

Paper No. ____

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VALVE CORPORATION,
Petitioner,

v.

IMMERSION CORPORATION,
Patent Owner.

Case No. IPR2024-00714
Patent No. 10,627,907

**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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1001	U.S. Patent No. 10,627,907
1002	Prosecution History of U.S. Patent No. 10,627,907
1003	Declaration of Jean Renard Ward
1004	CV of Jean Renard Ward
1005	U.S. Patent Application Publication No. 2008/0055244 (“Cruz-Hernandez”)
1006	U.S. Patent Application Publication No. 2007/0152988 (“Levin”)
1007	U.S. Patent Application Publication No. 2013/0147610
1008	U.S. Patent Application Publication No. 2001/0008849
1009	Proof of Service in <i>Immersion Corp. v. Valve Corp.</i> , 2:23-cv-00712
1010	Defendant Valve’s Motion to Stay Pending <i>Inter Partes</i> Review, <i>Immersion Corp. v. Valve Corp.</i> , 2:23-cv-00712 (W.D. Wash.)
1011	Federal Court Management Statistics (September 2023)
1012	U.S. Patent Application Publication No. 2006/0142657
1013	<i>Immersion Corp. v. Valve Corp.</i> , 2:23-cv-00712, Dkt. No. 1 (Complaint) (W.D. Wash.) (filed Oct. 20, 2023)
1014	Plaintiff’s Preliminary Infringement Contentions, <i>Immersion Corp. v. Valve Corp.</i> , 2:23-cv-00712 (W.D. Wash.) (served Oct. 20, 2023)
1015	Exhibit E to Plaintiff’s Preliminary Infringement Contentions, <i>Immersion Corp. v. Valve Corp.</i> , 2:23-cv-00712 (W.D. Wash.) (served Oct. 20, 2023)
1016	U.S. Patent Application Publication No. 2004/0032395 (“Goldenberg”)
1017	U.S. Patent Application Publication No. 2007/0139375 (“Rosenberg”)

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1018	U.S. Patent No. 6,203,432 (“Roberts”)
1019	November 21, 2023 Order Setting Jury Trial in <i>Immersion Corp. v. Valve Corp.</i> , Case No. 2:23-cv-00712 (W.D. Wash.)
1020	U.S. Patent No. 4,739,128
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1027	U.S. Patent No. 5,414,337
1028	U.S. Patent No. 4,590,909
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1031	U.S. Patent No. 2,679,234
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1034	U.S. Patent No. 5,289,439
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1053	U.S. Patent No. 5,388,992
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1066	Minsky, “Computational Haptics: The Sandpaper System for Synthesizing Texture for a Force-Feedback Display” MIT Thesis (1995)
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1105	U.S. Patent No. 6,107,765
1106	U.S. Patent No. 5,642,288
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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. 10,627,907 (“the ’907 patent”) was filed on August 8, 2018 as Application No. 16/058,399 and claims priority to U.S. Provisional Application No. 62/096,251, which was filed on December 23, 2014.

2. District Court Matters

The ’907 patent is at issue in the following pending case involving Petitioner: *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)

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Powers of attorney are submitted with this petition. Counsel for Petitioner consents to service of all documents via electronic mail.

Petitioner requests *inter partes* review of claims 1-20 of the '907 patent.

II. INTRODUCTION

The '907 patent relates to videogame controllers and other electronic devices that provide users with haptic effects. EX1001, 1:14-16. The patent describes a method and system for controlling a user input element (e.g., a videogame controller's joystick) that is associated with a haptic output device (e.g., an actuator) to provide users with "haptic effects" when the input element moves into certain position ranges. EX1001, 4:9-21. The haptic devices described in the patent were well known, as were the methods for producing haptic effects based on a user input element's position.

The challenged claims recite an input element with a range of motion that includes three defined position ranges: a primary range, a secondary range, and a "boundary range" partially overlapping each of the primary and secondary ranges. When the input element enters a position within the boundary range—e.g., a button is pushed into a position within the boundary range—a haptic effect is rendered.

Dividing an input element's range of motion into primary, secondary, and boundary "ranges" and rendering haptic effects based on the input element's position was known years before the critical date, including in Patent Owner's ("PO") own prior art. This petition presents multiple grounds independently demonstrating claims of the '907 patent are unpatentable.

III. CERTIFICATION OF STANDING

The '907 patent is available for IPR and Petitioner is not barred or estopped from requesting IPR of its claims. 37 C.F.R. §42.104(a).

IV. UNPATENTABILITY GROUNDS

Petitioner requests cancellation of the challenged claims as follows.

Ground	Reference(s)	Claim(s)	Basis
1	Goldenberg	1-6, 8-13, 15-19	102/103
2	Goldenberg, Cruz-Hernandez	7, 14, 20	103
3	Rosenberg	1-4, 6, 8-11, 13, 15-17, 19	102/103
4	Roberts, Rosenberg	5, 12, 18	103
5	Roberts, Rosenberg, Cruz-Hernandez	7, 14, 20	103
6	Levin	1, 3-4, 6, 8, 10-11, 13, 15, 17, 19	102/103

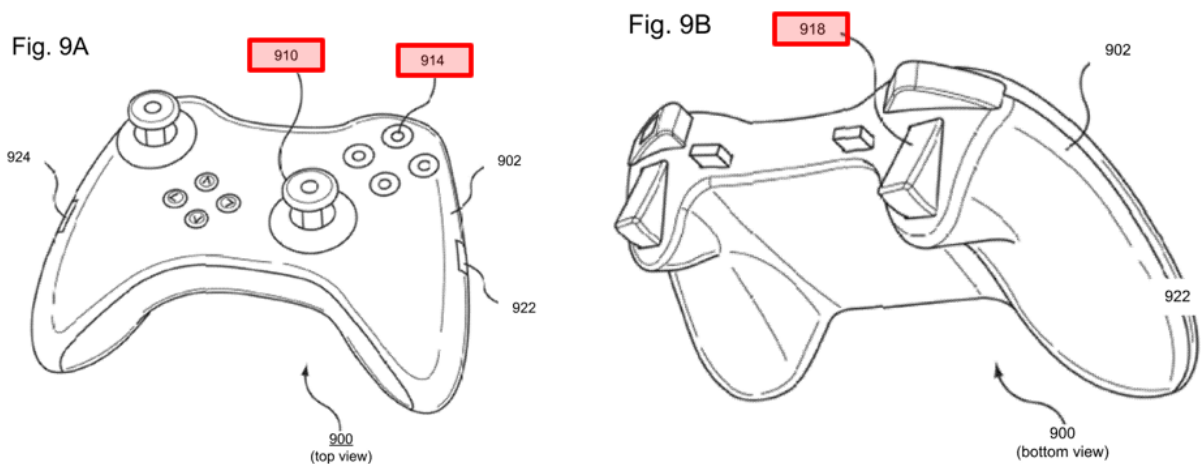
The '907 patent claims priority to a provisional application filed on December 23, 2014. All above-identified references are post-AIA §102(a)(1) prior art not subject to any exception—all published over one year before December 23, 2014:

Reference	Published
Levin	7/5/2007
Goldenberg	10/21/2003
Cruz-Hernandez	03/06/2008
Roberts	03/20/2001
Rosenberg	06/21/2007

V. THE '907 PATENT¹

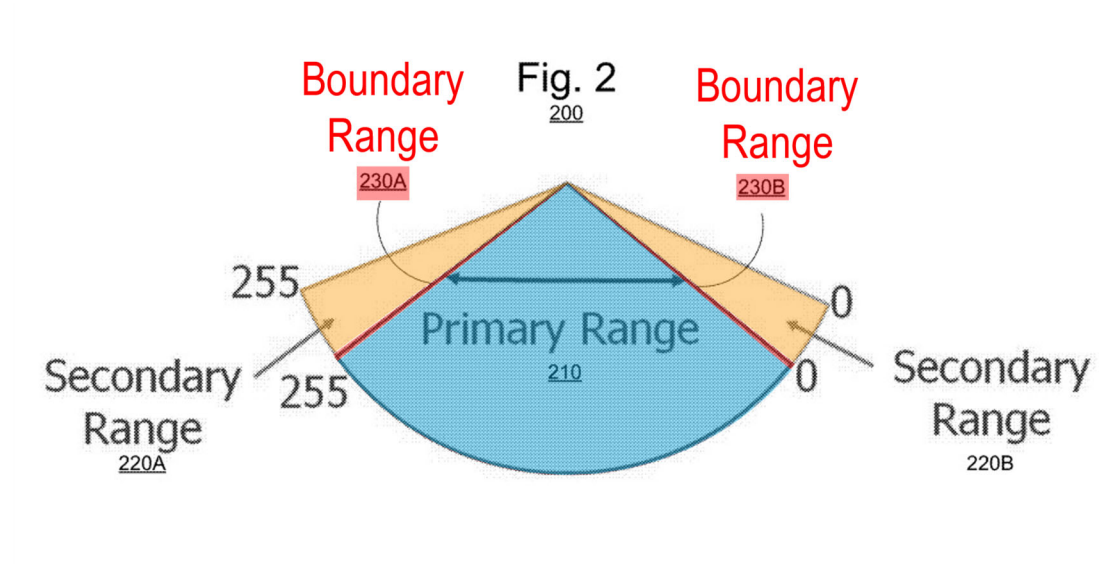
The '907 patent relates to devices that “produce haptic effects.” 1:14-33. “Haptic effects,” including resistive forces, “provide cues to users,” or “provide realistic feedback to create greater sensory immersion within a simulated or virtual environment.” *Id.* The patent concedes that videogame controllers with haptic feedback were known. *Id.*; see Ward, ¶72 (citing, e.g., EX1008).

The patent describes “systems and methods for controlling a boundary range of a user input element,” such as a button on a videogame controller, that is “associated with a haptic output device.” 2:39-41; Ward, ¶¶40, 73. Figures 9A-9B below depict an illustrative videogame controller with user input elements including joystick 810/910, button 814/914, and trigger 818/918 (13:27-32; 12:39-44):



¹ Unless otherwise noted, citations in Section V are to EX1001.

Figure 2 (annotated below) illustrates “a range of motion 200 for a user input element” such as a trigger. 5:13-18. “[R]ange of motion 200 may include a primary range 210 and secondary ranges 220A, 220B.” 5:19-20. Figure 2 also has labels for “boundary ranges 230A, 230B.” 5:20-23; Ward, ¶74.



“[B]oundary ranges 230A, 230B may be defined so as to partially overlap primary range 210 and secondary ranges 220A, 220B.” 5:20-23; Ward, ¶74.

A “position sensor” coupled to the input element determines the element’s position within its range of motion. 13:6-8; 5:44-46. The position sensor sends signals to a processor that instructs actuators to provide haptic effects. 13:16-20.; Ward ¶75,

Figure 4 provides a “flow diagram” for an illustrative embodiment. 9:8-11. At step 410, “primary” and “secondary” ranges of positions for the “user input element” are “define[d].” 9:21-23. At step 420, “a boundary range of positions for

the user input element” is “define[d]” and “partially overlap[s] each of the primary and secondary ranges.” 9:24-28. Once the ranges are defined, the “position of the user input element” is “monitor[ed]” (430), and haptic effects are rendered “when the user input element enters positions within the boundary range” (440). 9:28-33; Ward, ¶76.

A. The Challenged Claims

Claims 1-20 are reproduced in the Claim Listing (*infra* §X), and independent claim 1 is reproduced below with labels for individual limitations added:

1[PRE] A method for controlling a user input element associated with a haptic output device, the method comprising:

[1A] defining position and range information for the user input element associated with the haptic output device, including

[1A1] a primary range of positions,

[1A2] a secondary range of positions, and

[1A3] a boundary range of positions, wherein the boundary range of positions partially overlaps each of the primary range of positions and the secondary range of positions; and

[1B] rendering a haptic effect in response to an entry of the user input element to one or more positions within the boundary range of positions.

Independent claim 8 recites “[a] non-transitory computer readable storage medium storing a program configured to” perform claim 1’s method, and

independent claim 15 recites “[a] device comprising: a processor; and a memory storing a program for execution by the processor, the program including instructions for” performing claim 1’s method.

The dependent claims recite additional details, all of which were known in the art as demonstrated herein.

B. Person of Ordinary Skill in the Art (“POSA”)

POSAs would have had a bachelor’s degree in electrical engineering, computer science, or a related field, plus at least two years of industry or graduate level experience with software engineering, haptics programming, human-computer interaction, or other relevant experience. Ward, ¶¶38-42.

C. Prosecution History

The ’907 application was filed on August 8, 2018 with one independent claim. EX1002, 59; Ward, ¶77.

The applicant preliminarily amended claim 1 and added claims 2-20. *Id.*, 90-94. The examiner initially overlooked the preliminary amendment and issued an office action rejecting originally-filed claim 1 as anticipated by Quaid (EX1012). EX1002, 98-102 (finding that Quaid disclosed the claimed primary, secondary, and boundary ranges). Thereafter, the examiner issued a new office action only rejecting the amended independent claims for non-statutory double patenting. *Id.*, 219-223.

The applicant overcame the rejection with a terminal disclaimer. *Id.*, 252-253, 264; Ward, ¶78.

VI. CLAIM INTERPRETATION

Claim terms are construed according to their ordinary meaning in light of the specification and prosecution history. 37 C.F.R. § 42.100(b). Because the Petition’s art plainly discloses each element of the challenged claims under any plausible construction, no outer boundary constructions are necessary. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

VII. GROUNDS FOR UNPATENTABILITY

A. Ground 1: Claims 1-6, 8-13, and 15-19 Are Anticipated By and/or Obvious Over Goldenberg

1. Goldenberg (EX1016)

Goldenberg—owned by PO—was not disclosed during prosecution, pre-dates the earliest ’907 priority date by a decade, and describes the claimed positional range and haptic feedback concepts. Ward, ¶¶82-135.

Goldenberg relates to “control knob devices including force feedback” ([0007]) and discloses “haptic sensations for a rotational haptic feedback device such as a knob.” [0010]; [0041] (“The knob 26 is preferably provided with force feedback” that can “have the tactile feel of detents” which “affords a cleaner, richer user experience.”); Ward, ¶¶50, 82.

Goldenberg discloses “[a] number of force sensations...suitable for use with” knobs. [0068]. These force sensations can be grouped to form a “force model” ([0070]), which establishes rules “for implementing the force effects included in the model based on conditions such as time, knob *position*, motion, velocity.” [0102]; Ward, ¶83.

Goldenberg describes a “jog shuttle model” that provides the user a “control paradigm for scrolling through a list or controlling a function or value.” [0115]. The jog shuttle model is depicted in Figure 8. Vertical axis “F” represents the amount of force applied to the knob (via an actuator) and horizontal axis “x” represents the position of the knob’s rotation (clockwise or counterclockwise) relative to its origin position O:

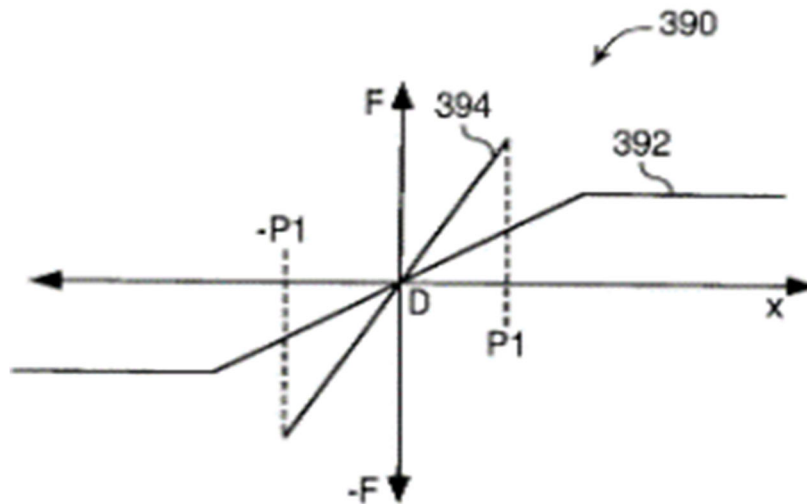


FIG. 8

[0115]-[0117] (“FIG. 7 is a force vs. position profile 390 illustrating a jog shuttle model.”); Ward, ¶¶84, & n.42 (explaining that the reference to Figure 7 is an obvious typographical error because Figure 8, not Figure 7, illustrates “profile 390”); [0027] (describing Figure 8) [0080].

2. Claim 1

[1PRE]: “A method for controlling a user input element associated with a haptic output device, the method comprising:”

A “*user input element*” is a portion of an electronic device “a user interacts with” to cause an action associated with the device. EX1001, 1:34-35; Ward, ¶85. Examples include buttons or triggers on a videogame controller. EX1001, 1:34-35, 4:31-33, 5:17-18.

Goldenberg’s control knob “is manipulated by the user to control various functions of [an electronic] device.” [0030]; [0031]; [0034]; FIG. 1. The control knob is “*a user input element*,” as claimed. Ward, ¶86.

The control knob includes “an actuator 84” ([0046]) that provides force or haptic feedback to the knob. [0010]; [0015]-[0016]; [0060]; FIG. 2. Thus, the control knob (“*a user input element*”) is “*associated with a haptic output device*,” as claimed. Ward, ¶87; EX1001, 4:36.

As discussed below for [1A]-[1B], Goldenberg discloses methods for controlling the haptic feedback provided to its knob. Ward, ¶¶88-104.

a. [1A]: “defining position and range information for the user input element associated with the haptic output device, including”

Goldenberg’s method uses “force profiles” that define, *inter alia*, “position and range information” used “to determine appropriate output actuator signals.” [0066]; Ward, ¶89. Goldenberg’s Figures 4A-4D, 5A-5B, and 8-10 illustrate force profiles that define “rotational positions” of the knob within its rotary degree of freedom. [0073]; *see* [0021]-[0029]; [0080]; Ward, ¶89.

Figure 8 below depicts Goldenberg’s “jog shuttle force model.” [0027]; [0070]; [0102]; [0116]; Ward, ¶90.

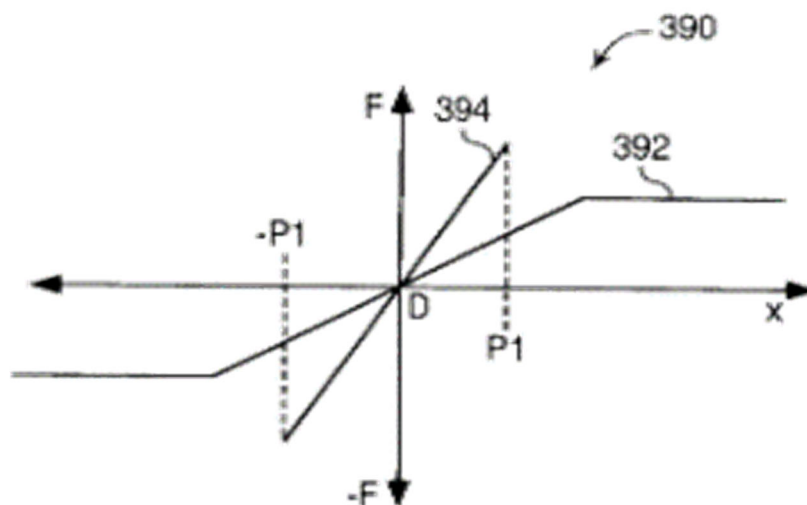


FIG. 8

With the “jog shuttle model,” “the force feedback knob is preferably provided with two spring effects” to “simulate a mechanical jog shuttle having mechanical springs.” [0116]. The first spring effect (“curve 392”) is “output over the entire

[rotational] range of the knob” and has a “medium amount of stiffness.” [0116]. “The force resists motion away from the origin O and increases in magnitude as the knob is moved away from the origin until the saturation level is reached [i.e., the curve flattens], at which point the force is no longer increased in magnitude but still resists motion away from the origin.” [0116]. Ward, ¶91. As seen in Figure 8, a positive force is output when the knob is turned clockwise from the origin position whereas a negative force is output when the knob is turned counterclockwise from the origin position. Ward, ¶91.

The second effect (“curve 394”) “overlap[s] the first effect but is only in effect over a small range between positions $-P1$ and $P1$ around the origin position.” [0116]. The second spring effect (curve 394) is much stiffer than the first, requiring greater force from the user to overcome which “provides a more ‘quality’ feel to the knob since the knob is less likely to feel loose to the user around the origin position.” [0116]; Ward, ¶92.

Goldenberg’s jog shuttle model (“force vs. position profile 390”) defines an “origin O” position dividing the knob’s rotational positions into two ranges. A first range of rotation positions to the right of the origin (**blue** below) correspond to force sensations output on the knob that resist clockwise rotation and increase until a saturation level is reached, whereas a second range to the left of the origin (**orange** below) corresponds to force sensations that resist counterclockwise rotation of the

knob and increase until another saturation level is reached. [0115]-[0117]; Ward, ¶93.

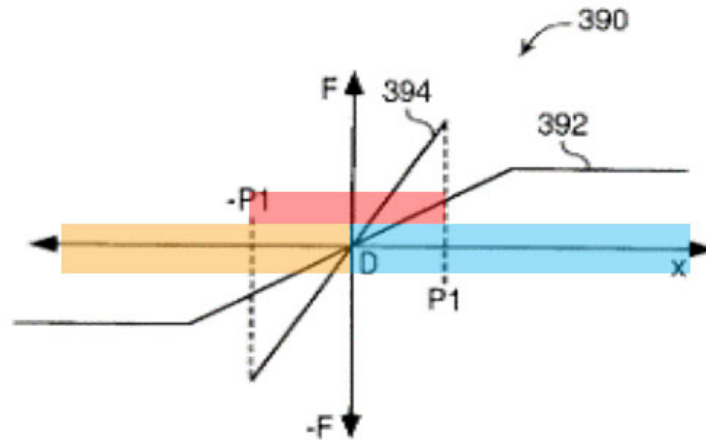


FIG. 8

[0115]-[0117]; Ward, ¶93.

Figure 8's "jog shuttle force model" further defines "positions $-P1$ and $P1$," that create a third "small range...around the origin position" (red above) in which the spring forces are greater than when the knob is positioned outside this range. [0116]; Ward, ¶94.

(1) [1A1]: "a primary range of positions"

Goldenberg's "jog shuttle force model" defines a range of the knob's rotary positions moving clockwise from the origin which correspond to positions to the right of the origin (**blue**). *Supra* §VII.A.1. In the joggle shuttle embodiment, this

range of positions is “*a primary range of positions*,” as claimed at least because clockwise rotation corresponds to moving video or audio forward, which is a primary function of a jog shuttle. [0117]; Ward, ¶95; *see* EX1002, 100 (finding that “distances in proximity to boundaries” are ranges and that any range can “constitute first and second ranges”).

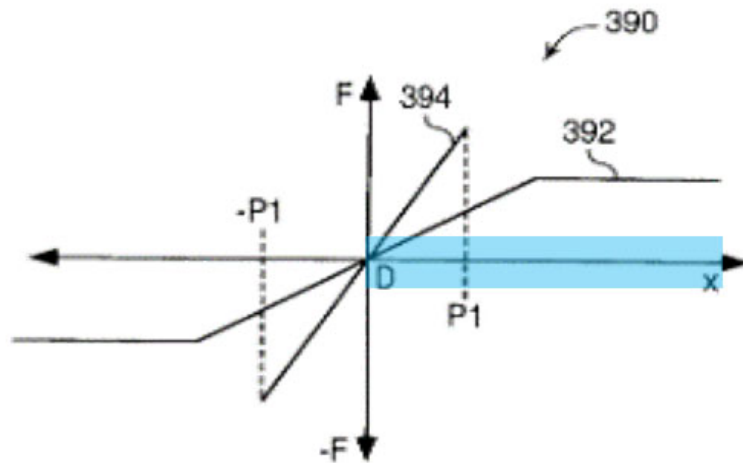


FIG. 8

[0115]-[0117]; Ward, ¶95.

(2) [1A2]: “a secondary range of positions”

Goldenberg’s “jog shuttle force model” defines a range of the knob’s rotary positions moving counterclockwise of the origin which correspond to positions to the left of the origin position (**orange**). *Supra* §VII.A.1. In the jog shuttle embodiment, this range of positions is “*a secondary range of positions*,” as claimed at least because counterclockwise rotation corresponds to moving video or audio

backwards, which is a secondary function (i.e., re-winding) of a jog shuttle. [0117]; Ward, ¶96; see EX1002, 100.

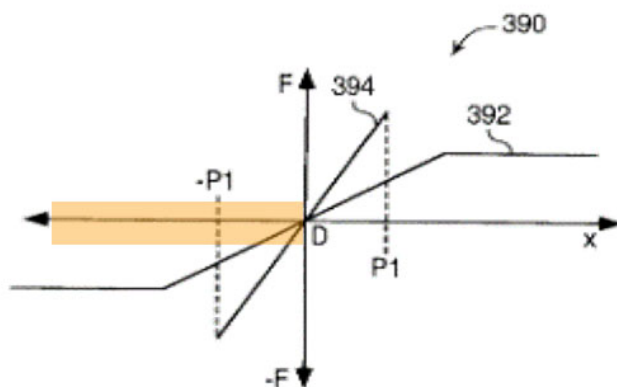


FIG. 8

[0115]-[0117]; Ward, ¶96.

- (3) [1A3]: “a boundary range of positions wherein the boundary range of positions partially overlaps each of the primary range of positions and the secondary range of positions”

The claimed “*boundary range of positions*” is a range of positions that “*partially overlaps each of the primary...and the secondary range[s].*” The claimed “*boundary range*” need not be a unique range of positions. Ward, ¶97. Rather, the boundary range may be made up partially or exclusively of positions that are in the primary range of positions and/or secondary range of positions. Ward, ¶97.

For example, when discussing Figure 2, the specification explains that primary range 210 “may be extended to render haptic effects within secondary ranges 220A, 220B **and**/or boundary ranges 230A, 320B.” EX1001, 5:23-25; FIG. 2. For primary range 210 to extend into, e.g., secondary range 220A it would need to extend through the entirety of boundary range 230A, making that boundary range of positions entirely within the primary range. Ward, ¶98.

Goldenberg’s “jog shuttle force model” defines this type of “*a boundary range of positions,*” i.e., the knob’s rotary **positions between “positions –P1 and P1” (red)** that form “a small range...around the origin position” over which first spring effect (curve 392) is output. [0116]; Ward, ¶99; *supra* §VII.A.1.

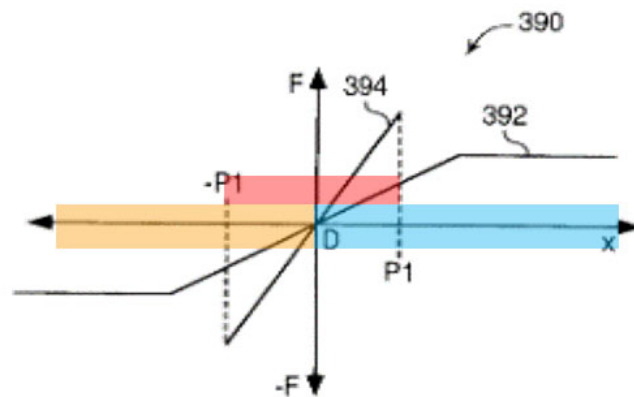


FIG. 8

[0115]-[0117]; Ward, ¶99.

As seen above, the “range” between “positions –P1 and P1” partially overlaps each of the “*primary range*” and “*second range*” of positions discussed for limitations [1A1]-[1A2]. Ward, ¶100. Thus, Goldenberg’s “range” between “positions –P1 and P1” meets limitation [1A3]. *Id.*

b. [1B]: “rendering a haptic effect in response to an entry of the user input element to one or more positions within the boundary range of positions.”

According to the ’907 patent, “haptic effects” include “force feedback” (EX1001, 1:23-27). Goldenberg’s method provides such force feedback to its knob, including when it implements the jog shuttle model. Abstract; [0007]; [0009]; [0014]; [0034]; [0041]; [0115]-[0017]; Ward, ¶¶101-104.

Limitation [1B] requires that “*a haptic effect*” is rendered “*in response to an entry of the user input element to **one or more positions within the boundary range of positions.***” Ward, ¶102. [1B] does not require that the haptic effect be rendered in response to initial entry into the boundary range, or that haptic feedback be provided at every position in the boundary range—any position(s) within the boundary range suffices. Ward, ¶¶102-103. Thus, rendering a haptic effect in response to movement to or through any position(s) within the boundary range meets [1B]. Ward, ¶102.

Goldenberg’s method “*render[s] a haptic effect in response to an entry of the user input element to one or more positions within the boundary range of positions*”

because the second haptic “stiffer” spring effect (“curve 394”)—is provided to the control knob “in response to entry” of the knob to one or more positions between the origin O and P1 when rotating clockwise, and in response to entry of the knob to one or more positions between O and -P1 when rotating counterclockwise. [0116]; Ward, ¶104.

3. **Claim 2: “The method of claim 1, wherein one of the primary range of positions, the secondary range of positions, and the boundary range of positions is calculated based on a movement of the user input element from a maximum out position to a grounding position.”**

POSAs would have recognized that Goldenberg’s knob would either have an infinite range of rotational movement or a limited range of movement, e.g., 180-degrees clockwise and 180-degrees counterclockwise, as those are the two plausible design options for a knob. Ward, ¶105. When implemented as a limited-range knob, POSAs understood that the typical degree of freedom for the knob includes a “*maximum out position*,” e.g., the farthest position to which the knob can be rotated in one direction, and “*a grounding position*,” e.g., the farthest position to which the knob can be rotated in the opposite direction. Ward, ¶106.

When implemented as a limited-range knob, the knob’s “*primary*” (clockwise) and “*secondary*” (counterclockwise) range of positions would therefore be “*based on a movement of the [knob] from a maximum out position*,” i.e., the furthest clockwise or counterclockwise position the knob can be rotated to, “*to a*

grounding position,” i.e., the furthest opposite position to which the knob can be rotated. Ward, ¶¶105-107.

4. Claim 3: “The method of claim 1, wherein a profile for the user input element is calculated by mapping each position of the user input element to an analog to digital conversion value.”

The '907 patent explains that after an input element is first initialized, a “profile” can be calculated to “set position and range information for the user input element[.]” EX1001, 9:44-57, Fig. 5. The “calculated profiles may map each position of the user input device to an ADC [analog to digital] value,” e.g., each position of the input element is mapped to an ADC value between 0 and 255. EX1001, 5:45; Ward, ¶108.

To provide force feedback on its knob, Goldenberg teaches the use of “force effect profiles” that map the knob’s physical position within its rotational freedom of movement to force magnitudes. [0116]; claim 23; [0009]; [0044]; Ward, ¶109.

To determine the knob’s position, Goldenberg teaches the use of “sensors 214” that “sense the position, motion, and/or other characteristics of knob 26...and provide signals to microprocessor 202 including information representative of those characteristics.” [0059]; *see* [0053]; FIG. 3. Exemplary sensors include “optical encoders.” [0059]; Ward, ¶110.

Goldenberg calculates “*analog to digital conversion value[s]*,” as claimed, to be used with each “force effect profile” that its knob can execute, including the jog shuttle profile (Figure 8), in at least two ways.

Digital Optical Encoder: Digital optical encoders like those Goldenberg discloses ([0059]) were conventional in 2014 and known to take as inputs analog values representing a device’s position and output corresponding digital values. Ward, ¶111 (citing, e.g., EX1007 for corroboration). This is consistent with Goldenberg’s disclosure that “sensor interface 208” receives “signals from a digital sensor such as an encoder and convert[s] the signals into a digital binary number.” [0057]; FIG. 3. POSAs would have understood that Goldenberg’s “optical encoder” (with sensor interface 208) mapped each physical position of the knob within its rotary degree of freedom to “*an analog to digital conversion value*,” as claimed. Ward, ¶¶61, 111.

Analog Sensor: Goldenberg also describes the conversion of analog signals from other sensors to digital values. “[T]o convert sensor signals to signals that can be interpreted by the microprocessor 202,” Goldenberg states, “[a]n [ADC] can also be used.” [0057]. POSAs understood that an ADC would be used in conjunction with a position sensor that outputs an analog value (e.g., “analog sensors such as potentiometers” ([0059])), to convert the analog sensor value to an “*analog to digital conversion value*.” Ward, ¶¶61, 112.

The analog to digital values that Goldenberg generates are used, or it would have been obvious to use them, to “calculate” each of Goldenberg’s stored “force profiles” because those profiles associate a force magnitude with a position of the knob. [0116]; Ward, ¶113. Stated differently, each ADC value would have had associated with it a corresponding force that the actuator was to provide to the knob. Ward, ¶113.

If Goldenberg is determined to not expressly disclose claim 3, modifying Goldenberg’s force profiles to “*map[] each position of the user input element to an analog to digital conversion value*” would have been obvious because POSAs would have recognized that Goldenberg’s profiles used position information to output detents at specific locations, e.g., “a designated origin position” such as the origin O of Figure 8. [0070]; [0116]; Ward, ¶¶59, 114.

5. Claim 4: “The method of claim 3, wherein the profile for the user input element is an increasing profile or a decreasing profile.”

The ’907 patent explains that in calculating a profile for the user input element, an increasing or decreasing profile can be used. EX1001, 9:58-59. For example, when each position of the input element is mapped to an ADC value between 0 and 255, then “an increasing profile will produce a value [0,255]” in 8-bit ADC mapping, while “a decreasing profile will produce a value [255,0]” in 8-bit ADC mapping. EX1001, 9:58-63; Ward, ¶116.

8-bit ADC mapping was well-known. Ward, ¶116. Creating increasing or decreasing ADC values for Goldenberg’s force profiles (*supra* §VII.A.4 (claim 3)) would have been a matter of straightforward design. Ward, ¶116. POSAs would not have put the values in a jumbled order, but in a monotonic order, and only two plausible monotonic orderings exist: increasing or decreasing. Ward, ¶116.

6. Claim 5: “The method of claim 1, wherein a normalized profile for the user input element is calculated by removing at least one of the secondary range of positions or the boundary range of positions from mapped analog to digital conversion values.”

The ’907 patent explains that a “normalized profile may be calculated by removing secondary and/or boundary ranges from the ADC data,” i.e., the ADC data of the originally calculated profile. EX1001, 9:65-67; *supra* §VII.A.4 (claim 3) (discussing calculated profiles). “For example, the calculated normalized profile...may map each position of the user input device, excluding secondary and/or boundary positions, to an ADC value between 0 and 255.” EX1001, 9:65-10; Ward, ¶117.

Goldenberg’s Figure 8 jog shuttle profile is an example of a bi-directional profile, i.e., a positive force is output when the knob is positioned clockwise from the origin position, and a negative force is output when the knob is positioned counterclockwise from the origin position. [0115]-[0117]; Ward, ¶¶118-120. Goldenberg teaches (and it was known in the art) that *uni*-directional (or uni-lateral)

profiles were also suitable; for example, Goldenberg's Figures 5A-5B and 9 depict such uni-lateral profiles. Ward, ¶¶59, 119-120; EX1018, [0162] (describing uni-directional and bi-directional force profiles); FIG. 10a-c. With a uni-directional force profile, force is only output when the knob is positioned in one direction relative to the origin, e.g., clockwise. Ward, ¶119. Likewise, with a uni-directional function profile, the function that a system performs based on the knob's position (e.g., scrolling) occurs only when the knob is moved in one direction. Ward, ¶119.

In view of Goldenberg's disclosure of both uni-directional and bi-directional profiles, POSAs would have recognized that Goldenberg's jog shuttle embodiment would have been improved if a user could optionally switch it from being bi-directional to uni-directional. Ward, ¶121.

For example, a jog shuttle is often used in video editing and playback systems and the jog shuttle controls scrolling speed. *See* [0031]; Ward, ¶118. The frames of a video are moved forward as the jog shuttle is turned clockwise, and the further from the origin position the knob turns, the faster the frames are moved forward. [0117]; Ward, ¶118. When the jog shuttle is turned counterclockwise, the video frames slow down until the jog shuttle returns to the origin point at which time the video frames will pause at the origin position and then start to re-wind if the jog shuttle continues to be rotated counterclockwise past the origin position. [0117]; Ward, ¶118.

POSAs would have recognized that a jog shuttle could be improved if it had the ability to operate in a uni-directional mode such that it would only perform scroll (and provide force feedback) in a positive (e.g., clockwise) or negative (e.g., counterclockwise) direction. Ward, ¶121. That is, in one mode, the jog shuttle would only scroll forward through video frames (and provide corresponding force feedback) and could not rewind, and in an alternate mode it could only rewind and not move forward. *Id.* This functionality would allow a user to immediately pause a video by turning the knob quickly to its origin position while eliminating the potential for the user to accidentally turn past the origin position and begin rewinding (or fast-forwarding) the video frames. Ward, ¶122. In other words, a user editing video could quickly turn the knob counterclockwise to pause the video without being concerned that she needs to turn the knob to the exact origin position to avoid an accidental rewind of the video. *Id.*

Permitting a user to change between a bi-directional and a uni-directional jog shuttle effect would have been consistent with Goldenberg's teachings that its knob can be used for multiple different functions, including rate control and position control functions. [0035]-[0040]; [0077] (“*A single knob* 26 can provide both rate control and position control over functions or graphical objects in different modes.”). As Goldenberg also teaches, the selection between varying modes (e.g., uni-directional clockwise, uni-directional counterclockwise, and bi-directional) would

have been achieved by pushing or pulling from its default position. [0040] (describing how a user can “select functions or settings” by pushing or pulling the knob); [0119] (describing how a user can “select or adjust a function of a device by providing a dual motion); [0124]; Ward, ¶123.

One obvious way to implement Figure 8’s jog shuttle profile as a uni-directional profile is shown below:

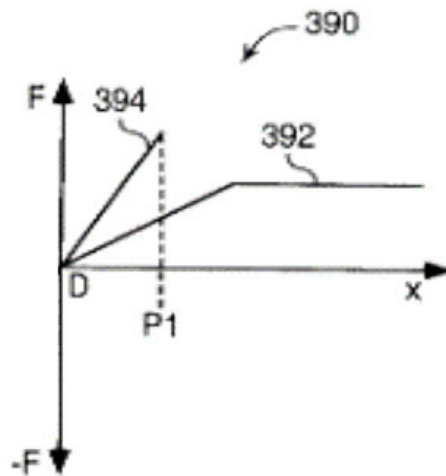


FIG. 8

Ward, ¶124; Goldenberg, FIGS. 5A-5B, FIG. 9; EX1018, [0162]; FIG. 10b.

In such an implementation, a “*normalized profile*” (relative to the bi-directional profile) for the knob would have been calculated by removing the counterclockwise positions of the knob from the original analog-to-digital data used to calculate the knob’s profile for the bi-directional jog shuttle profile. Ward, ¶125.

That is, the exemplary uni-directional profile shown above would have been calculated “*by removing...the secondary range of positions,*” i.e., the positions counterclockwise of the origin, “*from mapped analog to digital conversion values,*” as claimed. Ward, ¶125; *supra* §VII.A.2.b(2) ([1A2]).

7. Claim 6: “The method of claim 1, further comprising monitoring a position of the user input element.”

Goldenberg discloses a “control system” for its knob ([0020]), and that system includes a “sensor” that “provide[s] position...information” for the knob. [0044]; [0009], [0040], [0059], [0104]-[0105]; *supra* §VII.A.4 (claim 3). The sensor (together with the processor) thus “*monitor[s] a position of the user input element,*” as claimed. Ward, ¶126.

8. Claim 8

Independent claim 8 recites “*a non-transitory computer readable storage medium [CRM] storing a program configured to be executed by a processor, the program comprising instructions for*” carrying out claim 1’s method. Goldenberg discloses such a CRM. Ward, ¶127.

Goldenberg’s force profiles (e.g., the jog shuttle profile/model) are implemented by “microprocessor 202” which “process[es] sensor signals to determine appropriate output actuator signals by following the instructions of a ‘force process’ that may be stored in local memory 206 and includes calculation instructions, formulas, force magnitudes (force profiles), and/or other data.” [0066];

see FIG. 3 (local microprocessor 202); [0073] (“[F]orce profiles can be stored in a memory device on the device and a particular set can be provided on the knob 26 by a microprocessor.”). Goldenberg’s local memory 206 (RAM and/or ROM ([0056])), is “*a non-transitory computer readable storage medium storing a program configured to be executed by a processor,*” where the program is the set of software instructions executed by Goldenberg’s microprocessor to implement its force profiles. [0066]; Ward, ¶128.

The steps recited in the remaining limitations of claim 8 are identical to the method steps recited in [1A]-[1B], and are met and/or rendered obvious by for the same reasons discussed in §§VII.A.2.b-c. Ward, ¶129.

9. Claim 9-13

Dependent claims 9-13 add the same limitation to claim 8 that dependent claims 2-6 add to claim 1, respectively. Goldenberg’s CRM stores a program comprising instructions for performing the steps recited in claims 10-13 for the same reasons Goldenberg meets and/or renders obvious claims 2-6. *Supra* §§VII.A.3-7; Ward, ¶130.

10. Claim 15

Independent claim 15 is substantially identical to independent claim 1 except that claim 15 recites “*a device,*” and that “*device*” comprises both “*a processor*” and

“a memory storing a program for execution by the processor, the program including instructions for” carrying out a process identical to claim 1’s method. Ward, ¶131.

Goldenberg’s “control knob” is part of a “control panel 12 for an electronic *device*” and the knob “control[s] various functions of the device.” [0030]; *see* [0018]; FIG. 1. The “electronic device” can be “a controller for various automobile systems” or “a variety of other electronic or computer devices.” [0030]-[0031]. Goldenberg thus discloses “a device,” as claimed. Ward, ¶132.

Goldenberg further teaches that its “controlled device includes an electronic portion having a local microprocessor 202...[and] local memory 206.” [0054]; *see* FIG. 3. The memory 206 stores instructions, i.e., “*program code*,” for performing the steps recited in [1A]-[1B] for the reasons discussed in connection with claim 8. [0066]; Ward, ¶133; *supra* §VII.A.8.

Goldenberg thus discloses both “a processor,” and “a memory,” as claimed, and Goldenberg’s memory includes “*program code*” for performing claim 1’s method. Ward, ¶134.

11. Claims 16-19

Dependent claims 16-19 add the same limitation to claim 15 that claims 2-3 and 5-6 added to claim 1, respectively. Goldenberg meets claims 16-19 for the reasons it meets and/or renders obvious claims 2-3 and 5-6. *Supra* §§VII.A.3-4 and VII.A.6-7; Ward, ¶135.

B. Ground 2: Claims 7, 14, and 20 are Obvious Goldenberg in view of Cruz-Hernandez

Dependent claims 7, 14, and 20 limit their respective independent claims by requiring “*adjusting a profile and a normalized profile of the user input element to adjust for a change to a resting position of the user input element.*” Ward, ¶136. The ’907 patent explains that “after use...the user input devices may not return to the same resting position when the user interaction is removed.” EX1001, 10:5-8; Ward, ¶137. When that happens “the calculated profile and the calculated normalized profiles for such user input elements” may be adjusted so that “the changed resting position(s) may be accounted for while monitoring the position of the user input elements.” EX1001, 10:8-13; Ward, ¶137.

As discussed below, Cruz-Hernandez teaches adjusting a profile for a user element to account for a change in its resting position, and POSAs had reason to implement that technique in Goldenberg. Ward, ¶¶49, 138, 139.

1. Cruz-Hernandez (EX1005)²

Cruz-Hernandez—another prior-art reference assigned to PO—discloses “haptic feedback interface devices,” which include an “object 20” “moveable in at least one degree of freedom,” e.g., a knob. [0003], [0022], [0027]-[0028]. Cruz-Hernandez discloses “control schemes for [providing] haptic feedback” to the object.

² Unless otherwise noted, citations in Section VII.C.1 are to Cruz-Hernandez.

[0002]; Ward, ¶¶50, 139. Many of Cruz-Hernandez’s “control schemes” create “simulated detent force profiles” or “simulated spring forces,” paralleling the force profiles Goldenberg describes. [0028]; [0031]; Ward, ¶139. Indeed, Cruz-Hernandez explicitly incorporates by reference the application that published as Goldenberg. [0028].

In one embodiment, Cruz-Hernandez teaches a “**position reset**” function that can be used when, for example, simulating a detent. [0035]; Ward, ¶140. As Cruz-Hernandez explains, when an actuator is used “to output detent forces, a user will often release the object or manipulandum when the object is positioned off the center of the detent. Without position reset, the first detent output when the object is next engaged is not consistent with other detent outputs because the object did not start in the center of the detent.” [0035]; Ward ¶140.

“To provide more consistent initial detent interaction,” Cruz-Hernandez teaches that “the position of the object is redefined to be the center of the detent after the user has released the object.” [0035]. When the user then re-engages the object to move it again after the “position reset,” the object is centered within the detent again even though it had been released off-center. Ward, ¶141.

Although Cruz-Hernandez “primarily describe[s]...a simulated detent,” it explains that its teachings can be applied to “a spring force” as well. [0051]; *see* [0031] (discussing simulated spring forces); Ward, ¶142.

2. The Goldenberg-Cruz-Hernandez Combination

POSAs would have recognized that Cruz-Hernandez’s “position reset” function would provide a “more consistent” feel to a knob’s simulated detent or spring effects when the knob is re-engaged after inactivity. [0035]; Ward, ¶143. “Without position reset, the first detent output when the object is next engaged [after being at rest] is not consistent with other detent outputs because the object did not start in the center of the [first] detent.” [0035]; Ward, ¶143. For similar reasons, without position reset, when a user re-engaged a knob that simulates a spring, the knob would feel unrealistic as mechanical springs typically reset to their origin position when disengaged. Ward, ¶143. Goldenberg’s control knob would benefit from Cruz-Hernandez’s position reset technique. Ward, ¶143.

Goldenberg discloses “haptic sensations for a rotational haptic feedback device such as a knob.” Goldenberg, [0010]. Goldenberg’s “jog shuttle model” provides the user a “control paradigm for scrolling through a list or controlling a function or value.” Goldenberg, [0115]; FIG. 8. That model “simulate[s] a mechanical jog shuttle having mechanical springs,” and therefore “the force feedback knob is preferably provided with two spring effects.” [0116].

In view of Cruz-Hernandez, POSAs would have recognized that Goldenberg’s system would have benefited from Cruz-Hernandez’s “position reset” functionality. Ward, ¶143. Such functionality would have made Goldenberg’s various force

feedback effects—including the jog shuttle spring effect illustrated in Goldenberg’s Figure 8—feel more realistic and consistent. Cruz-Hernandez, [0035]; Ward, ¶143.

In this combination (“Goldenberg-Cruz-Hernandez”), when a user stops turning Goldenberg’s knob for a period of time, Goldenberg’s method would reset the origin position of Goldenberg’s spring effect (e.g., Goldenberg’s origin position O) to the stopped position of the knob so that when the knob is next turned it starts at that origin position even if the knob had been disengaged at a position some amount to the left or right of the origin. Ward, ¶144.

3. Claim 7

As demonstrated *supra* §§VII.A.4 and VII.A.6 discussing claims 3 and 5, Goldenberg discloses “*a profile...of the user input element*” and “*a normalized profile of the user input element,*” as claimed. Furthermore, the “*profile*” and the “*normalized profile*” both include a center position (i.e., origin O) for a spring effect. Goldenberg, Fig. 8. Therefore, resetting the center position, as Cruz-Hernandez teaches, constitutes “*adjusting a profile and a normalized profile of the user input element,*” as claimed. Ward, ¶¶145, 147-148.

In Goldenberg-Cruz-Hernandez, the spring’s center position is reset “*to adjust for a change to a resting position of the user input element,*” as claimed. Ward, ¶146. In use, the control knob is disengaged and re-engaged, resulting in repeated changes to its resting position. Ward, ¶146. With each change, Cruz-Hernandez’s

position reset function adjusts for the change so that when a user re-engages the knob, the jog-shuttle spring effect starts at the origin position rather than some position to the left or right of the origin. Ward, ¶146. Therefore, Goldenberg-Cruz-Hernandez meets each limitation of claim 7. Ward, ¶149.

4. Claims 14 and 20

Dependent claims 14 and 20 recite the same “*resting position*” function as claim 7, but they depend from claims 13 and 19, respectively. As shown in Ground 1, Goldenberg discloses claims 13 and 19. Goldenberg-Cruz-Hernandez meets claim 14 and 20 for substantially the same reasons it meets claim 7. *Supra* §VII.B.3; Ward, ¶150.

C. Ground 3: Claims 1-4, 6, 8-11, 13, 15-17 and 19 Are Anticipated By and/or Obvious Over Rosenberg

1. Rosenberg (EX1017)³

Rosenberg relates to “computer interface devices that provide force feedback to [] user[s].” [0002]. Rosenberg’s system includes interface device 14 with “user object 34” ([0062]) that can be a “steering wheel” ([0070]) or other device that may be grasped/contacted/controlled by a user such as a joystick. [0082]-[0084]; Ward,

³ Unless otherwise noted, citations in Section VII.D.1 are to Rosenberg.

¶151. A user “move[s] the object along provided degrees of freedom to interface with [a] host application program the user is viewing.” [0082].

Figure 1 depicts a “control system 10...for an interface device controlled by a host computer system.” [0050]. Rosenberg’s object 34 is coupled to “sensors 28, actuators 30, and microprocessor 26.” [0068]; Ward, ¶152; Fig. 1.

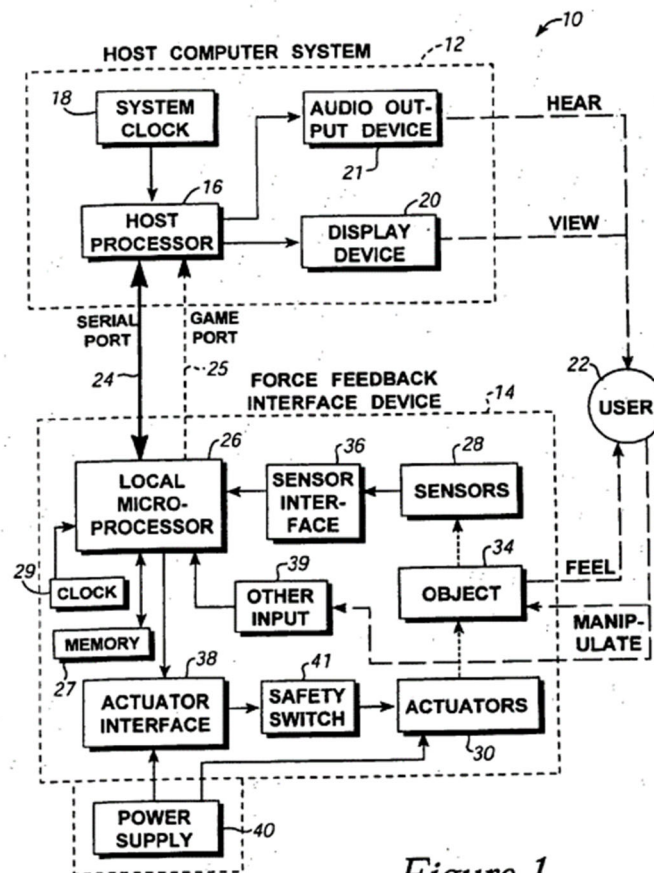


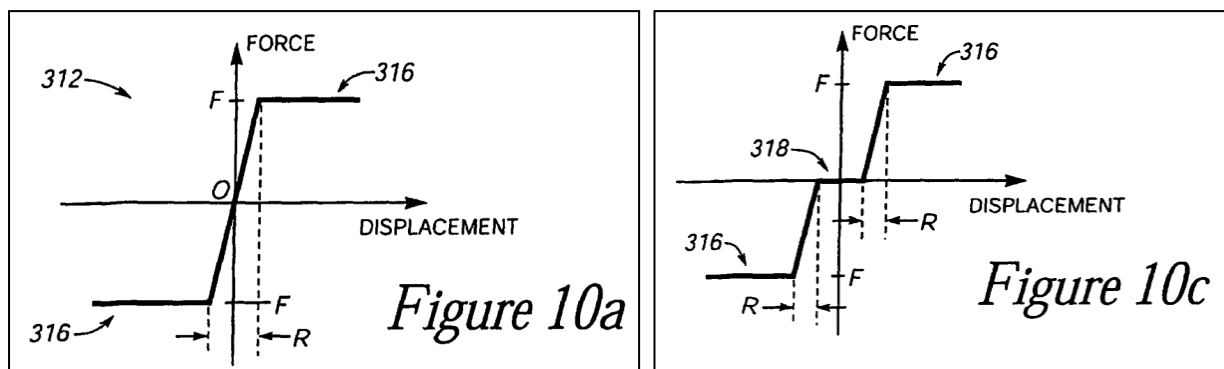
Figure 1

The sensors “sense the position, motion, and/or other characteristics of” object 34 ([0069]), and the actuators “transmit forces to user object 34...in response to signals received from [the] microprocessor.” [0073]-[0076]; [0088]. In a “host-controlled” embodiment (FIG. 4), the host computer instructs the microprocessor

what commands signals to send to the actuator. In a “reflex” embodiment (FIG. 5), the microprocessor independently sends commands to the actuator. [0065]; [0098]; [0114]; Ward, ¶153.

Rosenberg’s system provides force feedback through “force profile[s]” stored in memory. [0103]. The force profiles identify a force magnitude applied to object 34 when the object is at particular positions within its range of motion. Ward, ¶154.

Figures 10 (a)-(c) illustrate “force versus displacement profiles” for a restoring force command. [0164]. “The restoring force indicates a resistance against commanding a velocity in a direction of motion.” [0167]; *see* [0157] (describing “simulated inertias”); Ward, ¶155. “A restoring force applied to user object 34 always points back towards an origin position O (or ‘neutral position’) of the user object.” [0165]. The restoring force can be implemented with (Fig. 10(c)) or without (Fig. 10(a)) a deadband region (e.g., a region in which no or low signal is output). [0164]-[0166]; Ward, ¶155.



In the non-deadband implementation of Figure 10a (above left), “[a]s the object is moved toward the origin position O, the applied force is constant until the user object is moved within a localized region R about the origin position. When the user object is in the localized region R, the applied force rapidly drops to zero or a small value.” [0165]. This provides a “restoring sensation” that urges the object back to its origin position. [0165]; Ward, ¶156.

The deadband implementation shown in Figure 10(c) (above right) is similar except that “the applied force is about zero in an extended [deadband] region 318, about the origin position.” [0166]. This effect “allows the user to have some freedom to move object 34 a short distance around the origin before forces are applied.” [0166]; Ward, ¶157.

2. Claim 1

a. [1PRE]

Rosenberg’s method provides input to a video game using an interface device with a user-controllable object 34 such as a steering wheel or button. [0051]-[0052]; [0070]; [0082]. Ward, ¶158. Rosenberg’s user object is a “*user input element*” as claimed. EX1001, 1:34-38, 4:30-33, 5:15-18; Ward, ¶158; *supra* §VII.A.2.a. Rosenberg teaches methods for “*controlling*” the input device (user object) with different force commands. Ward, ¶158.

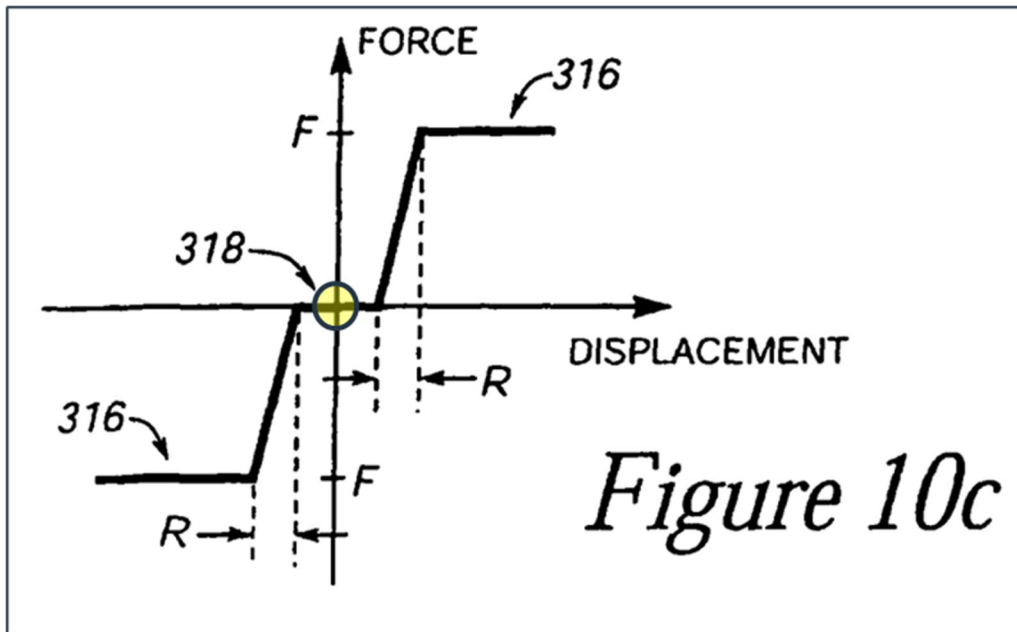
Rosenberg’s user object further incorporates an actuator, which is a “*haptic output device*” as claimed. [0062]; FIG. 1; *see* EX1001, 4:36-53; Ward, ¶¶50, 159. Rosenberg implements a method for “*controlling*” the user input element (user object) and performing steps [1A]-1[B] as detailed below. Ward, ¶¶159-182.

b. [1A]

Rosenberg’s system and method implement force commands that define “*position and range information*” for the user input element—i.e., user object. Rosenberg’s restoring force command and associated force profiles satisfy claim 1 in two ways, either of which is sufficient to anticipate claim 1. First, under patent owner’s interpretation of the claimed position ranges, Rosenberg’s force command *with* deadband anticipates claim 1. Second, under any reasonable interpretation of the claimed position ranges, Rosenberg’s force command *without* deadband anticipates claim 1. Ward, ¶160.

**(1) Restoring Force Command With Deadband
(Figure 10(c))**

Rosenberg’s restoring force command with a deadband region (Figure 10(c)) defines an origin (neutral) O position for the user object, circled below in yellow. [0165]; Ward, ¶161.



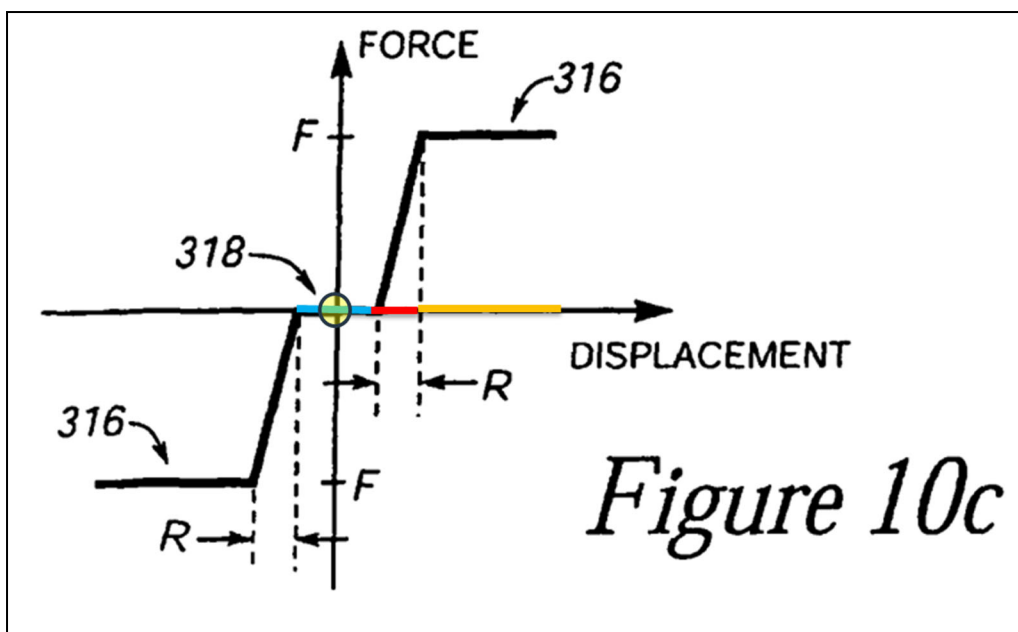
Outside of the origin position, Rosenberg’s actuator exerts a restoring force on the user object that tends the object back to its origin position. [0165]; Ward, ¶¶161-162. The “restoring force applied to user object 34 always points back towards” the origin position. [0165]. The exerted force is positive when the object moves in one direction (e.g., to the right) and negative when the object moves in the opposite direction (e.g., to the left). [0164], [0166]; Ward, ¶162.

Starting from the farthest righthand displacement from the origin, in region 316, the “magnitude of restoring force...generally remains constant.” [0165]. The constant magnitude in region 316 “is preferably limited to about 75% of the maximum possible force output ... so that jolts and vibrations can be overlaid on top of the restoring sensation.” [0165]; Ward, ¶164. When the object reaches a

“localized region R, the applied force rapidly drops to zero or a small value.” [0165]; Ward, ¶164.

In the deadband range of positions, the restoring force is “small or zero” ([0162]), and at the neutral (origin) position, the restoring force exerted is zero. [0165] (“This restoring forces then diminishes or vanishes as the object nears and reaches the origin position.”). Ward, ¶165.

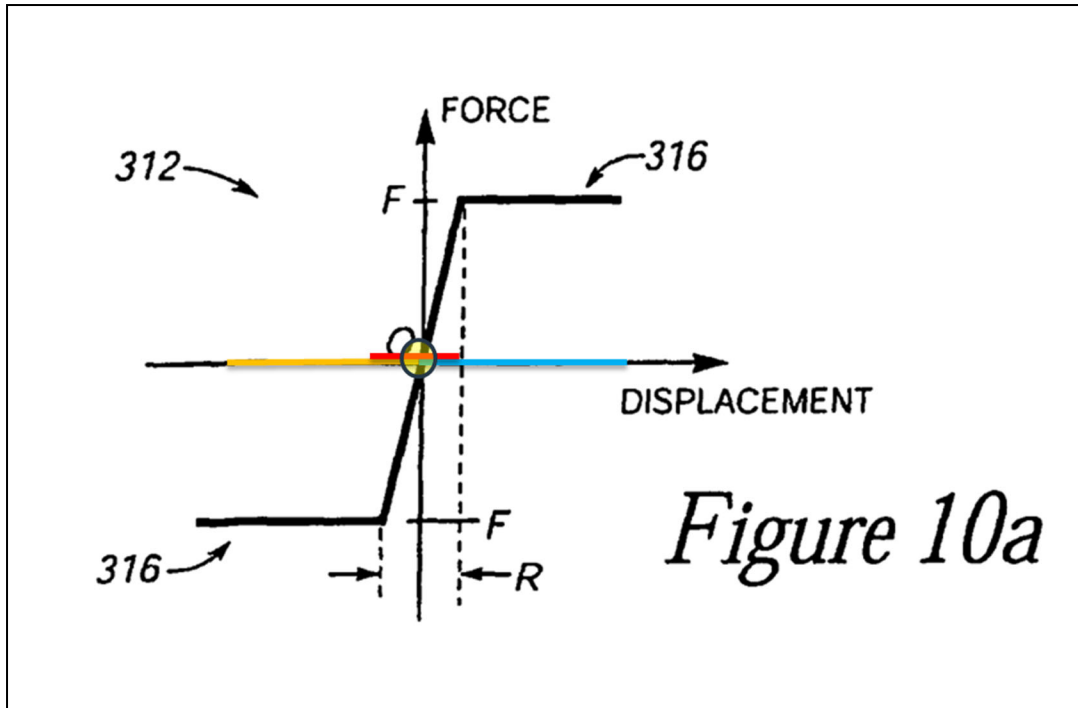
Rosenberg’s force restoring command with a deadband (Figure 10(c)) defines the following position ranges: a deadzone (region 318, **blue** below) that surrounds the origin position in which either no force or a small force is exerted on the user object, a constant force range of positions (region 316, **orange** below) in which a constant force is exerted on the user object, and a “localized region” range of positions R (**red** below) in which a changing force is exerted on the user object at a steep linear slope. Ward, ¶166.



(2) **Restoring Force Command Without Deadband
(Figure 10(a))**

Rosenberg's restoring force command *without* a deadband region (Figure 10(a)) exerts a bi-directional restoring force with “the force on the right side of the vertical axis is applied in one direction along a degree of freedom, and the force on the left side of the vertical axis is applied in the opposite direction along that degree of freedom.” [0164]; Ward, ¶167.

The no-deadband embodiment of Rosenberg's restoring force command includes an origin position O, a localized region R (where the force rapidly changes), and a region 316 (where a constant maximum force is exerted). [0164]-[0165]; Ward, ¶168. As illustrated in Figure 10(a), however, there is no deadband region. Ward, ¶168.



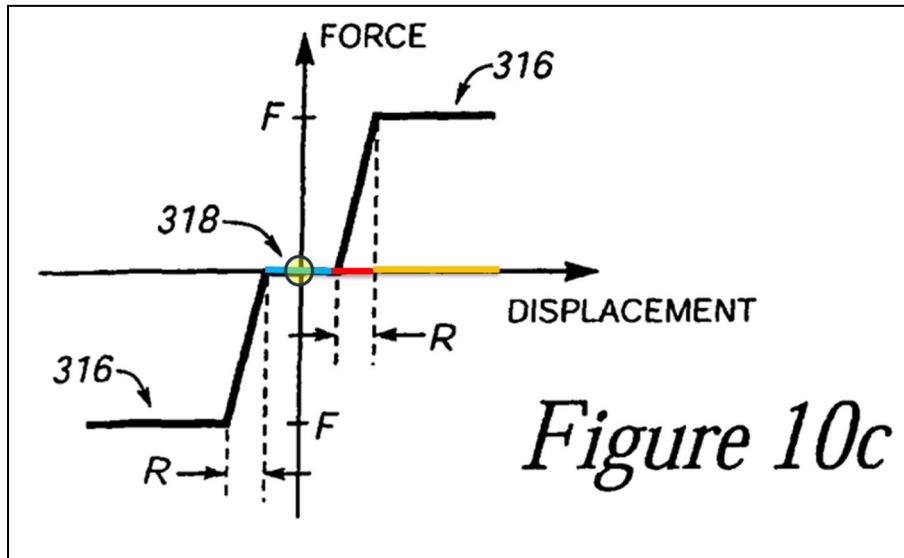
Rosenberg’s force restoring command without a deadband (Figure 10(a)) defines the following position ranges: a first range of positions in which a positive force (**blue** above) is exerted on the user object, a second range of positions in which a negative force (**orange** above) is exerted on the user object, and a localized region (**red** above) that surrounds the origin, in which a “rapidly” changing force is exerted until the object reaches its neutral (origin) position (moving in one direction) or region 316 (moving in the other direction). Ward, ¶169.

c. [1A1]-[1A3]

Rosenberg’s restoring force command—with and without a deadband region—satisfies [1A1]-[1A3].

(1) Restoring Force Command With Deadband (Figure 10(c))

The restoring force command includes a deadband (a.k.a. “deadzone”) range of positions (**blue**), in which either a low or zero restoring force is exerted on the user object. *Supra* §VII.C.2.b; Ward, ¶171.



In parallel litigation, PO argues that a videogame trigger’s “deadzone...where no analog values will be sent...is just one example of a primary range of positions.” EX1015, 7. Under PO’s interpretation of “*primary range of positions*,” the deadband range of positions (**blue**) is “*a primary range of positions*” even though a zero restoring force is exerted in the deadband. Ward, ¶172; *10X Genomics, Inc. v. Bio-Rad Labs*, IPR2020-00086, Paper 8 at 19 (April 27, 2020) (permitting petitioner

to rely on claim interpretation that PO relies upon “in the related district court litigation to assert infringement”).⁴

The restoring force command also includes a range of positions (**region 316, orange**) beyond which the restoring force is constant. *Supra* §VII.C.2.b; Ward, ¶173. In parallel litigation, PO argues that a videogame trigger’s end range “where the [same] maximum analog values will be sent once past this point” is “just one example of a secondary range of positions.” EX1015, 7. Thus, under PO’s interpretation of “*secondary range of positions*,” the region 316 of positions (**orange**) is “*a secondary range of positions*.” Ward, ¶173.

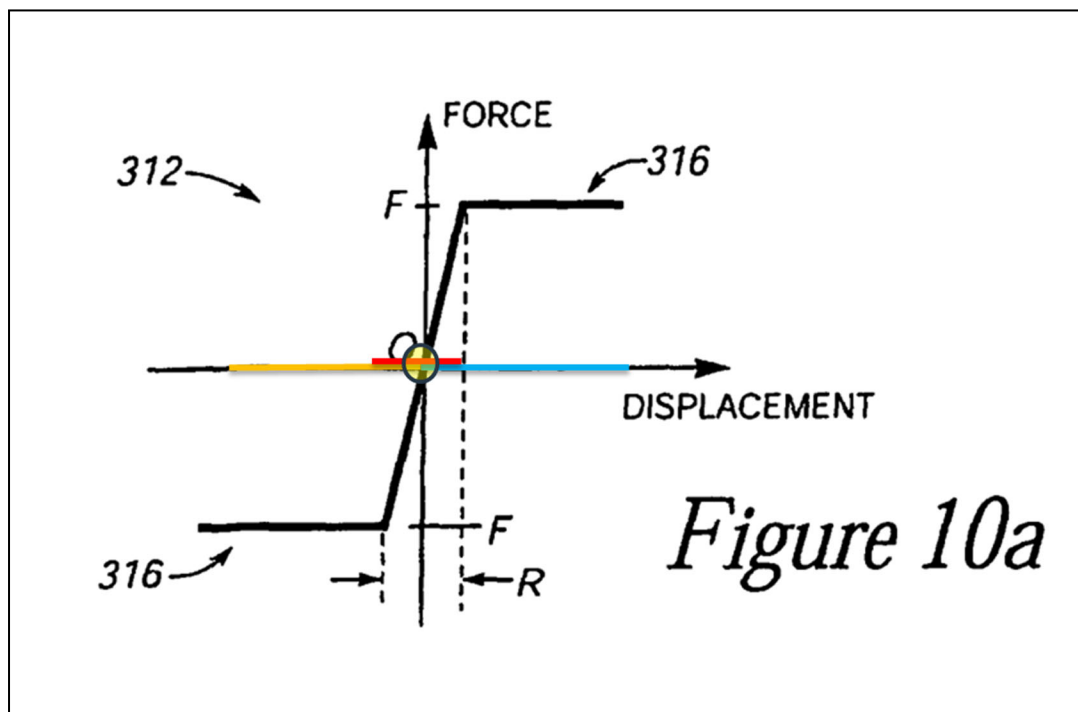
Finally, the restoring force command includes a localized region R (**red**) in which a “rapidly” changing force is exerted until the object reaches either deadband 318 or region 316. *Supra* §VII.C.2.b; Ward, ¶174. In parallel litigation, PO argues that “a range of positions *between*” a primary range of positions and a secondary range of positions and that generates signals “outside the trigger’s deadzone” is “just one example of a boundary range of positions that partially overlaps each of the primary range of positions and the secondary range of positions.” EX1015, 7-9. Thus, under PO’s interpretation, the localized region range of positions is a “*boundary range of positions*” that partially overlaps each of the primary and

⁴ Petitioner disagrees with PO’s interpretations in the litigation.

secondary ranges, as claimed—i.e., overlaps at the points where the lines in Figure 10(c) meet. Ward, ¶174.

**(2) Restoring Force Command With No Deadband
(Figure 10(a))**

As explained *supra* §VII.C.2.b(2) and illustrated below, the no-deadband embodiment of the restoring force includes an origin position O, a localized region R (where the force rapidly changes), and a region 316 (where a constant maximum force is exerted). [0165]; Ward, ¶175.



Rosenberg’s force restoring command without a deadband (Figure 10(a)) defines a clockwise range of positions (**blue**) in which a positive force is exerted on the user object, which is a “*primary range of positions*” as claimed. Ward, ¶¶175-176; see §VII.A.2.a(1); EX1002, 100 (discussing meaning of primary and secondary

ranges). Rosenberg’s force restoring command without a deadband also defines a counterclockwise range of positions (**orange**) in which a negative force is exerted on the user object, which is a “*secondary range of positions*” as claimed. Ward, ¶176; *see* §VII.A.2.a(2); EX1002, 100.

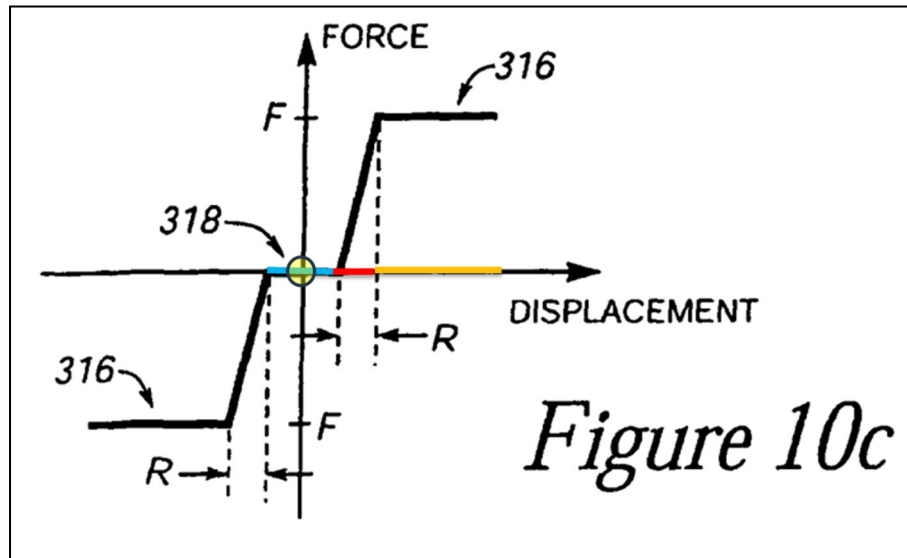
Rosenberg’s force restoring command without a deadband also defines a range of positions in a localized region (**red**) that surrounds the origin and in which a “rapidly” changing force is exerted until the object reaches its neutral (origin) position (moving in one direction) or region 316 (moving in the other direction). Ward, ¶177. The localized region extends in both directions and partially overlaps with the each of the primary and secondary ranges of positions. Ward, ¶177. Thus, localized region is a “*boundary range of positions*” that “*boundary range of positions partially overlaps each of the primary range of positions and the secondary range of positions*” as claimed. Ward, ¶177.

d. [1B]

Rosenberg’s restoring force command—with and without a deadband region—satisfies [1B]. To start, all of Rosenberg’s restoring force embodiments exert “restoring force” feedback with an actuator, which is a type of haptic feedback. [0011]; [0073]-[0077]; [0107]; [0164]-[0166]; *see* EX1001, 1:23-27; Ward, ¶¶50, 178.

**(1) Restoring Force Command With Deadband
(Figure 10(c))**

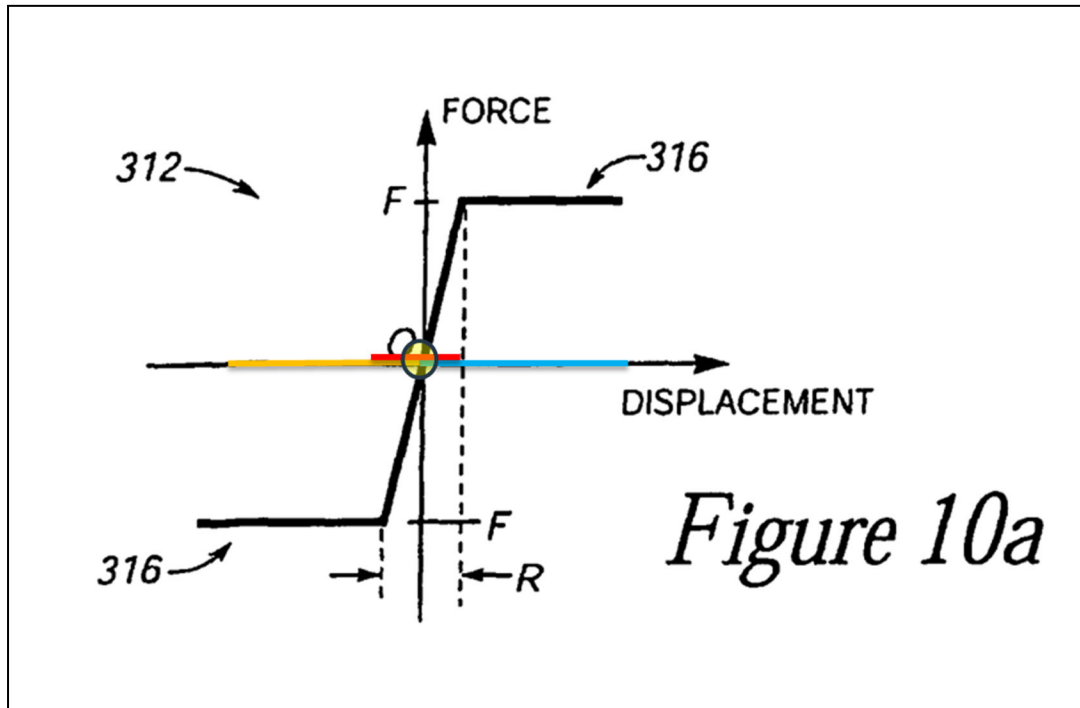
As discussed above, in Rosenberg’s deadband restoring force command embodiment, localized region R is the claimed boundary range of positions. §VII.C.2.c(1); Ward, ¶179. In localized region R —i.e., the claimed boundary range of positions—Rosenberg’s method exerts a “rapidly” changing (i.e., steep change in magnitude) restoring force. [0165]; Ward, ¶179.



Thus, Rosenberg outputs restoring force feedback (a type of haptic feedback) when the user object enters any position within the boundary range. As explained in §VII.A.2.c, rendering haptic feedback in any position within the boundary range satisfies [1B]. Ward, ¶¶50, 180.

**(2) Restoring Force Command With No Deadband
(Figure 10(a))**

In Rosenberg’s non-deadband embodiment of the restoring force command, localized region R is the claimed boundary range of positions. §VII.C.2.c(2); Ward, ¶181.



In localized region R—i.e., the claimed boundary range of positions—Rosenberg’s method exerts a “rapidly” changing (i.e., steep change in magnitude) restoring force. [0165]; Ward, ¶182. Thus, in the no-deadband restoring force command embodiment, Rosenberg outputs restoring force feedback (haptic feedback) when the user object enters any position within the boundary range. This satisfies [1B]. *Supra* §VII.F.2.c; Ward, ¶182.

3. Claim 2

Rosenberg teaches that its user object 34 can take the form of any device “that may be grasped or otherwise contacted or controlled by a user” such as a button ([0082]) or trigger ([0081], [0220]). Ward, ¶183. POSAs understood that the typical degree of freedom for buttons and triggers, e.g., those found on videogame controllers, includes a “*maximum out position*,” e.g., the farthest position to which the button or trigger can extend outward, and “*a grounding position*,” e.g., the farthest position to which the button or trigger can be pressed downward. Ward, ¶183.

Accordingly, when creating the “force versus displacement profiles” shown in Figures 10(a) and 10(c) [0164], Rosenberg’s method would calculate the total potential range of displacement for a button or trigger as extending from a maximum out position to a grounding position. Ward, ¶184. The primary, secondary, and boundary range of positions defined within those Rosenberg’s “force versus displacement profiles” as ranges within the button’s or trigger’s total potential range of displacement are therefore “*based on a movement of the user input element from a maximum out position to a grounding position*” as claimed. Ward, ¶184.

4. Claim 3

To provide force feedback on its control knob, Rosenberg teaches the use of “force profiles” that map object 34’s physical position within its freedom of

movement to force magnitudes that are to be output onto the object. [0164] (describing “*force versus displacement* profiles”); [0168] (same); Ward, ¶185. Exemplary “force profiles” are depicted in Rosenberg’s Figures 10a-10c, and each maps a position (“displacement” within its freedom of movement) of the object to a particular magnitude of force that is to be output onto the object based on its position. [0029]; [0164]; Ward, ¶185.

Rosenberg determines the position of its object within its freedom of movement by using “sensors 28” that “sense the position, motion, and/or other characteristics of a user object 34...and provide signals to microprocessor 26 including information representative of those characteristics.” [0069]; *see* [0020]; FIG. 1. Exemplary sensors include “optical encoders” which cooperate with “sensor interface 36... to convert sensor signals to signals that can be interpreted by the microprocessor 26.” [0069]-[0070]. Sensors can take the form of “analog sensors” and an ADC that “can convert the analog signal to a digital signal that is received and interpreted by microprocessor 26....” [0071]; Ward, ¶¶61, 186-190.

Rosenberg’s sensors are substantively the same as those disclosed in Goldenberg and perform the same analog-to-digital position-mapping function that Goldenberg’s sensors perform. *Supra* §VII.A.4; Ward, ¶191. Rosenberg thus uses its sensors to perform the method of claim 3 for the same reasons that Goldenberg uses its sensors to do so. *Supra* §VII.A.4; Ward, ¶191. Alternatively, implementing

Rosenberg such that it uses its sensors to perform the method of claim 3 would have been obvious for the same reasons it would have been obvious to implement Goldenberg to perform claim 3's method. Ward, ¶191.

5. Claim 4

As explained *supra* §VII.A.5 (claim 4), 8-bit ADC mapping was well-known. Ward, ¶192. Creating increasing or decreasing ADC values for Rosenberg's force vs. displacement profiles (*supra* §VII.C.4 (claim 3)) would have been a matter of straightforward design. Ward, ¶192. POSAs would not have put the values in a jumbled order, but in a monotonic order. Ward, ¶192. Only two plausible monotonic orderings exist: increasing or decreasing. Ward, ¶192.

6. Claim 6

Rosenberg satisfies claim 1 and further uses sensors to monitor the position of the user object—i.e., the “*user input element*” as claimed. [0068]; Ward, ¶193.

7. Claim 8

Independent claim 8 recites “*a non-transitory computer readable storage medium [CRM] storing a program configured to be executed by a processor, the program comprising instructions for*” carrying out claim 1's method. Rosenberg discloses such a CRM. Ward, ¶194.

Rosenberg's force profiles, including its Figures 10a and 10c restoring force profiles, can be implemented by a “local microprocessor 26” that “read[s] sensor

signals and calculat[es] appropriate forces from those sensor signals.” [0063]. “Local memory 27, such as RAM and/or ROM, is preferably coupled to microprocessor 26 in interface device 14 to store instructions for microprocessor 26 and store temporary and other data.” [0063]. Ward, ¶195.

Rosenberg’s local memory 27, which can be RAM and/or ROM ([0063]), is “*a non-transitory computer readable storage medium storing a program configured to be executed by a processor*,” where the program is the set of software instructions executed by Rosenberg’s microprocessor to implement its force profiles. [0125] (explaining local microprocessor causes actuator to output forces based on “reflex processes” that are “stored local to microprocessor 26 in, for example, memory 27 such as RAM or ROM” and include “algorithms, stored force profiles or values, conditions, etc.”); [0178] (“force profile” is “stored in memory”); [0280] (“assigned force ranges, magnitudes and models can also be stored in memory 27....”); Ward, ¶¶195-196.

The steps recited in the remaining limitations of claim 8 are identical to the method steps recited in [1A]-[1B], and are met and/or rendered obvious by for the same reasons discussed in §§VII.C.2.b-d. Ward, ¶197.

8. Claim 9-11 and 13

Dependent claims 9-11 and 13 add the same limitation to claim 8 that dependent claims 2-4 and 6 add to claim 1, respectively. Rosenberg’s CRM stores

a program comprising instructions for performing the steps recited in claims 9-11 and 13 for the same reasons Rosenberg meets and/or renders obvious claims 2-4 and 6. *Supra* §§VII.C.3-6; Ward, ¶198.

9. Claim 15

Independent claim 15 is substantially identical to independent claim 1 except that claim 15 recites “*a device*,” and that “*device*” comprises both “*a processor*” and “*a memory storing a program for execution by the processor, the program including instructions for*” carrying out a process identical to claim 1’s method. Ward, ¶199.

Rosenberg’s object 34 is part of an “interface device” that “outputs the indication of [the object’s] movement to the computer system.” [0011]. The “interface device” (depicted as 14 in Figure 1) is “*a device*,” as claimed. Ward, ¶200.

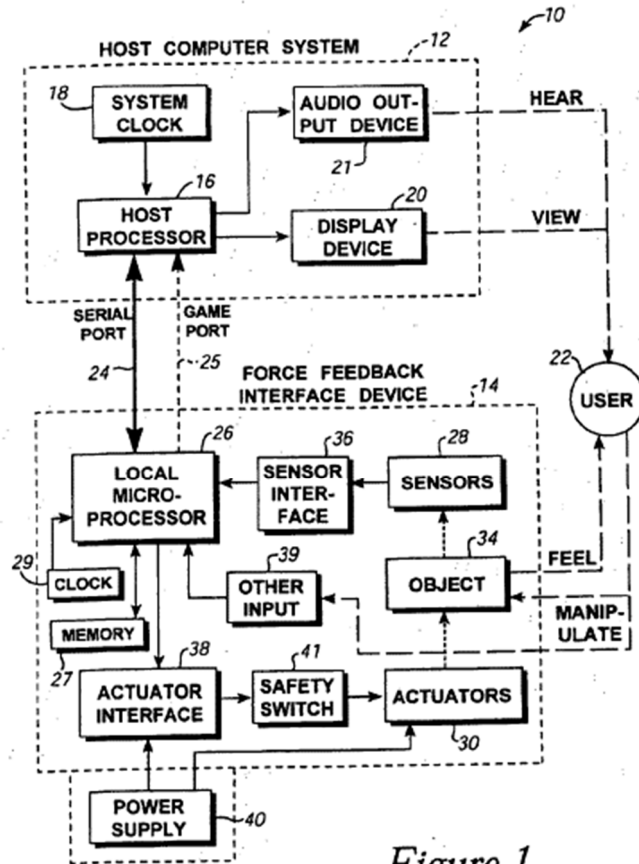


Figure 1

Rosenberg teaches (and Figure 1 shows) that the interface device includes a local microprocessor 26 ([0062]-[0063]) and a local memory 27 ([0063]). The memory 206 stores instructions, i.e., “*program code*,” for performing the steps recited in [1A]-[1B] for the reasons discussed in connection with claim 8. [0066]; Ward, ¶¶200-201; *see supra* §VII.C.7.

Rosenberg thus discloses both “*a processor*,” and “*a memory*,” as claimed, and Rosenberg’s memory includes “*program code*” for performing claim 1’s method. Ward, ¶202.

10. Claim 16-17 and 19

Dependent claims 16-17 and 19 adds the same limitation to claim 15 that claims 2-3 and 6 added to claim 1. Rosenberg meets claims 16-17 and 19 for substantially the same reasons it meets and/or renders obvious claims 3 and 6. *Supra* §VII.C.4 and VII.C.6; Ward, ¶203.

D. Ground 4: Claims 5, 7, 12, 14, 18, and 20 are Obvious Over Roberts and Rosenberg

1. Roberts (EX1017)⁵

Roberts discloses a videogame steering wheel. 2:63-3:10; FIG. 1. In an embodiment, the steering wheel has a total range of motion of 270 degrees. 5:31-33. A potentiometer connected to the wheel's shaft determines its position and outputs to a controller a digital "zero" signal when the wheel is turned to its furthest left physical limit and a digital "high signal" when the wheel is turned to its furthest right physical limit. 5:27-30. The potentiometer thus provides a controller with a digital signal corresponding to the position of the wheel within its 270 degrees of range of motion. 5:23-40; Ward, ¶204.

Roberts further discloses that a user can set a right and left "end-of-range of position" that results in a maximum or minimum "control signal in the game even though the input device can still be moved more, beyond the end-of-range position,

⁵ Citations in Section VII.D.1 are to Roberts unless otherwise noted.

until it hits the physical limit of its movement.” 5:37-41; 6:3-52. These end-of-range positions differ from the steering wheel’s physical limits. 5:34-37. That is, the end-of-range positions define a range of movement (e.g., 240 degrees of motion) that is narrower than the wheel’s full physical range of motion. *Id.*; Ward, ¶205.

Once end-of-range positions have been set, “the controller 52 continually monitors the current position of the” steering wheel to determine “where the current position is relative to the two end-of-range positions recorded in memory,” and then “outputs a control signal representative of the correct direction.” 6:53-58; Ward, ¶206 (explaining how the wheel’s position between the user-set end-of-range positions is determined via interpolation or via “a look-up table” generated based upon “end-of-range” position values). When the wheel’s position moves “[a]t and beyond the end-of-range positions, the maximum control signal...is generated.” 7:49-51. This is seen in Figure 4(a) below where the maximum control signal is designated 100%:

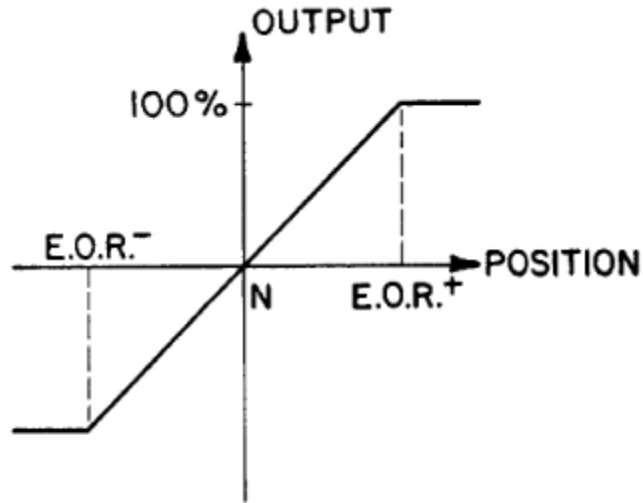


FIG. 4(a)

Ward, ¶206.

Roberts further teaches that a user can set a dead zone at or around the steering wheel's neutral position. 7:66-8:37. A deadzone around the neutral is shown below in Figure 4(c):

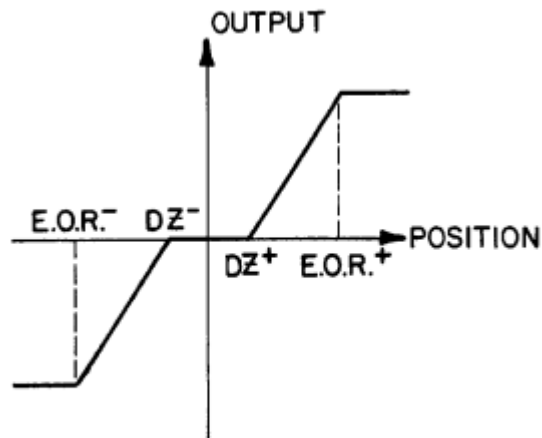


FIG. 4(c)

Ward, ¶207.

Roberts leaves it to POSAs to determine how the videogame system uses the control signal. 5:62-64; Ward, ¶208.

2. The Roberts-Rosenberg Combination

Roberts and Rosenberg both teach input devices that (a) utilize position sensors, (b) can be steering wheels, (c) have a neutral/origin position, (d) output a signal based on the device's positioning, and (e) can have a deadzone/deadband around the neutral or origin position. Roberts and Rosenberg also both provide feedback based on the steering wheel's position, with Roberts's feedback being visual feedback and Rosenberg's being tactile feedback (including restorative force feedback communicated via actuators coupled to the steering wheel). Ward, ¶209; *supra* §VII.C.1 (describing Rosenberg).

POSAs would have been motivated to implement Roberts's system such that its steering wheel was provided with an actuator that outputs to the steering wheel the restoring spring forces illustrated in Rosenberg's Figure 10c. Rosenberg, [0164]-[0167]; Ward, ¶210. For example, POSAs would have been motivated to provide Roberts's steering wheel with force feedback to provide well-known benefits of such feedback, including providing a more realistic sensory user experience and providing the user with tactile feedback on the steering wheel's position. Ward, ¶210 (citing, e.g., EX1005, EX1007 as corroboration); Rosenberg, [0164]-[0167].

Additionally, Roberts teaches that “[s]pring or *other mechanisms* (not shown) can tend the input device toward its neutral position.” Roberts, 3:49-50. POSAs would have understood that Rosenberg’s restoring force via an actuator would be a desirable and suitable design choice for another “mechanism” that “tends” the steering wheel toward its neutral position, including at least because Rosenberg teaches using such forces for the same purpose. Ward, ¶211; Rosenberg, [0164]-[0167].

In combining Rosenberg’s restoring force with Roberts’s steering wheel, POSAs would have recognized that Roberts (Figure 4(c)) and Rosenberg (Figure 10(c)) disclose similar embodiments that have a deadzone/deadband. Ward, ¶212.

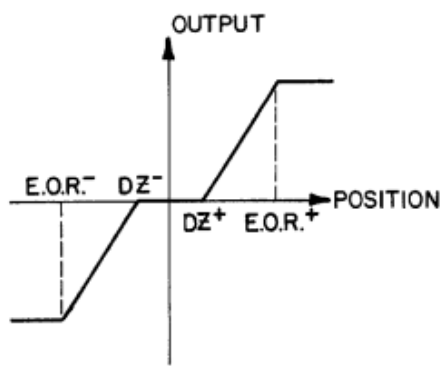


FIG. 4(c)

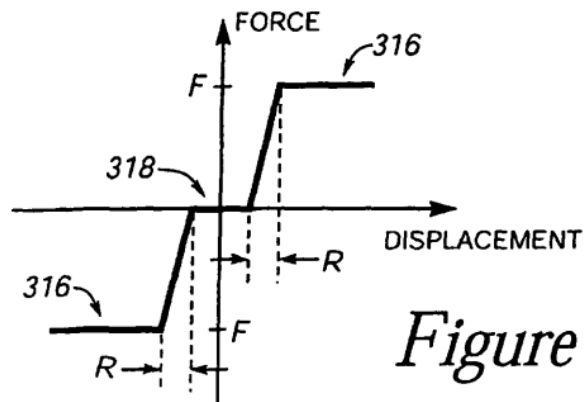


Figure 10c

POSAs would have known that Roberts’s deadband embodiment could easily be modified to implement Rosenberg’s deadband restoring force profile. Ward, ¶213. For example, in one obvious implementation, the “control signal” that Robert’s controller outputs based on the steering wheel’s position within its freedom

of movement would have been used to determine the steering wheel's "displacement" for use with Rosenberg's Figure 10c "force versus displacement profile[s]." Roberts, 3:20-25; Rosenberg, [0164]; Ward, ¶213. That is, the "control signal" would indicate the steering wheel's displacement and would be used to determine how much restoring force to provide the wheel. Ward, ¶213.

In combining Rosenberg and Roberts, POSAs would have maintained the capability to set end-of-range positions for the Roberts-Rosenberg steering wheel that differ from the physical limits of the steering wheel. Roberts, 5:16-41; Ward, ¶214. POSAs would have retained this capability because Roberts teaches that it allow users to, for example, "maximize their enjoyment and success in the game." Roberts, 1:23-33; Ward, ¶214. POSAs would have expected to succeed in doing so because such modification could be accomplished by coupling Roberts's steering wheel to an actuator, as taught by Rosenberg, and using routine computer engineering skills to utilize Robert's control signal with the force effect profile depicted in Rosenberg's Figure 10c. Ward, ¶214.

3. Claim 5

Claim 5 depends on claim 1. For purposes of Ground 4, Petitioner relies on Rosenberg's deadband restoring force profile depicted in Rosenberg's Figure 10c, which meets claim 1 under PO's interpretation of the claims for the reasons discussed above. Ward, ¶215; *supra* §VII.C.2.

Claim 5 adds to claim 1 a step of calculating a normalized profile “*by removing at least one of the secondary range of positions or the boundary range of positions from mapped analog to digital conversion values.*” According to the patent, “the calculated normalized profile... may map each position of the user input device, excluding secondary and/or boundary positions, to an ADC value between 0 and 255.” EX1001, 9:65-10; Ward, ¶216.

POSAs would have understood calculating a “*normalized profile*” in this manner refers to mapping the normalized ranges (e.g., the primary and boundary ranges but excluding the secondary range) to an ADC value, e.g., between 0 and 255. Doing so “*remov[es]*,” for example, the secondary range because no ADC value is mapped for the positions within the secondary range. Ward, ¶217.

Roberts-Rosenberg calculates a “*normalized profile*” in the same manner described in the ’907 patent. Ward, ¶218. As an initial matter, Roberts-Rosenberg may implement an analog sensor as taught by Rosenberg. Rosenberg, [0071]; Ward, ¶218. In such implementations, an ADC “can convert the analog signal to a digital signal that is received and interpreted by microprocessor 26 and/or host computer system 12, as is well known to those skilled in the art.” Rosenberg, [0071]; Ward, ¶218.

As discussed *supra* §VII.D.2, Roberts-Rosenberg implements Rosenberg’s deadband restoring force profile depicted in Rosenberg’s Figure 10c. As illustrated

immediately below and discussed *supra* §VII.C.2.c(1), under PO’s interpretation of claim 1, Rosenberg’s Figure 10c includes a secondary range of positions defined by “range 316.” [0165]; Ward, ¶219; *supra* §VII.C.2.c(1).

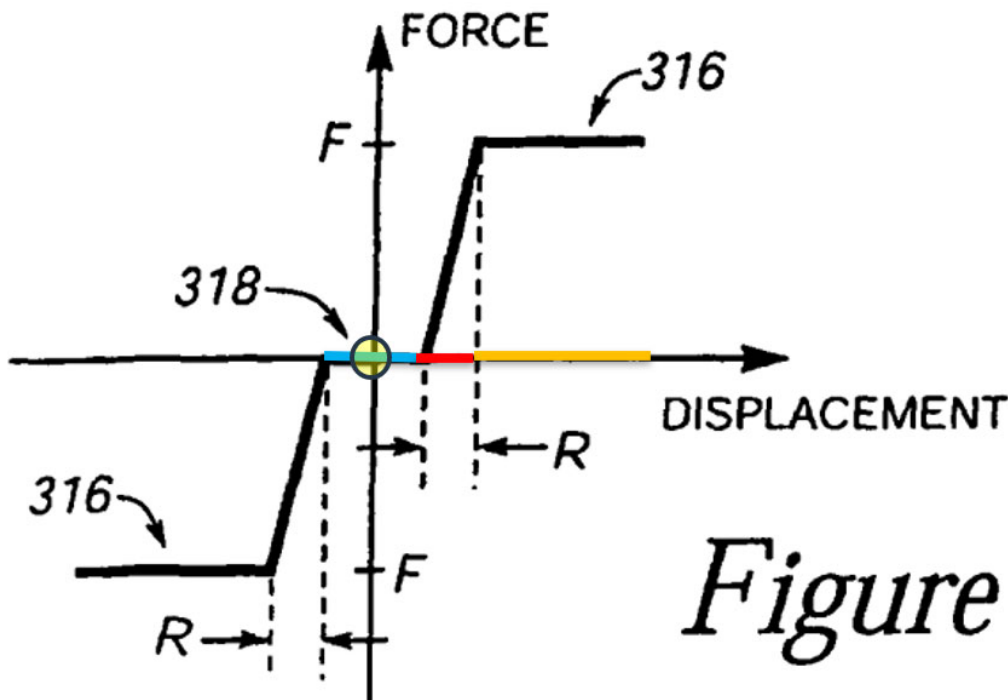


Figure 10c

In this secondary range of positions, Roberts-Rosenberg’s wheel outputs a constant near-maximum restoring force as discussed in §VII.C.2. Ward, ¶¶219; Rosenberg, [0165]-[0166].

In Roberts-Rosenberg, “region 316” would be defined when a user sets a rightmost and leftmost end-of-range position per Roberts’ teachings. Ward, ¶220. Once the two regions 316 have been defined by the user, Roberts-Rosenberg would then calculate position values for the steering wheel between the two region 316s, which results in “a normalized profile” for the wheel being “calculating by removing

at least...the secondary range of positions,” i.e., region 316, “*from mapped analog to digital conversion values*” under PO’s interpretation of the claims. Roberts, 6:53-62 (explaining how the wheel’s position between the user-set end-of-range positions is determined via interpolation or via “a look-up table that is generated based upon values of the end-of-range positions”); Ward, ¶220.

4. Claim 12

Dependent claim 12 adds the same limitation to claim 8 that dependent claim 5 adds to claim 1. Roberts-Rosenberg would have used Roberts’ CRM that meets claim 8 (*supra* §VII.C.7) and that CRM would have stored a program comprising instructions for performing the steps recited in claim 12 for the same reasons Roberts-Rosenberg renders obvious claims 5. *Supra* §VII.D.3; Ward, ¶221.

5. Claim 18

Dependent claim 18 adds the same limitation to claim 15 that dependent claims 5 adds to claim 1. Roberts-Rosenberg would have used Rosenberg’s device (implemented as Roberts’ steering wheel) that meets claim 15 (*supra* §VII.C.9) and that device would have stored a program comprising instructions for performing the steps recited in claims 18 for the same reasons Roberts-Rosenberg renders obvious claim 5. *Supra* §VII.D.3; Ward, ¶222.

E. Ground 5: Claims 7, 14 and 20 Are Obvious Over Roberts in view of Rosenberg and Cruz-Hernandez

Claim 7 adds to claim 1 the additional method step of “*adjusting a profile and a normalized profile of the user input element to adjust for a change to a resting position of the user input element.*” This additional step accounts for a change to the user input device’s resting position during use. EX1001, 10:5-13; Ward, ¶223.

Cruz-Hernandez teaches a “position reset” function that can be used when simulating a detent or spring effect. Cruz-Hernandez, [0031]; [0035]; [0051]; Ward, ¶224; *supra* §VII.B.1. Cruz-Hernandez teaches that this function is useful for any interface object that provides haptic feedback including a “wheel.” Cruz-Hernandez, [0027]-[0028].

“To provide more consistent” interaction with the interface object, Cruz-Hernandez teaches that “the position of the object is redefined to be the center of the detent after the user has released the object.” Cruz-Hernandez, [0035]. When, after a period of non-use, the user re-engages the object to move it again after the “position reset,” the object is centered within the detent again even though it had been released off-center. Ward, ¶225. Cruz-Hernandez teaches (and POSAs would have understood) that although Cruz-Hernandez “primarily describe[s]...a simulated detent,” its teachings can be applied to “a spring force” as well. Cruz-Hernandez, [0051]; *see supra* §VII.B.1; Ward, ¶225.

1. The Roberts-Rosenberg-Cruz-Hernandez Combination

Roberts-Rosenberg’s wheel “can have physical stops that prevent it from rotating” or “it can be designed to have infinite rotation.” 3:25-31. As explained in Ground 4, Roberts-Rosenberg’s steering wheel would have used actuators that simulate a restoring force that, in addition to providing a user with force feedback, would also “tend” the steering wheel “toward its neutral position.” Roberts, 3:49-50; Ward, ¶226; *supra* §VII.D.2.

In view of Cruz-Hernandez, POSAs would have recognized that there was a potential for a user to disengage the steering wheel before the actuators returned the wheel to its absolute neutral position. Cruz-Hernandez, [0035]; Ward, ¶¶227-229. To ensure that when the user next engages with the steering wheel, the wheel begins at its absolute neutral position, POSAs would have added Cruz-Hernandez’s “position reset” functionality to the Roberts-Rosenberg device. Ward, ¶¶227-229. Doing so would have beneficially “provide[d] more consistent” user interaction with device (Cruz-Hernandez, [0035]), which is consistent with Roberts’s intent to make steering wheels that “maximize” user “enjoyment and success in the game” (Roberts, 1:28-31). Ward, ¶230.

In Roberts-Rosenberg-Cruz-Hernandez, the software instructions that the steering wheel’s processor executes would include Cruz-Hernandez’s “position reset” functionality such that when the steering wheel is disengaged for a period of

time, the steering wheel's neutral position would be set as the then-current resting position of the steering wheel. Ward, ¶231. POSAs would have expected to succeed in implementing this combination because the modification could be accomplished using routine computer engineering skills. Ward, ¶231.

2. Claim 7

The steering wheel of Roberts-Rosenberg-Cruz-Hernandez meets claim 1 for the reasons the steering wheel of Roberts-Rosenberg does. Ward, ¶¶232-233; *supra* §VII.D.3 (claim 5).

Implemented to perform Cruz-Hernandez's position reset functionality when the steering wheel is not used for a period, the steering wheel of Roberts-Rosenberg-Cruz-Hernandez would adjust Rosenberg's restoring spring force profile to account for a new neutral position, which would require adjusting all other position ranges relative to the new neutral position. Ward, ¶233. Position reset may be carried out, e.g., in response to a user changing game modes, pausing and resuming gameplay, etc. Ward, ¶¶234-238. Thus, Roberts-Rosenberg-Cruz-Hernandez performs the step of "*adjusting a profile and a normalized profile of the user input element to adjust for a change to a resting position of the user input element*" as claimed. Ward, ¶239.

3. Claim 14

The steering wheel of Roberts-Rosenberg-Cruz-Hernandez meets claim 8 for the reasons the steering wheel of Roberts-Rosenberg does. Ward, ¶240; *supra* §VII.D.4 (claim 12).

Dependent claim 14 adds the same limitation to claim 13 (which depends from independent claim 8) that dependent claim 7 adds to claim 1. Implemented in view of Cruz-Hernandez to include Cruz-Hernandez’s “reset” functionality, Roberts-Rosenberg’s CRM (§VII.D.4 (claim 12)) would have stored a program comprising instructions for performing the steps recited in claim 14 for the same reasons Roberts-Rosenberg-Cruz-Hernandez renders obvious claim 7. *Supra* §VII.E.2; Ward, ¶¶240-241.

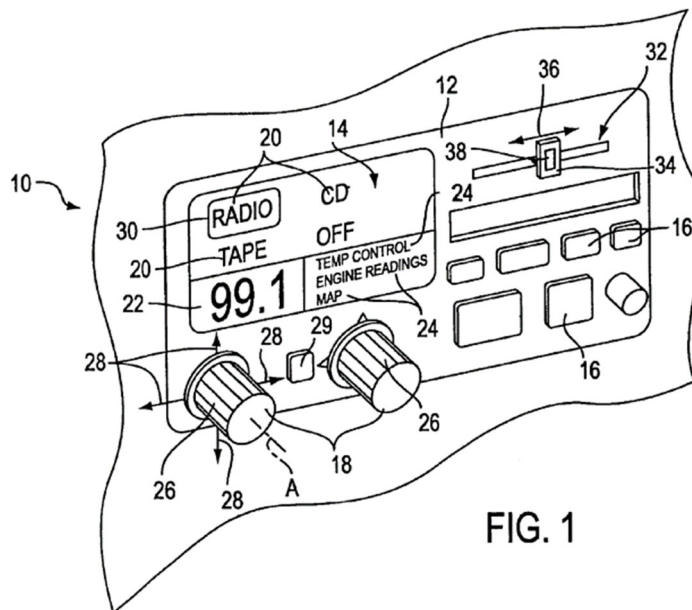
4. Claim 20

Dependent claim 20 adds the same limitation to claim 15 that dependent claim 7 adds to claim 1. Implemented in view of Cruz-Hernandez to include Cruz-Hernandez’s “reset” functionality, Roberts-Rosenberg’s device (*supra* §VII.D.5 (claim 18)) would have stored a program comprising instructions for performing the steps recited in claim 20 for the same reasons Roberts-Rosenberg-Cruz-Hernandez renders obvious claim 7. *Supra* §VII.E.2; Ward, ¶242.

F. Ground 6: Claims 1, 3-4, 6, 8, 10-11, 13, 15, 17, and 19 Are Anticipated By and/or Obvious Over Levin

1. Levin (EX1006)⁶

Levin discloses a device with a control panel that a driver can interact with to control various systems of a car such as its stereo or HVAC system. [0024], [0027]-[0030]. Levin's device (e.g., Fig 1) includes "[c]ontrol knobs 18" that incorporate force feedback using an actuator. [0030], [0047]; Ward, ¶243.



A user turns the control knob to adjust a system setting, e.g., temperature. [0030]; [0037]-[0039]; FIG. 2. As it turns, "force detents" are output via an actuator to "indicate particular settings or how far the knob has rotated." [0038]. For

⁶ Unless otherwise noted, citations in Section VII.A are to Levin.

example, “[t]emperature can preferably be adjusted by rotating knob 18, where force detents indicate each temperature setting.” [0039]; *see* [0048]. Using “force detents” allows a user to “feel” a change without “look[ing] at the display.” [0039]; Ward, ¶244.

Levin’s Figures 6A-6D illustrate detent force profiles. Force feedback may be provided when the control knob is moved to positions “within a range of [a] first detent” or “within a range of [a] second detent.” [0009]; Ward, ¶245. In Figure 6B’s implementation, “[a] portion of the range of the first detent overlaps a portion of the range of the second detent.” [0009]; Ward, ¶245.

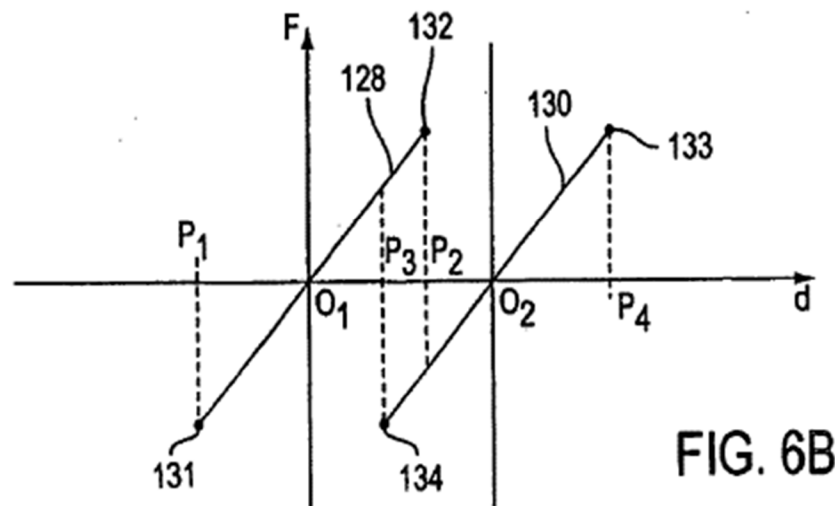
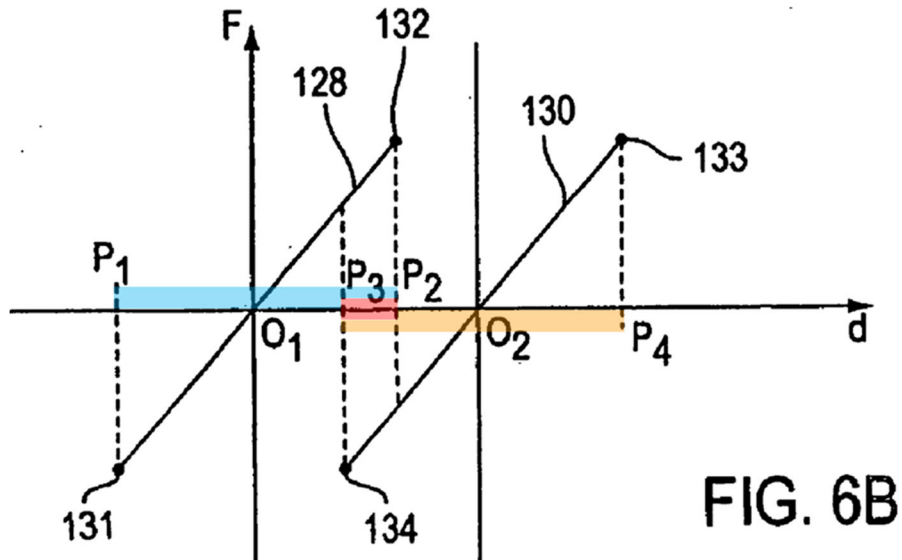


Figure 6B’s force detent profile has primary and secondary ranges of positions associated with the first detent 128 (**blue** below) and the second detent 130 (**orange**

below), respectively. A boundary range of positions overlaps with the primary and secondary ranges, namely the “overlap” range of positions (**red** below) (Ward, ¶246):



As demonstrated below, Levin anticipates and/or renders obvious most challenged claims. Ward, ¶247.

2. Claim 1

a. [1PRE]

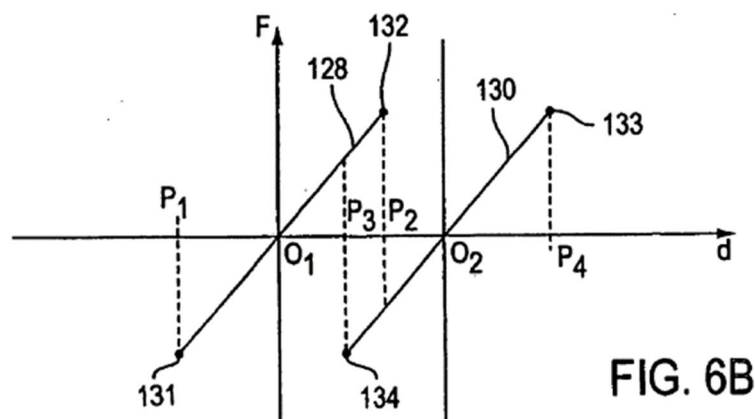
Levin’s “control knob 18” is a “*user input element*” because a user interacts with it to provide control input to an electronic device (e.g., a car radio). [0024]-[0027]; [0030]; FIG. 1; Ward, ¶248; *supra* §VII.F.1.

Levin's control knob is associated with a "*haptic output device*" as claimed because the control knob is coupled with an actuator ([0003], [0006]-[0010], [0047]), which is a "*haptic output device.*" EX1001, 4:36-53; Ward, ¶¶50, 249.

Levin discloses methods for controlling the "*user input element*" (e.g., control knob) by providing haptic feedback to it. Ward, ¶¶250-266; see §§VII.F.2.b-VII.F.2.c.

b. [1A]

Levin's method uses "detent force profiles," which are pre-defined force effects stored in a memory. [0049], [0067]; Ward, ¶251. The detent force profiles define the forces output at various "position[s] of the moved user object (knob) in a degree of freedom." [0067]; [0031]-[0032]. Figure 6B depicts six positions within the knob's degree of freedom: P1-P4 and O1-O2, with the latter two indicating the position of first and second detents ([0067], [0070]; Ward, ¶251):



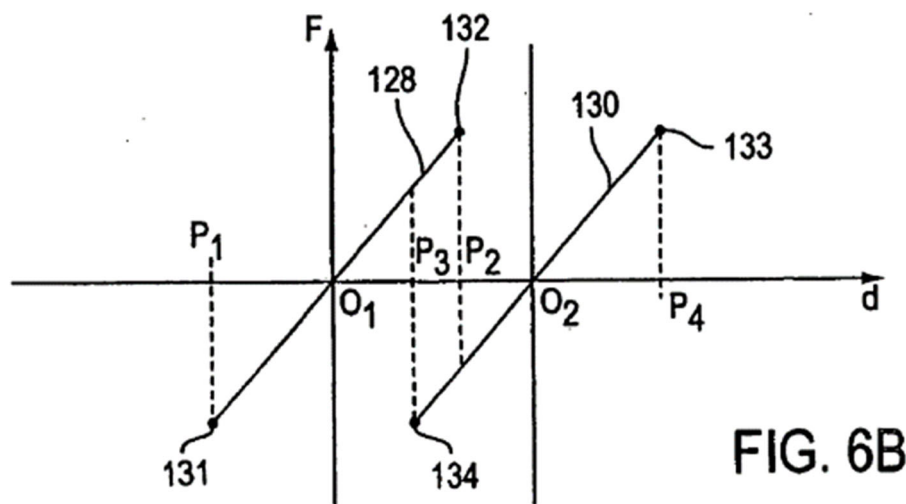
Levin's detent force profiles define ranges, including "a range of the first detent" (between P1 and P2 forming detent curve 128) and "a range of [a] second detent" (between P3 and P4 forming detent curve 130). [0009]; [0070]. Figure 6B also depicts Levin's "overlapped zone," i.e., the range "between positions P3 and P2." [0070]; Ward, ¶252.

Levin's detent force profiles "*defin[e] position and range information for the user input element associated with the haptic output device,*" as claimed. Ward, ¶253.

(1) [1A1]: a primary range of positions

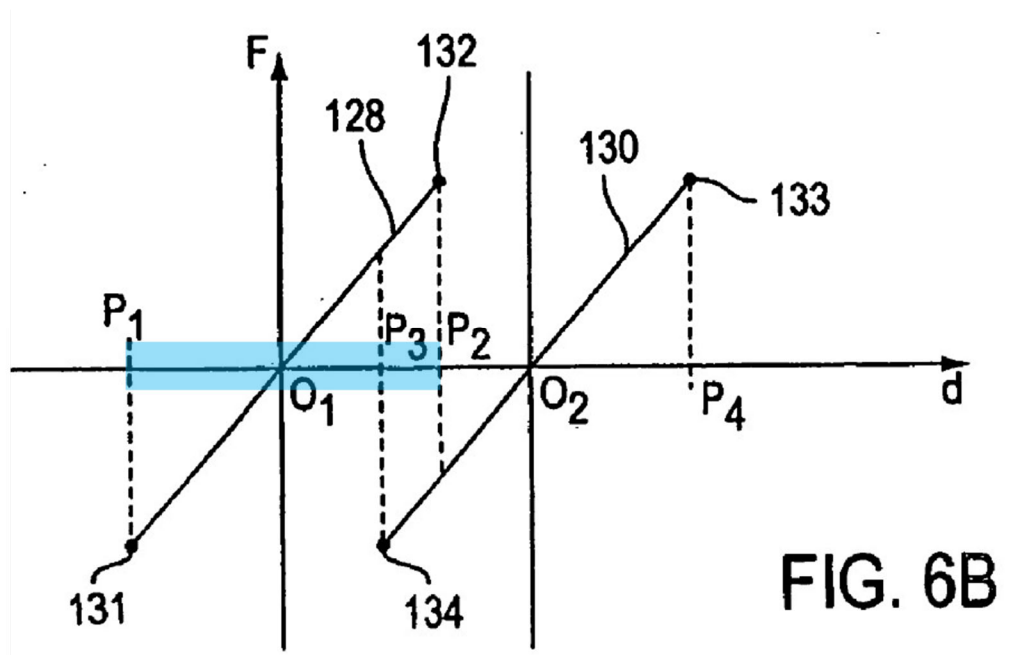
Levin's actuator outputs forces of varying magnitude on the control knob in a rotary degree of freedom when the knob rotates through various position ranges, including a "*primary range of positions*" as claimed. [0006], [0009]-[0011], [0067]-[0073]; Ward, ¶254.

Levin's Figure 6B force profile defines a "*primary range of positions.*" Ward, ¶255. In Figure 6B, the knob position is represented on horizontal axis d , while the force's magnitude is represented on vertical axis F . [0067]-[0070]; Ward, ¶255. "[A] positive F value indicates a force in one direction, and a negative F value indicates force in the opposite direction." [0067]. "Origin position[s]" O_1 and O_2 are positions of first and second detents, respectively. [0009], [0067]-[0070]; Ward, ¶255.



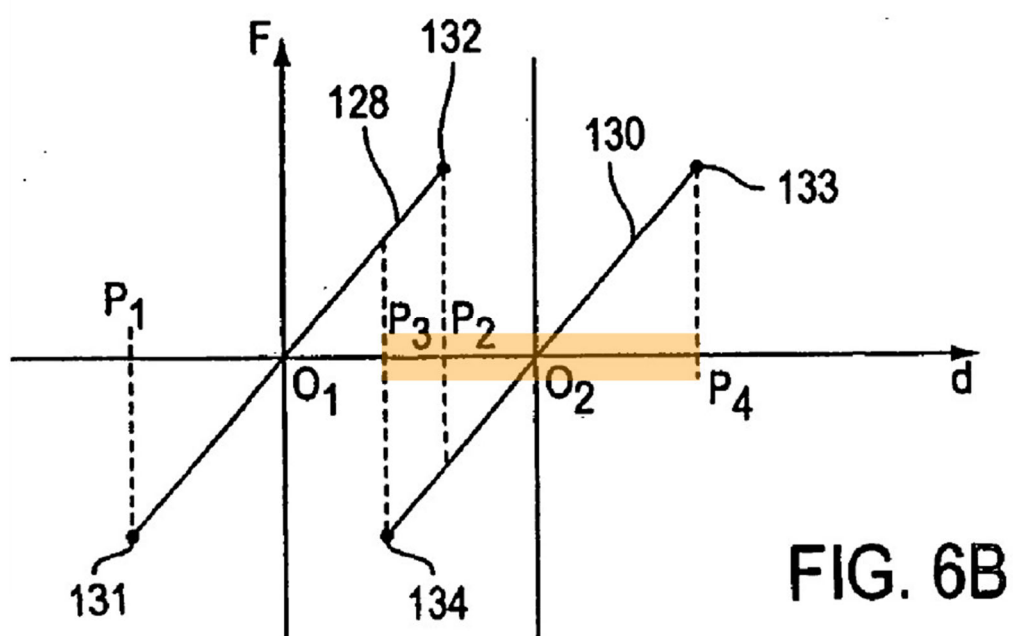
First force curve (128) is the diagonal line from point 131 (at knob position P_1) to point 132 (at knob position P_2) that depicts the force magnitude output for first detent O_1 . [0070]; Ward, ¶256. Second force curve (130) is the diagonal line from point 134 (at knob position P_3) to point 133 (at knob position P_4) that depicts the force output for the second detent O_2 . [0070]; Ward, ¶256.

Levin’s **range of positions from P_1 to P_2** (the “range of the first detent” [0009]) surrounding first detent O_1 is a “*primary range of positions*” as claimed at least because it is a range of positions within which the object moves and experiences a force of changing magnitude along the first force curve. [0009], [0067]-[0070]; Ward, ¶257.



(2) [1A2]: a secondary range of positions

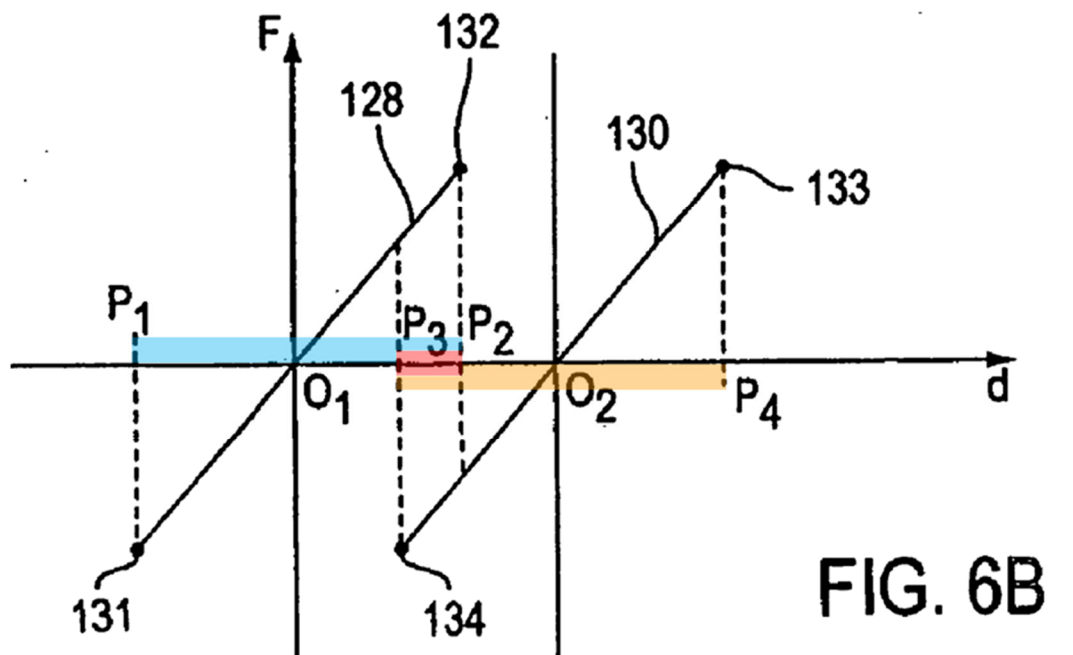
Levin's detent force profile includes a second force curve depicted below.



As illustrated, the detent force profile includes a secondary **range of positions from P₃ to P₄ (orange)** on the second force curve surrounding second detent O₂ (the “**range of the second detent**”). [0009], [0038], [0067]-[0070]; Ward, ¶258. Levin’s **range of positions from P₃ to P₄** (the “range of the second detent” [0009]) surrounding second detent O₂ is a “*secondary range of positions*” as claimed at least because it is a range of positions within which the object moves and experiences a force of changing magnitude along the second force curve. [0009], [0067]-[0070]; Ward, ¶258.

(3) [1A3]: a boundary range of positions

Levin’s force profile includes an “**overlapped zone**” between positions P₃ and P₂ (**red** below). [0070]; Fig. 6B; [0009] (“A portion of the range of the first detent overlaps a portion of the range of the second detent.”); [0011]; Ward, ¶259.



Levin’s “**overlapped zone**” (red) partially overlaps **range P₁ to P₂** of the **first detent O₁** (blue) (i.e., the claimed “*primary range of positions*”) and partially overlaps the **range P₃ to P₄** of the **second detent O₂** (orange) (i.e., the claimed “*secondary range of positions*”). Thus, Levin’s “**overlapped zone**” is a “*boundary range of positions*” that partially overlaps each of the “*primary range of positions*” and “*secondary range of positions*” as claimed. Ward, ¶¶259-260.

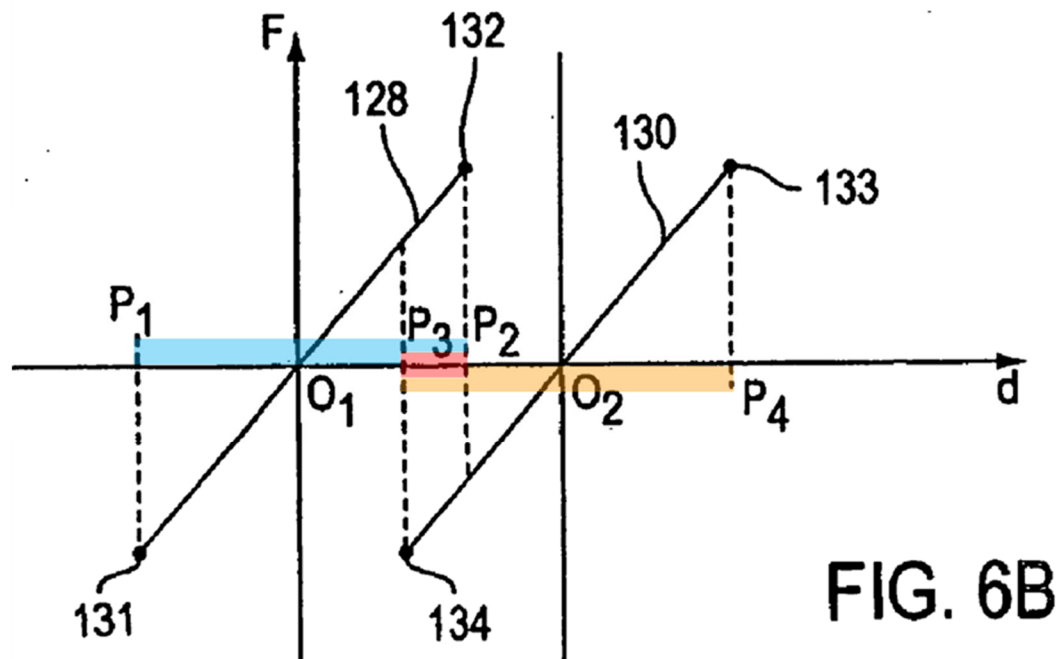
c. [1B]

Levin’s method provides force feedback (a haptic effect) to its control knobs via an actuator as the knob moves through the positions in its primary, secondary, and boundary ranges. See Title, Abstract, [0002]-[0011], [0047]-[0049], [0067]-[0071], [0086], [0094]; Ward, ¶261. Although Levin provides force feedback in

each range of positions, nothing in claim 1 or the specification precludes rendering haptic effects in the primary and secondary ranges in addition to rendering a haptic effect in the boundary range. Ward, ¶261.

The force curves in Figures 6B-6D illustrate the magnitude of the force feedback provided to the knob as it rotates, including as it rotates through Levin's **overlapped zone** (“*boundary range of positions*” as described above). *Supra* §§VII.F.1 and VII.F.2.b(3); [0069]-[0070]; Ward, ¶262.

As discussed *supra* §VII.F.2.b(3), Levin's Figure 6B illustrates “two detent curves 128 and 130” that partially overlap between positions P3 and P2 as shown below. [0070]; Ward, ¶263.



Levin's Figure 6C (below) illustrates the force feedback that occurs when the control knob is moved clockwise, e.g., from position O_1 toward position O_2 . [0071]; Ward, ¶264. As seen below, Levin's actuator outputs force feedback of increasing magnitude as the position of the knob rotates in one direction through positions in the overlapped zone starting at position 128 and continuing until the knob reaches position 132, at which point the actuator outputs a force of a lesser magnitude and in the opposite direction (illustrated by the yellow circle). [0070]-[0071], [0073]; Ward, ¶264. The force (depicted as 0.5M in the example shown) is of a "lesser magnitude" than the force that would be output at the start of the second force curve if there was no overlapped zone. [0073]; Ward, ¶264. "The use of a lesser magnitude at the beginning of the second detent [when there is an overlapped zone] reduces the tendency of the user to unintentionally skip past a second detent...." [0073]; Ward, ¶264.

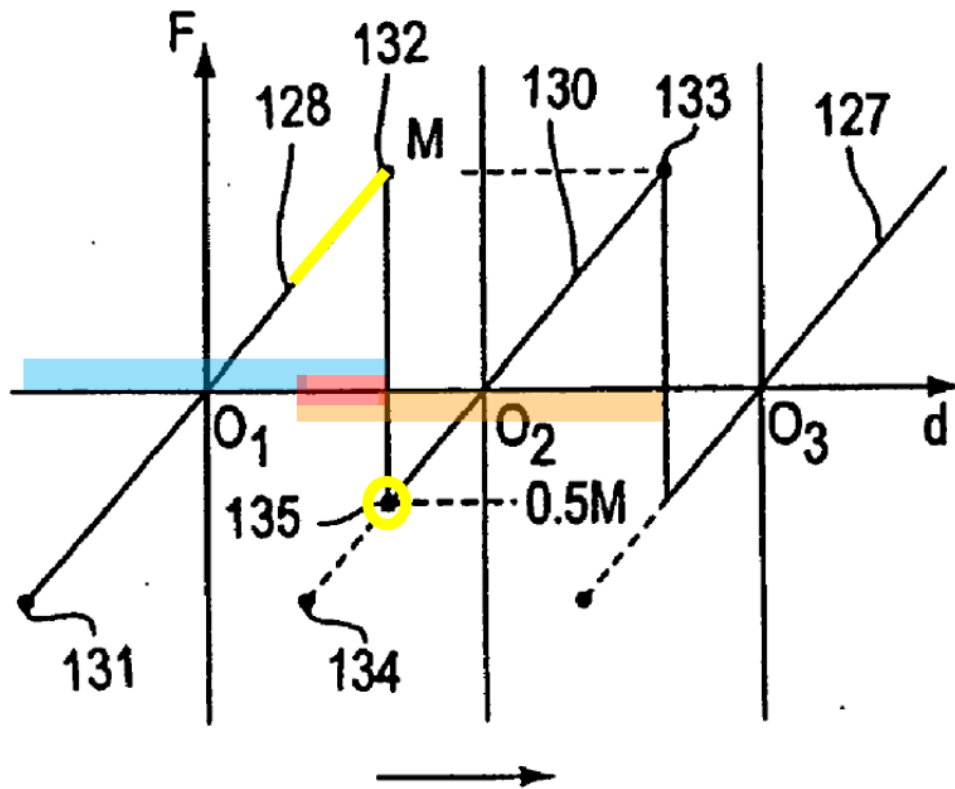


FIG. 6C

Levin's Figure 6D (below) illustrates the force feedback that occurs when the control knob is moved counterclockwise, e.g., from position O_2 toward position O_1 . [0072]; Ward, ¶265. As seen below, Levin's actuator outputs force feedback of increasing magnitude as the position of the knob rotates in counterclockwise through positions in the overlapped zone starting at position P2 (not depicted but shown in FIG. 6B as directly below position 132) and continuing until the knob reaches endpoint position 134, at which point the actuator outputs a force of a lesser magnitude and in the opposite direction (illustrated by the yellow circle). [0070]-[0071], [0073]; Ward, ¶265.

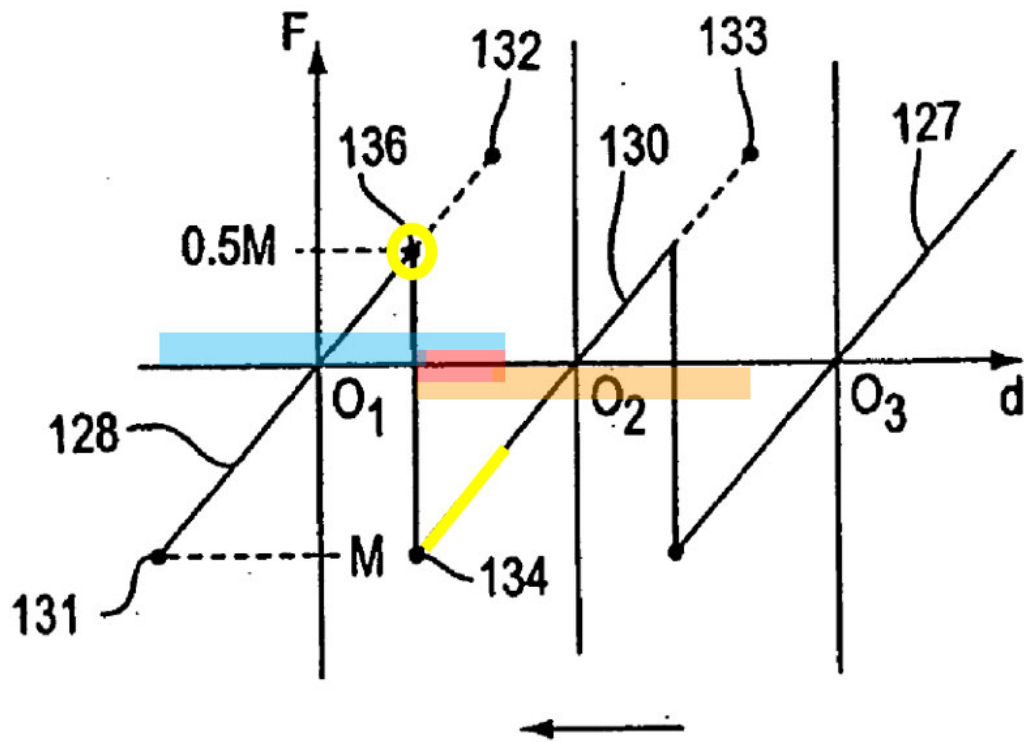


FIG. 6D

Levin's method therefore "*renders a haptic effect*" (the force feedback depicted in yellow in the annotated figures above) "*in response to an entry of the user input element to one or more positions within the boundary range of positions,*" as claimed. Specifically, it renders a gradual increase force feedback as the knob moves (clockwise or counterclockwise) through initial positions of the boundary range, and then renders force feedback of a lesser magnitude and in the opposition direction when the knob moves to an end position of the boundary range. Ward, ¶266.

3. Claim 3

To provide force feedback on its knob, Levin uses “detent force profiles” that map the knob’s physical position within its rotational freedom of movement to force magnitudes that are to be output onto the knob. [0067] (describing “detent force profiles” as comprising force magnitudes output based on the “distance or position” of the knob “in a degree of freedom”); [0075]; [0082]; Ward, ¶267. Force detent profiles are depicted in Levin’s Figures 6A-6D. Each maps a position of the knob to a force magnitude that is output onto the knob. [0021]-[0022]; Ward, ¶267.

Levin determines its knob’s position by using “sensors 214” that “sense the position” of “knob 26 along one or more degrees of freedom” and provide that information to microprocessor 202. [0093]; [0023]; FIG. 8. Exemplary sensors include “optical encoders” and “analog sensors” ([0093]) which cooperate with a “sensor interface 208” and/or “analog to digital converter (ADC)” to generate digital values to be “interpreted by the microprocessor 202” ([0090]). Ward, ¶¶268-272. Levin’s sensors are substantively the same as those disclosed in Goldenberg and perform the same analog-to-digital position-mapping function that Goldenberg’s sensors perform. *Supra* §VII.A.4; Ward, ¶273. Levin thus uses its sensors to perform the method of claim 3 for the same reasons that Goldenberg uses its sensors to do so. *Supra* §VII.A.4; Ward, ¶273. Alternatively, implementing Levin such that it uses its sensors to perform the method of claim 3 would have been obvious for the

same reasons it would have been obvious to implement Goldenberg to perform claim 3's method.

4. Claim 4

As explained *supra* §VII.A.5 (claim 4), 8-bit ADC mapping was well-known. Ward, ¶274. Creating increasing or decreasing ADC values for Levin's force profiles (*supra* §VII.F.3 (claim 3)) would have been a matter of straightforward design. Ward, ¶274. POSAs would not have put the values in a jumbled order, but in a monotonic order. Ward, ¶274. Only two plausible monotonic orderings exist: increasing or decreasing. Ward, ¶274.

5. Claim 6

Levin discloses “*monitoring a position of the user input element*,” as claimed. For example, Levin's sensor (*supra* §VII.F.3 (claim 3)) can “sense a range of positions of the knob 18 or a continuous motion of the knob.” [0043]; Ward, ¶275.

6. Claim 8

Independent claim 8 recites “*a non-transitory computer readable storage medium [CRM] storing a program configured to be executed by a processor, the program comprising instructions for*” carrying out claim 1's method. Ward, ¶276. Levin discloses such a CRM.

Levin's “[d]etent force profiles can be implemented by a microprocessor or other controller based on instructions stored in a computer readable medium” (Levin,

[0067]) which can be a “[l]ocal memory 206, such as RAM and/or ROM, ... to store instructions for microprocessor 202.” Levin, [0089], Fig. 8. Levin’s local memory is “*a non-transitory computer readable storage medium storing a program configured to be executed by a processor,*” where the program is the set of software instructions executed by Levin’s microprocessor to implement Levin’s detent force profiles. [0101]; Ward, ¶277.

The steps recited in the remaining limitations of claim 8 are identical to the method steps recited in [1A]-[1B], and are met and/or rendered obvious by for the same reasons discussed in §§VII.F.2.b-c. Ward, ¶278.

7. Claims 10-11 and 13

Dependent claims 10-11 and 13 add the same limitation to claim 8 that dependent claims 3-4 and 6 add to claim 1, respectively. Levin’s CRM stores a program comprising instructions for performing the steps recited in claims 10-11 and 13 for the same reasons Levin meets and/or renders obvious claims 3-4 and 6. *Supra* §VII.F.3-5; Ward, ¶279.

8. Claim 15

Independent claim 15 is substantially identical to independent claim 1 except that claim 15 recites “*a device,*” and that “*device*” comprises both “*a processor*” and “*a memory storing a program for execution by the processor, the program including instructions for*” carrying out a process identical to claim 1’s method. Ward, ¶280.

As seen in Levin’s Figure 1, Levin discloses a device 10 that includes an automotive control panel 12. [0024]; Ward, ¶281. Levin also describes other “devices,” including “a video game console” or “a controller” for such a console. [0026]; Ward, ¶281.

Levin’s device 10 includes the microprocessor 202 and memory 206 discussed in connection with claim 8. [0086]-[0087], FIG. 8. The memory 206 stores instructions for performing the steps recited in [1A]-[1B] for the reasons discussed in connection with claim 8. [0049]; Ward, ¶282; *supra* §VII.F.6.

9. Claims 17 and 19

Dependent claims 17 and 19 add the same limitation to claim 15 that claims 3 and 6 added to claim 1, respectively. Levin meets claims 17 and 19 for the reasons it meets and/or renders obvious claims 3 and 6. *Supra* §§VII.F.3 and VII.F.5; Ward, ¶283.

VIII. 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*⁷ if there is compelling evidence of unpatentability, which this Petition provides, thereby concluding the *Fintiv* analysis.

⁷ *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (Mar. 20, 2020) (precedential).

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 has requested 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*, IPR2019-01393, Paper 24 at 7 (June 16, 2020) (informative); *see* EX1010.

2. Timing of Trial

Though June 2025 is the trial-ready date (EX1019), the Board considers the median time to trial which is 27 months for the Western District of Washington (EX1011, 76), putting trial in late August 2025 just one month before a final written decision is expected. *Cf. Sony Interactive v. Quantum Imaging*, IPR2023-00954, Paper 11 at 26 (Dec. 11, 2023) (trial four months before FWD “weighs against discretionary denial”)

Moreover, Petitioner filed this petition diligently, roughly two months before the §315(b) deadline. EX1009, EX1013. 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 (EX1014, EX1015), the parties have invested little in the district court litigation, weighing

against discretionary denial. *Samsung Elecs. v. Netlist, Inc.*, IPR2022-00063, Paper 13 at 8 (May 5, 2022) (granting institution where no “claim construction and merits determinations” had yet been reached).

4. Overlap of Issues

Given the early stage of the litigation, the overlap between the issues before the Board and the district court are not yet known.

5. Litigation Defendants

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

B. Section 325(d)

Petitioner’s references were not cited during prosecution. Discretionary denial under §325(d) is not warranted.

IX. CONCLUSION

The Board should institute IPR against claims 1-20.

Respectfully submitted,

Date: March 22, 2024

/Richard Giunta/

Richard F. Giunta, Reg. No. 36,149
WOLF, GREENFIELD & SACKS, P.C.

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

I certify that on March 22, 2024, I will cause a copy of the foregoing document, including any exhibits or appendices filed therewith, to be served via Priority Mail Express at the following correspondence address of record for the patent:

Medler Ferro Woodhouse & Mills/Immersion
8201 Greensboro Drive, Suite 1060
McLean, VA 22102

Date: March 22, 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 13,994 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. Petitioner has relied on the word count feature of the word processing system used to create this paper in making this certification.

Date: March 22, 2024

/MacAulay Rush/

MacAulay Rush

Paralegal

WOLF, GREENFIELD & SACKS, P.C.

X. CLAIM LISTING

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

Claim 1
[1PRE] A method for controlling a user input element associated with a haptic output device, the method comprising:
[1A] defining position and range information for the user input element associated with the haptic output device, including
[1A1] a primary range of positions,
[1A2] a secondary range of positions, and
[1A3] a boundary range of positions, wherein the boundary range of positions partially overlaps each of the primary range of positions and the secondary range of positions; and
[1B] rendering a haptic effect in response to an entry of the user input element to one or more positions within the boundary range of positions.
Claim 2
The method of claim 1, wherein one of the primary range of positions, the secondary range of positions, and the boundary range of positions is calculated based on a movement of the user input element from a maximum out position to a grounding position.
Claim 3
The method of claim 1, wherein a profile for the user input element is calculated by mapping each position of the user input element to an analog to digital conversion value.
Claim 4
The method of claim 3, wherein the profile for the user input element is an increasing profile or a decreasing profile.
Claim 5
The method of claim 1, wherein a normalized profile for the user input element is calculated by removing at least one of the secondary range of positions or the boundary range of positions from mapped analog to digital conversion values.
Claim 6

The method of claim 1, further comprising monitoring a position of the user input element.
Claim 7
The method of claim 1, further comprising adjusting a profile and a normalized profile of the user input element to adjust for a change to a resting position of the user input element.
Claim 8
[8PRE] A non-transitory computer readable storage medium storing a program configured to be executed by a processor, the program comprising instructions for:
[8A] defining position and range information for the user input element associated with the haptic output device, including
[8A1] a primary range of positions,
[8A2] a secondary range of positions, and
[8A3] a boundary range of positions, wherein the boundary range of positions partially overlaps each of the primary range of positions and the secondary range of positions; and
[8B] rendering a haptic effect in response to an entry of the user input element to one or more positions within the boundary range of positions.
Claim 9
The non-transitory computer readable storage medium of claim 8, wherein one of the primary range of positions, the secondary range of positions, and the boundary range of positions is calculated based on a movement of the user input element from a maximum out position to a grounding position.
Claim 10
The non-transitory computer readable storage medium of claim 8, wherein a profile for the user input element is calculated by mapping each position of the user input element to an analog to digital conversion value.
Claim 11
The non-transitory computer readable storage medium of claim 10, wherein the profile for the user input element is an increasing profile or a decreasing profile.
Claim 12
The non-transitory computer readable storage medium of claim 8, wherein a normalized profile for the user input element is calculated by removing at least one of the secondary range of positions or the boundary range of positions from mapped analog to digital conversion values.

Claim 13
The non-transitory computer readable storage medium of claim 8, further comprising instructions for monitoring a position of the user input element.
Claim 14
The non-transitory computer readable storage medium of claim 13, further comprising instructions for adjusting a profile and a normalized profile of the user input element to adjust for a change to a resting position of the user input element.
Claim 15
[15PRE] A device comprising:
[15A] a processor; and
[15B] a memory storing a program for execution by the processor, the program including instructions for:
[15C] defining position and range information for the user input element associated with the haptic output device, including
[15C1] a primary range of positions,
[15C2] a secondary range of positions, and
[15C3] a boundary range of positions, wherein the boundary range of positions partially overlaps each of the primary range of positions and the secondary range of positions; and
[15D] rendering a haptic effect in response to an entry of the user input element to one or more positions within the boundary range of positions.
Claim 16
The device of claim 15, wherein one of the primary range of positions, the secondary range of positions, and the boundary range of positions is calculated based on a movement of the user input element from a maximum out position to a grounding position.
Claim 17
The device of claim 15, wherein a profile for the user input element is calculated by mapping each position of the user input element to an analog to digital conversion value.
Claim 18
The device of claim 15, wherein a normalized profile for the user input element is calculated by removing at least one of the secondary range of positions or the boundary range of positions from mapped analog to digital conversion values.

Claim 19

The device of claim 15, further comprising instructions for monitoring a position of the user input element.

Claim 20

The device of claim 19, further comprising instructions for adjusting a profile and a normalized profile of the user input element to adjust for a change to a resting position of the user input element.