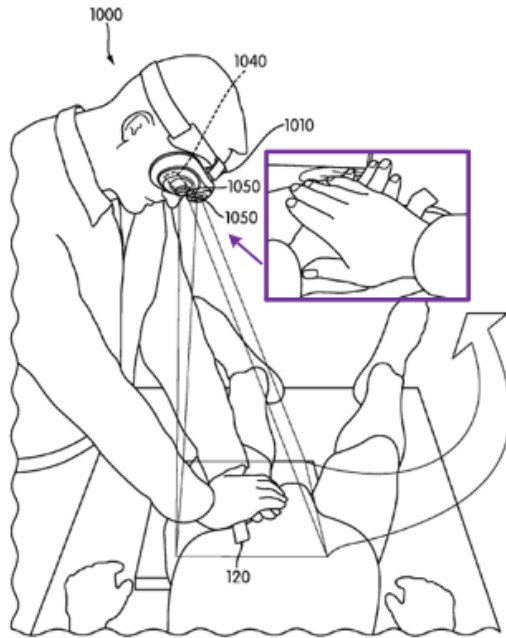


FIG. 5

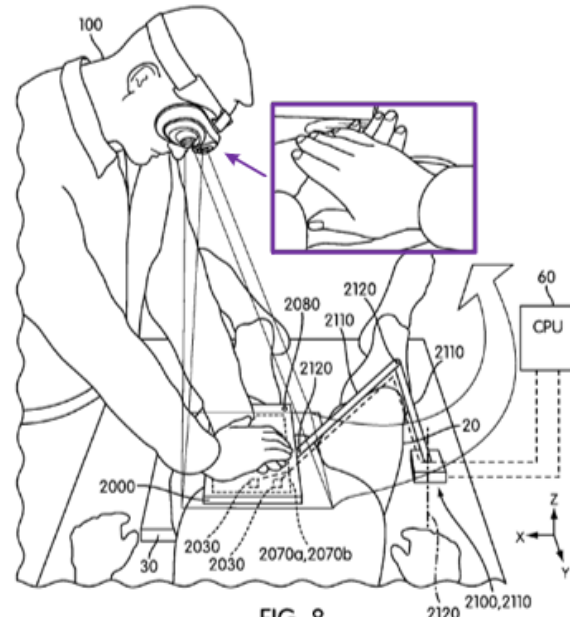


FIG. 8

B. Claim 1

1. [1PRE]: “A system comprising:”

Meglan’s simulator meets [1PRE]’s “system” because it comprises components that function together and meet all of claim 1’s limitations (*infra* §VIII.B.2-VIII.B.5). [0070]-[0072], [0082]-[0084], [0094], [0107]-[0109]; Welch, ¶213.

2. [1A]: “a proxy object...”

Meglan’s surrogate 20 and haptic substrate 2000, by themselves or together as a unit, meet [1A]. Welch, ¶214.

Surrogate 20 is a “body mannequin” that “provides a physical representation of the anatomic area of a human body” that trainee 100 interacts with to treat a virtual trauma. [0061]. A “surrogate” is another term for a “*proxy object*”—a real-world object used as a proxy for a virtual counterpart. [0059], [0061], [0125] (describing different objects used as a “surrogate for another object”); Welch, ¶59. Thus, surrogate 20 that provides the “physical surrogate” ([0066]) for a simulated trauma victim meets [1A]’s “*proxy object*.” [0062]-[0072]; Welch, ¶¶59-62, 215-216; *supra* §VII.B.2.a.

In Meglan’s FIG. 8 embodiment below, “sensorized substrate 2000” (boxed in red) provides haptic output via pulse and heat generators so that trainee 100 can feel characteristics of the virtual wound being treated. Abstract, [0107], [0011], [0113], [0117]; Welch, ¶217.

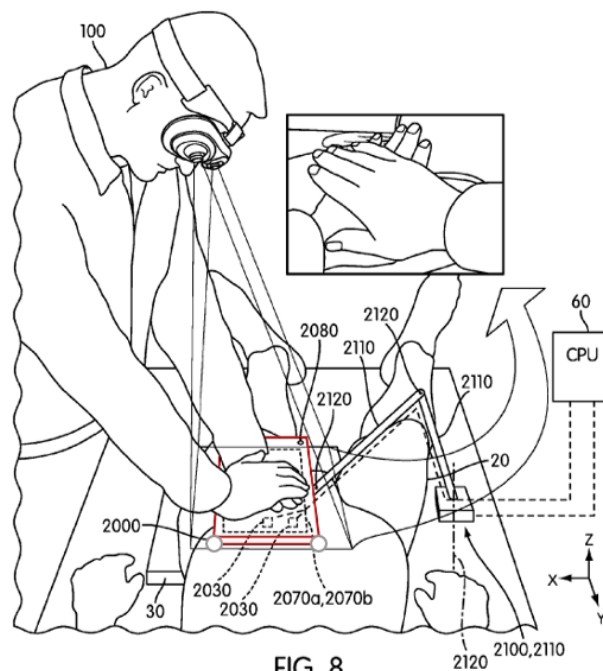


FIG. 8

Meglan's substrate 2000 is positioned in correspondence with the user's hands by device 2100 so that substrate 2000 is "sandwiched between the trainee's hands and the surrogate 20" such that when "trainee 100 attempts to contact the surrogate 20, the trainee 100 actually contacts the sensorized substrate 2000" ([0111]). [0108]-[0111]. Substrate 2000 is made "flexible" so that "gravity causes it to generally conform to the underlying surface of surrogate 20." [0109]. This "sheet-like" substrate "that has the feel of human skin" ([0114]) acts as a proxy for the skin of the anatomical region the trainee is treating and for the virtual wound for which substrate 2000 provides haptic feedback; it is thus "*a proxy object.*" [0118] (using substrate 2000 alone as the surrogate); Welch, ¶¶59-62, 218-219; *supra* §VII.B.2.a.

Substrate 2000 is designed both to conform to surrogate 20's surface so that the trainee can feel the underlying shape and to mimic the mannequin's skin-feel so that the trainee perceives the substrate and the surrogate as the same object, as if the trainee were interacting directly with surrogate 20, while simultaneously providing haptic feedback about characteristics of the virtual trauma victim and the wound (e.g., the victim's pulse and body heat, the blood flow from the wound, etc.). [0107]-[0111], [0113]-[0117]; Welch, ¶220. Thus, POSAs understood that surrogate 20 and substrate 2000 together form a "*proxy object*" for a simulated trauma victim. Welch, ¶220.

Any of these proxy objects meet [1A] because substrate 2000 comprises “pulse generators” and “heat generators” ([0107]) that are “*haptic output devices*.” [0029], [0111], [0113]; Welch, ¶221. Additionally, surrogate 20 itself meets [1A] because POSAs understood that surrogate 20 comprises the connected substrate that conformally contacts its surface, as the ’067 patent does not limit “*comprising*” to any particular relationship. [0108]-[0109], [0114]-[0115]; Welch, ¶¶222-223; EX1001, 6:26-29.

3. [1B]: “a display...”

Meglan’s simulator comprises “*a display*” implemented either as “a head mounted display equipped with a display(s)” for “an immersive experience” (e.g., FIGs. 5 and 8’s HMD 1010 with integrated display 1040), or as “a traditional computer monitor” (e.g., FIG. 1’s display 40). [0059]; *see also* [0070], [0094]. Either embodiment meets [1B]. Welch, ¶224.

As shown in annotated FIGS. 1 and 5 below, camera system 50/1050 captures real-time video of the physical objects in the environment (shaded **red**). Simulation program 90 (*see* FIG. 4, *infra* §VIII.B.5.a) “merges the input video feed” (outlined in **red**) from camera system 50/1050 with “simulated blood flow 150 and simulated wound 140” (i.e., “*a visual effect*”) and “provides this merged output video to the display” (highlighted in **purple**). [0082]; *see also* [0066], [0094], FIG. 8; Welch, ¶225; *supra* §VIII.A.

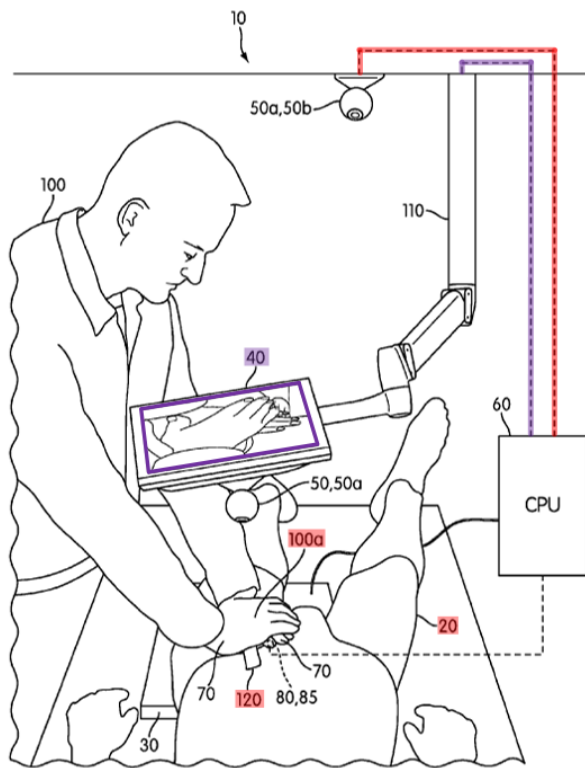


FIG. 1

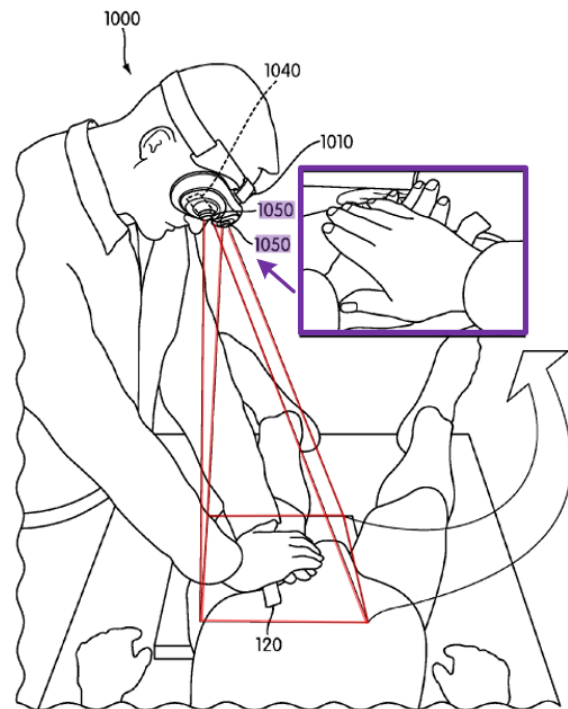


FIG. 5

As shown in the snapshots in FIG. 2 (before trainee begins treatment) and FIG. 3 (while trainee interacts with surrogate 20), the merged output video feed includes the “actual imaged objects” ([0084]) in the physical environment (indicated with **red**) with the simulated trauma overlaid on the surface of surrogate 20 and substrate 2000 “so that the real surrogate 20 is displayed with a simulated wound 140 and hemorrhaging blood 150” ([0066]) from the trainee’s viewpoint. *See also* [0070]-[0072], [0082]-[0083]; Welch, ¶226.

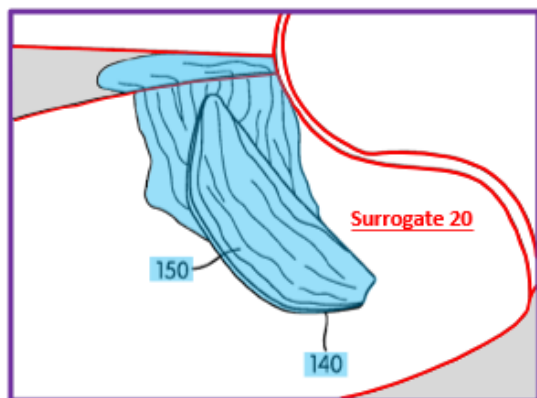


FIG. 2

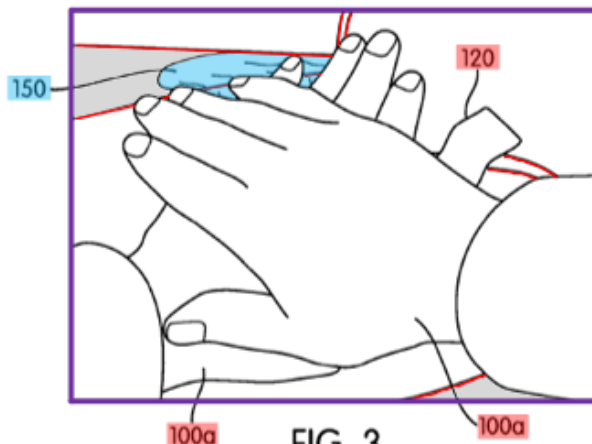


FIG. 3

Thus, display 40/1040 is “*configured to output a visual effect*” (i.e., the appearance of a virtual wound) “*onto a surface of the proxy object*” because the surface of the actual surrogate and substrate in the real-world video gets overlaid with the virtual wound in the output video. Welch, ¶227. This also meets Immersion’s broader interpretation that encompasses both AR and VR displays by displaying the virtual wound. [0082]-[0084]; Welch, ¶227.

Meglan also discloses a virtual-only display in which program 90 generates virtual re-creations of imaged physical objects so that the user sees a simulated view consisting of only virtual objects. [0084]. Meglan therefore also meets [1B] under Immersion’s interpretation in this additional way. EX1006, 4-5. Welch, ¶228.

4. [1C]: “a sensor...”

Meglan’s video camera system 50/1050 meets [1C] because its video feed is used to track the “position and orientation of objects viewed by the camera system” ([0072]). *See also* [0073], [0094]; Welch, ¶229.

Camera system 50/1050 may include multiple cameras, each of which is a claimed “*sensor*” (see, e.g., EX1001, 4:1-8 (disclosing that cameras are sensors)) and is used to “provide stereoscopic information to triangulate the location of the imaged objects.” [0072]-[0073]. Or camera system 50/1050 may include “a single camera that includes distance *sensors* whose measurements are...[used] in determining the position and orientation of the imaged objects.” [0072]-[0073]; Welch, ¶230.

Thus, Meglan’s camera system 50/1050 includes a claimed “*sensor*” producing data from which program 90 detects in real-time the “three-dimensional shape and position and orientation of the surrogate 20, the trainee’s hands, and any other object[s]” (including substrate 2000, [0113]) to “track and identify their movements” ([0074]), thus “*tracking a position of the proxy object,*” meeting [1C]. [0070]-[0074], [0078]-[0079], [0081]-[0082]; Welch, ¶231.

5. [1D]: “a processor configured to:”

Meglan’s “*processor* 60” meets [1D] because “simulation program 90” runs on processor 60 and “*configure*[s]” it to perform each of limitations [1D1]-[1D5] as demonstrated *infra* §§VIII.B.5.a-VIII.B.5.e. [0070], [0103] (“processor 60 may comprise any suitable *processor* for running the simulation program 90”); Welch, ¶232.

a. [1D1] “determine a modified visual effect...”

Meglan’s processor 60 performs [1D1] when program 90 modifies the simulated trauma viewed by trainee 100 based on the video stream from camera system 50/1050, as illustrated in FIG. 4 (annotated below).

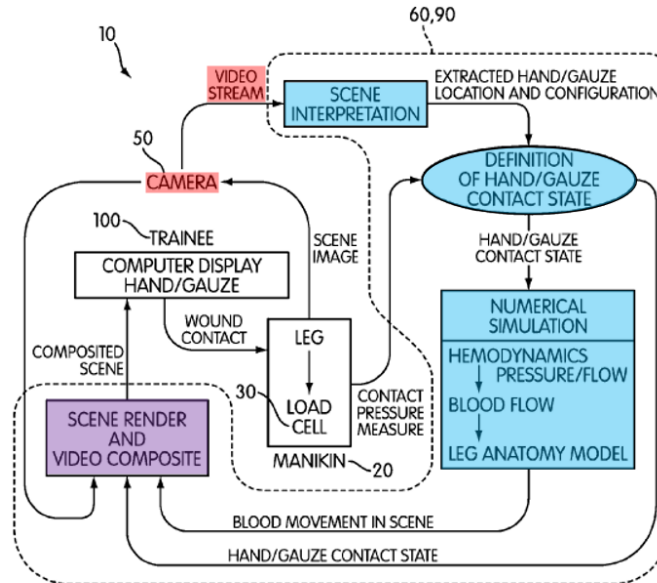


FIG. 4

Program 90 receives the video stream from camera system 50/1050 (emphasized in **red**) (i.e., “data received from the sensor”) and determines how to update simulated wound 140 and hemorrhage 150 based on the current “three-dimensional shape and position and orientation of the surrogate 20, the trainee’s hands, and any other object that interacts with the surrogate” ([0074]), trainee 100’s interaction with surrogate 20, and the characteristics of the specific injury being simulated, illustrated by functionality emphasized in **blue**. [0070]-[0082]; Welch, ¶¶233-234.

After updating the simulation, program 90 generates “a video signal representative of the simulated wound 140 and blood flow 150” as it appears in the updated simulation state (highlighted in **purple**). [0082]. Thus, the updated appearance of the hemorrhaging wound is “*a modified visual effect*” that program 90 determines in part from the video feed from camera system 50/1050—i.e., “*based in part on data received from the sensor.*” [0072], [0074]-[0083], [0094]; Welch, ¶235.

For example, FIGS. 2 and 3 (annotated below) illustrate “*modified visual effect[s]*” of the simulated wound 40 on the leg of surrogate 20 determined from the shape and position/orientation of surrogate 20 and trainee interaction detected from the camera system’s video feed. [0072], [0074], [0078]; Welch, ¶236.

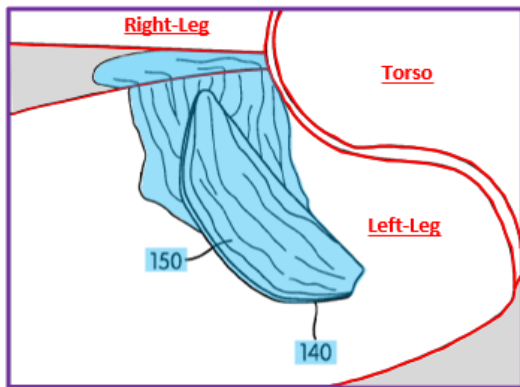


FIG. 2

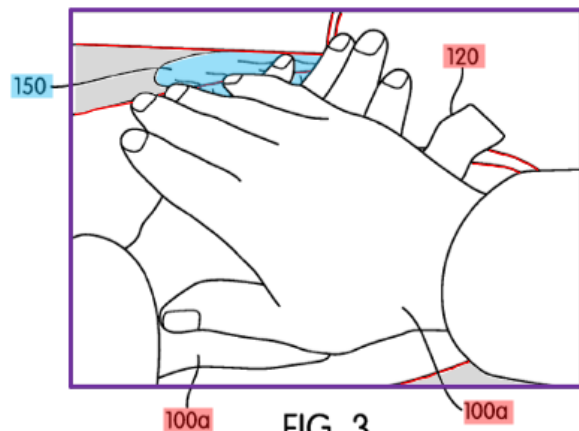


FIG. 3

Program 90 “uses the geometry of the surrogate” in the video feed to “computationally calculate simulated blood hemorrhage characteristics” ([0078]) to modify the appearance of wound 40 and hemorrhage 50 over time. FIG. 2 (above

left) shows one instant in time. [0070], [0074], [0078]-[0079], [0081]-[0082]; Welch, ¶¶236-237.

When trainee 100 interacts with surrogate 20, program 90 determines further “*modified visual effect[s]*” based on the video feed so that trainee 100 sees the “real time-impact on the wound 140 and blood flow 150 of his/her interaction” ([0082]) with surrogate 20. [0077], [0104]; *see also* [0065], [0090] (trainee 100’s changing perspective detected in the video changes the virtual wound’s appearance); Welch, ¶¶238-239.

b. [1D2]: “determine a haptic effect...”

Processor 60 performs [1D2] because program 90 determines multiple haptic effects based on the positions of objects detected in the video feed from camera system 50/1050. Welch, ¶240.

Substrate 2000’s pulse generators 2070a and heat generators 2070b are “operatively connected to processor 60” which controls their operation. [0106]-[0107] (disclosing that substrate 2000’s pulse/heat generators are operatively connected to processor 60, like glove 70’s pulse/heat generators). Welch, ¶241.

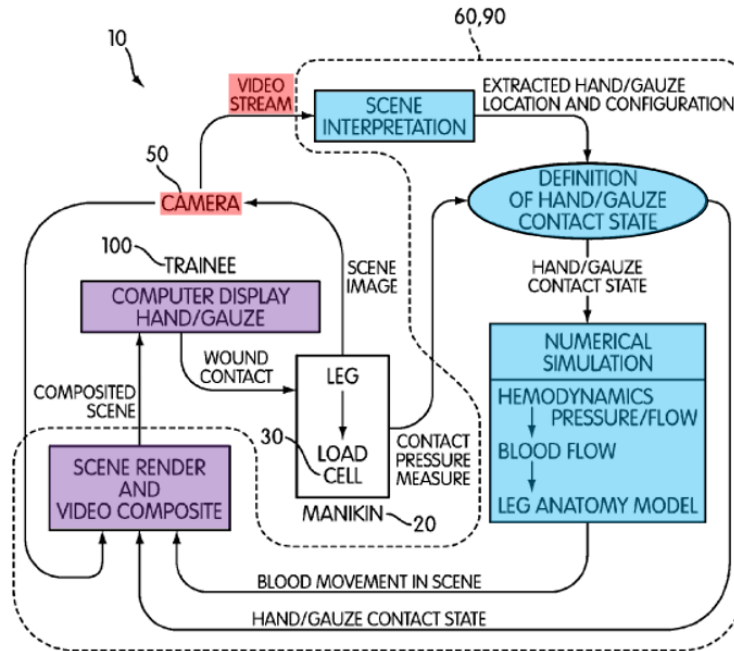
As one example of a haptic effect that meets [1D2], when program 90 determines that trainee 100’s hands are in contact with surrogate 20, program 90 uses “the location of the finger(s) over simulated vascular structures, combined with the current state of the hemodynamic simulation” to “calculat[e] a simulated pulse”

([0090]) that processor 60 signals to the pulse generator(s) to simulate haptically. *See also* [0106]-[0107]. The “specific feel of the pulse” provided by the “calculated simulated pulse” is a “*haptic effect*” that program 90 determines by combining load sensor data based on “the finger location(s) *detected by the camera system 50*” (i.e., “*based on data from the sensor*”) and the state of the simulation, thus meeting [1D2]. [0090]; Welch, ¶242.

As another example, when program 90 determines that trainee 100’s hands are in contact with surrogate 20 based on the video feed from camera system 50/1050 (i.e., “*based on data from the sensor*”), program 90 causes the heat generator to generate heat (i.e., “*determine[s] a haptic effect*”) “so that the trainee feels the heat of the simulated patient’s body and/or blood upon contact with the simulated patient and/or hemorrhaging blood.” [0089]; *see also* [0106]-[0107]; *compare with* EX1001, 4:39-43 (heating/cooling transducers provide “thermal” haptic effects); Welch, ¶¶243-244.

c. [1D3]: “transmit a display signal...”

Processor 60 performs [1D3] each time program 90 merges the updated “video signal representative of the simulated wound 140 and blood flow 150” (i.e., “*the modified visual effect*”—*supra* §VIII.B.5.a) with the camera system’s video feed and “provides this merged output video feed to the display 40” (highlighted purple). [0082]; *see also* [0094]; Welch, ¶¶245-246.



The “*modified visual effect*” of the updated virtual wound/hemorrhage is “*displayed on the proxy object via the display*” by being “directly visually overlaid” ([0059]) on video of the actual surrogate 20 and substrate 2000, as discussed *supra* §VIII.B.3. [0066], [0082]-[0084]; Welch, ¶247. Meglan’s alternative virtual-only display additionally meets [1D3] under Immersion’s interpretation. [0084]; Welch, ¶247.

d. [1D4]: “transmit a haptic signal...”

As discussed *supra* §VIII.B.5.b, substrate 2000’s haptic output generators “operatively connect to the processor 60” ([0107]) that causes those generators to generate haptic feedback. [0029], [0089]-[0090]. POSAs understood that this

involves processor 60 transmitting a signal to the haptic generators, instructing them what haptic effect to generate. Welch, ¶248.

Thus, processor 60 causing substrate 2000's pulse generator(s) to generate the "calculated simulated pulse" to provide the "specific feel of the pulse" to the trainee meets [1D4] ([0090]) and/or its heat generator(s) to "generate heat so that the trainee feels the heat of the simulated patient's body and/or blood" ([0089]), meets [1D4]. [0107]; Welch, ¶249.

e. [1D5]: "output the haptic effect...."

As discussed *supra* §VII.B.5.e, [1D5] is met for the same reasons as [1D4]. Specifically, processor 60 "*output[s] the haptic effect using the one or more haptic output devices*" by causing substrate 2000's haptic generators that are operatively connected to and controlled by processor 60 to output any of the haptic effects determined by program 90 (*see supra* §VIII.B.5.b). [0029], [0082], [0089]-[0090], [0107]; Welch, ¶¶250-251.

C. Claim 2

Meglan discloses implementing haptic feedback to trainee 100 via glove 70 or substrate 2000, both comprising haptic output generators. [0087]-[0088], [0105]-[0107]; Welch, ¶252.

Meglan further discloses that multiple trainees can use the simulator together to treat a simulated trauma, by interacting either with the same surrogate or with

different surrogates at different locations. [0124]. Though each trainee uses a different camera system and display, the devices are all “operatively connected to the centrally run program 90” executed by processor 60 ([0123]), which “aggregate[s] the simulated interactions so that each trainee sees the other trainees’ actions (e.g., via video feed of the other trainee’s hands) and effects on the simulated patient” ([0124]). Welch, ¶253.

POSAs understood that different trainees would use different disclosed haptic devices based on availability, preference, convenience, and/or role, thus beneficially providing flexibility in multi-trainee simulations. [0059] (describing flexibility of different camera/display systems); Welch, ¶254. In Meglan’s FIG. 8 embodiment, for example, when a first trainee interacts with substrate 2000, a second trainee would be allowed to participate in the same location using Meglan’s haptic glove. Trainee(s) at other locations may use Meglan’s haptic glove due to preference and/or availability. As another example, POSAs knew it may be advantageous for a trainee applying compression to use one type of haptic device while a trainee applying a tourniquet uses a different type, whether local or remote. Welch, ¶254.

Thus, multiple obvious and beneficial implementations of Meglan’s multi-trainee simulator would include both substrate 2000 used by a first trainee and gloves 70/70’ (with pulse generator(s) 70a’ and heat generators 70b’ illustrated in FIG. 7, below) worn by another trainee, thus further comprising “a wearable device

comprising one or more second haptic output devices.” [0088], [0106]; Welch, ¶255.

POSAs would have reasonably expected success in these implementations because they merely use the two types of haptic devices that Meglan teaches a trainee can use, in the multi-trainee scenario that Meglan teaches. Welch, ¶256

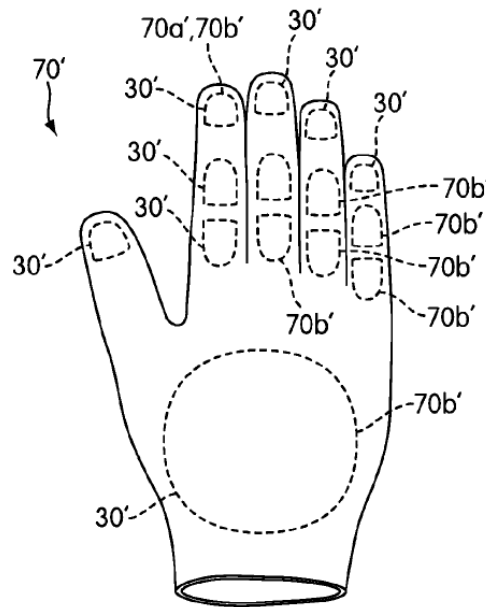


FIG. 7

D. Claim 3

As discussed *supra* §VIII.B.2, surrogate 20 provides an anatomical interface between trainee 100 and the simulated trauma and is therefore “an interface object.” Meglan’s “sensorized” ([0107]) substrate 2000 provides both the interface by which the simulator detects trainee 100’s interaction with surrogate 20 and the interface that outputs haptic feedback and is thus both “an interface object” and “an electronic device.” [0107]-[0111], [0116]; Welch, ¶257.

E. Claim 4

As shown in Meglan's FIGS. 1 and 5-8, surrogate 20 (and substrate 2000 conforming to it) has a generic, neutral anatomical shape (like conventional skin-colored, rubber training mannequins, [0059], [0061], [0114]) that can be made to look like a trauma victim with any of various types of wounds via an AR overlay simulation. [0082]. Surrogate 20 thus "comprises neutral physical characteristics" the same way the '067 patent describes. EX1001, 5:34-44 (describing proxy object with "neutral physical characteristics" as one requiring "visual overlay" to make it look a particular way); Welch, ¶258.

F. Claim 5

As discussed *supra* §§VIII.B.3, VIII.B.5.a, Meglan provides real-time composite video overlaying the simulated trauma on surrogate 20 so that surrogate 20 appears to have the virtual hemorrhaging wound 140/150. As the appearance of the simulated wound is modified in response to treatment by trainee 100, so is the appearance of surrogate 20 and its substrate 2000 seen via the display with the overlaid modified wound, meeting claim 5. [0082]; Welch, ¶259.

G. Claim 6

Meglan's head-mounted display 1010 comprising display 1040 is "*a wearable device*" worn on trainee 100's head, meeting claim 6. [0094]; Welch, ¶260.

H. Claim 7

Meglan's camera system 50/1050 meeting [1C]'s "*sensor*" (*supra* §VIII.B.4) comprises "*a camera*" meeting claim 7. [0072], [0094]; Welch, ¶261.

I. Claim 8

Meglan's simulator comprises load sensor(s) positioned under surrogate 20 or integrated in or on substrate 2000 that are operatively connected to processor 60. [0070], [0107], [0113], [0117]. Processor 60 receives data from the load sensors (i.e., "*input signal[s] from an input capture device*") and program 90 uses the load sensor data to calculate a simulated pulse (i.e., "*determine the haptic effect*") output by pulse generators to provide the "specific feel of the pulse" that "reflect[s] the strength of the trainee's pressing into the surrogate 20" ([0090]). *See also* [0107], [0113], [0117]; Welch, ¶262-263.

J. Claim 11

Claim 11 recites the method that claim 1's processor is configured to perform. Welch, ¶264. Thus, Meglan's simulator comprising processor 60 executing simulation program 90 meets claim 11 for the same reasons it meets claim 1. *See supra* §VIII.B.

K. Claim 12

As discussed *supra* §VIII.C, POSAs would have recognized that an obvious and beneficial implementation of Meglan's multi-trainee simulator would include

one or more trainees interacting with the same or different surrogates using gloves 70/70'. Welch, ¶265.

1. [12A]

Meglan discloses that “program 90 can aggregate the simulated interactions” of multiple trainees. [0124]. Thus, [11B]’s “*haptic effect*” determined for trainee 100’s interaction with surrogate 20 (*see supra* §VIII.B.5.b in connection with [1D2]’s same “*haptic effect*”) is a first haptic effect and program 90’s computation of a haptic effect (e.g., simulated pulse or heat sensation) corresponding to a second trainee’s interaction with a same or different surrogate meets “*determining a second haptic effect.*” [0088]-[0090], [0106]-[0107]; Welch, ¶266.

2. [12B]

Similarly, processor 60 performs [12B] when it causes haptic output generators of the haptic device (e.g., pulse and heat generators) used by the second trainee to produce corresponding haptic effects—i.e., for the same reasons [1D4] and [11D2] are met for the first haptic device used by the first trainee. [0088]-[0090], [0106]-[0107]; Welch, ¶267; *supra* §§VIII.B.5.d, VIII.J.

3. [12C]

When the second trainee uses gloves 70/70’ to interact with the shared simulation, [12C] is met by processor 60 causing pulse generator(s) 70a’ to generate the simulated pulse and/or causing heat generators 70b’ to produce heat sensations

computed from the detected contact between the trainee's hands wearing gloves 70/70' having these haptic output generators mechanically coupled thereto (*see e.g.*, FIG. 7, *supra* §VIII.C). [0088]-[0090], [0106]-[0107]; Welch, ¶268; *supra* §VIII.B.5.e.

L. Claim 15-20

Claims 15-20 recite identical limitations as claims 3-8, respectively, which are met by Meglan for the reasons discussed in the corresponding Sections listed below. Welch, ¶¶269-274.

- Claim 15: *supra* §VIII.D (claim 3).
- Claim 16: *supra* §VIII.E (claim 4).
- Claim 17: *supra* §VIII.F (claim 5).
- Claim 18: *supra* §VIII.G (claim 6).
- Claim 19: *supra* §VIII.H (claim 7).
- Claim 20: *supra* §VIII.I (claim 8).

M. Claim 21

Meglan's simulation program 90 "may be in any suitable form," including a "program on a hard drive, CD, DVD, network server" or any "machine-readable medium encoded with machine-executable instructions executable by the processor 60." [0104]. These are examples of "[a] *non-transitory computer-readable medium comprising program code.*" Welch, ¶275. Program 90 causes processor 60 to

perform [21A]-[21D]—i.e., the method of claim 11—for reasons demonstrated *supra* §§VIII.B, VIII.J. Welch, ¶275.

IX. GROUND 3: CLAIMS 1-8, 11-12 AND 15-21 ARE ANTICIPATED BY, OR ALTERNATIVELY OBVIOUS OVER, ROGERS

A. Rogers (EX1010)⁵

Rogers discloses a virtual-reality game system; an example is depicted in FIG. 1, below. [0001]-[0007]; [0021].

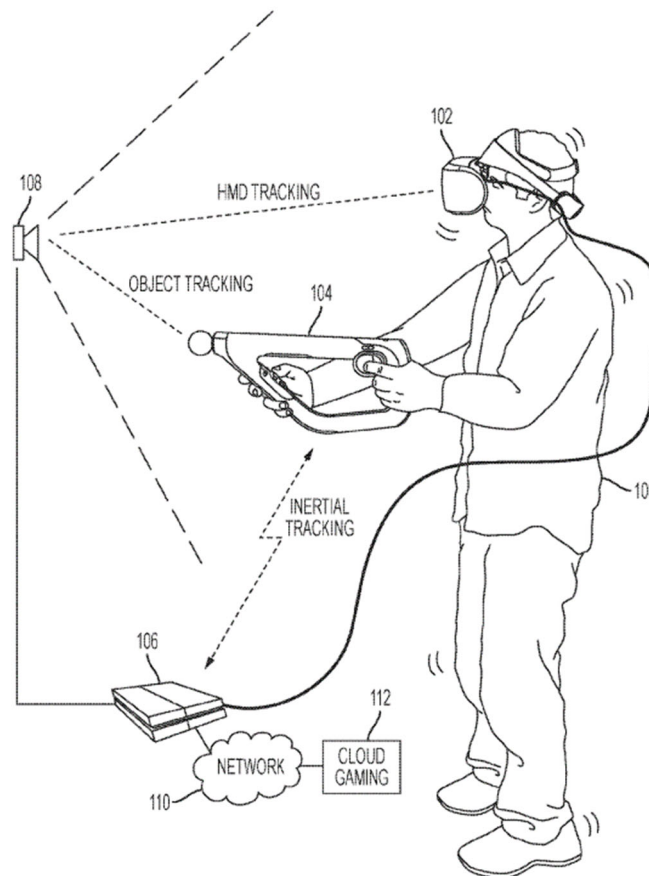


FIG. 1

⁵ Unless otherwise noted, citations in Section IX are to Rogers.

In Rogers's system, user 100 wears "a head-mounted display (HMD) 102...configured to display a video game or other content to the user" ([0042]) and holds "a directional interface object 104 to provide input for the video game" ([0044]). The system also includes a "computer 106" and a "camera 108" that "determine[s] the location and movements of the user 100, the HMD 102, and the directional interface object 104." [0043]-[0044], [0081]; Welch, ¶¶277-278. Inertial sensors within interface object 104 are also used to detect its location. [0044], [0111]; Welch, ¶278. Through HMD 102, user 100 sees a virtual video-game environment with a virtual weapon in place of interface object 104 and a pair of virtual hands in place of the user's own hands. [0007], [0107]-[0109]; Welch, ¶279. This is shown in FIGS. 10 and 11 below. [0054]-[0055], [0089], [0096], [0107]-[0109].

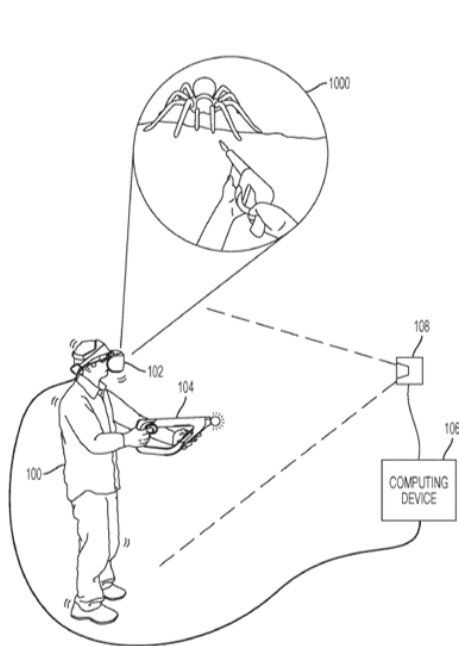


FIG. 10

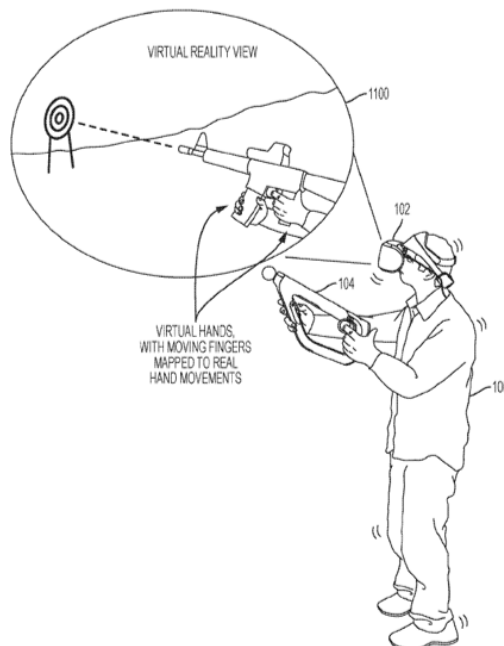


FIG. 11

Rogers also discloses a “video see-through” AR implementation in which video of the environment captured by HMD 102’s video cameras 202A and 202B (*see e.g.*, FIG. 2A-2 below) is “augmented with virtual elements to provide an augmented reality experience” via HMD 102. Rogers, [0063]; Welch, ¶280.

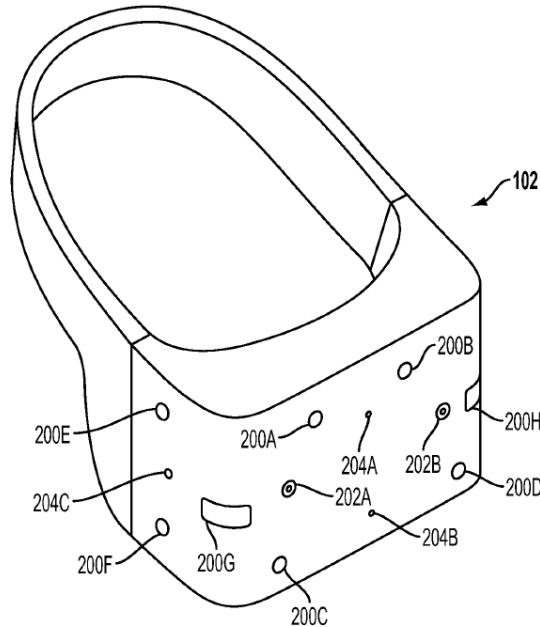


FIG. 2A-2

B. Claim 1

1. [1PRE]: “A system comprising:”

Rogers discloses “a *system* for interactive gameplay.” [0021]; *see also* [0018], [0042], claim 17, FIG. 1; Welch, ¶281.

2. [1A]: “a proxy object...”

Rogers’s interface object 104 meets [1A].

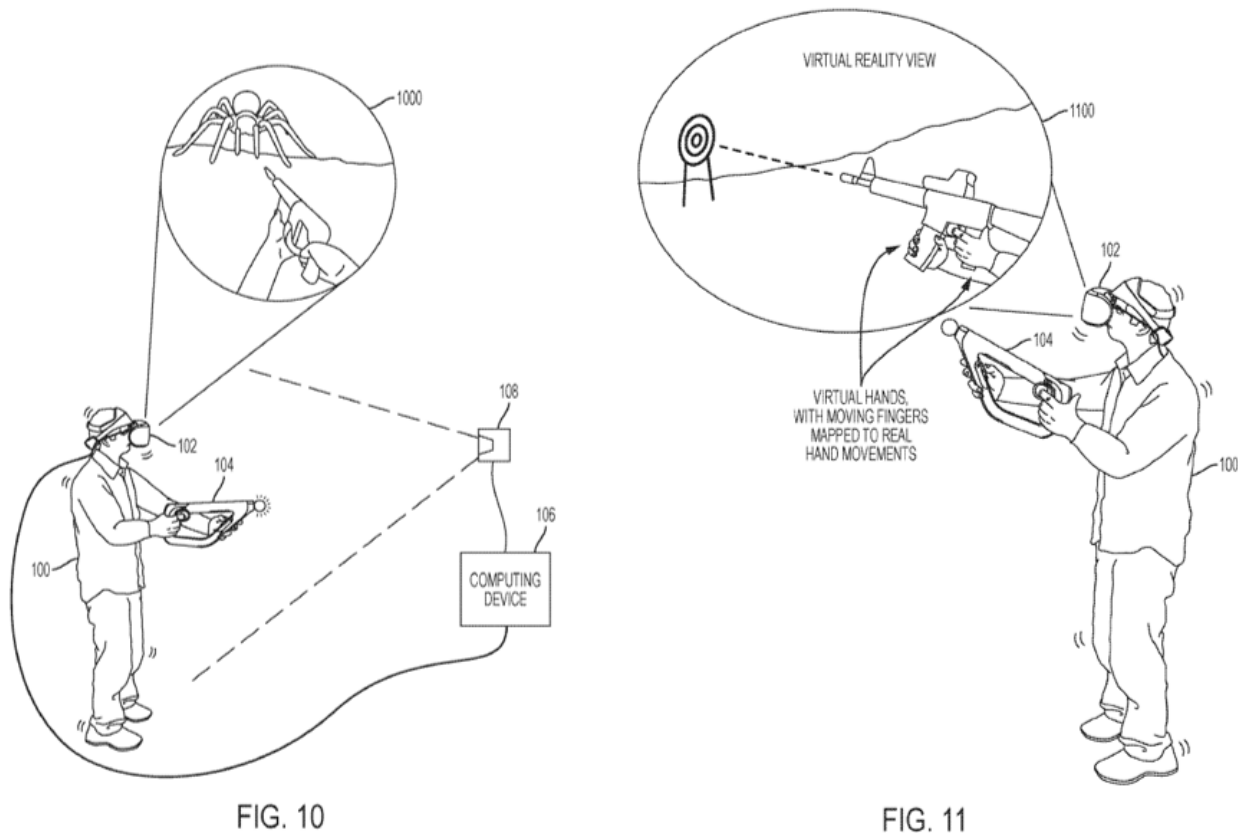
Interface object 104 “provide[s] input for the video game.” [0044]. As illustrated in FIGS. 10-11 above, interface object 104 acts as a proxy for a “virtual weapon” counterpart in the virtual environment that moves in correspondence with the real-world interface object 104; thus, the interface object is a “*proxy object*.” [0078]-[0096], [0107]-[0109], FIGS. 4A-4C, 5A, 10-12; Welch, ¶¶59-62, 282-285; EX1001, 5:34-38 (explaining “proxy object” is “an electronic device” or “an *interface object*”); *supra* §VII.B.2.a.

Interface object 104 includes “tactile feedback hardware” for rendering different “tactile sensations” ([0073])—e.g., “sensations of momentum” can be rendered by controlling interface object 104’s “moveable weight 800” (see FIG. 8) at variable accelerations, velocities, and distances to produce “a desired *haptic* effect” ([0105]). [0073], [0112], FIGS. 8, 12. Interface object 104 thus comprises “*one or more haptic output devices*” (i.e., tactile feedback hardware including moveable weight 800 and the hardware that controls it), and therefore meets [1A]. Welch, ¶¶286-288.

3. [1B]: “a display...”

Rogers’s HMD 102 that “is configured to *display* a video game or other content to the user 100” meets [1B]. [0042], [0060], [0070], [0107]-[0109], [0119]-[0131]; Welch, ¶¶289-290.

As shown in FIGS. 10-11 below, HMD 102 displays “virtual hands” that grip a “virtual weapon” based on how the user is holding interface object 104. [0096]-[0097], [0100], [0107], [0109]; Welch, ¶291.



In pending litigation, Immersion contends that a video-game controller is a “*proxy object*,” and that a virtual-reality headset is a display configured to “*output a visual effect onto a surface of the proxy object*,” if it depicts virtual hands (allegedly “*a visual effect*”) holding a **virtual representation** of the controller, even if not on the real-world controller itself. EX1006, 4-5. Indeed, Immersion contends that [1B] is met even when virtual hands are displayed alone, without any virtual

representation of the controller (the alleged “*proxy object*”) being displayed. EX1006, 5 (“WithoutController”).

Under Immersion’s interpretation, Rogers’s HMD is a “*a display configured to output a visual effect onto a surface of the proxy object*” because the HMD displays virtual hands holding the virtual weapon that is a “VR representation of the directional interface object 104.” [0108]; Welch, ¶¶292-294; *see also* EX1006, 13 (citing, as alleged evidence of infringement, “virtual hand and sword” or “virtual hand and weapons”).

Additionally, in Rogers’s “video see-through” AR embodiment (*supra* §IX.A, [0063]) where captured video of the physical environment is “augmented with virtual elements,” POSAs understood that augmented video displayed by HMD 102 of a video game like that illustrated in FIGS. 10 and 11, images of a virtual weapon (and optionally virtual hands) would be overlaid on the surface of interface object 104 in the captured video. [0043], [0063], [0068]-[0070], [0107]-[0109]; FIGS. 2A-2, 3; Welch, ¶¶295-298 (*citing* Meglan, [0059], [0082]-[0084], [0134], FIGS. 1-5, 10; EX1013, 362-364); *supra* §§II.

4. [1C]: “a sensor...”

Rogers’s system includes “camera 108” for “determin[ing] the location and movements of the...interface object 104.” [0044]; *see also* [0081] [0103]; Welch, ¶¶299-300. Camera 108 is “*a sensor for tracking a position of the proxy object.*”

Rogers's interface object 104 also "includes an inertial sensor" by which "inertial tracking [is] communicated with computer 106" ([0052]) to determine interface object 104's "location and orientation" ([0044]). *See also* [0111], FIG.1 ("Inertial Tracking"), claim 9. This inertial sensor is also "*a sensor for tracking a position of the proxy object.*" Welch, ¶¶300-302.

Consistent with the '067 patent's disclosure that "[a]ny suitable number, type, or arrangement of sensors can be used" in "any combination," POSAs understood that camera 108 and the inertial sensor together also meet [1C]'s "*sensor.*" EX1001, 4:1-18; Welch, ¶303.

5. [1D]: "a processor configured to"

Rogers's system includes "computer 106" that can be "any general or special purpose computer known in the art," including a "gaming console" or a "personal computer." [0043], FIG. 1. Rogers explains that gaming consoles and personal computers, like computer 106, include "a processor" that can process "software stored on a computer readable medium" ([0135]). *See also* [0003] (explaining a "game console is designed with specialized processing hardware, including a CPU," i.e., a processor), [0153]; Welch, ¶¶304-305.

Rogers explains that "computer 106...execute[s] a video game." [0043]. In Rogers's system, "executing [a] video game is defined by a game engine 320." [0068]-[0070], FIG. 3. POSAs understood that a game engine includes a set of

executable software instructions. Welch, ¶306. In view of Rogers’s disclosures, POSAs would have understood that the processor within computer 106, e.g., its CPU, is what “executes” a video game in accordance with the game engine’s instructions because that is a conventional task a processor performs, just like Rogers says processor 1450 is “programmed with software instructions...to coordinate the various elements of Game System 1400” ([0147]). [0018], [0043], [0063], [0068]-[0070], FIG. 3; Welch, ¶307.

Computer 106’s processor is “*a processor*” as claimed and is “*configured to*” perform limitations [1D1] to [1D5] when executing a video game, as discussed below. Welch, ¶308.

a. [1D1]: “determine a modified visual effect...”

Computer 106’s processor meets [1D1] because, in response to the user moving interface object 104, the processor modifies the appearance of both the virtual object corresponding to interface object 104 and the virtual hands that hold it. Welch, ¶309.

As explained *supra* §IX.B.4 ([1C]’s “*sensor*”), computer 106 receives images from camera 108 and inertial tracking information from interface object 104’s inertial sensor to determine the “location and orientation” of interface object 104 ([0044]), shown as “Object Tracking” and “Inertial Tracking” in FIG. 1, below. [0018], [0044], [0052]-[0053], [0106]; Welch, ¶310.

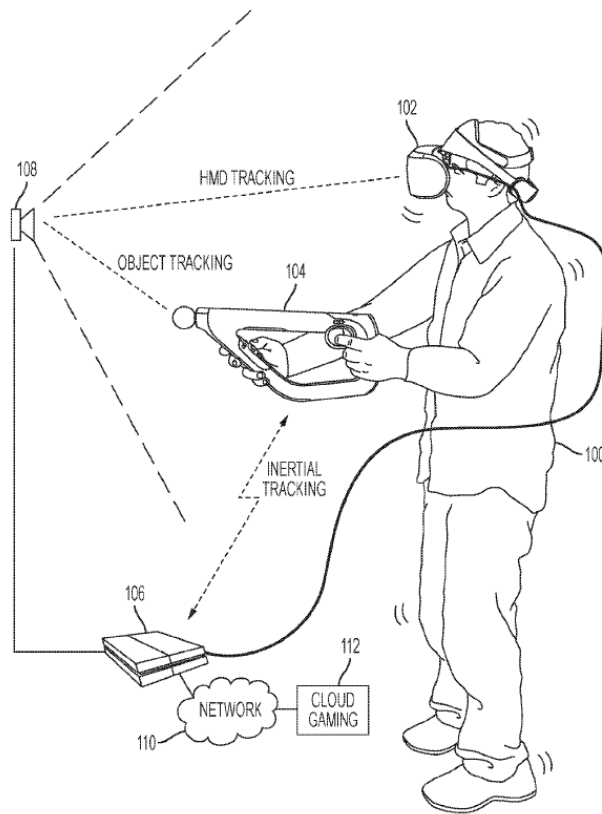


FIG. 1

As user 100 moves interface object 104 to control a virtual weapon (*see, e.g.*, [0107]-[0109], FIGS. 10-11, below) in a video game executed by computer 106 ([0043]), computer 106's processor tracks interface object 104's location and orientation based on camera 108's images and inertial tracking information from interface object 104's inertial sensor—i.e., “*based in part on data received from the sensor*” (*see supra* §IX.B.4). [0044], [0052], [0055], [0106]; Welch, ¶311.

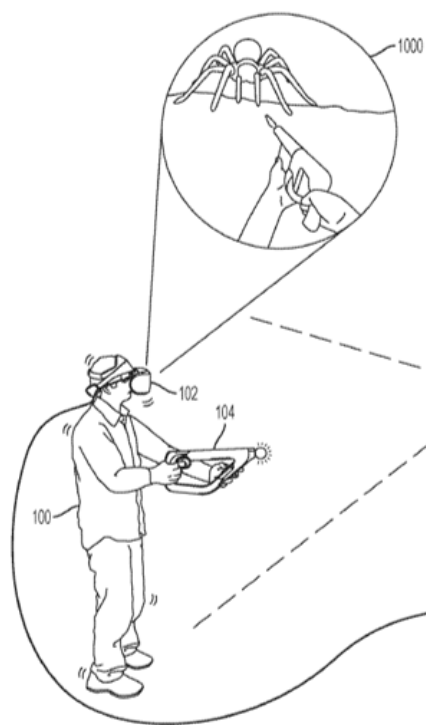


FIG. 10

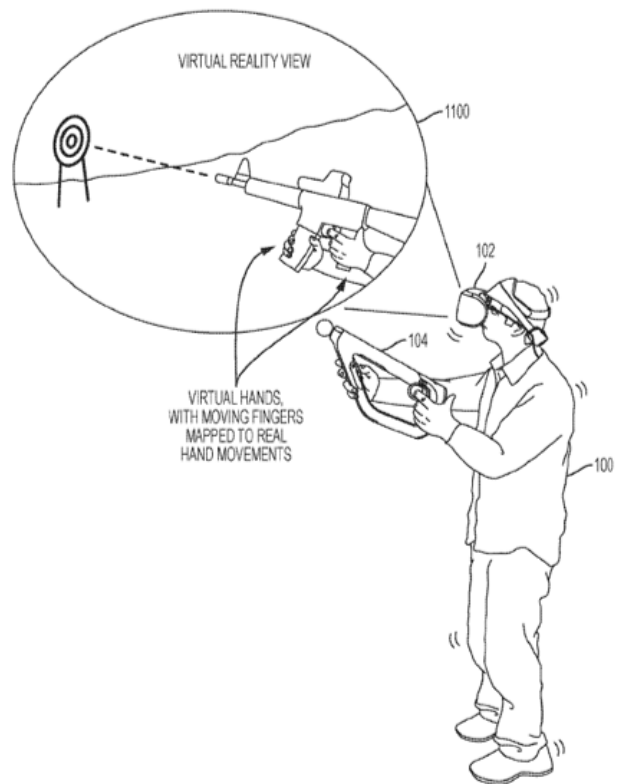


FIG. 11

Computer 106's processor renders the video displayed on HMD 102 (*see* [0018], [0043], [0070]) so that the display of the virtual weapon and virtual hands holding it (i.e., “a *modified visual effect*”) changes in correspondence with the detected location and orientation of interface object 104—i.e., computer 106's processor determines the “*modified visual effect*” that the user sees as virtual hands gripping a virtual weapon that points in the same direction detected for interface object 104, thus meeting [1D1]. [0018], [0043]-[0045], [0052]-[0055], [0068]-[0070], [0106]-[0109]; Welch, ¶¶312-313; EX1016, 7-10.

In Rogers's AR embodiment (*supra* §IX.B.3), computer 106's processor modifies the appearance of the virtual weapon (and optionally virtual hands) in the

augmented video to match the detected location/orientation of interface object 104. [0043]-[0045], [0063], [0068]-[0071], [0106]-[0109]; Welch, ¶314.

b. [1D2]: “determine a haptic effect...”

Rogers’s game engine includes “tactile feedback module 326” that “provide[s] signals to tactile feedback hardware included in...interface object 104.” [0073], FIG. 3. As explained for limitation [1A], interface object 104 includes “tactile feedback hardware” ([0073]) that includes “movable weight 800” and the hardware that controls it “in response to tactile feedback data received from a computer” (i.e., computer 106 in the FIG. 1 system) to produce a “desired haptic effect”—e.g., “when a user reloads their corresponding virtual weapon by, for example, *pointing the directional interface object 104 upward*, the moveable weight 800 may be caused to move so as to mimic the sensation of weapon reloading mechanics of the virtual weapon.” [0105]; Welch, ¶¶315-317.

As discussed for [1D1], the direction that interface object 104 points is determined from camera 108’s images and inertial sensor data (i.e., “*data received from the sensor*”—*supra* §IX.B.4); thus computer 106’s processor performs [1D2] by detecting that interface object 104 is pointed upwards for reload and providing the “tactile feedback data” to control moveable object 800 to produce the “reloading” haptic effect. [0105]; Welch, ¶¶318-319.

c. [1D3]: “transmit a display signal...”

Computer 106’s processor “*transmit[s] a display signal associated with the modified visual effect to the display*” when it “*output[s] the video*” of the changing appearance of the virtual hands holding the virtual weapon as the user points interface object 104 in different directions ([1D1]’s “*modified visual effect*” discussed *supra* §IX.B.5.a) “for rendering by the HMD 102” ([1B]’s “*display*”). [0043] (“computer 106...output[s] the video...from the video game for rendering by the HMD”); *see also* [0018], [0070], FIG. 3; Welch, ¶¶320-323.

HMD 102 displays the “*modified visual effect...on the proxy object*” under Immersion’s broader interpretation for the reasons discussed *supra* §IX.B.3. Welch, ¶324; EX1006, 4-6, 10 (alleging [1D3] is met because “[t]he virtual hand is rendered differently as the controller moves”).

In Rogers’s AR embodiment (*supra* §IX.B.3), computer 106’s processor outputs augmented video to HMD 102 for display with the modified appearance of the virtual weapon (with or without virtual hands) overlaid on interface object 104 in the captured video. [0018], [0043], [0063], [0070]; Welch, ¶325; *supra* §VII.B.5.a.

d. [1D4]: “transmit a haptic signal...”

As discussed above for [1D2], computer 106’s processor “provide[s] *signals* to tactile feedback hardware” within interface object 104 ([0073]) that controls the

movement of weight 800 to “mimic the sensation of weapon reloading mechanics of the virtual weapon” ([0105]), thus performing [1D4] because the “tactile feedback hardware” ([0073]) comprising moveable object 800 and the hardware that controls it to produce the “desired haptic effect” ([0105]) are “*haptic output devices*.” Welch, ¶¶326-327.

e. [1D5]: “output the haptic effect...”

As discussed above for [1D2], when computer 106’s processor transmits haptic feedback data to interface object 104’s “tactile feedback hardware” ([0073]) to move object 800 to produce a “haptic effect” that “mimic[s] the sensation of weapon reloading mechanics of the virtual weapon” ([0105]), computer 106’s processor uses “*one or more haptic output devices*” (including moveable weight 800 and the hardware that controls it) to “*output the haptic effect*” as claimed. Welch, ¶¶328-329.

C. Claim 2

Rogers’s head-mounted display 102 is “*a wearable device*,” as claimed. [0005], [0042], [0119]-[0131], FIG. 1 (below); Welch, ¶330.

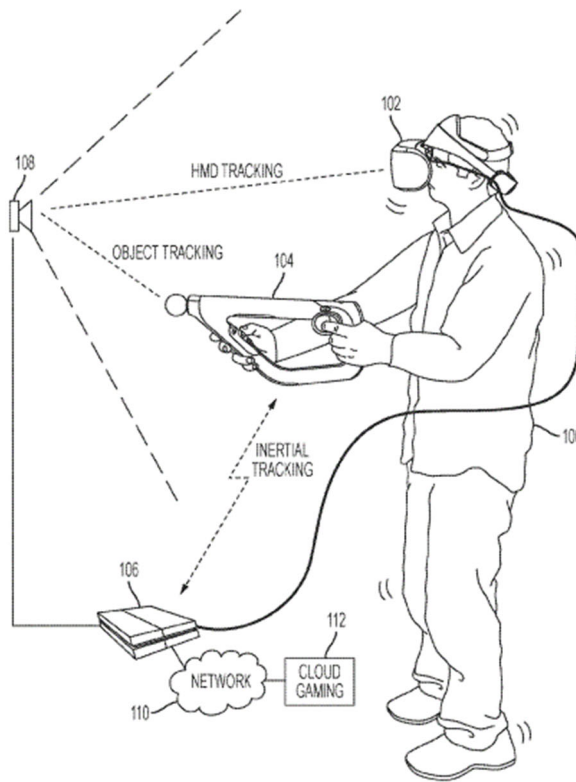


FIG. 1

The HMD comprises “*one or more second haptic output devices*” because it includes “*tactile feedback hardware*” for providing “*tactile feedback.*” [0073], [0125], FIG. 12; Welch, ¶¶331-332.

D. Claim 3

As discussed for [1A], Rogers’s interface object 104 (“*proxy object*”) is both an “*electronic device*” and an “*interface object.*” Welch, ¶333.

E. Claim 4

As shown in FIGS. 10-11, Rogers’s interface object 104 has a neutral, generic tubular shape that can be made to look like a desired “*virtual weapon*” on the VR or

AR display. Interface object 104 thus “comprises neutral physical characteristics” the same way the ’067 patent describes. EX1001, 5:34-44 (describing proxy object with “neutral physical characteristics” as one requiring “visual overlay” to make it look a particular way); Welch, ¶334.

F. Claim 5

Claim 5 is met for the same reasons that [1D1] is met.

As discussed *supra* VII.B.5.a, VII.B.5.c, as user 10 moves interface object 104 to control a virtual weapon, [1D1]’s “*modified visual effect*” of the changed appearance of virtual hands holding the virtual weapon at the detected location/orientation of interface object 104 as it moves is displayed by HMD 102, which meets claim 5 at least under Immersion’s interpretation. EX1006, 10, 26 (alleging claim 5 is co-extensive with [1D1]); Welch, ¶¶335-336.

G. Claim 6

As explained *supra* §IX.D (claim 3), the head-mounted display 102, i.e., the claimed “*display*,” is a “*wearable device*.” Welch, ¶337.

H. Claim 7

As explained with respect to [1C], a claimed “*sensor*” in Rogers’s system is a “*camera*,” meeting claim 7.

Another claimed “*sensor*” is an “inertial sensor” within interface object 104, e.g., “a magnetometer” (“*magnetic sensor*”), “*accelerometer*,” or “gyroscope”

(“gyrometer”). [0111]. Rogers thus meets claim 7 for this separate reason. Welch, ¶338.

I. Claim 8

First, Rogers’s camera 108 is an “*input capture device*” because it “capture[s] images of the interactive environment” ([0044]) and computer 106 performs claim 8 because it receives and uses camera 108’s captured images to cause [1D2]’s “*haptic effect*” to be output for the reasons discussed *supra* §§IX.B.5.b, IX.B.5.d-IX.B.5.e. Welch, ¶¶340-341.

Additionally, Rogers’s interface object 104 includes “selection buttons” ([0051]-[0052]) that provide “controller input” to computer 106’s processor when pressed by the user ([0069]). These buttons are thus “*input capture device[s]*.” POSAs understood that these buttons, described as being similar to those that “are common to various other game console controllers” ([0051]), would be used for common purposes such as selecting a videogame to play and/or selecting a particular weapon in a game. [0059]; Welch, ¶¶342-343. Computer 106’s processor would thus perform claim 8 when executing a video game, selected via interface object’s “selection buttons,” for which [1D2]’s “*haptic effect*” is part of the game functionality (e.g., a first-person shooter game) and/or when a weapon is selected for which [1D2]’s “*haptic effect*” is part of the selected weapon’s functionality. [0051], [0059]; Welch, ¶344.

Alternatively, Rogers meets claim 8 under Immersion’s position in the pending litigation that “*the haptic effect*” in claim 8 need not be the same “*haptic effect*” recited in [1D2]. *Compare* EX1006, 14-18 (mapping [1D2] to controller movement) *with id.*, 28-29 (mapping claim 8 to trigger pulls). Rogers teaches that interface object 104 includes a trigger used to “fire a virtual weapon” ([0050]), and that activating it causes the moveable weight to “provid[e] a kickback sensation similar to that of an actual weapon” ([0105]). Welch, ¶345.

J. Claim 11

Claim 11 recites the method that claim 1’s processor is configured to perform. Welch, ¶¶346. Rogers meets claim 11 for the same reasons Rogers meets claim 1. *See supra* §IX.B.

K. Claim 12

1. [12A]

The same processor-executed “tactile feedback module 326” that determines a first haptic effect for interface object 104 (as discussed above for [1D2]) also provides signals to tactile feedback hardware “included in [the] HMD” ([0073]). *See also* [0125]. Computer 106’s processor is therefore configured for “*determining a second haptic effect,*” meeting [12A]. Welch, ¶347.

2. [12B]

As discussed above for [12A], Rogers’s “tactile feedback module 326” is “configured to provide *signals* to tactile feedback hardware included in [the] HMD.” [0073], [0125]. The “tactile feedback hardware” within the HMD are “*one or more second haptic output devices*,” as claimed. Welch, ¶348.

3. [12C]

As discussed above for [12B], in response to a signal from Rogers’s processor, the “tactile feedback hardware” within the HMD “caus[e] movement and/or vibration of the [HMD] so as to provide tactile feedback to the user” ([0125]). *See also* [0073]. Computer 106’s processor is thus configured to “*output[] the second haptic effect using the one or more second haptic output devices*,” as claimed. Welch, ¶¶349. POSAs understood Rogers’s disclosure that the “tactile feedback hardware” is “included in” the HMD to mean, or at least suggest, the hardware is “*mechanically coupled to*” the HMD, i.e., “*a wearable device*,” as claimed. Welch, ¶¶349-350.

L. Claims 15-20

Claims 15-20 recite identical limitations as claims 3-8, respectively, which are met by Rogers for the reasons discussed in the corresponding Sections listed below. Welch, ¶¶351-356.

- Claim 15: *supra* §IX.D (claim 3).

- Claim 16: *supra* §IX.E (claim 4).
- Claim 17: *supra* §IX.F (claim 5).
- Claim 18: *supra* §IX.G (claim 6).
- Claim 19: *supra* §IX.H (claim 7).
- Claim 20: *supra* §IX.I (claim 8).

M. Claim 21

Claim 21 recites a computer-readable medium comprising program code to cause a processor to perform the method of claim 11.

Rogers teaches that its “disclosure can also be embodied as computer readable code” (i.e., “*program code*”) “on a computer readable medium.” [0155]. “[V]arious general-purpose machines,” e.g., computer 106 (FIG. 1) or video server system 1420 (FIG. 14), “can be used with computer programs written in accordance with [Rogers’s] teachings.” [0154]; *see also* [0147] (explaining processor for video server is programmed with “software instructions”). Rogers thus meets claim 21. Welch, ¶¶357-358.

X. NO BASIS FOR DISCRETIONARY DENIAL

A. *Fintiv*

Under the Director’s Interim Procedure for Discretionary Denials, the Board will not deny institution based on *Fintiv*⁶ if there is compelling evidence of unpatentability, which this Petition provides, thereby concluding the *Fintiv* analysis. *Nokia of Am. Corp. v. TQ Delta, LLC*, IPR2022-00471, Paper 11 at 19-21 (Aug. 18, 2022). Regardless, the *Fintiv* factors also weigh against discretionary denial.

1. Potential for Stay

Petitioner will seek a pre-institution stay, but without “specific evidence” how the court will rule, this factor is neutral. *Sand Revolution II v. Cont’l Intermodal Grp.–Trucking LLC*, IPR2019-01393, Paper 24 at 7 (June 16, 2020) (informative).

2. Timing of Trial

Though June 2025 is the trial-ready date (EX1031), the Board considers the median time to trial which is 27 months for the Western District of Washington (EX1029, 76), putting trial in late August 2025, likely shortly *after* a final written decision here. *Cf. Sony Interactive v. Quantum Imaging*, IPR2023-00954, Paper 11 at 26 (Dec. 11, 2023) (trial four months *before* FWD “weighs *against* discretionary denial”).

⁶ *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (Mar. 20, 2020) (precedential).

Moreover, Petitioner filed this petition diligently, roughly four months after receiving Immersion’s list of asserted claims, and nearly three months before the §315(b) deadline. EX1005, EX1030. Factor 2 thus weighs against denial. *Fintiv*, Paper 11 at 11 (“expeditiously” filed petitions “weigh[] against [denial]”).

3. Litigation Investment

Other than initial motion practice and preliminary contentions, the parties have invested little in the district-court litigation, weighing against denial. *Samsung Elecs. Co. v. Netlist, Inc.*, IPR2022-00063, Paper 13 at 8 (May 5, 2022) (granting institution where no “claim construction and merits determinations” had occurred in litigation).

4. Overlap of Issues

Immersion does not assert challenged claims 4 and 16. EX1006, 2-38. This IPR will address claims the district court will not, weighing against denial. *Markforged Inc. v. Continuous Composites, Inc.*, IPR2022-00679, Paper 7 at 32-33 (Oct. 25, 2022).

5. Litigation Defendants

Petitioner is the district-court defendant, which “is far from an unusual circumstance.” *Sand Revolution II*, Paper 24 at 12-13. This factor is neutral.

B. *Advanced Bionics*

None of this Petition's references were cited during prosecution.
Discretionary denial under §325(d) is not warranted.

XI. CONCLUSION

The Board should institute IPR and cancel claims 1-8, 11-12, and 15-21.

Dated: 02-07-2024

Respectfully,

Valve Corporation,

By: /Elisabeth Hunt/
Elisabeth H. Hunt, Reg. No. 67,336
WOLF, GREENFIELD & SACKS, P.C.

CERTIFICATE OF SERVICE UNDER 37 C.F.R. § 42.6 (E)(4)

I certify that on February 7, 2024, I will cause a copy of the foregoing document, including any exhibits or appendices filed therewith, to be served via Overnight FedEx at the following correspondence address of record for the patent:

Immersion / Kilpatrick Townsend and Stockton
Mailstop: IP Docketing – 22
1100 Peachtree Street
Suite 2800
Atlanta, GA 30309

Date: February 7, 2024

/MacAulay Rush/
MacAulay Rush
Paralegal
WOLF, GREENFIELD & SACKS, P.C.

CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24, the undersigned certifies that the foregoing IPR petition contains 13,997 words excluding a table of contents, a table of authorities, Mandatory Notices under § 42.8, a certificate of service or word count, or appendix of exhibits or claim listing. Petitioners have relied on the word count feature of the word processing system used to create this paper in making this certification.

Date: February 7, 2024

/MacAulay Rush/

MacAulay Rush

Paralegal

WOLF, GREENFIELD & SACKS, P.C.

XII. CLAIM LISTING

The following claim listing assigns element labels (e.g., [1A1], [1A2], etc.) to certain claims for clarity.

Claim 1
[1PRE] A system comprising:
[1A] a proxy object comprising one or more haptic output devices;
[1B] a display configured to output a visual effect onto a surface of the proxy object;
[1C] a sensor for tracking a position of the proxy object
[1D] a processor configured to
[1D1] determine a modified visual effect based in part on data received from the sensor
[1D2] determine a haptic effect based in part on data received from the sensor
[1D3] transmit a display signal associated with the modified visual effect to the display, the modified visual effect to be displayed on the proxy object via the display
[1D4] transmit a haptic signal associated with the haptic effect to the one or more haptic output devices
[1D5] output the haptic effect using the one or more haptic output devices.
Claim 2
The system of claim 1, further comprising a wearable device comprising one or more second haptic output devices.”
Claim 3
The system of claim 1, wherein the proxy object comprises one or more of: a shoe, an article of clothing, an electronic device, a display, an interface object, or an interior of a vehicle.
Claim 4
The system of claim 1, wherein the proxy object comprises neutral physical characteristics.
Claim 5

The system of claim 1, wherein the modified visual effect is configured to modify an appearance of the proxy object through the display.
Claim 6
The system of claim 1, wherein the display comprises at least one of: a wearable device or a mobile device.
Claim 7
The system of claim 1, wherein the sensor comprises at least one of a camera, a laser, a radar, an accelerometer, a gyrometer, a pressure sensor, a magnetic sensor, a light sensor, a tracking sensor, or a microphone.
Claim 8
The system of claim 1, wherein the processor is further configured to receive an input signal from an input capture device and determine the haptic effect based in part on data received from the input capture device.
Claim 11
[11PRE] A method comprising:
[11A] determining a modified visual effect based in part on data received from a sensor;
[11B] determining a haptic effect based in part on data received from the sensor;
[11C] transmitting a display signal associated with the modified visual effect to a display, the modified visual effect being displayed on a surface of a proxy object via the display, the proxy object comprising one or more haptic output devices;
[11D] transmitting a haptic signal associated with the haptic effect to the one or more haptic output devices; and
[11E] outputting the haptic effect using the one or more haptic output devices.
Claim 12
[12PRE] The method of claim 11, further comprising:
[12A] determining a second haptic effect;
[12B] transmitting a second haptic signal associated with the second haptic effect to one or more second haptic output devices; and
[12C] outputting the second haptic effect using the one or more second haptic output devices, the one or more second haptic output devices being mechanically coupled to a wearable device.
Claim 15

The method of claim 11, wherein the proxy object comprises one or more of: a shoe, an article of clothing, an electronic device, a display, an interface object, or an interior of a vehicle.
Claim 16
The method of claim 11, wherein the proxy object comprises neutral characteristics
Claim 17
The method of claim 11, wherein the modified visual effect is configured to modify an appearance of the proxy object through the display.
Claim 18
The method of claim 11, wherein the display comprises at least one of: a wearable device or a mobile device.
Claim 19
The method of claim 11, wherein the sensor comprises at least one of a camera, a laser, a radar, an accelerometer, a gyrometer, a pressure sensor, a magnetic sensor, a light sensor, a tracking sensor, or a microphone.
Claim 20
The method of claim 11, further comprising receiving an input signal from an input capture device and determining the haptic effect based in part on data received from the input capture device.
Claim 21
[21PRE] A non-transitory computer readable medium comprising program code, which when executed by a processor is configured to cause the processor to:
[21A] determine a modified visual effect based in part on data received from a sensor;
[21B] determine a haptic effect based in part on data received from the sensor;
[21C] transmit a display signal associated with the modified visual effect to a display, the modified visual effect being displayed on a surface of a proxy object via the display, the proxy object comprising one or more haptic output devices;
[21D] transmit a haptic signal associated with the haptic effect to the one or more haptic output devices; and
[21D] output the haptic effect using the one or more haptic output devices.