

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

META PLATFORMS, INC.
Petitioner,

v.

IMMERSION CORPORATION
Patent Owner.

Case IPR2023-00945
U.S. Patent No. 10,664,143

EXHIBIT 2002

DECLARATION OF GREGORY ABOWD, D.Phil.

TABLE OF CONTENTS

I.	BACKGROUND AND QUALIFICATIONS	1
II.	BASES OF OPINIONS	2
III.	APPLICABLE LEGAL STANDARDS	3
	A. Ordinary Skill in the Art	3
	B. Claim Construction	5
	C. Obviousness	5
IV.	OVERVIEW OF THE '143 Patent	8
V.	EXEMPLARY CLAIM OF THE '143 Patent	9
VI.	THE ASSERTED PRIOR ART	10
	A. The Nogami Reference (Ex. 1003)	10
VII.	CLAIM CONSTRUCTION	15
VIII.	NOGAMI DOES NOT DISCLOSE THE CLAIMED “POSITION SENSOR” REQUIRED BY CLAIMS 1-2, 8-9, and 15-16	15
	A. Nogami’s remote magnetic receiver is not a position sensor	17
	B. Nogami fails to disclose the '143 Patent’s claimed limitation, “wherein the position sensor is positioned on the peripheral”	21
IX.	NOGAMI DOES NOT DISCLOSE “receive one or more sensor signals from the position sensor” required by claims 1, 8, and 15	25
X.	NOGAMI DOES NOT DISCLOSE “determine a haptic signal based on the position of the peripheral in real space” required by claims 1, 8, and 15	25

I, Gregory Abowd, declare as follows:

1. I have been retained by Folio Law Group PLLC, counsel for Patent Owner Immersion Corporation (“Immersion”) to assess the challenged claims of U.S. Patent No. 11,664,143 (“the ’143 patent”). I am being compensated for my time. My compensation is not dependent in any way upon any outcome of the Petition for *Inter Partes* Review of the ’143 patent (“the Petition”).

I. BACKGROUND AND QUALIFICATIONS

2. I have more than 30 years of experience in the field of computer science. In 1986, I received a Bachelor of Science (“B.S.”) with Honors in Mathematics from the University of Notre Dame. In 1987, I obtained a Master of Science (“M.Sc.”) from the University of Oxford in the United Kingdom in Computation. In 1991, I received a D. Phil. from the University of Oxford in Computation. At the University of Oxford, the term “Computation” referred to the field that is known in the United States as “Computer Science.”

3. I am employed by Northeastern University (“Northeastern”), where I am the Dean of the College of Engineering and Professor of Electrical and Computer Engineering.

4. I have extensive experience in Human Computer Interaction (HCI), with specific expertise in the technologies of interaction, including haptics and touch interfaces. My D. Phil. thesis was entitled *Formal Aspects of Human-*

Computer Interaction. I am co-author of one of the first textbooks in HCI, first published in 1994. I have won numerous Best Paper awards at a number of conferences related to user interfaces and wireless networks. I have also received several “test of time” awards for my publications, which is usually awarded to papers 10 years after publication and based on long-term impact. I am the most cited academic author in the world in the area of mobile and ubiquitous computing technologies.

5. My contributions to the fields of Human-Computer Interaction (“HCI”) and Ubiquitous Computing have been recognized through numerous awards. In 2008, I was named a Fellow of the Association for Computing Machinery. That same year, I was inducted into the ACM CHI Academy, the most prestigious honor for researchers in HCI. In 2023, I was awarded the Lifetime Research Achievement award by ACM SIGCHI, the leading academic professional society in HCI.

6. A detailed record of my professional qualifications, including a list of patents and academic and professional publications, is set forth in my curriculum attached as an appendix to this declaration.

II. BASES OF OPINIONS

7. In the course of performing my analysis and forming my opinions, I have reviewed the Petition and its Exhibits 1001–1008 including the materials listed below:

- U.S. Patent No. 11,664,143 (“the ’143 Patent”) (Ex. 1001)
- IPR Petition IPR2023-00945
- Declaration of Dr. Jeremy Cooperstock (Ex. 1002)
- US Patent App. Pub. 2009/0066725 (“Nogami”) (Ex. 1003)
- Prosecution History of the ’143 Patent. (Ex. 1007)

III. APPLICABLE LEGAL STANDARDS

A. Ordinary Skill in the Art

8. My opinions in this declaration are based on the understandings of a person of ordinary skill in the art—sometimes referred to as an “ordinary artisan” or by the acronyms “POSITA” (person of ordinary skill in the art) or “PHOSITA” (person having ordinary skill in the art)—as of the time of the invention, which I understand to be the earliest priority date (September 30, 2010) of the ’143 Patent. I understand that the person of ordinary skill in the art is a hypothetical person who is presumed to have known the art relevant to the challenged claims of the ’143 Patent at the time of the invention.

9. I understand that, in assessing the level of skill of a person of ordinary skill in the art, one should consider the type of problems encountered in the art, the prior solutions to those problems found in the prior art references, the rapidity with which innovations are made, the sophistication of the technology, the level of education of active workers in the field, and my own experience working with those

of skill in the art at the time of the invention.

10. I understand that the Petitioner and Patent Owner have proposed that the level of skill in the art at the time of the '143 patent is as follows:

A person of ordinary skill in the art would have possessed a bachelor's degree in electrical engineering or computer science (or an equivalent degree), and two years of practical or industry experience in the field of human computer interaction, including implementation of computer-based systems and software for providing haptic feedback effects to a user and determining the position and/or orientation of a device used by a user (such as a device worn on the human body). A person could also have qualified as an ordinarily skilled artisan with more formal education and less practical or industry experience, or vice versa.

11. I understand that Immersion proposes that the definition of a POSITA should be defined as follows. I agree with this definition.

A person of ordinary skill in the art would have possessed a bachelor's degree in electrical engineering or computer science (or an equivalent degree), and two years of practical or industry experience in the field of human computer interaction, including implementation of computer-based systems and software for providing haptic feedback effects to a user. A person could also have qualified as a person of ordinary skill in the art with more formal education and less practical or industry experience, or vice versa.

12. Consistent with this definition, I was at the time of invention, and am, a POSITA through my education, research experience and work experience. As of the date of the invention, I was familiar with the types of problems encountered in systems that use haptic feedback and the rapidity at which innovations are made.

B. Claim Construction

13. I understand that claims of the '143 Patent in this IPR are generally interpreted according to their ordinary and customary meaning taking into consideration the so-called “intrinsic evidence” of the patent consisting of (1) the claim language; (2) the specification; and (3) the prosecution history.

14. I understand that claim terms may be explicitly defined in the patent specification or they may be implicitly defined through consistent usage in the specification. I also understand that the scope of claim terms may be limited by statements in the specification or prosecution history where the applicant clearly disavows or disclaims subject matter.

C. Obviousness

15. Counsel has informed me, and I understand, that an issued patent claim is invalid as obvious if it can be shown that the differences between the patented subject matter and the prior art are such that the subject matter as a whole would have been obvious, at the time the invention was made, to a person having ordinary skill in the art. Relevant considerations include the level of ordinary skill in the art;

the scope and content of the prior art; differences between the prior art and the claims at issue; and the objective indicia, or secondary considerations, of nonobviousness.

16. In this regard, I am informed and I understand that the secondary considerations of nonobviousness could include factors such as commercial success, long felt but unresolved needs, the failure of others, skepticism by experts, praise by others, award and accolades, and copying.

17. Counsel has informed me, and I understand, that in order to evaluate the obviousness of any claim of the '143 Patent over a given prior art combination, I should analyze whether the prior art references, included collectively in the combination, disclose each and every element of the allegedly invalid claim as those references are read by the person of ordinary skill in the art at the time of the invention.

18. Counsel has informed me, and I understand, that even where all of the claim limitations are expressly disclosed in the prior art references, there must be some showing that a person of ordinary skill in the art would have been motivated to combine such prior art references, and explanation of how the combination would be achieved, and that there would have been a reasonable expectation of successfully achieving the claimed invention from such combination.

19. Counsel has informed me, and I understand, that absent some additional

reasoning, mere routine optimization for a person of ordinary skill in the art to arrive at the claimed invention through combination of prior art references is insufficient to support a conclusion of obviousness.

20. Counsel has informed me, and I understand, that to rely on a reference it must be analogous prior art. Counsel has informed me and I understand that a reference is considered analogous prior art: (1) if the reference is from the same field of endeavor as the claimed subject matter, or (2) if the reference “is reasonably pertinent to the particular problem with which the inventor is involved,” even though the reference is not within the field of the inventor’s endeavor.

21. Counsel has informed me, and I understand, in considering the obviousness of a claimed invention, one should not view the invention and the prior art with the benefit of hindsight. In an obviousness analysis, one must be aware of the distortion caused by hindsight bias and must be cautious of arguments reliant upon ex post reasoning. Counsel has instructed me and I understand that when considering obviousness, I should not consider what is known today or what was learned from the asserted patents. Instead, obviousness is assessed by the person of ordinary skill in the art at the time the invention was made.

22. In this regard, I am informed and I understand that the ’806 Patent may not be used as a guide to select and understand the prior art, because such an approach, at a minimum, discounts the value of combining various existing features

or principles in a new way so as to achieve a new result.

23. Counsel has informed me, and I understand, that obviousness cannot be predicated on what was unknown at the time of the invention, even if the inherency of a certain feature is later established. Counsel has also informed me, and I understand, that unknown properties of the prior art may not be relied upon to provide the rationale for modifying or combining the prior art to reach the claimed subject matter.

24. Counsel has informed me, and I understand, that a reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant of the '143 Patent.

IV. OVERVIEW OF THE '143 PATENT

25. The '143 patent is directed to a system and method for providing haptically-enhanced interactivity with interactive content such as virtual objects displayed to a user via live video. EX1001, Abstract, 1:25-42. In virtual reality systems, users can interact with virtual objects in a virtual environment, e.g., by manipulating physical objects in the real world to interact with a virtual object. *Id.*, 1:27-3. These systems typically further incorporate augmented reality technology to integrate 3D virtual objects based on this live video. *Id.*, 1:38-43.

26. As mentioned above, the '143 patent teaches techniques that enhance the user experience in virtual reality systems. The inventors of the '143 patent recognized that in conventional virtual reality systems at the time, visual and/or audio feedback may provide a sense of interaction with virtual objects to users.” EX1001, 1:44-45. However, virtual objects may be presented to a user on video displays such that the virtual object can be seen as moving with accompanying sound effects at times, while at other times, the virtual object may be seen moving without accompanying sound effects. *Id.*, 1:45-48.

27. The inventors of the '143 patent sought to further enhance how users experienced and interacted with such virtual objects by introducing a physical sense of interaction with virtual objects to users by way of haptic feedback on peripheral devices worn or held by users (e.g., interactive clothing, accessories, mobile devices, remote controls, etc.). *See, e.g., id.*, 1:48-50, 2:6-27, 2:66-3:14, 3:64-4:14. This type of haptic feedback such as vibrations and touch feedback to the user provides “a more compelling and complete user experience while interacting with interactive virtual content.” *Id.*, 2:66-3:14.

V. EXEMPLARY CLAIM OF THE '143 PATENT

28. Independent claim 1 is recited below:

1. A system comprising:
a position sensor;
a processor; and

a non-transitory computer-readable medium comprising program code that is executable by the processor to cause the processor to:

output first interactive content to a display, the first interactive content comprising a virtual environment;

receive one or more sensor signals from the position sensor;

determine a position of a peripheral in real space based on the one or more sensor signals, the peripheral configured to be worn on a user's head;

output second interactive content to the display based on the position of the peripheral in real space, the second interactive content being different from the first interactive content;

determine a haptic signal based on the position of the peripheral in real space and the second interactive content; and

transmit the haptic signal to a haptic output device, the haptic output device being configured to receive the haptic signal and output haptic feedback.

VI. THE ASSERTED PRIOR ART

A. The Nogami Reference (Ex. 1003)

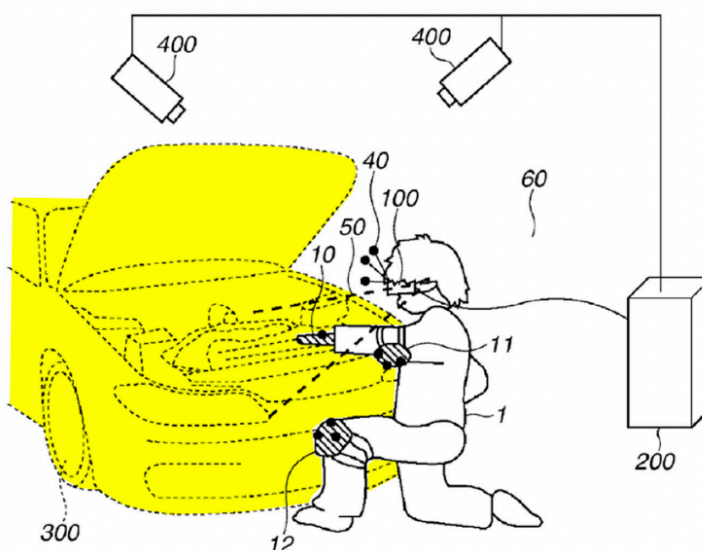
29. U.S. Patent Application Publication No. 2009/0066725 to Nogami et al. (“Nogami”) discloses an information processing apparatus and method for “implement[ing] an interaction between a virtual space and a user who observes the virtual space.” EX1003, ¶ [0002]. Nogami’s invention is generally directed to varying the intensity of haptics stimulation provided by vibration motors mounted

on wearable accessories such as gloves and elbow pads. *See, e.g.*, EX1003, ¶¶ [0062]-[0072], [0081], [0120]-[0122].

30. Nogami addresses the prior art systems' inability to "appropriately adjust the intensity of stimulation to be provided **according to contact of a user with a virtual object based on whether the user is aware of the contact.**" EX1003, ¶ [0025]. In prior art systems, when the user *consciously* contacted a virtual object, the user can easily recognize the contact even if the intensity of the stimulation is low. EX1003, ¶ [0022]. However, when the user *unconsciously* contacted the virtual object, the user may not recognize the stimulation if the intensity of the stimulation on a part of the user's body that unconsciously contacted the virtual object is not high enough. *Id.*

31. To address this problem, Nogami is "directed to a method for controlling a stimulation based on a result of a determination as to whether a user has consciously performed contact with a virtual object in the case of notifying, to the user, contact of the user with the virtual object using stimulation." EX1003, ¶ [0026] (emphasis added). Nogami illustrates this concept in the figures below.

FIG.1



EX1003, Fig. 1 (highlighting added by Petitioner at Pet., 18).

32. In Figure 1, user 1 is wearing HMD 100 (head mounted display), knee pad stimulation unit 12, elbow pad stimulation unit 11, and glove stimulation unit 10. *See, e.g.*, EX1003, ¶¶ [0045]-[0051], [0059]-[0060]. Through HMD 100, user 1 is able to view a virtual environment including virtual object 300, which is a “virtually expressed imitation image of an automobile.” *Id.*, at ¶ [0050]. This virtual viewpoint through the lense of HMD 100 is shown in Figure 1 as a view angle with dotted lines and labeled as “attention range 50,” an area or range in which the user can visually perceive the virtual object. *Id.*, at ¶¶ [0098]-[0101]. On the other hand, range 60 is the area outside of range 50, which Nogami refers to as a “non-attention range” because this area is not within the user’s view through HMD 100 *Id.*, ¶

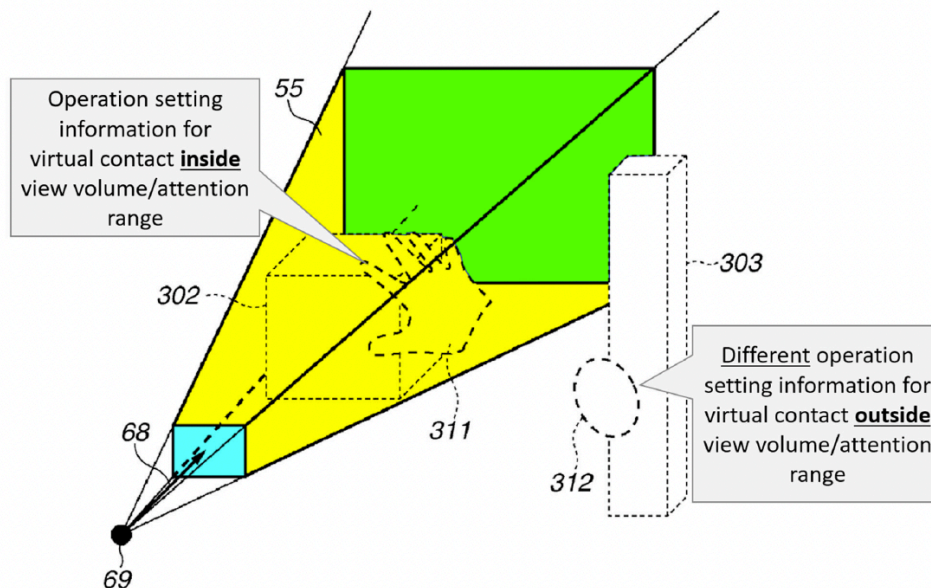
[0101].

33. In Figure 1, the glove (or, e.g., a virtual depiction of a hand holding a work tool) is shown making contact with the virtual car 300. *Id.*, ¶¶ [0101]-[0102], [0270]. This contact point is located within the attention range 50 (i.e., in the area viewable through HMD 100). (*Id.*). But the contact point of the knee pad and virtual car 300 (or e.g., contact of elbow pad with virtual car 300) is shown as located outside the view angle of attention range 50. *Id.*, ¶ [0103]. As such, Nogami teaches that the haptic intensity of glove stimulation unit 10 has a different (lower) intensity than elbow pad stimulation unit 11 because the contact point of the glove with the virtual car is *inside* the attention range while the contact point of the knee or elbow pad with the virtual car is *outside* the attention range. *See, e.g., id.*, ¶¶ [0103], [0120] (“operation setting information can differ according to whether region virtual object contacting the background virtual object is located within the virtual range”), ¶¶ [0121]-[0122], ¶¶ [0180]-[0181]. In other words, the level of intensity for the stimulation unit mounted on the elbow pad should be higher because it’s contact with the virtual car may be unconscious and outside of the user’s attention range such that a sufficiently higher intensity is needed for the user to recognize the stimulation.

34. Another example of an attention range is shown in Figure 6 of Nogami below. Here, attention range 55 is the user’s viewpoint of a virtual environment

including virtual object 302, as well as region virtual object 311, which is a virtual depiction of a glove stimulation unit 10 generated by imitating a shape of the user's hand. EX1003, ¶¶ [0140]-[0141]. In this illustration, region virtual object 311 representing the user's hand is making contact with the virtual object 302 where the point of contact is inside the attention range. *Id.*, ¶¶ [0148]-[0149]. Conversely, outside of the user's attention range 55 is virtual object 303 making contact with region virtual object 312, which is a virtual depiction of an elbow pad stimulation unit 11 generated by imitating the user's elbow. *Id.*

FIG.6



Pet., 35 (annotations and colored highlights added by Petitioner).

35. In this example, Nogami teaches that glove stimulation unit 10 depicted by region virtual object 311 is configured to generate a different, lower intensity

level than the elbow pad stimulation unit 11 depicted by region virtual object 312. *Id.*, ¶¶ [0152]-[0154]. This is because the point where the glove is in contact with the virtual object 302 is inside the attention range, i.e., conscious contact; whereas the point where the elbow pad is in contact with the virtual object 303 is outside the attention range, i.e., is unconscious contact, such that a higher intensity is needed for the user to recognize the contact. *Id.*, ¶¶ [0152]-[0154]; *see also, e.g., id.*, ¶¶ [0180] – [0181].

VII. CLAIM CONSTRUCTION

36. I understand that Petitioner believes none of the claim terms in the challenged claims require express construction at this time. Pet. at 6. I also understand that Patent Owner submits that all claim terms in the challenged claims should be given their plain and ordinary meaning. I further understand that in the parallel litigation, the Western District of Texas has construed the claim term “real space” as having plain and ordinary meaning.

37. Therefore, in my analysis of the challenged claims throughout this Declaration, I apply the plain and ordinary meaning of each claim term as understood by a POSITA in the context of the ’143 Patent specification.

VIII. NOGAMI DOES NOT DISCLOSE THE CLAIMED “POSITION SENSOR” REQUIRED BY CLAIMS 1-2, 8-9, AND 15-16

38. I have reviewed the Petition and Declaration of Dr. Jeremy Cooperstock (Ex. 1002) regarding this claim limitation. My understanding is that Petitioner and

Dr. Cooperstock argue that Nogami's magnetic receiver satisfied the claimed position sensor in independent claims 1, 8, and 15 and dependent claims 2, 9, and 16. As I detail further below, this magnetic receiver is not a position sensor as required by the '143 Patent.

39. Independent claims 1, 8, and 15 require a position sensor for determining the position of the peripheral. Challenged dependent claims 2, 9, and 16 require the positions sensors to be mounted on the peripheral. The '143 patent explains that the position sensor can be implemented in at least two ways. One way is "remote sensing" where the position sensor is physically separate from the peripheral. EX1001, Fig. 1, 3:15-28, 3:64-4:5, 5:35-48. This implementation is not claimed by the dependent claims. Another implementation is where the position sensor is mounted on the peripheral. This implementation *is* claimed by the dependent claims. EX1001, 5:52-58, 13:14-15, 13:56-57, 14:37-39.

40. Nogami also describes two implementations for position sensing. But, in my opinion, neither implementation has a position sensor mounted on the peripheral. I understand that, Petitioner expressly avoids the first embodiment in its attempt to map the claimed position sensor because in that embodiment, position and orientation sensor 400 is not mounted on HMD 100.

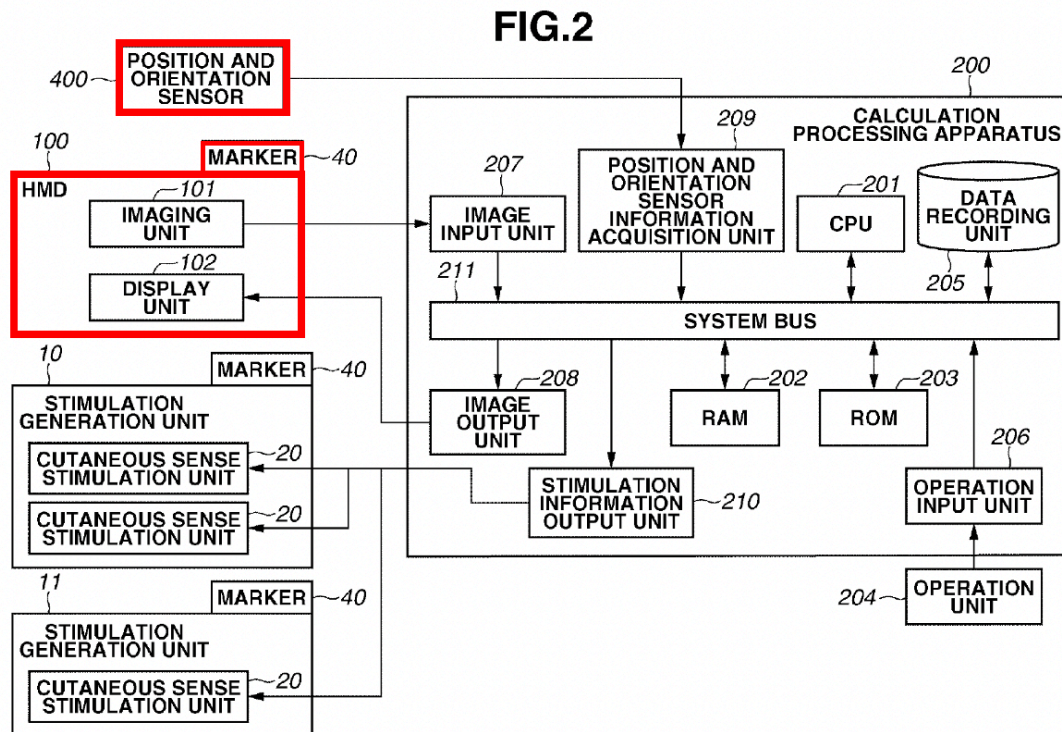
41. I understand that Petitioner instead looks to Nogami's second embodiment and specifically points at its magnetic receiver mounted on HMD 100

as the claimed position sensor. But in my opinion, this magnetic receiver does not qualify as the claimed position sensor, and therefore, fails to disclose both the independent *and* dependent claims.

42. As I explain below, Nogami’s magnetic receiver is not a position sensor because it does not provide the position of HMD 100; rather, the magnetic receiver is merely a building block component that provides raw signals relied upon by Nogami’s position and orientation sensor 400—which is physically remote from HMD 100—in order to determine the peripheral’s position. If Nogami discloses a position sensor at all, at best, it discloses a remote position sensor physically separated from the peripheral; but not a position sensor mounted on the peripheral as required by the dependent claims of the ’143 patent.

A. Nogami’s remote magnetic receiver is not a position sensor

43. As shown in Nogami’s Figure 2 below, Nogami employs a position and orientation acquisition system that includes “position and orientation sensor 400” for determining position and orientation information regarding HMD 100—which Petitioner alleges is the claimed “peripheral in free space.” Pet., 25. The figure shows that position and orientation sensor 400 is separate from HMD 100.

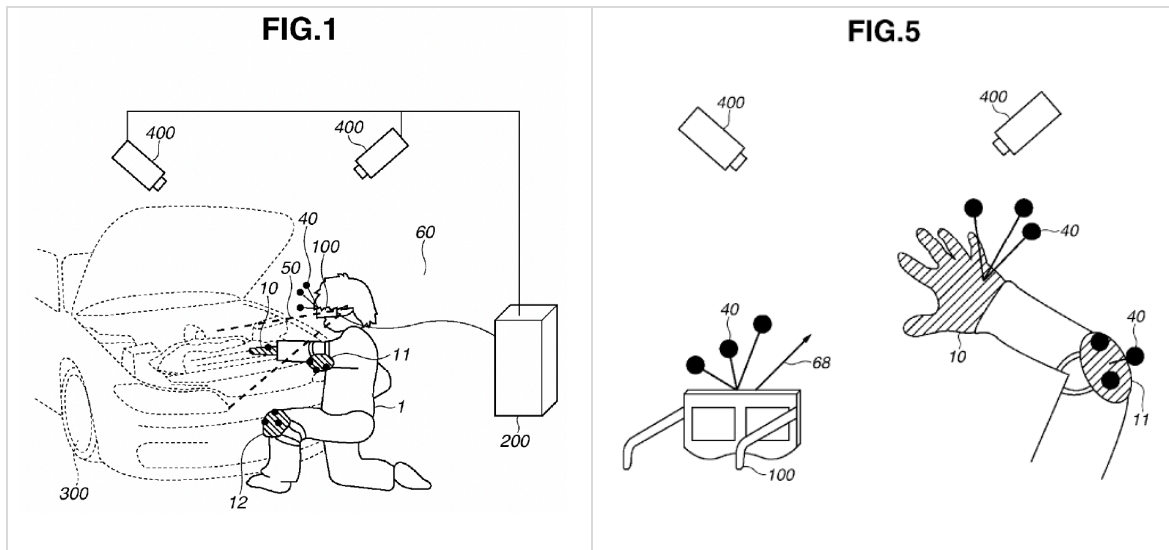


EX1003, Fig. 2.

44. As I mentioned above, I understand that Nogami discloses two embodiments for position and orientation sensor 400. But, both embodiments involve a remote position sensor that is separate from the peripheral, and therefore, fail to disclose dependent claims 2, 9, and 16. In Nogami's first position sensor embodiment, position and orientation sensor 400 includes one or more cameras for capturing an image of marker 40 disposed on HMD 100 as shown in Figure 2 above. In this way, position and orientation sensor 400 acquires position and orientation information of marker 40, i.e., it detects the position and orientation of HMD 100.

EX1003, ¶¶ [0073]-[0074], ¶ [0079]. Figure 1 shows position and orientation sensor

400's cameras pointed at the user to acquire position and orientation information of the marker 40 mounted on items the user is wearing, including HMD 100, glove, and elbow and knee pads. This is also further illustrated in Figure 5.



EX1003, Figs. 1, 5. I understand that Petitioner does not rely on this embodiment because position and orientation sensor 400 is not mounted on HMD 100. In this embodiment, the only thing mounted on HMD 100 is marker 40, which is not a position sensor. EX1003, ¶¶ [0073]-[0076], [0138].

45. As I've explained above, Petitioner relies instead on Nogami's second embodiment for position and orientation sensor 400, which includes a magnetic receiver mounted on HMD 100. But in my opinion, this magnetic receiver is not a position sensor as it is no different than marker 40 mounted on the peripheral in the first embodiment. Neither of them are position sensors, rather they are used by a

remote position sensor in determining the position of the peripheral.

46. In my opinion, the magnetic receiver only provides raw magnetic field detection signals to the separate position and orientation sensor 400 unit, which derives the position and orientation information. Similar to the first embodiment, which relies on the combination of marker 40 mounted on HMD 100 *and* the remote camera—which Petitioner concedes does not meet the claimed limitation—this embodiment relies on the combination of a magnetic receiver, a remote magnetic transmitter, and position sensor and a *separate* orientation information acquisition unit that determines position and orientation information based on detection by the magnetic receiver.

47. Nogami explains that “a magnetic sensor can be **used** for acquiring the position and orientation information about the HMD 100 [...] In this method, **a transmitter for generating a magnetic field is provided** in real space, and the HMD100 [has] **a receiver for detecting a change in the magnetic field** occurring accordingly as the HMD 100 change[s] [its] position within the magnetic field. In addition, the method acquires the position and orientation information in a sensor coordinate system of each of the receivers **based on a signal indicating a result of the detection by the receiver.**” EX1003, ¶¶ [0077]-[0078] (emphasis added).

48. According to Nogami, this magnetic sensor-based embodiment includes at least a magnetic field transmitter physically separate from the HMD 100

and a magnetic field receiver. Further, it must still include a *separate* position and orientation sensor 400 unit for determining the position and orientation information of the magnetic receivers “**based on a signal indicating a result of the detection by the receiver.**” EX1003, ¶¶ [0077]-[0078] (emphasis added).

49. Thus, Nogami’s magnetic receiver is not capable of directly providing position and orientation information. Like marker 40 in the remote camera embodiment, the magnetic receiver is merely a building block component that works together with other remote components such as the magnetic transmitter. EX1003, ¶¶ [0077]-[0078]. Also, a separate position and orientation information sensor unit is still needed to use the magnetic receiver signals to determine position information of HMD 100, because the magnetic receiver alone cannot determine HMD 100’s position.

50. In my opinion, additional components physically separate from HMD 100 such as the magnetic transmitter and position and orientation information sensor are necessary to determine position and orientation of HMD 100. Therefore, Nogami’s magnetic receiver does not meet the claimed position sensor.

B. Nogami fails to disclose the ’143 Patent’s claimed limitation, “wherein the position sensor is positioned on the peripheral”

51. The ’143 patent specification describes two types of implementations for the position sensor—(1) remote sensing and (2) on-peripheral sensing. The latter is claimed by dependent claims 2, 9, and 16. The ’143 patent describes remote

sensing as follows:

In accordance with some implementations, the position sensor 118 may sense the position of the peripheral 102 by remote sensing. **Remote sensing of the position of the peripheral 102 may include triangulation based on RFID, WiFi, or other wireless communication protocol, capacitive field sensing, optical or other types of motion tracking, access to data from device-embedded sensors such as magnetometer, accelerometer / gyroscope, and/or other remote sensing techniques.**

EX1001, 5:39-48 (emphasis added).

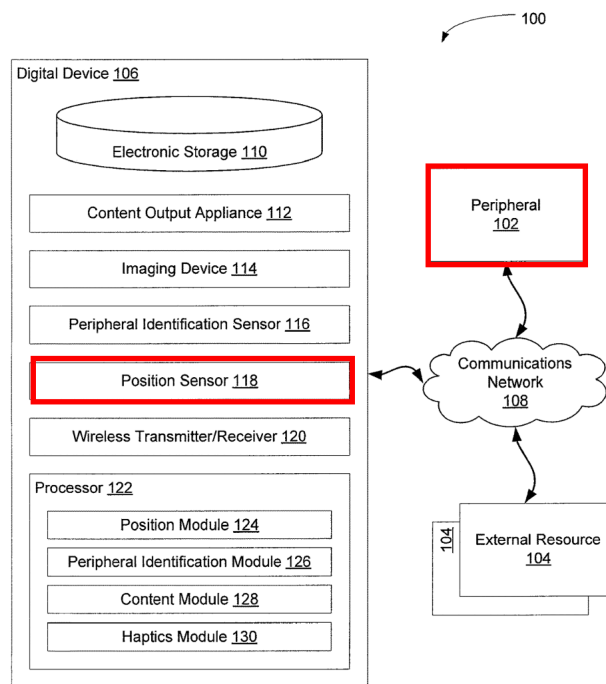


FIG. 1

EX1001, Fig. 1 (red highlights added).

52. In contrast, the '143 patent on-peripheral sensing, in which a position sensor is mounted on a peripheral and can provide position information of the peripheral. This is the opposite of remote sensing because this sensor can determine the position of the peripheral by itself without relying on triangulation techniques or other sensors that are physically separate from. Dependent claims 2, 9, and 16 correspond to this implementation, which is described as follows:

In some implementations, the **position sensor 118 may include one or more sensors carried by peripheral 102**. For example, **the position sensor 118 may include one or more of an accelerometer, a gyroscope, a digital compass, and/or other sensors configured to generate output signals conveying information related to the position and/or motion of peripheral 102**.

EX1001, 5:52-58 (emphasis added). In contrast to remote sensing, the position sensor in this implementation only includes sensors such as a digital compass or accelerometer that are capable of acquiring position or motion information without the need for any additional remote components. Based on my reading of the patent, this is why the description of the on-peripheral sensor implementation does not include a magnetometer, unlike for remote sensing. *Compare* EX1001, 5:39-48 with EX1001, 5:52-58.

53. I understand that Petitioner argues that the '143 patent also “discloses

a magnetic sensor (which the '143 patent calls a 'magnetometer') as an example of a position sensor." Pet., 13. I disagree with this reasoning. As discussed above, the patent did not refer to the magnetometer as a position sensor. Instead, it referred to the magnetometer as one of the examples of components *used in remote sensing*. In my opinion, such remote sensing components including for example, WiFi-based triangulation components and magnetometers do not by themselves qualify as the claimed position sensor. EX1001 5:42-48..

54. As I've explained above, Nogami employs remote sensing, which is the opposite of on-peripheral position sensing according to the '143 patent. I understand that Petitioner points to the magnetic receiver mounted on HMD 100 for the claimed position sensor mounted on the peripheral (Pet., 11-13). But, this is no different than the magnetometer described in the remote sensing implementation of the '143 patent, which is outside the scope of dependent claims 2, 9, and 16.

55. Moreover, even though Petitioner does not rely on the camera-based position sensor embodiment in Nogami, that too is similar to the remote sensing implementation of the '143 patent, which is the opposite of the on-peripheral sensor recited in the challenged dependent claims. For example, the '143 patent describes:

The position sensor 118 may be configured to sense a position of the peripheral 102 in the real world. The **position sensor 118 may sense the position of the peripheral 102 visually, in some implementations. In**

such implementations, the position sensor 118 may be the imaging device 114.

EX1001, 5:35-39 (emphasis added); *see also* EX1001, 5:11-14 (“imaging device 114 may include [...] a digital camera, a web camera, an analog camera, a 3D camera, a stereo camera, and/or other imaging devices). In my opinion, Nogami only discloses remote sensing. There is no disclosure at all in Nogami for an entirely self-sufficient position sensor unit mounted on the peripheral. Thus, Nogami’s magnetic receiver is not a position sensor, nor is it a position sensor that is positioned on a peripheral.

IX. NOGAMI DOES NOT DISCLOSE “RECEIVE ONE OR MORE SENSOR SIGNALS FROM THE POSITION SENSOR” REQUIRED BY CLAIMS 1, 8, AND 15

56. In my opinion, the claim limitation in independent claims 1, 8, and 15 that recites “receive one or more sensor signals from the **position sensor**” is also not disclosed by Nogami for the same reasons that I’ve explained above for why Nogami does not disclose the “position sensor.”

X. NOGAMI DOES NOT DISCLOSE “DETERMINE A HAPTIC SIGNAL BASED ON THE POSITION OF THE PERIPHERAL IN REAL SPACE” REQUIRED BY CLAIMS 1, 8, AND 15

57. I understand that claims 1, 8, and 15 also recite “determine a haptic signal based on the position of the peripheral in real space,” which is a key requirement of the invention in meeting its goal to provide users with an enhanced experience for interacting with the virtual world. This enhanced and immersive

experience is provided with haptic feedback sensations delivered to the user. *See, e.g.*, EX1001, 2:1-8.

58. For example, the '143 Patent describes a haptics module configured to determine the **haptic feedback based on** the identification of the peripheral and **the one or more position parameters** of the peripheral in free space. *Id.*, 2:3-5 (emphases added); *see also, id.*, 6:48-60 (“position module 124 may be configured to determine the one or more position parameters that are related to the position of one or more peripherals”), 7:36-39. The patent illustrates this in Step 410 of Figure 4 below:

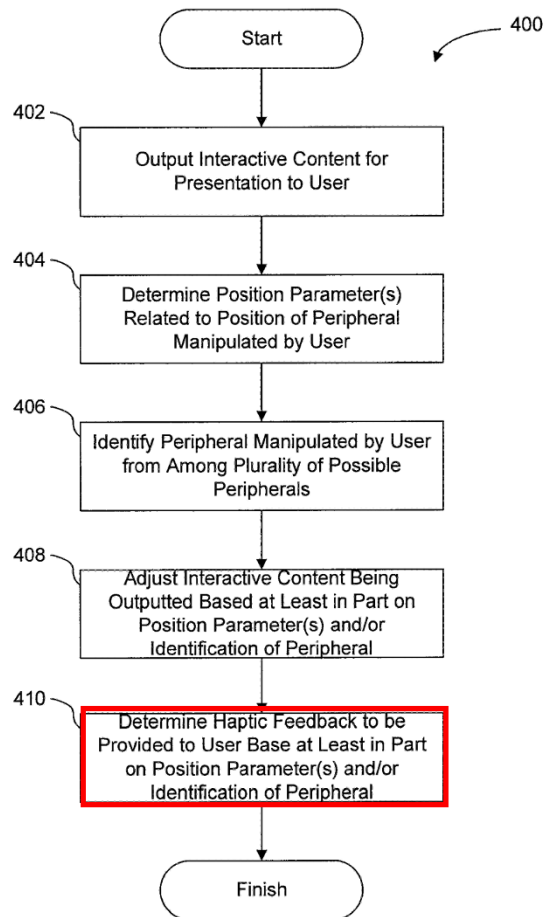


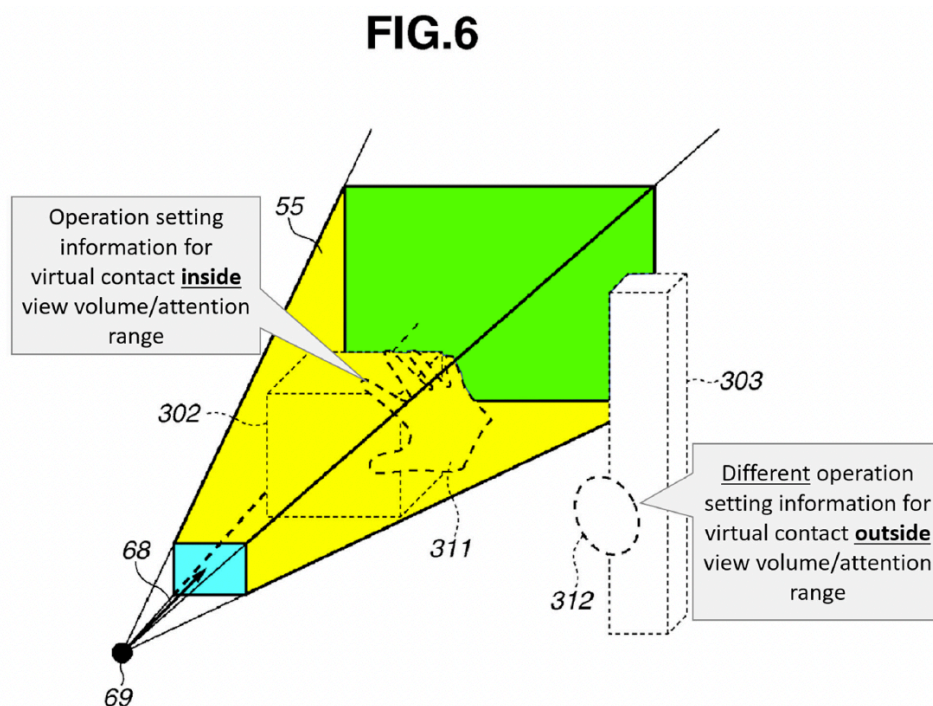
FIG. 4

EX1001, Fig. 4 (red highlight added).

59. I have reviewed the Petition and Declaration of Dr. Jeremy Cooperstock (Ex. 1002) regarding this claim limitation. My understanding is that Petitioner and Dr. Cooperstock argue that Nogami discloses this claim limitation by pointing to Nogami's stimulation generation units 10, 11, and 12, which provide haptic feedback to the user *based on the contact made* between the wearable or hand-held accessories containing the stimulation units (e.g., units 10, 11, 12) and the virtual

object. Pet., 34-35.

60. I disagree with this theory. In my opinion, Nogami does not determine a haptic signal based on the position of the peripheral. Moreover, Nogami would not have any need to do so because Nogami is directed to a different problem and different solution relative to the '143 Patent. Nogami determines a haptic signal based on whether the contact point between the user's body part and a virtual object is *inside* or *outside* the attention range of the user that is viewable through HMD 100. This is illustrated in the Petition with the annotated illustration of Nogami's Figure 6 that I have reproduced below.



Pet., 35 (annotations and colored highlights added by Petitioner).

61. In my opinion, determining haptic feedback to the user based on the

position of the peripheral in free space is not the same as basing it on whether the contact point of the the user's body part with a virtual object is inside or outside the attention range of a user head-mounted display. Determining haptic feedback based on whether the user's body part is making contact with a virtual object inside or outside the attention range as taught by Nogami does not achieve the same results or benefits as basing haptic feedback on the position of the peripheral free space as required by the '143 patent.

62. Nogami's coarse-grained approach provides different haptics based on the user's *attention range*. In other words, the possible variation of haptic feedback is binary relative to the bounds of the *view volume* space—i.e., one level of intensity for any contact made inside the view volume and another level of intensity for any contact made outside the view volume. Pet. 34-37. As such, fine-grained movement of the HMD 100 within the bounds of a given view volume will *not* affect haptic feedback because the determination of the appropriate haptic signal is *not* based on the particular position of the peripheral in real space, as required by the claims. Instead, Nogami only bases this determination on the bounds of the view volume space.

63. Nogami fails to disclose the '143 Patent's fine-grained provision of haptic feedback based on the user peripheral's movement in free space because Nogami is directed to solve an entirely different problem than the one that the '143

patent is directed to. Nogami was concerned with the disadvantages of the prior art systems in which the user may not recognize the haptic stimulation if the intensity of the stimulation on a part of the user's body that **unconsciously** contacted the virtual object is not high enough. Nogami solved this problem by **controlling a stimulation based on a result of a determination as to whether a user has consciously performed contact with a virtual object** in the case of notifying, to the user, contact of the user with the virtual object using stimulation.” EX1003, ¶ [0026] (emphasis added).

64. But the '143 patent was concerned with a different objective—i.e., to provide a richer interactive experience for a user's interaction with the virtual world and its interactive content. *See, e.g.*, EX1001, 2:66-3:14, 7:25-44, 11:23-47. The '143 patent was not concerned with the problem faced by Nogami. Therefore, Nogami's solution would not have been suitable for the objectives of the '143 patent.

65. In my opinion, Nogami does not determine a haptic signal based on the position of the peripheral in real space as required by the claims of the '143 patent and in accordance with the stated goals of the '143 Patent.

I declare under penalty of perjury that the foregoing is true and correct. I acknowledge that willful false statements and the like are punishable by fine and/or imprisonment, that all statements made of my own knowledge are true, and that all statements made on information and belief are believed to be true.

Executed September 8, 2023, in Boston, Massachusetts.

By: 

Gregory D. Abowd