

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VALVE CORPORATION.

Petitioner,

v.

IMMERSION CORPORATION

Patent Owner.

Case No. TBD

Patent No. 9,430,042

DECLARATION OF JEAN RENARD WARD

Valve Exhibit 1003 Valve v. Immersion
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I. INTRODUCTION

1. My name is Jean Renard Ward. I have been retained by Wolf, Greenfield & Sacks, P.C., counsel for Petitioner Valve Corp. to assess Claims 1-7 (“the challenged claims”) of U.S. Patent No. 9,430,042 (“the ’042 Patent”) (EX1001). I am being compensated for my time at the rate of \$500 per hour, plus actual expenses. This is consistent with the rate I generally charge for this sort of work. My compensation is not dependent in any way upon the outcome of the *inter partes* review of the ’042 Patent, nor on the outcome of any related litigation.

2. I expect to make myself available for deposition in this matter. This Declaration is based on information currently available to me. I reserve the right to continue my investigation and study, which may include a review of documents and information that may be produced, as well as a review of deposition testimony from depositions for which transcripts are not yet available or that may yet have taken place in this matter. Therefore, I expressly reserve the right to expand or modify my opinions as my investigation and study continue, and to supplement my opinions in response to any additional information that becomes available to me, any matters raised by Immersion or the Patent Office, and/or other opinions provided by Immersion’s experts, or in light of any relevant orders by an appropriate authoritative body.

II. QUALIFICATIONS AND PROFESSIONAL EXPERIENCE

3. I received an SBEE degree (combined program in Electrical Engineering and Computer Science) from the Massachusetts Institute of Technology as a member of the class of 1973.

4. I am a practicing engineer. For a number of years, I have primarily been doing consulting projects and contract development work under the business name of Rueters-Ward Services. I have worked professionally in the general field of software engineering and relevant hardware for approximately 50 years, primarily in pen/touch computing and related technologies, applications of public-key cryptography, and web development. In recent years, my major projects have concerned pen/touch computing: also referred to simply as pen computing or touch computing. Pen computing refers to computing that makes use of a pen, stylus (including a finger), or other touch-sensitive tool, and a tablet or touchscreen. This is contrasted with computing that makes use of devices such as a physical keyboard or a physical mouse.

5. During and immediately after my university studies, from 1973 to 1977, I worked at Data General Corporation on compilers and source-level emulation tools for a number of programming languages.

6. For the next approximately 17 years, I worked primarily on many aspects of pen computing, both software and hardware, at a number of development

companies. From 1977 to 1987, I was heavily involved in the development of base technology and three generations of pen-computing products of Pencept Inc., a pioneering commercial company for pen-computing technology that I co-founded. Pencept filed for and was granted a number of patents for my work during that time. My contributions included developing novel techniques for gesture and handwriting recognition, new paradigms for pen- and stylus-based user interfaces, two generations of an applicative computer language for gesture and handwriting recognition, and engineering solutions to problems with touchscreens and digitizing tablets.

7. While at Pencept, I participated in the re-engineering of off-the-shelf commercial tablets that detected touch from an electronic stylus; the engineering evaluation of off-the-shelf tablet technologies, including at least one having transparent touchscreen sensors that responded both to finger touches and to touch by a specialized stylus; and the design of a custom electronic tablet responsive to an electromagnetic stylus.

8. During that time and in the years following, I authored or co-authored a number of peer-reviewed articles concerning pen-computing, generative models for handwriting variability, and digitizer/touchscreen technologies and error behaviors.

9. These articles are listed in my CV, which is EX1004 to this declaration.

I was an invited speaker at an international research conference on handwriting recognition in Montreal, Canada. I also made presentations concerning gesture input for Pencept and its competitors to the Graphical Kernel System (GKS) and Programmer's Hierarchical Interactive Graphics System (PHIGS) standardization committees for computer graphics systems, and organized and chaired a panel discussion concerning real-world problems of handwriting recognition technology at another academic conference. I was also invited to visit and speak to the research groups in pen computing at a number of major computer technology companies, including IBM in the United States and the AEG-Telefunken Research Center in Germany.

10. In 1989, I joined the Freestyle development group at Wang Laboratories as a Software Architect. Freestyle was a direct-manipulation pen-computing system that integrated stylus- and voice-input and annotations. During my tenure there, Wang filed for and later was granted U.S. and international patents for my work on simulating virtual keyboard and mouse input from stylus user input on a touch-sensitive tablet. In addition, I was the lead engineer for Wang on a joint hardware project with for a low-power, touchscreen technology using a capacitive stylus for a line of highly-portable handheld computers.

11. In 1991, at the end of Freestyle development, I joined Slate Corporation, a company formed to develop pen-centric applications for both the new Pen-Point (GO Corporation) and Pen Windows (Microsoft) operating systems for tablet and touchscreen computers. During that time, I was Slate's representative and the co-chair of a number of meetings involving GO Corporation, Microsoft, and other companies concerning the JOT cross-platform storage-level standard for compressed electronic ink data, and was the primary author of the first draft for that standard. I made presentations regarding the history of pen computing to technical groups interested in the topic. I also conducted tutorials on touchscreen/pen interfaces and technology at two annual meetings of the Society for Information Display, the leading engineering society for display technologies.

12. From approximately 1993 onward, my professional work has been primarily as an independent developer and consultant in the areas of applications of public-key cryptography and computer security, in addition to pen/touch computing.

13. Since the late 1980s, I have maintained an extensive library of references relating to pen-computing, touchscreens, and related technical subjects. I have continually published a working annotated bibliography of these references on the internet for more than 20 years.

14. In about 1985 to 1987, I was preparing an article for publication in the IEEE journal "Systems Man and Cybernetics", which included a substantial review

of problems presented by handwriting variability in the field of handwriting and gesture recognition using touch screens and tablets. About this same time, I also prepared a tutorial article for the IEEE publication Computer Graphics and Applications on some of the broad variety of touch screen and tablet technologies and an introduction to their technical limitations. In the course of preparing those articles, I began keeping a bibliography in electronic form, with annotations, to assist in referencing the articles. I also spent several days, for each article, doing technical research in the MIT engineering library – the Internet did not exist at that time. At the end of those projects, I had an electronic database of several hundred references with annotations. To assist me in keeping up to date and preparing possible future presentations or articles (such as a presentation I gave a few years later on the history of pen and touchscreen computing), I decided to add other references I collected in my professional work, and to continue adding references of interest.

15. When the Internet became available, a number of technical people in computer-related fields began publishing their technical materials on the Internet as a service to each other. As a service to those with an interest in the field, I also began posting my bibliography online in about the early 1990s. In more recent years, because of my professional work and because of the relation to applications, the bibliography also contains references related to computer security, cryptography, and DRM digital rights management.

16. The bibliography is available on my professional web site at www.ruetersward.com, and on a number of mirrors. The annotations appearing in the bibliography were written by me to provide a short statement/reminder of what I thought was interesting and/or relevant about each reference at the time. It has been my usual practice to update the bibliography at irregular periods several times a year or more often, as I had time. The bibliography has been cited in refereed technical papers by others, by the USPTO, and in academic degree theses such as at M.I.T.

17. I obtained copies of the many of the publications and references in the course of the projects I have worked on throughout my career, others through my independent reading and study. I keep hard or electronic copies of the majority of the references as part of my personal records. I have read the references in my bibliography because of my professional work, my intellectual interests, to keep up to date with developments in pen-computing and other fields, and/or to record the history of the field.

18. I also have a personal collection of touch screen and touch tablet devices that I have acquired over the years. These include equipment from past projects I have worked on, as well as other items I considered of note, including a very early model portable phone with an integrated touch screen and display, a very early calculator that used an electromechanical touchpad for handwritten entry of

calculations, at least one model of a very early PDA with an integrated touch screen and display and handwriting recognition, and various models from the early 1990's of portable touchscreen computers running one or another complete touchscreen operating systems, and devices such as smartphones with haptic/vibrotactile feedback.

19. A copy of my curriculum vitae with descriptions of my education, professional achievements, and qualifications is attached to this declaration as EX1004. It includes a listing of relevant industry experience, publications, presentations, and prior testimony.

III. MATERIALS REVIEWED AND CONSIDERED

20. My findings, as explained below, are based on my years of education, research, experience, and background in the fields of software engineering, haptics programming, human-computer interaction and/or pen and touch computing, as well as my investigation and study of relevant materials for this declaration. When developing the opinions set forth in this declaration, unless noted otherwise, I have assumed the point of view of a person having ordinary skill in the art ("POSITA"), as set forth in Section V below. In forming my opinions, I have studied and considered the materials identified in the list below

Exhibit	Description
1001	U.S. Patent No. 9,430,042

1002	Prosecution History of U.S. Patent No. 9,430,042
1003	Declaration of Jean Renard Ward
1004	CV of Jean Renard Ward
1005	U.S. Provisional Application No. 60/877,333
1006	European Patent No. 2126667
1007	U.S. Patent No. 6,636,197
1008	U.S. Patent Application Publication No. US 2006/0038781
1009	U.S. Patent No. 6,429,846
1010	U.S. Patent No. 5,734,373
1011	U.S. Patent No. 6,243,078
1012	U.S. Patent Application Publication No. US 2006/0119573
1013	U.S. Patent No. 5,977,867
1014	U.S. Patent No. 6,128,006
1015	U.S. Patent No. 6,819,990
1016	U.S. Patent No. 6,686,911
1017	U.S. Patent No. 6,917,867
1018	U.S. Patent Application Publication No. US 2007/0222765
1019	Plaintiff's Preliminary Infringement Contentions, <i>Immersion Corp. v. Valve Corp.</i> , 2:23-cv-00712 (W.D. Wash.) (served Oct. 20, 2023)
1020	Amended Joint Status Report and Discovery Plan, <i>Immersion Corp. v. Valve Corp.</i> , 2:23-cv-00712, Dkt No. 45 (W.D. Wash) (filed Nov. 2, 2023)
1021	Exhibit C to Plaintiff's Preliminary Infringement Contentions, <i>Immersion Corp. v. Valve Corp.</i> , 2:23-cv-00712 (W.D. Wash.) (served Oct. 20, 2023)
1022	International Application Publication Number WO 02/102616
1023	U.S. Patent Application Publication No. US 2006/0047386
1024	U.S. Patent Application Publication No. US 2007/0120830

1025	U.S. Patent No. 6,157,372
1026	U.S. Patent No. 6,418,362
1027	International Application Publication Number WO 97/25821
1028	International Application Publication Number WO 00/65553
1029	Negroponte, "HUNCH An Experiment in Sketch Recognition" in UCLA, Environmental Design: Research and Practice, Proceedings of the EDRA 3/ar 8 Conference (1972)
1030	Foley, "Fundamentals of Interactive Computer Graphics" (1982) (excerpts)
1031	Buxton, "There's More to Interaction than Meets the Eye" in Norman, ed., User Centered Systems Design (1986)
1032	Rosch, "Alternative Input--Digitizing Tablets-Pointing the Way to Easier Input," PC Magazine p. 227 (Nov. 28, 1989)
1033	U.S. Patent No. 5,491,495
1034	Buxton, "Issues and Techniques in Touch-Sensitive Tablet Input," SIGGRAPH '85, 19:3, 215 (1985)
1035	U.S. Patent No. 4,202,041
1036	Evans, "Tablet-Based Valuers That Provide One, Two, or Three Degrees of Freedom," Computer Graphics, 15:3 (Aug. 1981)
1037	U.S. Patent No. 5,903,229
1038	U.S. Patent Appl. 2006/0291666A1
1039	WO2006020305
1040	U.S. Patent Appl. 2007/0222765A1
1041	U.S. Patent No. 494,562
1042	Davis, "The RAND Tablet: A Man-Machine Graphical Communication Device" in Proceedings-Fall Joint Computer Conference (1964)
1043	U.S. Patent No. 3,482,241
1044	U.S. Patent No. 5,708,460
1045	U.S. Patent No. 6,492,979

1046	U.S. Patent No. 5,510,813
1047	Buxton, "Touch Gesture and Marking," ch. 7 in Baecker, ed., Readings in Human-Computer Interaction (1995)
1048	U.S. Patent No. 6,160,489
1049	Strong, "An Electrotactile Display," IEEE, Trans. On Man-Machine Sys., mms-11:1 (Mar. 1970)
1050	Massie, "Initial Haptic Explorations with the Phantom: Virtual Touch Through Point Interaction" MIT Thesis (1996)
1051	Bliss, "Optical-to-Tactile Image Conversion for the Blind," IEEE, Trans. On Man-Machine Sys., mms-11:1 (Mar. 1970)
1052	European Patent Publication No. EP0265011A1
1053	U.S. Patent No. 5,388,992
1054	IBM, "Mouse Ball-Actuating Device with Force and Tactile Feedback," IBM Technical Disclosure Bulletin 32:9B (Feb. 1990)
1055	Fukumoto, "Active Click Tactile Feedback for Touch Panels," CHI 2001 Interactive Posters (2001)
1056	WO9200559A1
1057	U.S. Patent Appl. No. 2006/0241864A1
1058	U.S. Patent No. 5,782,639
1059	U.S. Patent Appl. No. 2006/0049010
1060	WO2004042693
1061	U.S. Patent Appl. No. 2003/0030619
1062	U.S. Patent No. 6,424,333
1063	EP0799597A1
1064	U.S. Patent No. 5,719,561
1065	U.S. Patent No. 5,973,441
1066	Minsky, "Computational Haptics" MIT Thesis (1995)
1067	U.S. Patent No. 5,451,924

1068	Patrick, “Design Construction and Testing of a Fingertip Tactile Display for Interaction with Virtual and Remote Environments,” MIT Thesis (1990)
1069	Massie, “The Phantom Haptic Interface—A Device for Probing Virtual Objects” in ASME, Dynamic Systems and Control (1994)
1070	U.S. Patent No. 5,982,352
1071	U.S. Patent No. 6,131,097
1072	U.S. Patent No. 6,337,678
1073	U.S. Patent No. 6,219,034
1074	U.S. Patent No. 6,219,032
1075	U.S. Patent No. 4,885,565
1076	U.S. Patent No. 6,031,518
1077	U.S. Patent No. 7,084,859
1078	U.S. Patent No. 6,848,263
1079	U.S. Patent No. 6,275,231
1080	West, “Developing High Quality Data Models,” EPISTLE (1996)
1081	U.S. Patent Appl. No. 2003/0122779
1082	Leonard, “Windows XP Hacks and Mods For Dummies” (2005)

IV. MY UNDERSTANDING OF THE RELEVANT LAW

21. I am not an attorney. My knowledge of the law is that of a lay person. As I am not a legal expert, I offer no opinions on the law. Unless noted otherwise, wherever I may use a term which has some special meaning in a legal context, I imply no such special legal meaning should be assigned to use of that term. Further, as I have no special expertise in the law, I am likely unaware whether a term even

might or might not have some special legal meaning, nor what any such meaning might be.

22. In developing my opinions, Petitioner's attorneys ("Counsel" for short) discussed various relevant legal principles with me. When I have thought that my understanding could be based inadvertently in some part on my experience elsewhere, I have sought to confirm or correct that understanding with Counsel. I understood these principles when they were explained to me and have relied upon such legal principles, as explained to me, in the course of forming the opinions set forth in this declaration. I summarize my understandings in this respect as follows:

23. I understand that "*inter partes* review" (IPR) is a proceeding before the United States Patent & Trademark Office for evaluating the patentability of an issued patent's claims based on prior-art patents and printed publications.

24. I understand that, in this proceeding, Petitioner has the burden of proving that the challenged claims of the '042 Patent are unpatentable by a preponderance of the evidence. I understand that "preponderance of the evidence" means that a fact or conclusion is more likely true than not true.

25. I understand that, in IPR proceedings, claim terms in a patent are "construed" or given their ordinary and customary meaning as understood by a person of ordinary skill in the art ("POSITA") in the context of the entire patent and the prosecution history pertaining to the patent. If the specification or prosecution

history provides a special definition for a claim term that differs from the meaning the term would otherwise possess, that special definition controls. I have applied these standards in my analysis and in deriving the opinions in this declaration.

26. I understand that a patent or other publication must first qualify as prior art before it can be used to render a patent claim anticipated or obvious. I understand that whether or not a particular reference qualifies as prior art is a legal determination: as I am not a lawyer, I have relied on Counsel to inform me as to whether a reference qualifies as prior art.

27. I understand that determining whether a particular patent or printed publication constitutes prior art to a challenged patent claim can require determining the effective filing date (also known as the priority date) to which the challenged claim is entitled. I understand that for a patent claim to be entitled to the benefit of the filing date of an earlier application to which the patent claims priority, the earlier application must have described the claimed invention in sufficient detail to convey with reasonable clarity to the POSITA that the inventor had possession of the claimed invention as of the earlier application's filing date. I understand that a disclosure that merely renders the claimed invention obvious is not sufficient written description for the claim to be entitled to the benefit of the filing date of the application containing that disclosure.

28. I understand that for an invention claimed in a patent to be patentable, it must be, among other things, new (novel—*i.e.*, not anticipated) and not obvious from the prior art. My understanding of these two legal standards is set forth below.

A. Legal Standard for Anticipation

29. I understand that for a patent claim to be “anticipated” by the prior art (and therefore not novel), each and every limitation of the claim must be found, expressly or inherently, in a single prior-art reference. I understand that a claim limitation is disclosed for the purpose of anticipation if a POSITA would have understood the reference to disclose the limitation based on inferences that a POSITA would reasonably be expected to draw from the explicit teachings in the reference when read in light of the POSITA’s knowledge and experience.

30. I understand that a claim limitation is inherent in a prior art reference if that limitation is necessarily present when practicing the teachings of the reference, regardless of whether a person of ordinary skill recognized the presence of that limitation in the prior art.

B. Legal Standards of Obviousness

31. I understand that if a patent claim is not anticipated, a patent claim may be invalid if it would have been obvious in view of a single prior-art reference or a combination of prior-art references.

32. I understand that a patent claim is obvious if the differences between the subject matter of the claim and the prior art are such that the subject matter as a whole would have been obvious to a person of ordinary skill in the relevant field at the time the invention was made. Specifically, I understand that the obviousness question involves a consideration of:

- the scope and content of the prior art;
- the differences between the prior art and the claims at issue;
- the knowledge of a person of ordinary skill in the pertinent art; and
- if present, objective factors indicative of non-obviousness, such as commercial success, long-felt but unresolved needs, failure of others, etc. sometimes referred to as “secondary indicia” or “secondary considerations.”

To my knowledge, Patent Owner has not asserted any such secondary considerations with respect to the '042 Patent.

33. I understand that in order for a claimed invention to be considered obvious, a POSITA must have had a reason for combining teachings from multiple prior-art references (or for altering a single prior-art reference, in the case of obviousness in view of a single reference) in the fashion proposed.

34. I further understand that in determining whether a prior-art reference would have been combined with other prior art or with other information within the

knowledge of a POSITA, the following are examples of approaches and rationales that may be considered:

- combining prior-art elements according to known methods to yield predictable results;
- simple substitution of one known element for another to obtain predictable results;
- use of a known technique to improve similar devices in the same way;
- applying a known technique to a known device ready for improvement to yield predictable results;
- applying a technique or approach that would have been “obvious to try,” *i.e.*, choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success.
- known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to one of ordinary skill in the art;
- some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior-art reference or to combine prior-art reference teachings to arrive at the claimed invention. I understand that this teaching, suggestion, or motivation

may come from a prior-art reference or from the knowledge or common sense of one of ordinary skill in the art.

35. I understand that a universal motivation known in a particular field to improve technology can provide a motivation to combine prior art references even absent any hint or suggestion in the references themselves. I also understand that obviousness is determined in light of all the facts and that a given course of action often has simultaneous advantages and disadvantages, and that this does not necessarily obviate the existence of a motivation to combine teachings from multiple references.

36. I understand that for a single reference or a combination of references to render the claimed invention obvious, a POSITA must have been able to arrive at the claimed invention by modifying, implementing, or combining the teachings of the applied references.

V. THE PERSON OF ORDINARY SKILL IN THE ART

37. I understand that the novelty of a patent claim is based on the point of view of a Person of Ordinary Skill in the Art (“POSITA”). I understand that a POSITA is a hypothetical person of ordinary inventive skill in the relevant art, who would also be aware and understand the teachings of all possible prior art references. I also understand that a POSITA is not an automaton, but a person of ordinary creativity. I have applied this standard throughout my declaration.

38. I was asked to provide an opinion as to the level of skill for a POSITA as of December 27, 2006.

39. The '042 Patent relates to systems and method for providing vibrotactile feedback to a user via an actuator coupled to an input device such as a physical knob or a touchpad. Based on how a user manipulates the input device, a processor generates a signal that causes an actuator to produce a vibrotactile effect (*e.g.*, vibration), and that vibrotactile effect is felt by the user manipulating the input device. EX1001 at 1:50-2:3. In particular, the patent relates to vibrotactile effects that mimic mechanical detents, *i.e.* “virtual detents.” EX1001 at 1:14-44.

40. In the context of the '042 Patent and the relevant prior art, a POSITA in this matter would have 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, and/or human-computer interaction, including experience with user-interfaces and applications involving touchscreens, touchpads, and related devices as well as with the basic electronic and hardware operation of such devices.

41. In reaching this opinion as to the hypothetical POSITA, I have considered the types of problems encountered in the art, the prior art solutions to those problems, the rapidity with which innovations are made, the sophistication of

the technology, and the educational level and professional capabilities of workers in the field.

42. I have at least the qualifications of a POSITA. In many aspects my qualifications and expertise exceed that of a POSITA. However, I have also worked with many people who fit the characteristics of the POSITA, and I am familiar with their level of skill in and around December 27, 2006.

43. When developing my opinions for this declaration, and unless otherwise noted, my analysis and conclusions are based on the point of view and expertise of a POSITA.

VI. PRIMARY REFERENCES CONSIDERED

44. As I discuss more fully in Section XI, my analysis in this declaration focuses primarily on the following references:

Reference	Exhibit No.	Shorthand
U.S. Patent No. 6,819,990	EX1015	Ichinose
U.S. Patent No. 6,686,911	EX1016	Levin
WIPO Appl. Publ. No. WO 02/102616	EX1022	Wang
U.S. Patent No. 6,429,846	EX1009	Rosenberg-I
U.S. Patent No. 6,636,197	EX1007	Goldenberg

VII. SUMMARY OF MY OPINIONS

45. As I discuss more fully in Section XI, my opinion is that Claims 1-19 of the '042 Patent are each unpatentable. In particular, I have concluded that:

- Ichinose in view of Levin renders obvious Claims 1-19.
- Wang in view of Ichinose renders obvious Claims 1-19.
- Rosenberg-I anticipates and/or renders obvious Claims 1-19.
- Rosenberg-I in view of Goldenberg renders obvious Claims 1-19.

VIII. AN OVERVIEW OF THE STATE OF THE RELEVANT ART

46. As part of my analysis and review, I considered what would be known and understood by a POSITA as of December 27, 2006, which Counsel has informed me is the earliest priority date to which Claims 1-19 are entitled. I give an overview here: additional overview comments on the background knowledge of a POSITA are presented in my analyses of the primary references. The overview, of course, cannot be exhaustive.

A. An Overview of Touchpads and Similar Devices

47. The following is not intended to provide a narrow definition of any term, but to show the breadth of understanding a POSITA would have in considering the art, and teachings of the art.

48. In context, a POSITA would understand that touchpads broadly include a class of sensor devices that sense a touch or contact in some fashion and produce

a useful signal in response.¹ A given touchpad device may be intended primarily to be used to detect touches by a particular type of object, such as a finger or a special stylus.

49. Many touchpad devices have a flat surface to be touched. Touchpad devices include devices usable for pointing, in that they can be used to input position values for a touch on a surface (for example, “x” and “y co-ordinates”, or sometimes only a single position ordinate). Thus they may be used as locator devices – that is, they can be used to input a position or location – and general teachings regarding locator devices would apply.

50. Other terms used to describe touchpad-type devices include proximity sensors, touch(-sensitive) surface/device, contact sensor, touchscreen, tablet, touch tablet, touch plate, digitizer tablet/pad/panel (also just “digitizer”), touch panel, stylus input device, telautograph, telescriber, cursor pad, handwriting input transducer, electronic/digital writing board or writing plaque, electronic drawing

¹ I give further notes of terms for touchpad below. For ease in reading, I will generally just use the terms “touchpad” or “digitizer” (short for “tablet digitizer”). Exceptions may be in a particular context such as when quoting from a reference, or may be inadvertent. A POSITA would understand this in no way implies any distinction of teachings.

board, scriptoscope, electronic/digitizing pantograph, electrographic/graphical input device, light pen/gun, graphics table/tablet, telewriter, writing telegraph, electrowriter, touch mouse, electronic/digital whiteboard, touch(-sensitive) display, tabletop (touch) display, and so forth. Further terms used to describe touchpad devices or equivalents technology include positional input device, handwriting terminal, touch sensitive orthogonal data field input device, etc.

51. If encountering a reference that used the terms touchpad and touchscreen (for example) distinctly, a POSITA would recognize that a touchscreen has been taught to be constructed using a transparent touchpad integrated with a display, as well as other ways to integrate with a display.² A POSITA would understand that a reference to a touchscreen also teaches a touchpad, or that the teachings may be applied to a touchpad, and vice versa, as for all these devices.

52. A POSITA would also know and understand that some touchpad devices only provide contact/non-contact information, or only pressure/force information, or a valuator input, and no direct X/Y (or X/Y/Z) position information.

² For example, this is described in EX1029 (Negroponte, “HUNCH An Experiment in Sketch Recognition”) on page 22-1-4: “The tablet has...a transparent surface which permits it to be used vertically in front of the display with the minor inconvenience of a half inch paralax [sic] (figure 6).”

A POSITA would also know and could apply teachings of how devices could be used to provide locator input, nonetheless. For example, a POSITA would know that X/Y position values (that is, locator input) can be done by combining two valuator inputs by using one input for an X value and another for a Y value.

53. A POSITA would have been familiar with the teachings of locator devices and other types of devices, such as explained in references that teach classification of input devices by their use into locator, evaluator, pick, and other types of input devices.³ A POSITA would understand that touchpads are readily used as locator devices, and that locator devices generally may be substituted one for another in a system with only readily-understood changes, such as converting relative position input to absolute position or vice-versa, or converting a force into to relative position information, etc. A POSITA would therefore understand that teachings regarding one kind of locator device (for example: mouse, joystick, or light pen) may be applied to other kinds of locator devices (for example: touchpad, gaze tracker, or stylus tablet).

54. On this point, a POSITA would know and understand that it was a conventional practice for vendors of touchscreen, tablet, and touchpad devices to

³ For example, EX1030 (Foley, “Fundamentals of Interactive Computer Graphics” (1982)) and EX1031, (Buxton, “There’s More to Interaction than Meets the Eye”).

include or provide a mouse-like “relative” output mode or a “mouse driver” software so that their device could be substituted more readily for a computer mouse in the large number of existing computer applications and computer systems.⁴

55. A POSITA would be well-aware that many touchpads also provide additional information beyond X/Y position information, such as a force/pressure (or pseudo-force/pressure) value or proximity height. Force/pressure as well as proximity values may be used as a “z” ordinate input values, as may values from additional input devices. Other information that some devices provide about a touch or contact may include lateral forces/pressures, contact area (which may be used as a surrogate for force/pressure, *e.g.*, pressing harder with a compliant fingertip tends to increase the contact area), thermal information, contact area shape or orientation, touches (or near-touches) by multiple objects, information about the type of object (*e.g.* a special stylus vs. a finger), etc.

56. While many touchpad devices provide position information for the touch, a POSITA would also understand the term to include touchpads that simply report a touch on the pad (without providing information about where on the pad the

⁴ For example, a POSITA would have known how this is noted in EX1032 (PC Magazine, “Alternative Input--Digitizing Tablets-Pointing the Way to Easier Input”) at page 228.

touch occurred). Further, a POSITA would understand that touch pads that report position may also comprise multiple smaller touchpad component sensors, the position information being derived from which sensor component(s) indicated a touch or degree of touch.

57. A POSITA would also know and understand the teachings of virtual/simulated/logical devices that may be implemented comprising a touchpad, and that the virtual devices are intended to be, and are, obvious equivalents to their non-virtual models. For example, touch-buttons, keys, sliders, and keypads, keyboards, computer mice, trackballs, and also virtual touchpads may be emulated via or in areas on a touchpad device, or using data from a touchpad device. This would include understanding that multiple such virtual devices may be implemented on a single physical touchpad. Thus a POSITA would also understand that properties and teachings of the physical devices may be applied to the virtual devices.

58. Similarly, a POSITA would also find it equally obvious to replace a virtual device with an equivalent physical device.

59. A POSITA would know and understand techniques for implementing many different virtual devices with touchpads, including virtual rotary devices such as scroll wheels, rotary selectors, knobs, and jog dials/wheels. Virtual devices provide the same functionality as the equivalent physical device, but in a simulated

fashion. On this point, a POSITA would also be abundantly aware of the teachings of virtual keypads and keyboards producing “typed” characters on a display, and virtual buttons.⁵ A POSITA would also have known that rotary controls could be simulated virtually on touchpads and the like, in various ways.⁶

⁵ Exemplary references include: EX1033 (U.S. Patent No. 5,491,495) (teaching implementations of simulated/virtual keyboards, computer mice, and touchpads); EX1034, (Buxton, “Issues and Techniques in Touch-Sensitive Tablet Input”) (teaching advantages of virtual input devices in general, and of pressure sensing with a larger number of levels of pressure); EX1035 (U.S. Patent No. 4,202,041) (describing dynamically variable keyboard terminal, teaching “soft” keyboards, referencing virtual pushbuttons in prior art).

⁶ The references known to a POSITA would include EX1036 (Evans, “Tablet-Based Valuers That Provide One, Two, or Three Degrees of Freedom”), which teaches both “turntable” and “number wheel” devices on a tablet, as well as other devices. EX1036, page 3. The references also include: EX1037 (U.S. Patent No. 5,903,229), which teaches a jog dial emulation input device in which a user moves a cursor by making substantially circular strokes with a fingertip on the surface of an input device at 1:5-9; EX1038 (U.S. Patent Appl. 2006/0291666A1), which teaches a virtual thumb wheel for volume control in a graphical user interface at [0036]; and

60. Historically, a POSITA would know that the technology for touchpads (with reporting of position and at least one bit of pressure information) date back at least to the telautograph,⁷ and touchpads were integrated with digital computers by the 1960's;⁸ thus, a POSITA would be aware that the range of relevant prior art is both very deep and very broad.

61. Location information could be determined more-or-less directly (for example, from actual position on the surface, or from which sub-component(s) reported a detection), or indirectly or algorithmically (for example, from a computation involving detected forces at edges or corners of the surface, or from

EX1039 (WO2006020305), which teaches a virtual scroll wheel on a touch screen device at 36:31 to 37:14; also EX1040 (U.S. Patent Appl. 2007/0222765A1), which teaches a volume control rotator implemented on a touchscreen or touchpad for adjusting volume, also using a semi-transparent lid overlay at [0048]-[0051].

⁷ For example, although perhaps not the earliest reference, EX1041 (U.S. Patent No. 494,562) is one such reference.

⁸ For example: EX1042 (Davis, "The RAND Tablet: A Man-Machine Graphical Communication Device") (teaching a stylus-tablet touch input device for interactive use with a computer); EX1043 (U.S. Patent No. 3,482,241) (teaching a touch display (touchscreen) measuring changes in capacitance).

propagation times for an acoustic, optical, or magnetostrictive signal, or reflections). A POSITA would also know that sensing need not be incorporated into a touch surface itself. For example, position could be detected via one or more light beams above the working surface, via camera-based imaging, via sensors behind the surface, or via a pantographic mechanism separate from the surface.

62. A POSITA would also know that a touch on a surface may be detected in many ways, including indirectly by a proxy for physical contact, such as proximity or force/pressure signals of a sensor of the surface exceeding some threshold, or by a force-sensitive or mechanical switch in the tip of a stylus separate from the surface.

63. To the extent there may be an attempt to argue that a touchpad or touch-sensitive device in the prior art must respond to an “actual” touch, a POSITA would have known that common technologies for touchpads included capacitive sensing of proximity, and electromagnetic signal coupling with an electronic stylus. Capacitive sensors work by measuring changes in capacitance, either self-capacitance or mutual-capacitance,⁹ caused by a conductive object in proximity. It would be well

⁹ A POSITA would appreciate that self-capacitance sensors measure an increase in capacitance to ground, and mutual-capacitance sensors measure a decrease in capacitance between two conductors. On this point, a POSITA would also be

known to a POSITA that capacitive sensors may not respond at all to a touch by a non-conductive object (such as a plastic stylus or a pencil), since they induce no change in capacitance. It would also be well-known that they may not respond to finger touches if the user is wearing a non-conductive glove, has particularly dry skin, or under some grounding conditions, and that they can respond with false touches due to water droplets, etc.¹⁰

64. On the same point, a POSITA would know that the electromagnetic sensors would generally not respond to any touch by a finger, but only by a particularly-matching electronic stylus.

65. A POSITA would know also about similar quirks of other sensing technologies, such as optical sensing. In general, a POSITA would understand that touches are detected functionally.

familiar with the practical complexities of capacitively-coupled noise and poor grounding.

¹⁰ This all would have been abundantly well known to a POSITA, but it is mentioned, for example, in EX1044 (U.S. Patent No. 5,708,460) at 1:29-30 (“Accordingly, such [a capacitive type] system will not respond to touch with a glove or a non-capacitive stylus.”).

66. A POSITA would also understand the many ways multiple sensor technologies had been and could be integrated in one device, to multiple effects.¹¹

B. An Overview of Haptics

67. A POSITA would be familiar with the term “haptics” as referring to a relation to contact or touch involving the human body. In the context of the relevant art it would have been used to characterize both input to a system via touch, and output or display from a system and perceived by one or more of the human senses

¹¹ One of many such examples a POSITA would have known, is EX1045 (U.S. Patent No. 6,492,979 (“Kent”)). Kent teaches incorporating both FSR (force sensing resistor) and capacitive sensing in one device and various alternatives, including using capacitive sensing for position and FSR sensing for pressure, and also using either or both in determining position to accomplish greater reliability of performance. *See, e.g.,* Kent, Abstract, 3:14-16 (“In one embodiment of the invention, projective-capacitive sensors are used as the primary sensor and one or more force sensors are used to obtain touch validation.”). Kent also cites to multiple further examples in its own prior art, such as EX1046, U.S. Patent No. 5,510,813, as an example of using resistive/conducting layers to determine a touch position and capacitive sensing for detecting the force of the touch. Kent, 1:64-2:5.

of touch.¹² A POSITA would also know that other terms used in the art, such as “tactile,” “kinesthetic,” “tactual,” “force output,” etc. had also been used interchangeably with “haptic” in various contexts, and would understand the meanings in context.

68. For ease in reading, I will generally use the terms ‘haptic’ and ‘tactile.’ Concerning haptic output or display, a POSITA would be familiar with multiple examples of and techniques for haptic output and feedback, including forces, vibrations, and electrical stimulation, as well as patterns of haptic output.¹³

69. In addition to haptic/touch input devices (discussed in part above along with touchpad haptic input devices), a POSITA would have been familiar with

¹² For example, a POSITA would have known how EX1047 (Buxton, “Touch Gesture and Marking,” chapter 7 of Baecker, *Human-Computer Interaction*) discusses both haptic input and haptic output, as well as force feedback.

¹³ For example, EX1048 (U.S. Patent No. 6,160,489) teaches the use of a plurality of distinctive tactile alert patterns (vibrations) generated with an axially offset counterweight driven by a motor, since audible alerts may not be heard. EX1049 (Strong, “An Electrotactile Display”) teaches direct electrotactile stimulation of the nerves in touching fingers, using different amplitudes to indicate different touch areas and boundaries.

multiple kinds of electronically-controlled haptic/tactile actuators for output of haptic effects. These would include voice-coil actuators,¹⁴ oscillatory or piezoelectric actuators,¹⁵ solenoids,¹⁶ and electromagnetic¹⁷ actuators, among many others.

¹⁴ For example, EX1050 (Massie, “Initial Haptic Explorations with the Phantom: Virtual Touch Through Point Interaction”) teaches piezo elements and voice-coil speakers as vibrotactile actuators.

¹⁵ For example, EX1051 (Bliss, “Optical-to-Tactile Image Conversion for the Blind”) describes piezoelectric actuators for producing tactile vibrations at small spacing.

¹⁶ For example, EX1052 (European Patent Publication No. EP0265011A1) teaches using piezoelectric or electromagnetic tactile elements as a matter of design choice for a computer mouse: a computer processor sends signals to activate the tactile elements, such as to produce vibrations while the cursor coincides to a special area.

¹⁷ For example, EX1053 (U.S. Patent No. 5,388,992) teaches voice-coil or small motor transducers to produce tactually perceived vibrations and also teaches directly converting output sound signals to tactile vibrations.

70. A POSITA would be familiar with various techniques involving force-based feedback or output, such as simulations of real-world sensation. As one example, a POSITA would be familiar with techniques for simulating clicks, frictions, textures, and resistive forces, via special and/or temporal patterns of vibrations.¹⁸

71. Along the same lines, a POSITA would know the teachings that haptic “jolt” sensations can be produced by short bursts or periods of vibration¹⁹. In

¹⁸ For example, EX1054 (IBM, “Mouse Ball-Actuating Device with Force and Tactile Feedback”) teaches tactile outputs for clicks, vibrations, crossing over line boundaries, and making mouse detents. It also teaches different tactile feedback for different regions, such as stepping over a grid or into an illegal zone. EX1055 (Fukumoto, “Active Click Tactile Feedback for Touch Panels”) teaches generating click feel sensations to a tapping fingertip using short periods of vibration, vibrating the whole touch panel. EX1056 (WO9200559A1) teaches simulating textures, clicks, and edge effects via continuous or pulsed vibrations, when the user’s finger or stylus is moving across a surface, as well as “soft” function keys.

¹⁹For example, EX1057 (U.S. Patent Appl. No. 2006/0241864A1) teaches authentication sensations composed of quick jolts, over varying duration (e.g. 240 milliseconds), the jolts being constructions as sinusoidal vibrations of 80 Hz or 20

addition, a POSITA would also know from prior-art teachings that a jolt sensation is a vibrotactile sensation.²⁰ For that matter, a POSITA would know from the prior

Hz, etc. at [0107], [0109], [0110]. Likewise, EX1055 (Fukumoto “Active Click Tactile Feedback for Touch Panels”) teaches a “click feel” (that is, jolt sensation) that is expressed by adding a single pulse or short burst signal by an electric to vibration transducer (page 121), and EX1058 (U.S. Patent No. 5,782,639) teaches a chassis mounted vibration generator which simulates jolts from explosions at 19:52-53.

²⁰For example, this was taught by EX1059 (U.S. Patent Appl. No. 2006/0049010) which discloses at [0026] that: “Other vibrotactile effects may also be implemented, such as a jolt, shake, buzz, or other suitable vibrotactile effect.” (emphasis added). Likewise, EX1060 (WO2004042693) teaches that “Suitable tactile sensations include vibrations, for example, jolts and textures, and a plurality of distinct tactile sensations can be created by varying the frequency, amplitude and waveform output by the actuator 6” at 5:12-15 (emphasis added). Also EX1061 (U.S. Patent Appl. No. 2003/0030619) states at [0045] “a jolt of ‘pulse’ sensation can be output, which is a single impulse of force that quickly rises to the desired magnitude and then is turned off or quickly decays back to zero or small magnitude” and continues at [0060] “[i]n vibrotactile embodiments, only a very small range of motion is required

art that vibrotactile sensations also include sensations for clicks, touch and contact, rotation, textures, and thumps etc.²¹, and that vibrotactile sensations can be substituted for force-reflecting reactive feedback.²²

to produce effective pulses (jolts) or vibrations on the direction pad 18.” (emphasis added).

²¹ For example, EX1062 (U.S. Patent No. 6,424,333) teaches vibrotactile simulation of sensations of textures (1:35), pressure (5:18-25), and contact with fluids and solids (5:41-43); EX1063 (EP0799597A1) teaches vibro-tactile stimulation to convey a sense of rotation at 3:20-23; EX1064 (U.S. Patent No. 5,719,561) teaches using an array of vibrators to give the sensation of jumps or taps on user's forearm and upper arm; EX1065 (U.S. Patent No. 5,973,441) teaches the creating of thumping sensations (that is, jolts) utilizing piezo transducers in a vibratory mode; EX1066 (Minsky, “Computational Haptics: The Sandpaper System for Synthesizing Texture for a Force-Feedback Display”) teaches simulating texture sensations through vibration.

²²For example, this would be known from EX1067 (U.S. Patent No. 5,451,924), which discusses using vibrotactile sensory modalities as substitution for force feedback (9:51-53), pointing to some of the burdens of reactive force feedback (3:32-50). It would also be known from references such as EX1068 (Patrick,

72. A POSITA would also be aware of the broad motivations for incorporating haptic feedback in interactive systems such as to take the place of lacking haptic feedback of mechanical systems,²³ providing “cue” information about an object or some status,²⁴ a confirmation that an input or gesture was accomplished

“Design Construction and Testing of a Fingertip Tactile Display for Interaction with Virtual and Remote Environments”), which also points to advantages of using tactile (vibrotactile) display as a substitute instead of reactive display, for example at page 12 (“tactile feedback might be substituted for reactive force-feedback”), and page 23, (“detailed design of a vibrotactile display”).

²³ For example, EX1069 (Massie, “The PHANToM Haptic Interface—A Device for Probing Virtual Objects”) teaches the importance of haptic cues and “feeling the [virtual] buttons click”, when virtual buttons substitute for physical buttons/switches with the absence of sound.

²⁴ As one example, EX1070 (U.S. Patent No. 5,982,352) teaches a “digitizer” pad or touchscreen incorporating tactile feedback cues, both passive and active, via piezo vibrators, air blasts, sound waves or the like, as well as sensing of force location.

successfully,²⁵ to provide different haptic feedback or output to indicate an action on a particular region or software element,²⁶ or to provide output and feedback circumstances in which audio, visual, or other output or display might not be effective.²⁷

²⁵ For example, EX1071 (U.S. Patent No. 6,131,097) teaches the use of haptic cues, for example to indicate a particular selection has actually occurred.

²⁶ For example, EX1072 (U.S. Patent No. 6,337,678) teaches graphical buttons, and a control processor receiving commands which specify the type of haptic response each touch exhibit, with different feels between disabled and enabled buttons. EX1073 (U.S. Patent No. 6,219,034) teaches associating operating system user interface elements, such as buttons, with types of tactile commands, as well as teaching profiles. EX1074 (U.S. Patent No. 6,219,032) teaches associating force sensations with graphical objects, to assist the user in selecting a desired function or to inform the user of graphical objects.

²⁷ For example, EX1075 (U.S. Patent No. 4,885,565) teaches tactile feedback to indicate a successful selection via a touchscreen, because audio feedback may be masked by radio or road noise, and to minimize taking away visual contact.

73. As well as this, a POSITA would know the teachings of providing varying feedback depending on force/pressure levels of an input.²⁸

74. In addition, a POSITA would also be aware of the historical range of teachings of vibrational and force haptic feedback, including feedback based on a pressure sensor input, in critical situations. Accordingly, a POSITA would appreciate the width and depth of the range of relevant prior art.

IX. OVERVIEW OF THE '042 PATENT

A. An Overview of the Patent Specification

75. The '042 Patent is directed to systems and methods for providing virtual detents through vibrotactile feedback. EX1001 at Abstract; 1:14-18. As its name implies, vibrotactile feedback typically consists of a vibration that provides sensory feedback to a user.

76. The Patent describes a “virtual detent” as vibrotactile feedback that simulates a mechanical detent. EX1001 at 1:30-43; 3:6-15. A mechanical detent is a physical mechanism that, for example, provides resistance to movement such as rotational movement or linear movement. EX1001 at 1:30-42.

²⁸ For example, a POSITA would know the teachings of references such as: EX1062 (U.S. Patent No. 6,424,333), which teaches vibrational feedback of varying levels depending on the force or pressure input by a user on an object.

77. As the Patent explains, detents are often used to “divide a rotation into discrete increments” similar to the discrete “clicks-stops” experienced when rotating the knob on a traditional car radio. EX1001 at 1:30-42. Another example familiar to a POSITA in 2006 of a detent used to resist rotational movement can be seen in the game shows *Wheel of Fortune* or the *Price is Right*. In both shows a large wheel is divided into discrete segments and rubber flippers (or something similar) are used to restrict the wheel from going backwards.

78. Another familiar example is the scroll wheel on a typical computer mouse—as your finger moves it back or forward, small “clicks” can be felt and thus provide tactile feedback to the user as to how far in a direction the scroll wheel has been moved. For example, U.S. Patent No. 6,031,518 (EX1076) discloses a computer mouse with a “detent mechanism...to provide a segmented feel to the rotation of the wheel.” EX1076 at 3:47-49. A POSITA would also know that the same types of detents were used with devices that move linearly such as a slider: for example, U.S. Patent No. 7,084,859 (EX1077) teaches the usefulness of the tactile feel provided by “ratchet clicks ... when moving a knob or slider,” as well as other means. EX1077 at 22:21-23.

79. According to the Patent, traditional mechanical devices such as knobs or sliders were being replaced by electronic controls that were less intuitive to users because they did not provide a similar user experience. EX1001 at 1:22-37. “For

example, without click-stops or ‘detents,’ or otherwise a sense of mechanical resistance, it may be difficult to obtain a similar experience from an electronic substitute for a traditional mechanical control device or even effectively and efficiently operate such a device.” 1:33-37. The Patent thus sought to simulate in electronic devices the mechanical resistance that detents provided in traditional mechanical devices.

80. The Patent discloses a system that includes an input device as well as a processor, sensor, and actuator. EX1001 at 3:24-30; FIG. 1. As relevant to Claims 1-19 of the Patent, the “input device” is a touchpad. A sensor of the touchpad detects manipulation of the input device (*e.g.*, a finger moving on the touchpad) and sends an input signal to the processor which, among other things, outputs a signal to the actuator to produce a vibrotactile effect onto the input device. EX1001 at 3:61-4:38.

81. The actuator is configured to “simulate mechanical feedback through vibrotactile feedback” such that it can “provide the perception of a detent (*i.e.*, a virtual detent) without the traditional means necessary for a mechanical detent.” 5:66-6:4. As one example, the actuator can provide vibrotactile feedback in the form of “a click effect replicating a mechanical click.” EX1001 at 6:4-11; *see also* EX1001 at 6:16-17 (“In one embodiment, the virtual detent may comprise a simulated click generated through a single pulse.”); 8:42-43 (“[T]he processor 206 may generate one type of detent signal, such as a click effect”). Because the actuator

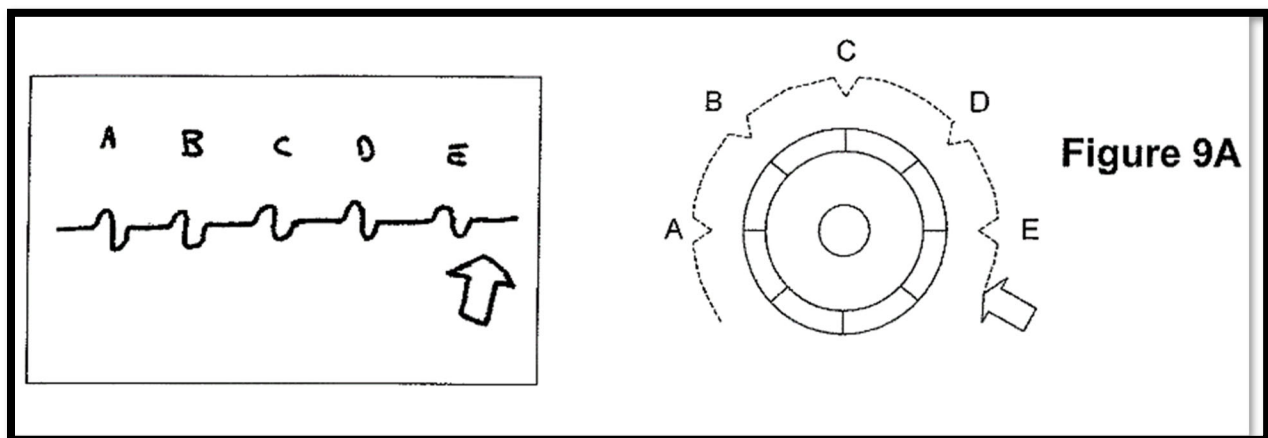
provides vibrotactile feedback, not mechanical feedback, it can provide “feedback to non-mechanical input devices” such as touchpads. EX1001 at 6:21-25.

82. The actuator “can be any of a variety of different types of force producing devices.” EX1001 at 6:32-37. This includes “an eccentric rotating mass (ERM) actuator, a multifunctional (MFT) actuator, a linear mass actuator, an electro-magnetic actuator, a motor, a voice coil, a pneumatic or hydraulic actuator, an electro-active polymer, or any other suitable actuator.” EX1001 at 6:33-37. Each of these were conventional actuators with which a POSITA would have been well familiar by 2006.

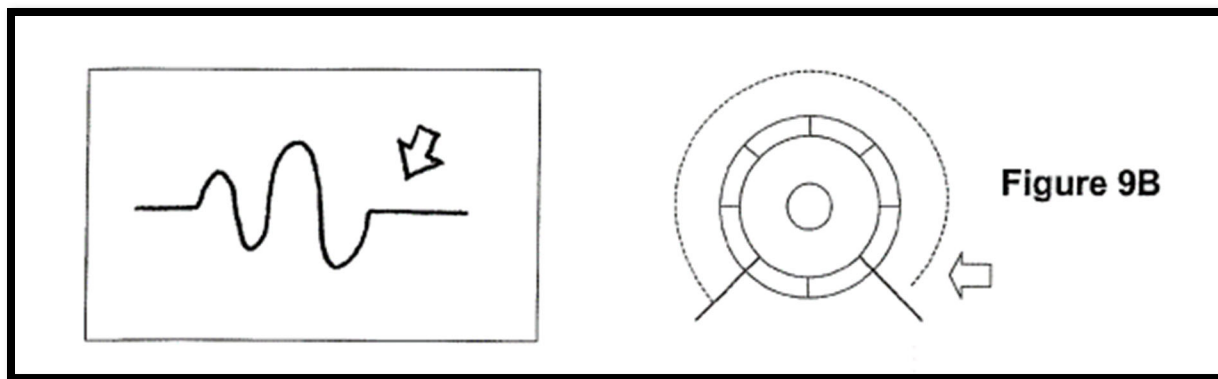
83. To cause the actuator to produce a vibrotactile effect, the processor accesses a “detent profile” and generates a “detent signal” based on the input signal and the accessed detent profile. EX1001 at 1:63-65, 4:35-60. Figures 9A to 9H illustrate various exemplary virtual detent profiles. EX1001 at 13:36-38. These profiles can be stored in memory as computer code. EX1001 at 8:54-67.

84. As Figures 9A to 9H illustrate, a “virtual detent profile” is a defined vibrotactile effect represented by force magnitudes and width patterns that simulate a particular mechanical detent. In other words, the profile dictates (a) when the actuator initiates its vibrotactile effect, (b) how hard (magnitude) the actuator vibrates an input device such as a touchpad, and (c) for how long (width) the actuator vibrates.

85. For example, Figure 9A (reproduced below) shows a vibrotactile effect to be used when a physical knob is rotated through discrete points A-E. EX1001 at 13:47-53. As the knob on the right-hand side is rotated from point A to E, the magnitude and width of vibrotactile feedback that the actuator outputs on the knob is governed by the profile depicted on the left-hand side and that feedback simulates the magnitude and width of a mechanical detent. EX1001 at 13:47-53. In other words, as the user turns the knob on the right, he or she feels distinct “clicks” at locations A to E, just as he or she would expect to feel when turning a traditional knob with mechanical detents.



86. Figures 9B to 9H depict other virtual detent profiles for simulating common mechanical detents. For example, Figure 9B depicts a “hard stop virtual detent profile” that simulates a “barrier” when a “maximum” position is reached, *e.g.*, when a stereo’s volume is turned to its maximum setting. EX1001 at 13:54-62.



87. The Patent explains that the input device—whether it be a knob like that used in Figures 9A-9H or a touchpad—controls a system. For example, the knob “may be located on a stereo receiver, and configured to control the volume of the stereo.” EX1001 at 10:65-11:1; *see also* EX1001 at 7:28-38 (“The system to be manipulated 110 may comprise a system capable of electrical or electromechanical control, such as and without limitation, a stereo system, a video system, a climate system (e.g. air conditioning and/or heating), a navigation system, automotive systems, wireless communication devices, security systems, a television, a video game system, a washing machine or a drying machine, or an oven.”).

88. In other embodiments (and in each of Claims 1-19), the single input device controls multiple systems such as “a car’s temperature system, navigation system, and/or communication system.” EX1001 at 11:1-3.

89. In addition to generating detent signals for the actuator, the processor also generates system signals to manipulate the system(s) under control so that the system(s) are “manipulated at substantially the same time as the vibrotactile

feedback is generated,” which gives “the user the impression of mechanical detents.” EX1001 at 12:65-13:7; FIG. 8. Stated differently, as the user feels the virtual detent, a system setting is also changed—for example, each click effect felt with the Figure 9A virtual detent profile discussed above could correspond to moving through radio frequency in large increments in a car radio, or the temperature setting on a car’s heating/air conditioning system increasing by one degree.

B. An Overview of the Prosecution History

90. The Applicant’s original claim 1 (reproduced in full below) recited a method comprising “receiving an input signal comprising information associated with a manipulation of an input device,” and “generating a vibrotactile signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising a virtual detent.” EX1002, 49.

1. A method comprising:
receiving an input signal comprising information associated with a manipulation of an input device, and
generating a vibrotactile signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising a virtual detent.

91. The Examiner rejected originally-filed claim 1 (and others) as obvious over Grant (EX1012) in view of Huang (EX1017). EX1002, 115-120. Among other

findings, the Examiner found that Huang disclosed a “virtual detent” at column 4, lines 25-48. I agree, inasmuch as Huang describes a “brake controller 18” that “may be programmed with a map to provide a detent or virtual detent function which correlates the brake position signal with the position signal and/or the other sensor signals. The detent function provides tactile feedback to the operator of the input device that a predetermined position of the operator input device 10 is being approached and/or has been reached.” EX1017, 4:25-48 (emphasis added).

92. In response, the Applicant amended the claims, limiting the “input device” to a “touchpad” (EX1002, 132-139):

1. (Currently Amended) A method comprising:

receiving an input signal comprising information associated with a manipulation of an input device, wherein the input device comprises a touch-pad;

and

generating a vibrotactile signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising a virtual detent.

93. However, the Examiner maintained the earlier rejection because Grant disclosed a touchpad. EX1002, 147-155. The Applicant then further amended the claims, limiting the “input device” to a touchpad “configured to control a system,” and also added the step of: “receiving a detent profile associated with the system,

the detent profile comprising haptic data associated with a virtual detent.” EX1002, 159-168:

1. (Currently Amended) A method comprising:

receiving an input signal comprising information associated with a manipulation of an input device configured to control a system, wherein the input device comprises a touch-pad;

receiving a detent profile associated with the system, the detent profile comprising haptic data associated with a virtual detent; and

generating a vibrotactile signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising [[a]] the virtual detent.

94. The Examiner again found the claims obvious over Grant and Huang. EX1002, 194-202.

95. The Applicant amended the claims again. This time requiring that the touchpad be configured to control “a plurality of systems,” not just one. EX1002, 206-215.

1. (Currently Amended) A method comprising:

receiving an input signal comprising information associated with a manipulation of an input device configured to control a plurality of systems, wherein the input device comprises a touch-pad;

receiving a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent; and

generating a vibrotactile signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent.

96. In response, the Examiner rejected the claims as obvious over Grant in view of Nyysönen (EX1018). EX1002, 234-241. The Examiner found Grant discloses a touchpad that controls multiple systems, Nyysönen discloses receiving detent profiles for multiple systems, and a POSITA had reason to add Nyysönen's detent profiles to Grant's system. EX1002, 235-236.

97. The Applicant responded by arguing that Nyysönen (called "Tuomo" by the Applicant) did not disclose "virtual detent[s]." EX1002, 254. The Examiner disagreed. EX1002, 261-269. The Examiner said a "detent" is "a device used to mechanically resist or arrest the rotation of a wheel, axle, or spindle; as click-stops, used to divide a rotation into discrete increments." EX1002, 267. The Examiner then explained that although Nyysönen did not use the word "detent," it discloses

“virtual knobs” that “are obviously divided into discrete increments” and thus are “the same as virtual detents.” EX1002, 267.

98. The Applicant argued that Nyysönen does not disclose that its virtual knob has discrete increments or “virtual detent[s].” EX1002, 280. The Applicant further explained that while Nyysönen used vibrotactile feedback, it did not disclose using such feedback with virtual knobs. EX1002, 280-281. The Examiner maintained the rejection (EX1002, 393-396), and the Applicant appealed. EX1002, 400, 485-488.

99. The Board of Patent Appeals and Interferences (BPAI) then reversed the Examiner’s rejection. EX1002, 587-592. The BPAI found that although Nyysönen discloses a virtual knob and vibrotactile feedback there was no disclosure in Nyysönen (or Grant) of “virtual knobs having increments or haptic effects associated therewith” and thus no disclosure of a “detent profile” and/or a “virtual detent.” EX1002, 590. The claims were subsequently allowed. EX1002, 1022.

X. CLAIM INTERPRETATION

100. I understand that claim terms must be construed according to their plain and ordinary meaning when read in in light of the specification and the prosecution history.

101. In the prior art analysis that I provide in Section XI, I apply the plain and ordinary meaning of the claim terms with the exception that in Grounds 3-4 I

explain how the prior art anticipates or renders obvious Claims 1-19 under an interpretation of the claims with which I disagree, but which I understand Patent Owner currently contends is the proper interpretation of the claims. In other words, my analysis in Grounds 3-4 uses the interpretation of the claims that Patent Owner thinks is right even though I disagree with that interpretation. I discuss this in more detail in Grounds 3-4.

XI. UNPATENTABILITY GROUNDS

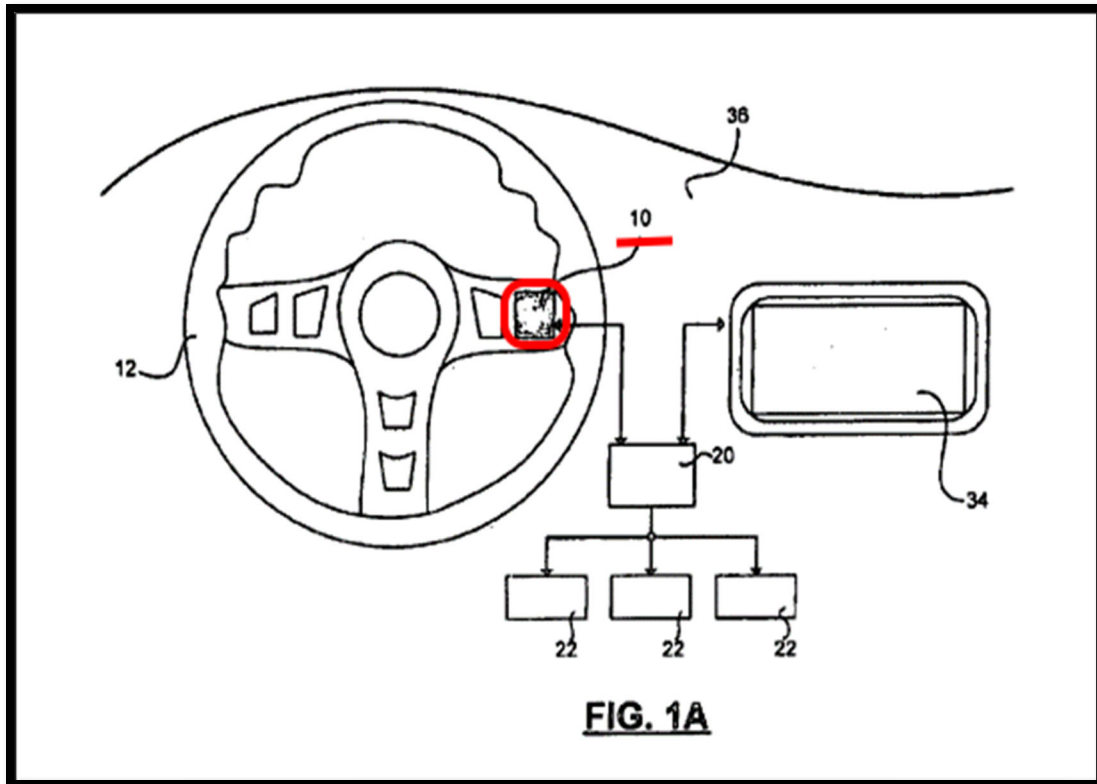
102. To the extent that “unpatentability” may be a legal term, I use the term only to indicate that I find that a claim to be either anticipated or obvious based on my analysis.

A. Ground 1: Claims 1-19 Would Have Been Obvious Over Ichinose and Levin

1. Ichinose (EX1015)²⁹

103. Ichinose discloses a system for controlling devices in a car. Abstract; 1:40-58. Ichinose’s system includes a “touchpad 10 [that] is mounted on a steering wheel” (2:23-25), as seen below in Figure 1A (annotation added):

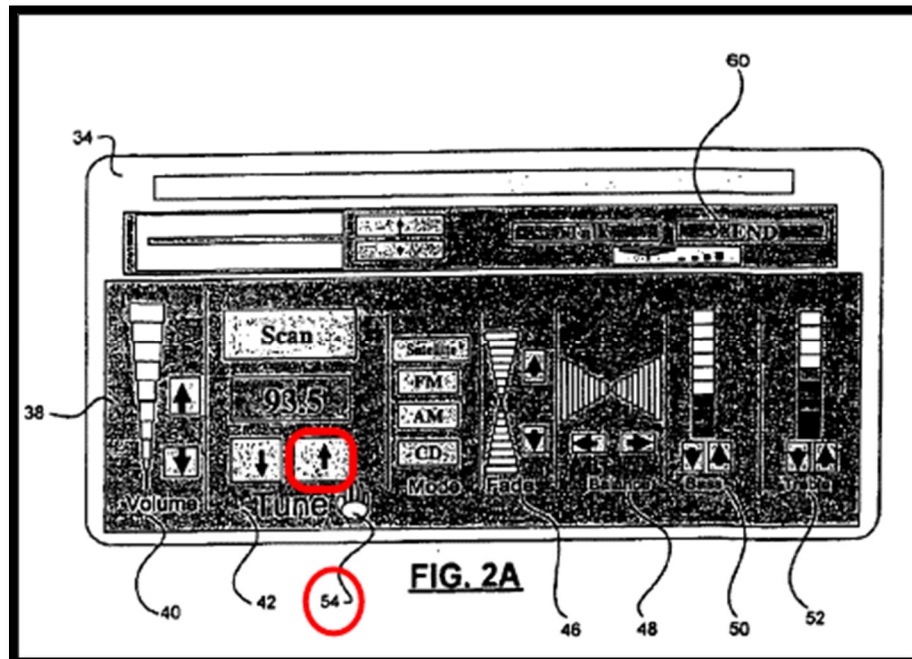
²⁹ Unless otherwise noted, citations in Section XI.A.1 are to Ichinose.



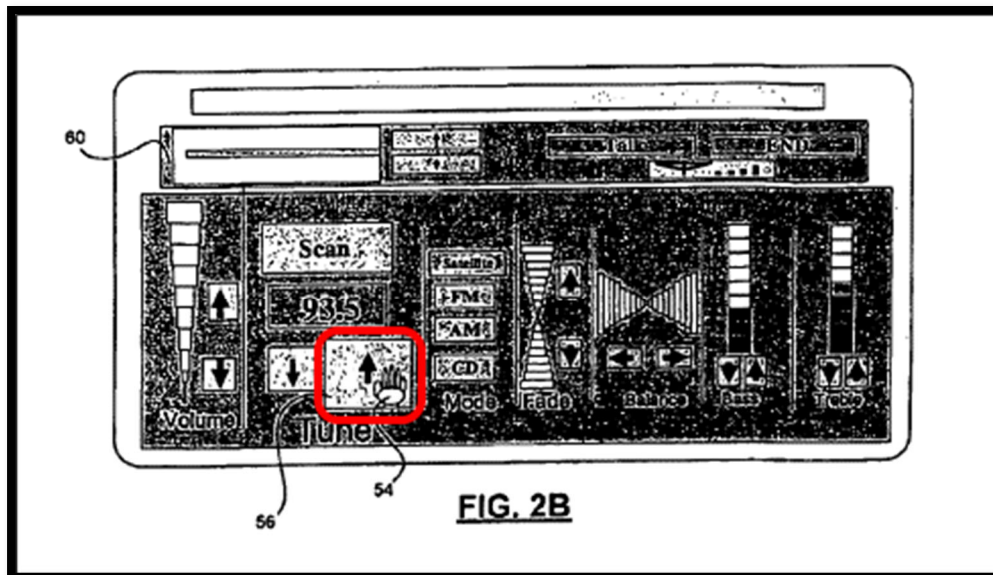
104. As a user “slide[s]” a finger “across” the touchpad, it “generates signals” that are sent to “software module 20, allowing the user to interact with controllable devices 22 using the touchpad.” 2:33-39. Exemplary “controllable devices” include “a radio, power windows, a heating and cooling system, and a navigation system.” 1:11-15; *see also* 3:48-61; FIG. 8.

105. In operation, a “cursor” is presented on display 34 and the cursor moves within the display in response to the user touching the touchpad. 2:52-57; FIG. 1A. The user can position the cursor over a particular function, for example the radio’s tuning function, and “adjust the [radio’s] tuning” by “tapping the touchpad.” 2:62-3:9; FIG. 2A-5B.

106. The above-described functionality is depicted, for example, in Figures 2A and 2B. As seen in Figure 2A (below, annotation added), the cursor 54 (which appears as a hand on the screen) is positioned near but not on the tuning button with an up arrow:



107. In Figure 2B (reproduced below, annotation added), the cursor (via the touchpad) is moved on top of the tuning button which causes the tuning button under the cursor 54 to become “enlarged,” and tuning of the radio can then be adjusted (upward) by tapping that button via the touchpad. 2:62-3:9.

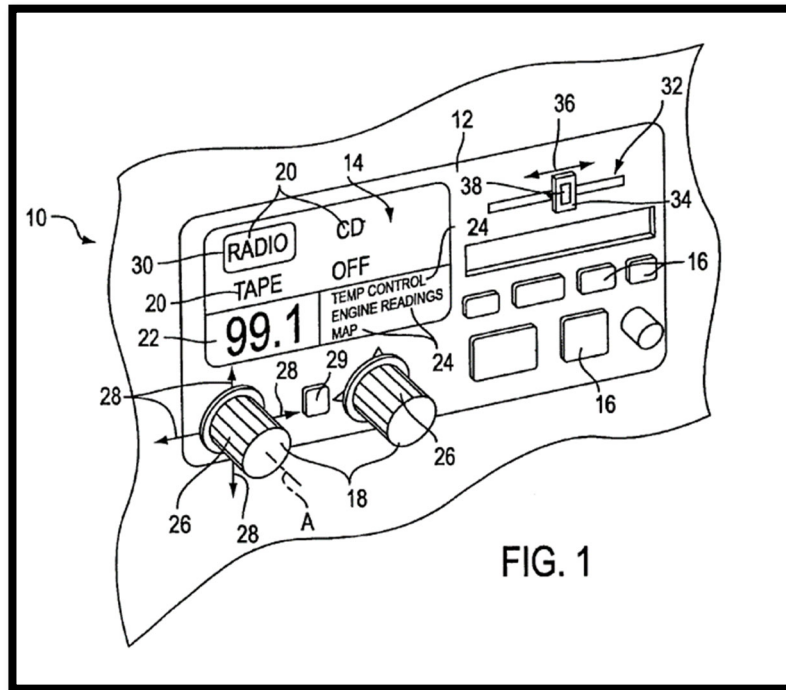


108. Figures 2A and 2B illustrate how to change the tuning of the car radio. Figures 3A and 3B show similar functionality for the car's "mobile telephone" system. 3:19-30. Figures 4A-4B and 5A-5B show similar functionality for adjusting either the fan speed of the car's HVAC system or the HVAC mode being used. 3:31-46.

109. Ichinose discloses that its touchpad 10 includes "a feedback device" that "actuates, causing the user to experience a tangible vibration" thereby "provid[ing] the user with indicia relating to the user's interaction with the touchpad [] and the display." 4:5-24. For example, the feedback device actuates when "the user taps the touchpad 10 to select a function or device." 4:24-33. Ichinose explains that "variations of the feedback device 80 are anticipated" and that "[a]ny suitable actuator that is operable to provide vibration or tapping to the touchpad may be used." 4:33-35.

2. Levin (EX1016)³⁰

110. Similar to Ichinose, Levin discloses a “control panel” used in a car to control various systems such as the heating system, the radio, navigation, and/or cellular telephone. 4:9-33. An exemplary panel is shown in Figure 1 below:



111. Levin’s panel includes “control knobs 18” that incorporate force feedback using an actuator. 5:30-50; 9:60-10:10. Feedback can also be used with a “slider” moving “in a linear degree of freedom.” 14:16-21; claim 3; FIG.1 (element 32).

112. In operation, a user turns the control knob to adjust a system setting, for example the car’s temperature. 5:30-50; 7:32-8:26; FIG. 2. When the knob is

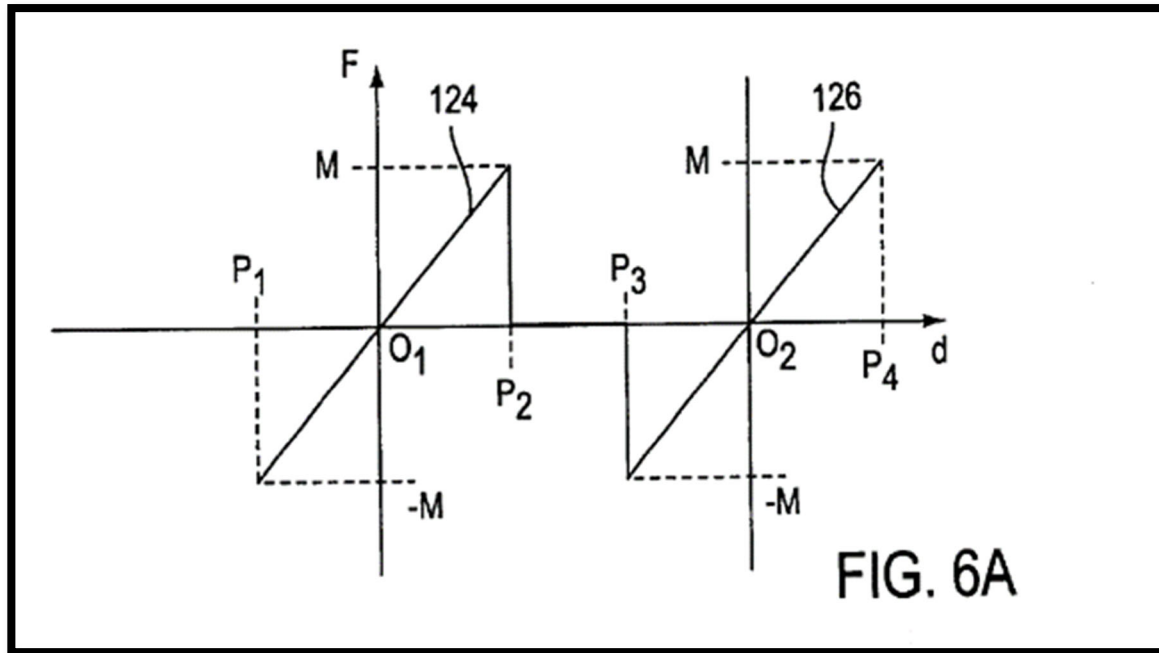
³⁰ Unless otherwise noted, citations in IV.C.2 are to Levin.

turned, “force detents” are output onto the knob to “indicate particular settings or how far the knob [] has been rotated.” 7:55-62. For example, “[t]emperature can preferably be adjusted by rotating knob 18, where force detents indicate each temperature setting.” 8:21-26; *see also* 10:11-32. Using “force detents” allows a driver to “feel” a change in a system setting “so that the driver need not look at the display.” 8:18-26.

113. Levin is explicit that its force feedback can take the form of vibrotactile feedback. 8:8-16 (“A small vibration can be output on the knob 18 in the rotary degree of freedom, where the frequency (or magnitude) of the vibration forces correlate with the magnitude of fan rotation speed, i.e., a high fan speed provides a fast vibration.”); 14:26-29 (“Other force effects include damping forces, texture forces, jolts, obstruction forces, assistive forces, periodic forces such as vibration forces, and end-of-travel forces.”); 18:49-53 (“[V]ibration force sensations can be provided by outputting a periodic sine wave or square wave for the magnitude of the force over time.”); 23:29-32 (“The force process can command distinct force sensations, such as vibrations, textures, jolts, or even simulated interactions between displayed objects.”); claims 28-30.

114. Levin’s Figure 6A (below) illustrates a “detent force profile[] suitable for use with” the control knobs. 14:30-32. Detent force profiles “can be implemented by a microprocessor or other controller based on instructions stored

in” memory. 14:30-35. “[C]urve 124,” seen below, “represents the force output for a single detent over a position range for the detent,” and “curve 126 represents another detent that is encountered shortly after leaving the previous detent curve 124 when turning the knob in a particular direction.” 14:30-15:8



115. The detent profile shown above in Figure 6A corresponds to the virtual detent profile shown in Figure 9A in the '042 Patent. They each depict a series of successive detents that would mimic the mechanical detents often associated with a mechanical knob or slider; in other words, this type of profile mimics the “click”-effects of traditional mechanical knobs and sliders.

3. The Ichinose-Levin Combination

116. In view of Levin, a POSITA would have had reason to implement Ichinose’s vehicle control system such that it used Levin’s “force detents” to

simulate common detents such as “click-stops” of a mechanical knob or slider. EX1001 at 6:16-17 (“virtual detent may comprise a simulated click generated through a single pulse”); 8:41-43 (“one type of detent signal ...[is] a click effect”); 11:59-63 (“click effect virtual detent”).

117. Levin itself would have motivated a POSITA to make the combination because Levin teaches that “force detents” beneficially allow a driver to “feel” a change in a vehicle setting without needing to look at a display “which is particularly useful” when the driver is actively driving a vehicle. Levin at 8:15-19; 10:17-42; *see also* Levin at 3:31-33 (“force feedback...provide[s] the user with greater control”). Levin’s teaching aligns with Ichinose’s system which provides vibrotactile feedback to a driver so he or she “can be confident that a function or device was properly selected without directing his or her attention away from the road.” Ichinose at 4:31-33. Although Ichinose already provides vibrotactile feedback, it explains that “[o]ther variations...are anticipated.” Ichinose at 4:33-35. A POSITA would have understood Levin’s “force detents” to be such a known variation.

118. Beyond Levin’s explicit motivation, implementing Ichinose such that it used Levin’s “force detents” would have been the use of a known technique (Levin’s “force detents” to simulate mechanical detents) to improve similar devices (vehicle

control systems) in the same way (providing user with tactile feedback that minimize distraction). The use of such a known technique would have been obvious.

119. The Ichinose-Levin combination would have maintained Ichinose's system, and would have augmented that system so that it stored Levin's various "force detents" in a memory that Ichinose's "command processor" accesses to generate a feedback signal to Ichinose's feedback device. Ichinose at 4:46-61; FIG. 8; Levin at 14:30-35. Numerous uses of Levin's force detent profiles in Ichinose's system would have occurred readily to a POSITA.

120. To start, Ichinose teaches up and down arrow keys to adjust various system parameters such as radio settings. For example, Figures 2A and 2B that I discussed above illustrate how a user moves a cursor (via the touchpad) onto a "tuning control button 56" to adjust the radio station by "tapping the touchpad" when the cursor is over the button. Ichinose at 2:47-3:9; *see also* Ichinose at 3:19-46; FIGS. 3A-5B (showing similar functionality for other systems, including HVAC). Ichinose explains that its "feedback device 80 actuates when the user taps the touchpad 10 to select a function or device," for example when selecting the "tuning control button" to adjust the radio. Ichinose at 4:18-30. Although Ichinose does not describe what feedback is provided when the user taps "tuning control button 56" to adjust the radio station, Levin teaches providing a "detent force (e.g., jolt)...to indicate how much a particular value has been changed. For example, a jolt can be

output for each 10 MHz of frequency that is increased.” Levin at 7:55-8:2; FIG. 2. (I note that while Levin here gives a “jolt” as one example (“e.g.”) of a detent force, Levin also teaches detent force profiles created from periodic waves – that is, vibrations. See for example Levin at 3:9-12, 4:1-2.) For that matter, a POSITA would be aware that it was known in the art to produce vibrotactile jolt sensations with bursts of vibration. A POSITA thus had reason to output a “detent force” each time a user taps the up/down button to change the radio frequency. See EX1021 at 13 (identifying feedback associated with a “Directional Pad,” *i.e.*, a single click, as a “virtual detent”).

121. A POSITA would have understood that Levin’s “jolt” detent force is a form of vibrotactile effect. More specifically, a POSITA would have known that a “jolt” could be produced by a short single vibration of particular magnitude, and it would feel like a “click” to a user touching the touchpad. Levin’s “jolt” thus aligns with the “click effect replicating a mechanical click” that the ’042 Patent discusses. EX1001 at 6:6-11; 6:16-18, 10:14-17.

122. Levin also teaches detent force profiles created from periodic waves, which are multiple vibrations that occur over a period of time. See for example Levin at 4:1-2, 3:9-12.

123. Next, Levin also teaches “the magnitude of the force detents can differ based on the value being controlled. For example, a radio frequency having a higher

value might be associated with a stronger force detent, while a lower radio frequency might be associated with a weaker force detent when it is displayed, thus informing the user generally of the radio station being displayed without requiring the user to look at the display 14.” Levin, 10:33-42. A POSITA thus had reason to adjust the magnitude of the “detent force” that is output when users tap Ichinose’s “tuning control button” based on radio frequency. For example, the “detent force” has increase magnitude/force as the radio frequency is higher (e.g., 107.3 FM) and has less magnitude/force as the frequency gets lower (e.g., 89.9 FM). A POSITA would appreciate that this beneficially allows a driver to know (roughly) where he or she is in the radio’s spectrum of available frequencies without directing his or her attention from the road. *See*, for example Ichinose at 4:31-33 (“The user can be confident that a function or device was properly selected without directing his or her attention away from the way.”).

124. Finally, Levin teaches that car settings can be adjusted via a “slider control 32” such as the one depicted in Levin’s Figure 1. Levin at 7:7-31. A POSITA would have understood that sliders were known alternatives to the up/down buttons that Ichinose uses to adjust radio settings or HVAC fan-speed settings. For example, U.S. Patent No. 6,848,263 (EX1078) discloses the use of a virtual slider-bar on a touchscreen display to adjust car setting such as temperature or air flow. EX1078 at 1:40-48; 2:21-41; FIG. 2. Likewise, U.S. Patent No. 6,275,231

(EX1079), discloses the use of virtual slider presented on a touchscreen display to adjust car settings such as sideview mirror adjustments. EX1079 at 15:11-26; 16:4-11; FIGS. 13-15. U.S. Patent No. 7,084,859 (EX1077) likewise discloses the use of a virtual slider on a touch screen that is moved via a user's finger. EX1077 at 35:23-33; FIGS. 10a-10b. It would have been a straightforward matter of design choice for a POSITA to replace Ichinose's virtual up/down buttons with a virtual slider that users move with Ichinose's cursor 54. As the slider is moved linearly, "force detents are output for each station and/or each preset station previously programmed by the user." Levin at 7:7-31; 10:11-46.

125. The above-described implementations relate to adjusting a radio, but a POSITA would have understood that the implementations were applicable to other system settings such as temperature. Ichinose at 3:31-46; FIGS. 4A-4B.

126. A POSITA reasonably would have expected success in implementing any of the above implementations because Levin's "force detents" are executed by a processor (Levin, 19:54-20:3), such as Ichinose's command processor, and can be output by "any of a variety of different types of actuators" (Levin, 10:1-5), which Ichinose's system includes. Ichinose, 4:34-35 ("[a]ny suitable actuator").

127. Although Levin discloses outputting "force detents" on a physical knob or slider, a POSITA understood that similar detents, *e.g.*, vibrations or jolts, could be output onto a touchpad, such as Ichinose's touchpad, using conventional

actuators. On this latter point, I note that the '042 Patent itself provides no details on how its actuator provides virtual detents to a touchpad, underscoring that such implementations details were already well-known. EX1001 at 6:32-45.

4. Claim 1

a. [1PRE]: “A method comprising:”

128. Ichinose-Levin’s system performs Ichinose’s “method for device control.” *E.g.*, Ichinose, claim 17. Ichinose-Levin thus meets 1PRE.

b. [1A]: “receiving an input signal comprising information associated with a manipulation of an input device configured to control a plurality of systems, wherein the input device comprises a touch-pad;”

129. Ichinose-Levin’s system includes Ichinose’s “command processor 86” and its “touchpad 10.” Ichinose at 4:36-67; FIG. 8. “[T]ouchpad 10 generates an input signal 84 indicative of user interaction with the touchpad 10,” and “command processor 86 ...processes [*i.e.*, “receives”] the input signal.” Ichinose at 4:36-40. Ichinose-Levin’s “command processor” thus “*receiv[es] an input signal comprising information associated with a manipulation of an input device...wherein the input device comprises a touch-pad,*” as claimed.

130. Ichinose-Levin’s “touchpad” is also “*configured to control a plurality of systems,*” *i.e.*, Ichinose’s “controllable devices 22,” *e.g.*, HVAC, audio, and navigation systems. Ichinose at 1:11-28 (detailing a plurality of controllable vehicle devices which are systems as claimed); 2:41-43; 4:65-67; claim 10 (“plurality of

controllable devices”); FIG. 8 (identifying “devices 22” as “HVAC,” “audio,” and “navigation” systems).

c. [1B]: “receiving a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent”

131. Ichinose-Levin’s “command processor” “*receiv[es] a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent,*” as claimed.

132. As explained above at Section XI.A.3, Ichinose-Levin stores Levin’s “detent force profiles” in memory and its “command processor” would access (i.e., “*receiv[es]*”) those profiles from memory to “generate[] a feedback signal 92” that is communicated to “the feedback device 80” to provide “tangible feedback,” i.e., vibrotactile feedback, to the driver when, for example, the driver is adjusting a vehicle system such as the radio’s tuning. Ichinose at Abstract; 1:39-58; 2:63-67; 4:5-23; 4:46-61. Each “detent force profile” in Ichinose-Levin is “*associated with one of the systems,*” as claimed, because each profile is specific to a particular function that the system being adjusted performs. Levin at 8:3-26 (explaining how different force feedback occurs when a driver interacts with different systems within the car); 10:11-56 (similar discussion; “The force feedback be integrally implemented with the control functions performed by the knob.”); 11:37-40 (“Since the spring force and detent forces are programmable and can be output as directed

by a microprocessor or other controller, a single knob 18 can provide both rate control and position control over functions or graphical objects.”); claim 56 (reciting a device that selects a “mode” and then outputs force sensations “associated with said mode”).

133. A POSITA would know that associations need not be unique, nor all one-to-one, nor exclusive³¹. The claim language is also devoid of anything to limit the plain broad meaning. A POSITA would understand that the force profile the processor accesses to use to indicate the positions of “ticks” for discrete values for controlling a particular system is associated with that system because the processor is programmed to use that particular profile with that particular system (it may also use other profiles with that same system). A POSITA would understand that as a simple matter of design choice or optimization, a particular profile could be used with more than one system or subsystem, or that two profiles stored as distinct, but identical (or functionally-identical) data could be merged into one³². For that matter, a POSITA would readily understand that it may be desirable to use the same (or

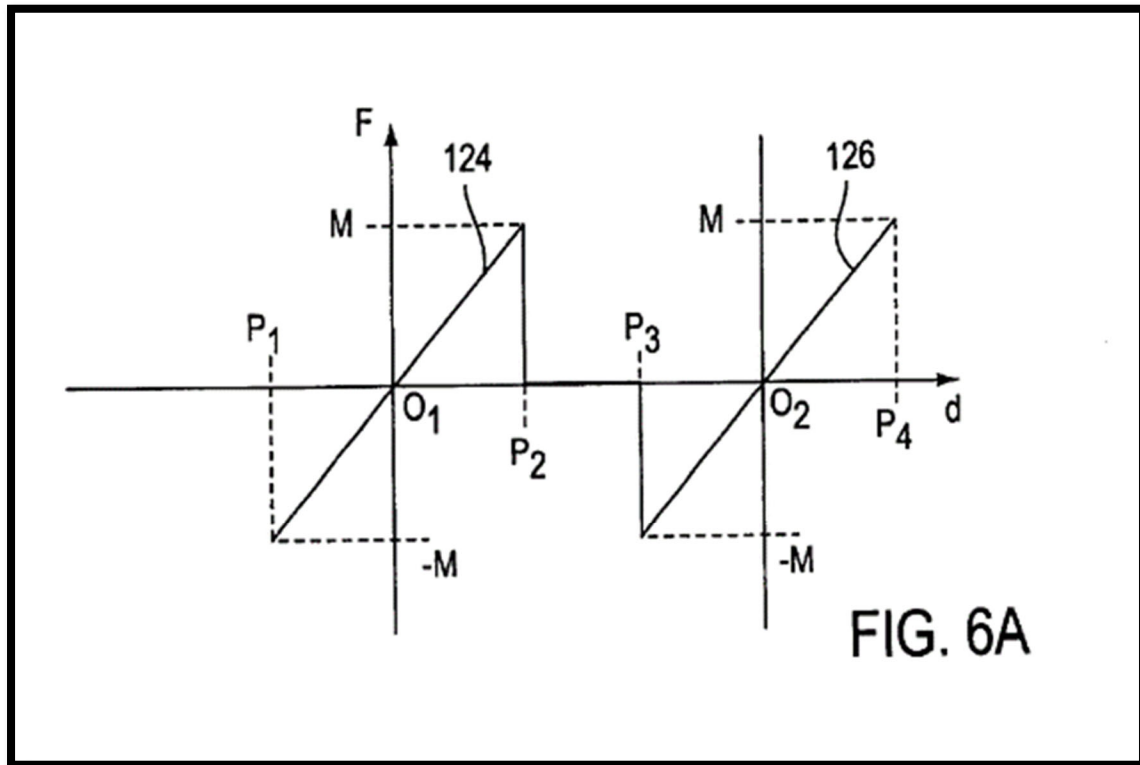
³¹Although this was taught formally and explicitly in multiple textbooks and tutorials, one example is EX1080 (West, “Developing High Quality Data Models”).

³²A POSITA would also readily see this as a potential implementation-choice optimization to save memory space, simplify customization procedures, etc.

functionally identical) sensation and force profile across more than one system – for example, a particular sensation to indicate that the current system is inoperative, or in a fault condition (for example, something is jammed in the mechanical operation of the system, or voltage is low, etc.).

134. Levin’s “detent force profiles” are each a “*detent profile comprising haptic data associated with a virtual detent,*” as claimed. For example, Levin explains that its “detent force profiles” include data that “represents the magnitude of force” that an actuator would output onto the input device based on “position” of the input device. Levin at 14:30-45. With a touchpad, a POSITA would understand that the “position” of the input device would correlate to the position and/or movement of a user’s finger across the touchpad from one position to another. Together, the force magnitude and position data comprise “*haptic data*” as claimed.

135. Figure 6A (below) illustrates an exemplary “detent force profile” (Levin at 14:30-32):



136. Using Figure 6A as example, if a driver's finger starts on the touchpad at "the detent origin O_1 " and moves toward "the detent origin O_2 ," "an increasing magnitude of force is output" until the user reaches P_2 when force magnitude drops to zero. Levin at 14:59-64. Subsequently, this process would repeat as the user's finger approaches the next detent. Levin at 15:3-8. A POSITA would understand that the process illustrated in Figure 6A results in a "click" detent similar to the "clicks" experienced when rotating a mechanical knob or sliding a mechanical slider.

137. The detent profile depicted in Figure 6A would have been used with the virtual-slider implementation that I discussed above in which successive detents or "clicks" are felt as the radio (or temperature) is changed by pushing the virtual slider.

138. For the other implementations where a “click” virtual detent is provided each time the up/down virtual button is tapped or held down, a POSITA would have understood that a similar “detent force profile” would have been used that included at least the magnitude of the vibration that the actuator would need to output to simulate the “click.” Levin at 10:16-17 (“force detents can be simple jolts”); 14:26-29; 23:23-33.

139. Levin’s “detent force profiles” are thus a “*detent profile comprising haptic data associated with a virtual detent,*” as claimed, and the “command processor” of Ichinose-Levin receives a “detent force profile” from memory to simulate one of the mechanical detents, *i.e.*, “*a virtual detent,*” as discussed above.

d. [1C]: “generating a vibrotactile signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent”

140. Ichinose-Levin’s “command processor” processor “generates [a] feedback signal 92,” *i.e.*, “*a vibrotactile signal,*” that is “communicated to the feedback device 80,” which is an actuator that outputs a vibrotactile effect (*e.g.*, vibration) in response to the feedback signal. Ichinose at 4:7-9 (“When activated, the feedback device 80 actuates, causing the user to experience a tangible vibration through the touchpad 10.”); 4:33-35 (“feedback device 80” can be “any suitable actuator that is operable to provide vibration”); 4:53-61; claim 17; FIGS. 7-8. As I discussed for limitation [1B], the command processor in Ichinose-Levin generates

the feedback signal based on one of Levin's "force detent profiles," which include haptic data associated with a virtual detent.

141. Ichinose-Levin's command processor thus "*generat[es] a vibrotactile signal,*" i.e., a "feedback signal," that is "*configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent,*" as claimed.

- 5. Claim 2: "The method of claim 1, further comprising generating a system signal associated with a system to be manipulated, the system signal based at least in part on the input signal, and wherein generating a system signal and generating the vibrotactile signal occur substantially simultaneously."**

142. Ichinose-Levin's system performs claim 2's method when a user uses the system's touchpad to adjust a setting of one of the vehicle's controllable devices, e.g., adjusting the volume or tuning of a radio.

143. For example, in response to an "input signal" that is "indicative of user interaction with the touchpad," the command processor of Ichinose-Levin generates (1) a "feedback signal 92" that causes the feedback device coupled to the touchpad to generate a vibrotactile effect and (2) a "command signal 94" that "is communicated to the controllable devices 22." Ichinose at 4:36-67. The "command signal" is "*a system signal associated with a system to be manipulated, the system signal based at least in part on the input signal,*" as claimed.

144. Ichinose further discloses that the “command signal” and “feedback signals” are generated “*substantially simultaneously*,” as claimed. For example, Ichinose explains that “the feedback device 80 actuates when the user taps the touchpad 10 to select a function or device.” Ichinose at 4:28-30 (emphasis added); *see also* Ichinose at 4:5-23. In other words, the feedback device vibrates in response to a feedback signal at substantially the same time as a selection is made that triggers generating a command signal.

145. Generating both signals “*substantially simultaneously*” would also have been obvious in view of Levin which suggests doing so because its force feedback occurs when a system setting (e.g., temperature or radio channel) is changed. *E.g.*, Levin, 2:49-52 (“[M]icroprocessor preferably receives the sensor signals and controls a function of a device in response to the sensor signals, and also sends force feedback signals to the actuator to control forces output by the actuator.”) (emphasis added); 7:11-24 (“as the user moves the knob 34, force sensations...can be output and felt by the user”; “the motion left or right of knob 34 can control the radio frequency 22, where force detents are output for each station”); 8:19-26; 11:28-32. (emphasis added). Indeed, a POSITA would understand that a purpose of a “detent” is to provide tactile feedback to a user that a selection has made. A POSITA would understand therefore that delay between the “detent” feedback and a change

in the system preferably would be minimized. On this point, see also Levin, 8:15-19 (“the user can feel the fan settings at the detents”).

6. Claim 3: “The method of claim 1, wherein the vibrotactile signal is based at least in part on the input signal.”

146. In Ichinose-Levin, “*the vibrotactile signal*,” i.e., “feedback signal 92,” “*is based at least in part on the input signal*,” i.e., “input signal 84,” as claimed. Ichinose at 4:36-61 (“touchpad 10 generates an input signal 84 indicative of user interaction with the touchpad 10...command processor 86 tracks the position of the...cursor 54, according to the input signal 84... [and] generates a feedback signal 92 according to the position of the cursor”); *see also* Ichinose at 2:62-67 (explaining device “functions” can be adjusted when a user positions the cursor a displayed icon for the function); FIGS. 2A-6.

7. Claim 4: “The method of claim 1, wherein the vibrotactile signal is further based in part on the status of the input device.”

147. The ’042 Patent does not explain what “*the status of the input device*” means, but I understand that Patent Owner has taken the position that Claim 4 is met when the touchpad is simply used in a manner that causes a vibrotactile effect to occur. EX1021 at 15 (“On information and belief, using the touchpad with a given behavior, such as ‘As Mouse’ or ‘As Joystick,’ requires maintaining state that reflect the status of the input device.”).

148. In Ichinose-Levin, “*the vibrotactile signal*,” i.e., “feedback signal 92,” “*is based in part on the status of the input device*,” under Patent Owner’s apparent interpretation of the claim. For example, Ichinose teaches that “feedback signal 92” is only generated when a user is touching the touchpad in a manner indicating that an adjustment to a system setting has been selected. See above §XI.A.4.d (discussing limitation [1C]); Ichinose at 2:62-67 (“When the cursor 54 is positioned over a desired function, the user may select or adjust the function. For example, the user may position the cursor 54 over the tuning functions 42. The user may adjust the tuning 42 by positioning the cursor 54 over a tuning control button 56 and tapping the touchpad 10.”); 4:53-55. A POSITA would understand that when a user is touching the touchpad in a manner not indicating that an adjustment to a system setting has been selected, then no “*vibrotactile signal*” is generated, but such a signal is generated when a user is touching the touchpad in a manner indicating that an adjustment to a system setting has been selected.

149. Because the “*vibrotactile signal*” is only generated when a user is contacting the touchpad at a particular location or manipulating the touchpad such that it moves cursor 54 to a particular location in a graphical user interface, e.g., in a manner causing cursor 54 to touch tuning button 56 in FIG. 2A-2B, the signal is “*based in part on the status of the input device*,” i.e., whether a user is contacting the

touchpad such that it positions a cursor over an object to be controlled (e.g., button 56 in FIGS. 2A-2B or a virtual slider).

150. Moreover, the only reference to “status” in the ’042 Patent is its disclosure that a vibrotactile signal “may be based at least in part on a status of a system to be manipulated. In one embodiment, a signal is not generated if a system is off.” EX1001 at 11:49-53. The patent thus teaches that “status” can be as simple as whether something is on or off.

151. Implementing Ichinose-Levin such that it would base the vibrotactile signal to at least in part on whether the input device (*i.e.*, touchpad) is operational or not (for example, powered-off or simply broken) would have been an obvious implementation to a POSITA because it would ensure that a user would not be misled by vibrotactile signals being generated when the device is not operational. For example, a POSITA would simply have the system produce no vibrotactile signals, or perhaps produce a persistent haptic effect, indicating the mode of the device³³ (in this case, non-functional.)

³³Although a POSITA would find this a matter of common sense, such indication of mode would also be known from references such as EX1081 (U.S. Patent Appl. No. 2003/0122779) at [0087].

8. Claim 5: “The method of claim 1, further comprising determining whether to generate a vibrotactile signal.”

152. The “feedback signal 92” in Ichinose-Levin is generated when a user positions a cursor “over a desired function,” *e.g.*, tuning button 56 in FIGs. 2A-2B or a virtual slider. Ichinose at 2:62-67; see above §XI.A.3 (discussing obvious implementations of Ichinose-Levin). Ichinose-Levin’s system thus “*determines whether to generate a vibrotactile signal,*” as claimed, at least because it generates a “feedback signal” only when a user is performing a particular action, *e.g.*, tapping tuning button 56 or moving a virtual slider.

9. Claim 6: “The method of claim 5, wherein determining whether to generate a vibrotactile signal is based at least in part on a status of the system to be manipulated.”

153. As I discussed above in Section XI.A.3, one implementation of Ichinose-Levin would result in the magnitude of the “detent force” that is output when a user taps Ichinose’s “tuning control button” being based on radio frequency, *i.e.*, lower frequencies have lower magnitude detents than higher frequencies. In this implementation, which vibrotactile signal Ichinose’s “command processor 86” generates depends on the radio system’s then-current frequency (*i.e.*, high or low), which is a “*status of the system to be manipulated,*” as claimed. Alternatively, for largely the same reasons I discussed above for claim 4, an obvious implementation of Ichinose-Levin would have been one in which the system does not generate a vibrotactile signal when the system to be manipulated, *e.g.*, the car’s radio, is turned

off because the lack of a vibrotactile signal would indicate to the user that the system is off, and functioning otherwise would be confusing and undesirable

10. Claim 7: “The method of claim 1, further comprising determining one of a plurality of virtual detents to generate.”

154. As I discussed above for limitation [1B], Ichinose-Levin stores Levin’s “detent force profiles” in memory and its “command processor” would access those profiles from that memory “to generate a feedback signal 92” that is communicated to “the feedback device 80” to provide “tangible feedback,” *i.e.*, vibrotactile feedback, to the driver. Ichinose at Abstract; 1:39-58; 4:5-23; 4:46-61. Ichinose-Levin teaches that “detent force profiles” may be specific to a particular function that a system performs, *e.g.*, controlling vent fan rotation speed, the volume for the audio system’s sound speakers, “snap-to” detents for favorite stations on the radio, or the HVAC system’s temperature setting. Levin at 8:7-26; 10:11-34.

155. For example, the virtual detent I discussed above in §XI.A.3 in which the magnitude of the detent varies depending on the radio channel frequency being selected is different than the standard “click” detent that is output when a virtual slider is moved to adjust the car’s temperature setting. Ichinose-Levin thus includes a “*plurality of virtual detents*” as claimed.

156. Ichinose-Levin “*determines one of a plurality of virtual detents to generate,*” as claimed, at least because the “detent force profile” that the “feedback signal” instructs an actuator to perform is selected from multiple “detent force

profiles” that Ichinose-Levin stores, *e.g.*, the “detent force profile” associated with changing radio stations must be selected rather the “detent force profile” associated with changing the vehicle’s temperature.

11. Claim 8: “The method of claim 1, wherein the detent profile comprises a first detent profile, and further comprising receiving a second detent profile.”

157. As I discussed above for limitation [1B] and claim 7, Ichinose-Levin stores Levin’s “detent force profiles” in memory, and each profile may be associated with a particular system being controlled. Accordingly, a POSITA would consider it an obvious design feature that when a user switches from controlling a first system (*e.g.*, radio) to a second system (*e.g.*, HVAC), the “command processor” in Ichinose-Levin would “*receiv[e] a second detent profile,*” as claimed, at least because it would receive a new “detent force profile” for the second system.

158. In addition, in Ichinose-Levin, in the context of selecting a nearest preprogrammed station for a radio system, Levin teaches the use of “sets of detent force profiles”, and “a particular set can be provided on the knob 18 by a microprocessor” Levin at 10:33-56 (emphasis added). A POSITA would understand this to teach the use of multiple detent profiles for a single system, that is, it teaches that Ichinose-Levin has access to multiple (*i.e.*, “sets”) of profiles, and a particular “set” of that multiple can be provided to the knob.

12. Claim 9

a. [9PRE]: “A method comprising:”

159. Limitation [9PRE] is identical to limitation [1PRE] and is thus met by Ichinose-Levin for the same reasons that the combination met limitation [1PRE].

b. [9A]: “detecting a change in position of an input device configured to control one of a plurality of systems, wherein the input device comprises a touchpad;”

160. Ichinose-Levin meets [9A] largely for the reasons it meets [1A].

161. The lone difference between the two limitations is the fact that limitation [9A] requires “*detecting a change in position of*” the touchpad, whereas limitation [1A] requires “*receiving an input signal comprising information associated with a manipulation of*” the touchpad. In other words, [9A] requires detecting a change in “position” of the touchpad whereas [1A] requires receiving information associated with a user’s “manipulation,” *i.e.*, touching, of the touchpad.

162. In the context of touchpads, the language of limitation [9A] makes little sense because the position of a touchpad is not typically changed, and any such change in a touchpad’s position (e.g., you turn your laptop clockwise which arguably changes the position of the touchpad) is not typically used by the touchpad to interact with the electronic device associated with the touchpad. Most likely the language of [9A] reflects a remnant of the Applicant’s originally filed claims in which the input device was not limited to a touchpad and thus included devices such as knobs

where the language of [9A] would make more sense to a POSITA because a knob's (rotary) position can change.

163. Regardless, I understand that Patent Owner currently contends that the “change in position” recited in limitation [9A] is the change in position of a user's finger on the touchpad. EX1021 at 18-22 (citing “moving a finger across the surface of the trackpad” as a “change in position”). In other words, Patent Owner treats limitation [9A] as if it were substantively identical to limitation [1A].

164. Nonetheless, applying that construction, Ichinose-Levin's system meets claim [9A]. Specifically, in Ichinose-Levin, “touchpad 10 generates an input signal 84 indicative of user interaction with the touchpad 10” and “tracks the position” of a cursor that corresponds to the user's interaction with the touchpad. Ichinose at 4:36-61. Ichinose-Levin's system thus “*detect[s] a change in position of an input device,*” *i.e.*, movement of a user's finger from one position on the touchpad to another.

- c. **[9B]: “receiving a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent; and”**

165. Limitation [9B] is identical to limitation [1B] and is thus met by Ichinose-Levin for the same reasons that the combination met limitation [1B].

- d. [9C]: “generating a detent signal based at least in part on the detent profile and the change in position, the detent signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent, the vibrotactile effect based at least in part on the detent signal.”

166. Ichinose-Levin meets [9C] largely for the same reasons it meets [1C].

167. The difference between the two limitations is the fact that [9C] requires “generating” “the detent signal” based on, not only the “*detent profile*,” but also “*the change in position*” (emphasis added) of the touchpad. Ichinose-Levin’s system performs that additional step.

168. For example, as I discussed above for [9A], Ichinose-Levin’s system “tracks the position” of a cursor that corresponds to the user’s interaction with the touchpad. Ichinose at 4:46-61. Ichinose further teaches that “feedback signal 92,” *i.e.*, “*detent signal*,” is generated when a user is touching the touchpad in a manner indicating that an adjustment to a system setting has been selected, which occurs when the user “position[s] the cursor [] over” a particular function, *e.g.*, tuning button 56 or a virtual slider. Ichinose at 2:62-67; 4:53-55; see above §XI.A.4.c-d (discussing limitations [1B] and [1C]); also see above §XI.A.3 (discussing obvious implementations of Ichinose-Levin).

169. Ichinose-Levin’s system thus generates “*the detent signal*” based at least in part on the “*change in position*” of the input device, *e.g.*, a user’s finger

moves the cursor onto a window for a particular function such as “tuning.” Ichinose at 2:62-67 (“The user may adjust the tuning 42 by positioning the cursor 54 over a tuning control button 56 and tapping the touchpad 10.”).

13. Claim 10

170. Claim 10 is reproduced below with labels added for reference:

Claim 10
[10PRE] A non-transitory computer-readable medium on which is encoded program code, the program code comprising:
[10A] program code for receiving an input signal comprising information associated with the manipulation of an input device configured to control one of a plurality of systems, wherein the input device comprises a touch-pad;
[10B] program code for receiving a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent; and
[10C] program code for generating a detent signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent.

171. As seen above, Claim 10 recites a computer-readable medium with program code “for” performing each step of method claim 1, which steps Ichinose-Levin performs as discussed for claim 1. More specifically, [10A] corresponds to [1A], [10B] correspond to [1B], and [10C] corresponds to [1C].

172. As I explained earlier, Ichinose’s system utilizes a “command processor” and “software module” to perform its functionality. Ichinose, 4:36-67; FIG. 8. A POSITA would have understood that processor-implemented methods, such as those Ichinose’s “command processor” performs, would have conventionally been stored on a CRM, and thus a POSITA had reason to store on a CRM the

program code needed to cause Ichinose's command processor to perform the method steps of claim 1.

173. Levin also would have motivated a POSITA to store Ichinose's processor-implemented methods on a CRM because Levin teaches that its "detent force profiles," which Ichinose-Levin include, can be "based on instructions stored in a computer readable medium, such as a memory circuit, magnetic disk, optical disk, etc." Levin at 14:30-35.

174. Either in view of their own background knowledge of computer-readable media and processor-implemented methods or in view of Levin's disclosure of a computer-readable medium storing instructions for a processor to execute, a POSITA would have found it obvious to store the instructions that Ichinose's "command processor" executes in a computer-readable medium such as RAM.

14. Claim 11: "The computer-readable medium of claim 10, further comprising program code for generating a system signal associated with a system to be manipulated, the system signal based at least in part on the input signal."

175. Claim 11 recites a computer-readable medium with program code "for" performing each step of method claim 2. Ichinose-Levin discloses claim 11 for the same reasons it discloses claims 2 and 10.

15. Claim 12: “The computer-readable medium of claim 10, further comprising program code for determining whether to generate a detent signal.”

176. Claim 12 recites a computer-readable medium with program code “for determining whether to generate a detent signal.”

177. Ichinose-Levin discloses claim 12 for the same reasons it discloses claims 5 and 10.

16. Claim 13: “The computer-readable medium of claim 10, further comprising program code for determining a virtual detent to generate.”

178. Claim 13 recites a computer-readable medium with program code “for determining a virtual detent to generate.”

179. Ichinose-Levin discloses claim 13 for the same reasons it discloses claims 7 and 10.

17. Claim 14

180. Claim 14 is reproduced below with labels added for ease of reference:

Claim 14
[14PRE] A non-transitory computer-readable medium on which is encoded program code, the program code comprising:
[14A] program code for detecting a change in position of an input device configured to control one of a plurality of systems, wherein the input device comprises a touch-pad;
[14B] program code for receiving a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent; and

[14C] program code for generating a detent signal based at least in part on the change in position, the detent signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent, the vibrotactile effect based at least in part on the detent signal.

181. As seen above, Claim 14 recites a computer-readable medium on which is encoded program code “for” performing each step of method claim 9, which steps Ichinose-Levin performs as discussed for claim 9. More specifically, [14A] corresponds to [9A], [14B] correspond to [9B], and [14C] corresponds to [9C].

182. As I explained above for claim 10, either in view of their own background knowledge of computer-readable media and processor-implemented methods or in view of Levin’s disclosure of a computer-readable medium storing instructions for a processor to execute, a POSITA would have found it obvious to store the instructions that Ichinose’s “command processor” executes in a computer-readable medium such as RAM.

183. Ichinose-Levin therefore meets claim 14 for the same reasons it meets claims 9 and 10.

18. Claim 15

a. [15PRE]: “A system comprising:”

184. Ichinose-Levin is an implementation of Ichinose’s “system” for controlling a vehicle’s devices. Ichinose at 4:36-37; FIG. 8.

- b. [15A]: “an input device configured to control one of a plurality of systems, wherein the input device comprises a touch-pad”**

185. Ichinose-Levin’s system includes “touchpad 10.” Ichinose at FIG. 8. For the same reasons I discussed above for [1A], “touchpad 10” is configured “*to control one of a plurality of systems,*” as claimed.

- c. [15B]: “a processor in communication with the input device,”**

186. Ichinose-Levin’s system includes “command processor 86.” Ichinose at 4:40-43; FIG. 8. For the same reasons I discussed above for [1A], “touchpad 10” is “*in communication with*” the command processor 86.

- i. [15B1] “the processor configured to receive an input signal and a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent,”**

187. For the same reasons I discussed above for [1A], the command processor 86 in Ichinose-Levin is configured “*to receive an input signal and a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent,*” as claimed.

- ii. [15B2] “the processor further configured to generate a detent signal; and”**

188. Limitation [15B2] is substantively identical to limitation [1C], which command processor 86 performs in Ichinose-Levin for the reasons discussed above with respect to [1C].

189. The lone difference between the two limitations is the fact that [15B2] uses the term “*detent signal*,” whereas [1C] uses the term “*vibrotactile signal*.”

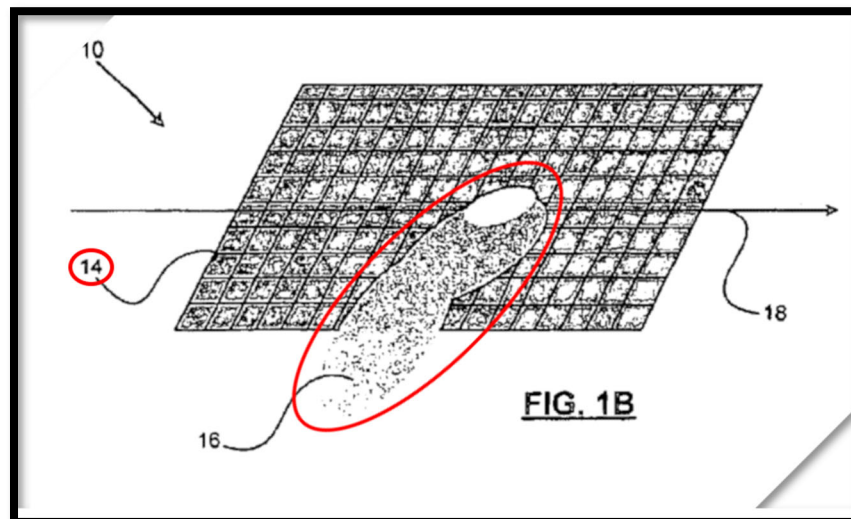
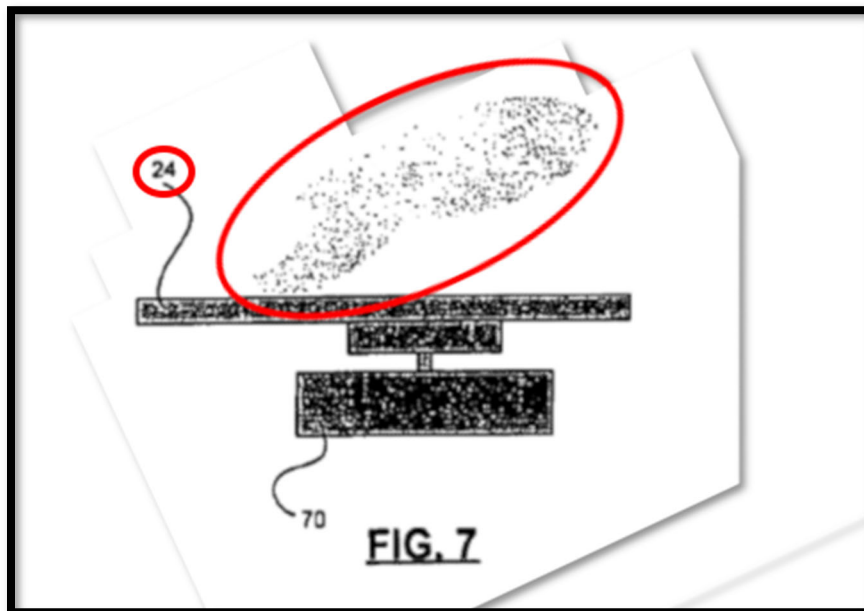
190. The '042 Patent describes a “*detent signal*” as the signal that the processor generates to cause an actuator to output a vibrotactile effect. *See, e.g.*, EX1001 at 4:35-39 (“The processor 106 may generate a signal, such as a detent signal, to the actuator 108. The detent signal may be configured to cause an actuator 108 to produce a vibrotactile effect in the form of a virtual detent on the input device 102.”). The “detent signal” thus performs the same function as the “*vibrotactile signal*” recited in [1C]. Inasmuch as the '042 Patent teaches explicitly that the detent signal may be configured to cause a vibrotactile effect in the form of a virtual detent, a POSITA would have understood the '042 Patent to be using the two terms in an equivalent manner.

191. The “feedback signal 92” of Ichinose-Levin therefore meets both limitations [15C] and [1C] for the reasons discussed in above regarding [1C].

- d. **[15C]: “at least one actuator coupled to the input device, the at least one actuator configured to receive the detent signal and produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent.”**

192. Ichinose-Levin’s system includes “feedback device 80” which is an actuator. Ichinose at 4:24-35.

193. A POSITA would have interpreted Ichinose's Figure 7 (below) to depict the actuator coupled to the housing of touchpad 10. Ichinose, 2:10-11. In particular, a POSITA would have understood that element 70 in Figure 7 is an obvious error, and a POSITA would readily understand the correct meaning: "feedback device 80" as element 70 is shown in FIG. 6 as a "navigation function." Ichinose at 3:48-52.



194. A POSITA would understand this because:

- First, Figures 1B and 7 are described jointly in Ichinose. Ichinose at 4:5-67.
I show both figures above with added annotations for clarity.
- Second, the unlabeled finger in Figure 7 is clearly the labeled finger 16 of Figure 1B.
- Third, although element 24 is never referenced in the description of Figure 7 in Ichinose's specification, it is clearly related to the "touchable area" 14" of touchpad 10 in Figure 1B (thus, also indicating a reference to the touchpad).
- Fourth, regarding "14/24": By their similar numberings, a POSITA would understand the numbering itself may likely connote related if not identical elements, especially when in related figures, and especially when there is no conflicting definition in the specification's text.
- Fifth, element 80 is described for Figure 7 as a "feedback device" which causes a tangible vibration "through the touchpad 10."

195. The feedback device is thus coupled to the touchpad that is illustrated above in Fig. 7 as being contacted by a finger.

196. Alternatively, it would have been obvious to couple the actuator to the input device – the touchpad – so that vibrotactile effects could be provided to the

input device, which is a conventional design that Levin also teaches. Levin at Abstract (“An actuator is coupled to the knob to output a force.”).

19. Claim 16: “The system of claim 15, wherein the processor is further configured to control a system based at least in part on a manipulation of the input device.”

197. As I discussed above with respect to claim 2, Ichinose-Levin’s system performs a vehicle-control operation that is based on a user contacting the touchpad and which controls an aspect of a system, *e.g.*, radio.

20. Claim 17: “The system of claim 15, wherein the processor is further configured to determine whether to generate a detent signal.”

198. As I discussed above with respect to claim 5, Ichinose-Levin’s system includes a “command processor 86” that “*determine[s] whether to generate a detent signal.*”

21. Claim 18: “The system of claim 15, wherein the at least one actuator is coupled to a housing of the input device.”

199. As I discussed above with respect to limitation [15C], Ichinose-Levin’s system (or an obvious implementation of it) includes an “*actuator,*” *i.e.*, feedback device 80,” that is coupled a housing touchpad 10. A POSITA would find it at least implausible that the touchpad would not be coupled in some way to some kind of housing of the input device.

22. Claim 19: “The system of claim 15, wherein the input device comprises a sensor.”

200. Ichinose-Levin’s touchpad operates “by means of touch inputs as is known in the art.” Ichinose at 2:27-36.

201. A POSITA would therefore have understood the touchpad to be a conventional touchpad which includes a “sensor,” for example, a capacitive or resistive sensor, to sense a touch on the pad’s surface.

202. In addition, Levin specifically states that capacitive sensors or resistive sensors were well known to the skilled in the art. Levin at 21:67-22:3.

203. Even without the disclosure of Levin, using capacitive sensors or resistive sensor(s) in Ichinose-Levin’s touchpad would have been obvious because capacitive sensors and resistive sensors were two common and well-known sensors for touchpads.

204. Also on this point, a POSITA would have found the disclosure of a touchpad comprising a sensor at least to be inherent in Levin, from Levin’s teaching of a touch-sensitive surface to allow a user to touch display images directly on a display to select those images and an associated setting or function, Levin at 5:17-21, as well as in Ichinose, which teaches that selectable areas of a display may be emphasized as the user interacts with a touchpad, as was known in the art, Ichinose at 2:58-51.

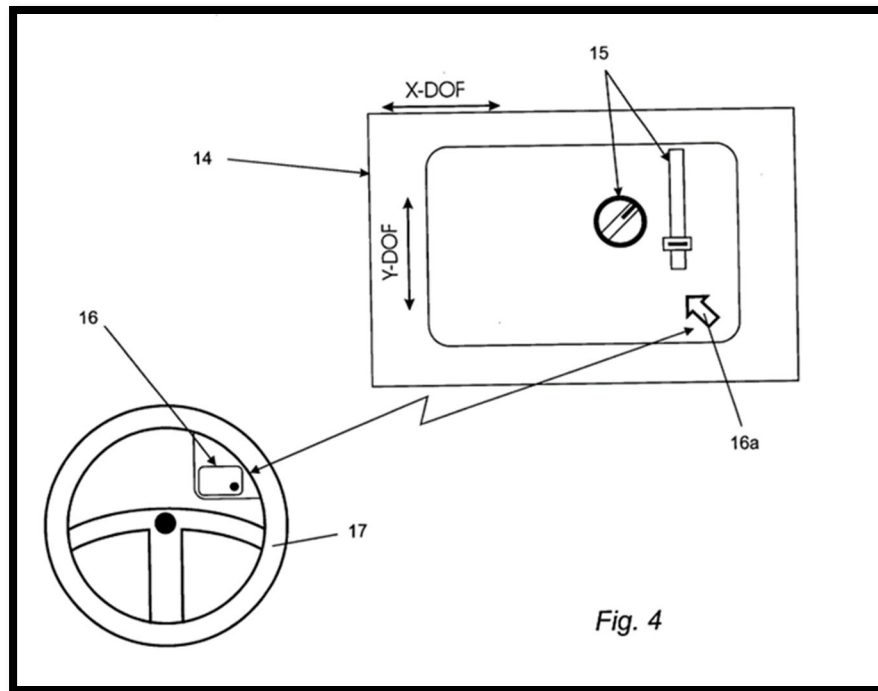
B. Ground 2: Claims 1-19 Would Have Been Obvious Over Wang in view of Ichinose

1. Wang (EX1022)

205. Wang discloses a system “for controlling...vehicle subsystems.” Wang at Abstract. The system includes a “haptic device” that a driver uses to manipulate a virtual control device shown on a display, and that “haptic device” provides “a force effect” to the driver so that he or she “can feel a sense of touching or force through the haptic device while controlling...the vehicle systems.” Wang at Abstract.

206. In Wang’s system, “conventional physical knobs, levers and controls are replaced with virtual knobs, levers, controls and haptic technology.” Wang at 2:4-8. These “virtual” controls are displayed on a “virtual device panel” and each corresponds to particular “automobile hardware to be controlled.” Wang at 2:23-29; *see also* Wang at 4:2-4. A driver interacts with the “virtual” controls using a “haptic device” which allows the driver to “control various subsystems within the vehicle such as the radio, environmental control and windshield wipers or the like.” Wang at 4:4-8.

207. Figure 4 depicts an exemplary system with a virtual knob and virtual slider (elements 15) shown on “virtual device panel 14,” and “haptic device 16” located on a steering wheel. Wang at 8:2-5.



208. In this embodiment, the haptic device is a “thumb-actuated device”³⁴ that contains actuators to generate “force effects.” Wang at 7:26-29; 9:20-28; *see also* Wang at 16:1-8 (“This dashboard system can be an LCD panel (virtual device panel) with a haptic device attached so that the driver can feel virtual buttons and knobs. This haptic device is mounted close to or on the steering column/wheel, well within the driver's vision. The haptic device may include a small ‘mouse,’ which the driver can grab on to or actuate with their thumbs/fingers, thereby allowing him or her to “feel” the virtual controls on the virtual device panel.”); claim 13 (“said

³⁴A POSITA would understand this to be a touchpad or an equivalent.

haptic devices are installed on a steering wheel such that a user can handle easily the haptic devices with his or her hand, finger, or thumb”).

209. Using the haptic device, the driver can position a cursor (element 16a) over a virtual knob or virtual slide and then manipulate that knob or slider (*e.g.*, rotate or push it), which causes the actuators in the haptic device to “emulate a series of detents as the knob rotates.” Wang at 8:29-31; *see also* Wang at 7:18-22 (“emulate...detent effects encountered while rotating the dial”); 16:22-24 (“What’s more, the owner finds he or she can turn virtual knobs and push virtual slider controls as if they are real.”); 16:30-17:2 (“each and every control feels like its mechanical counterpart”).

210. Wang’s system includes a “control devices/indicator library 20” that includes “software representing all possible controls and indicators that are available for a given dashboard system.” Wang at 10:7-9. “To configure a dashboard layout, the user selects the desired control/indicator from the library 20 and drags/copies it to the layout screen on the virtual device panel 14. Each control/indicator has associated properties whereby the user can set the type of effects, size, strength of force effects, etc.” Wang at 10:9-15.

2. Ichinose

211. I described Ichinose above in Section XI.A.1.

3. The Wang-Ichinose Combination

212. Wang's "haptic device 16" is not described in detail, but Wang teaches that it can be controlled by a driver's "thumbs/fingers." Wang at 16:6-8; claim 13 ("a user can handle easily the haptic devices with his or her hand, finger, or thumb"). A POSITA would have understood that one obvious implementation of the haptic device would have been a touchpad because that is a known input device that is controlled by a driver's fingers.

213. For example, a POSITA would understand a touchpad could supply the X-DOF and Y-DOF of the up to three active degrees of freedom, and the passive $\frac{1}{2}$ DOF (Z-DOF) that Wang says its haptic device 16 supplies. Wang at 9:20-29. For that matter, a POSITA would be well-aware that simulated or virtual rotational devices such as rotary knobs as well as simulated or virtual linear devices like a slider can also be implemented using a touchpad, with the movement of the user's finger causing the virtual knob to rotate or the virtual slider to slide. Thus, a POSITA would understand that – while optional – a touchpad could supply a Rotary DOF as well.

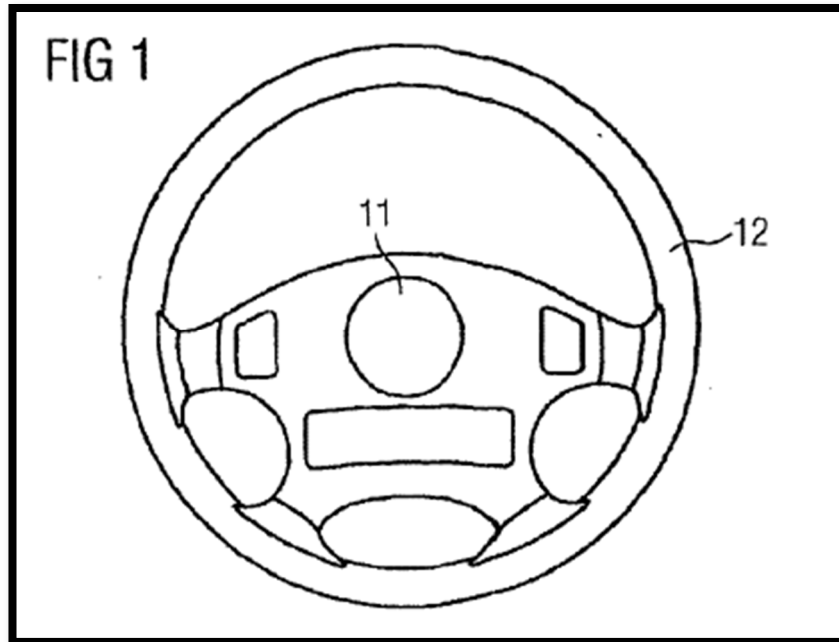
214. As I explained above in Ground 1, Ichinose discloses the use of a haptic-enabled touchpad on a steering wheel to control automotive systems and output haptic feedback. A POSITA would have viewed using Ichinose's "touchpad 10" to implement Wang's haptic device 16 to be the simple substitution of one

known element (Wang's touch-sensitive haptic device) for another (Ichinose's touchpad 10) to obtain predictable results.

215. The use of touchpads in automobile applications, including touchpads that provide haptic feedback, was also well-known to a POSITA.

216. For example, U.S. Patent Application No. 2006/0047386 (EX1023) discloses "touch sensitive pads" that are "mounted on the steering wheel of [a] motor vehicle" and which "the vehicle operator touches...to perform functions such as controlling operation of the radio or adjusting a window." EX1023 at Abstract; FIGS. 5-6. The touchpads are also able to output vibrations as a form of feedback to the user. EX1023 at [0008]; [0045]-[0046]; FIGS. 5-6.

217. Likewise, U.S. Patent Application No. 2007/0120830, filed in 2005, discloses a touchpad for use on a "steering wheel" and which outputs "haptic outputs." EX1024 at Abstract, [0014]; claim 21. The touchpad is seen below as element 11 in FIG. 1 of EX1024:



218. Likewise, U.S. Patent No. 6,157,372 (EX1025) discloses the use of a “touchpad” to control numerous systems within a car including a radio system and a HVAC system. EX1025 at 2:23-37; 2:64-3:47. As this reference explains, the “touchpad” can be located in various user-accessible parts of the car, including “on a hub of a steering wheel.” EX1025 at 3:1-4.

219. Finally, U.S. Patent No. 6,418,362 (EX1026) discloses a “thumb input pad” located on a steering wheel and which can be implemented as “a digital touch pad.” EX1026 at 2:42-46; FIGS. 1, 7C.

220. As Ichinose and the above-discussed references make clear, selecting Ichinose’s particular touchpad to implement Wang’s haptic device 16 would have been a simple and routine design choice for a POSITA.

221. Additionally, a POSITA reasonably would have expected success in the Wang-Ichinose combination because touchpads, such as Ichinose's touchpad 10, were conventional input devices by 2006 and their use to input coordinate signals to an electronic device, such as Wang's virtual device panel would have required only routine skill. Moreover, Wang's haptic device 16 already includes "actuators" to provide haptic feedback (Wang, 7:26-29), thus simplifying the process of incorporating Ichinose's actuator-driven touchpad.

4. Claim 1

a. [1PRE]: "A method comprising:"

222. Wang-Ichinose's "haptic vehicle control system" performs a method of controlling vehicle systems and generating haptic feedback. Wang at 2:23-3:7; *see also* Wang at 15:29-17:15.

b. [1A]: "receiving an input signal comprising information associated with a manipulation of an input device configured to control a plurality of systems, wherein the input device comprises a touchpad;"

223. Wang-Ichinose's system includes Wang's "supervisory/computer processor." Wang at 4:13-14 ("dashboard system is controlled via a computer/processor"); 5:1-13 ("supervisory/computer process 12 is the heart of the dashboard system); FIG. 1. As discussed herein, the "supervisory/computer processor" performs the claimed steps [1A] to [1C].

224. As discussed above, Wang-Ichinose's system includes Wang's "haptic device 16," implemented as a touchpad such as Ichinose's touchpad 10. The device "allows the user to interface with the virtual control devices/indicators displayed on the virtual device panel." Wang at 6:8-13; FIG. 1. "The operating position of the haptic device corresponds to that of a cursor 16a on the screen of the virtual device panel." Wang at 9:24-26; FIG. 4. When implemented as a touchpad, a POSITA would understand that the "operating position" is the position and/or movement of the user's finger on the touchpad and that the cursor's movement corresponds to position and/or movement of the user's finger on the touchpad.

225. Using the touchpad, the cursor can be positioned over a virtual control on the virtual device panel, which allows the control to be manipulated so as to control the system associated with that virtual control. Wang at 2:29-3:7 ("the haptic device...manipulates the virtual control device," and "the plurality of automobile hardware can be controlled...according to virtual controls"); 6:15-26; 8:9-11. Accordingly, Wang's "haptic device 16" is an *"input device,"* and in the Wang-Ichinose system that input device is a *"touchpad,"* as claimed.

226. Wang's supervisory computer/processor *"receiv[es] an input signal comprising information associated with a manipulation of an input device,"* i.e., haptic device 16 (implemented as a touchpad), because Wang's haptic device "communicates" with the virtual device panel via the supervisory

computer/processor and that processor “control[s] the haptic device.” Wang at 9:24-28; 5:1-13 (“supervisory/computer processor 12 is the heart of the dashboard system” and “control[s] the haptic device 16”).

227. “[H]aptic device 16” is “*configured to control a plurality of systems,*” as claimed because a driver uses it to control vehicle systems such as the radio or air conditioning. Wang at 1:3-5 (“controlling...various subsystems and hardware in a vehicle”); 2:18-19 (“plurality of subsystem[s] can be controlled”); 3:2-7; 4:11-13 (similar); 16:15-17:15 (detailing systems that can be controlled).

c. **[1B]: “receiving a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent; and”**

228. Wang-Ichinose’s system “*receiv[es] a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent,*” as claimed.

229. Wang-Ichinose’s system includes “control devices/indicator library 20” that stores in memory “software representing all possible controls and indicators that are available for a given dashboard system.” Wang at 10:7-18. “Each control/indicator has associated properties whereby the user can set the **type of effects, size, strength of force effects, etc.**” Wang at 10:13-15 (emphasis added). One such “effect” that can be “associated” with a virtual control is an “emulate[d]...detent effect[] encountered while rotating [a virtual] dial.” Wang at

7:21-22; *see also* 8:6-9 (“Force effects to emulate the feel of a mechanical rotary knob or a slider...”); 8:29-31 (“[T]he Rotary-DOF can be programmed to emulate a series of detents as the knob rotates. In all cases, the strength and type of the force effects can be set by the user.”); 6:8-21 (explaining that with haptic device 16 a “virtual dial feels real”).

230. The “associated properties” that Wang stores in its “control devices/indicator library,” include both the type of effect (e.g., detent) and the strength (e.g., the magnitude of force applied) of the effect. Wang at 10:7-15. The “associated properties” for a control device that is, for example, a virtual knob is a “*detent profile comprising haptic data associated with a virtual detent*,” as claimed.

231. Wang’s “supervisory computer/processor” “receiv[es]” from the “control devices/indicator library” the “associated properties,” i.e., “*detent profile*,” that is “*associated with*” a particular virtual control for a system that a driver is manipulating. For example, one “associated propert[y]” in Wang’s “library” would be associated with a virtual environmental control knob that a user rotates to adjust temperature, while another “associated propert[y]” in Wang’s “library” would be associated with a volume control virtual slider that a user slides linearly to adjust the audio system’s volume. In each case, Wang’s “associated propert[y]” is associated with a particular system (for example, the car’s temperature system or audio system) that the virtual control controls. Wang at 4:13-14 (explaining the entire “dashboard

system is controlled via a computer/processor”); 5:1-13 (“the supervisory/computer process 12 is the heart of the dashboard system...[i]t is responsible for...accessing the external memory”); 5:20-6:2 (describing how “control devices/indicator library” enables user to “select and drag various desired virtual control devices” onto the virtual display for manipulation); 10:8-22 (the “control devices/indicator library...includes various software representing all possible controls and indicators that are available for a given dashboard system,” and is located in external memory or “incorporated into the supervisory computer/processor 12”); 11:24-12:17; FIG. 1.

232. Accordingly, Wang’s “supervisory computer/processor,” when used in Wang-Ichinose’s system, “*receiv[es] a detent profile associated with one of the systems,*” as claimed.

- d. [1C]: “**generating a vibrotactile signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent.**”

233. Wang-Ichinose’s system includes haptic device 16 (implemented as a touchpad) which itself includes “actuators” driven to produce “force effects” to “emulate...detent[s].” Wang at 7:26-29 (explaining actuators “required to generate the force effect[.]” are contained “within the housing (not shown) of the haptic device 16”); 7:18-22 (describing an emulated, *i.e.*, virtual, detent effect); 8:6-9 (“Force effects to emulate the feel of a mechanical rotary knob or a slider...”); 8:29-31

(“[T]he Rotary-DOF can be programmed to emulate a series of detents as the knob rotates.”); 6:8-21 (explaining that a “virtual dial feels real”).

234. A POSITA would have understood that the “force effect” that Wang-Ichinose’s haptic device provides to emulate a detent would have been generated by a vibration that a user feels on his or her finger, *i.e.*, a “vibrotactile effect.” A POSITA would have understood that actuators coupled to touchpads were a conventional way to provide haptic feedback by vibrating the touchpad using short vibrations or vibratory pulses. This is confirmed, for example, by EX1023 which explains that: “vibrator 502 could be used, which is placed underneath the touch pad 112. By placing the vibrators underneath the touch pads, the operator can be provided with force-feedback by short vibration or pulses, to confirm recognition of finger actions (presses and gestures).” EX1023 at [0046] (emphasis added).

235. Indeed, Ichinose—whose touchpad is the touchpad used in the Wang-Ichinose combination—also discloses providing vibrations to a touchpad to provide a user with haptic feedback. For example Ichinose teaches:

When activated, the feedback device 80 actuates, causing the user to experience a tangible vibration through the touchpad 10. The feedback device 80 provides the user with indicia relating to the user's interaction with the touchpad 10 and the display 34. For example, as the user slides a finger across the touchpad 10, the feedback device 80 may actuate at discrete intervals to indicate the position of the cursor 54. In particular, the feedback device 80 may actuate when the cursor 54 is moved to a different area of the display 34. For example, the feedback device 80 actuates when the cursor 54 is moved from the mode function 44 to the tuning function 42, as shown in FIG. 2A. Additionally, the feedback

device 80 actuates when the cursor 54 is moved over a control button such as the tuning control button 56, as shown in FIG. 2B.

Ichinose at 4:7-21 (emphasis added).

236. Accordingly, Wang’s “force effects,” including its emulated detents, when implemented using Ichinose’s touchpad in Wang-Ichinose, are “*vibrotactile effects*,” as claimed. Alternatively, it would have been obvious to implement the force effects as “vibrotactile effects” in Wang-Ichinose given Ichinose’s above-reproduced disclosure that its touchpad vibrates to provide feedback to a user. Such an implementation would have been the obvious use of known technique (vibration of a touchpad for haptic feedback) to improve similar devices (touchpads) in the same way.

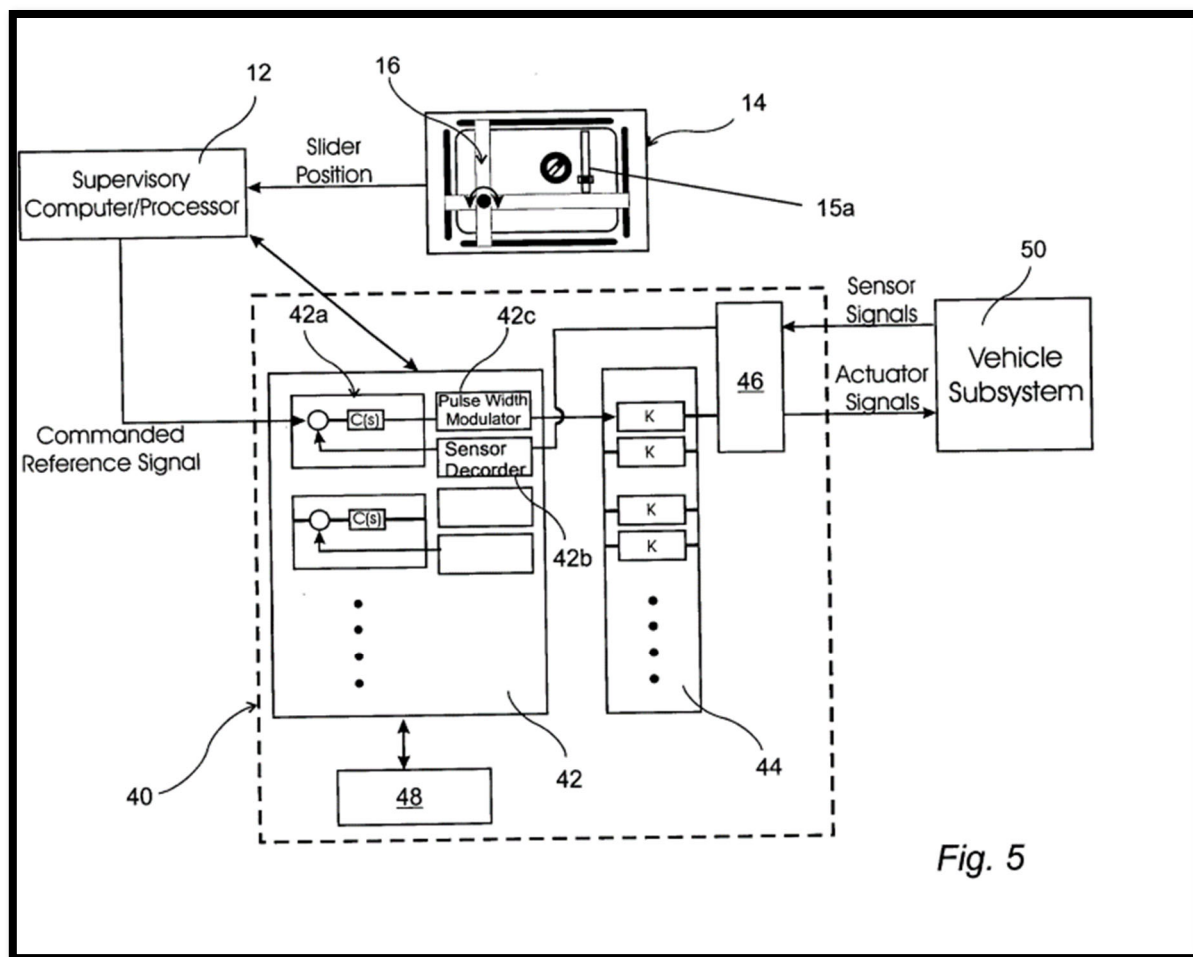
237. Wang’s “supervisory computer/processor” “is responsible for ... controlling the haptic device 16.” Wang at 5:1-12. A POSITA would have understood that the processor “control[s] the haptic device 16” by generating electronic signals that are sent to the device to drive its actuator(s). Wang at 11:24-12:17 (explaining how “supervisory computer/processor 12” transforms information into command “signal[s]” for use by other electronic components). These signals cause the actuator(s) to produce force effects in accordance with the “associated properties” stored in the “control devices/indicator library” for the virtual control being manipulated. *See* my discussion above regarding [1B].

238. Wang’s supervisory computer/processor, when used in Wang-Ichinose, thus “*generat[es] a vibrotactile signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent,*” as claimed.

5. **Claim 2: “The method of claim 1, further comprising generating a system signal associated with a system to be manipulated, the system signal based at least in part on the input signal, and wherein generating a system signal and generating the vibrotactile signal occur substantially simultaneously.”**

239. Wang-Ichinose meets claim 2 when a user uses haptic device 16 to adjust a setting of one of the vehicle’s controllable devices, *e.g.*, adjusting the volume of a radio.

240. Wang’s “real-time interface” (emphasis added) 40 permits a vehicle’s systems/hardware to “be controlled...according to virtual controls being carried out in the dashboard system.” Wang at 2:8-3:8; *see also* Wang at 10:22-12:17 (describing the “real-time interface”); claims 24-26. The “real-time interface 40” is depicted in Figure 5 below (10:22-30):



241. Wang’s “supervisory computer/processor...is responsible for... coordinating the functionality of the intelligent real-time interface 40.” Wang at 5:1-9. When a driver positions a cursor over a virtual control device (*e.g.*, a virtual slider or knob) and adjusts that control device (*e.g.*, pushes the virtual slider up or rotates the knob), the supervisory computer/processor generates a “commanded reference signal” in real time to instruct the “real-time interface” to adjust a setting of the system associated with the control device being adjusted. Wang at 11:24-12:17

(describing how processor generates a “commanded reference signal” that is sent to the real-time interface).

242. A POSITA would have understood that the “commanded reference signal,” (*i.e.*, “*a system signal*,” as claimed) is generated “*substantially simultaneously*” with the signal instructing the haptic device’s actuators to output a force effect that simulates a detent (discussed above for [1B]) because those effects are also generated in real-time to “emulate a series of detents as the knob rotates.” Wang at 8:29-30 (emphasis added); *see also* Wang at 7:21-22 (“detent effects encountered while rotating the dial”) (emphasis added); Wang at 2:20-22 (“a user can feel a sense of touching or force through the haptic device while controlling or monitoring the vehicle subsystems”) (emphasis added); Wang at 3:6-8 (same); *see also* Wang at claims 1 and 24. The virtual knob’s rotation causes the supervisory computer/processor to generate at substantially the same time the signal(s) needed to actuate the haptic device’s actuators and to cause the “real-time interface” to adjust the system associated with the knob being rotated.

6. Claim 3: “The method of claim 1, wherein the vibrotactile signal is based at least in part on the input signal.”

243. In Wang-Ichinose’s system, the “vibrotactile signal” generated by the Wang’s supervisory processor is based on the input signal received from haptic device 16 (implemented as a touchpad). *See* my discussion above for [1A]; *see also*, for example, Wang at 8:29-30 (when the user rotates a virtual knob a vibrotactile

signal is generated to “emulate a series of detents as the [virtual] knob rotates”); 7:21-22 (“emulate friction or detent effects encountered while rotating the dial”).

7. Claim 4: “The method of claim 1, wherein the vibrotactile signal is further based in part on the status of the input device.”

244. As I explained above in Ground 1 when previously discussing claim 4, the ’042 Patent does not explain what “*the status of the input device*” is but I understand that the Patent Owner has taken the position that claim 4 is met when the touchpad is simply used in a manner that causes a vibrotactile effect to occur. EX1021 at 15 (“On information and belief, using the touchpad with a given behavior, such as ‘As Mouse’ or ‘As Joystick,’ requires maintaining state that reflect the status of the input device.”).

245. In Wang-Ichinose the “vibrotactile signal” I discussed for [1C] is generated when a user manipulates a virtual control by using the touchpad in a manner that causes Wang’s haptic device to interact with a virtual control such as a virtual knob or slider (Wang at 2:15-17; 2:30-3:2; 6:13-26; 8:9-11), and thus the signal is “*based in part on the status of the input device*” under Patent Owner’s interpretation of the claim, *i.e.* it is based on the “*status*” of the “*input device*” being used to manipulate Wang’s cursor to interact with a virtual control such as a virtual knob or slider.

246. Moreover, the only reference to “status” in the ’042 Patent is its disclosure that a vibrotactile signal “may be based at least in part on a status of a system to be manipulated. In one embodiment, a signal is not generated if a system is off.” EX1001 at 11:49-53. The patent thus teaches that “status” can be as simple as whether something is on or off.

247. Implementing Wang-Ichinose such that it would base the vibrotactile signal at least in part on whether the input device (*i.e.*, touchpad) is operational or not (*e.g.*, powered-off or simply broken) would have been an obvious implementation to a POSITA as it would ensure that a user would not be misled by vibrotactile signals being generated when the device is not operational. For example, a POSITA would simply have the system produce no vibrotactile signals, or perhaps produce a persistent haptic effect, indicating the mode of the device³⁵ (in this case, non-functional).

³⁵Although a POSITA would find this a matter of common sense, such indication of mode also would be known from references such as EX1081, U.S. Patent Appl. No. 2003/0122779 at [0087]. A POSITA would also find it in the teachings of Wang at 16:25-26 which states: “the haptic reconfigurable dashboard system can also tell him or her which control is active.” (emphasis added). A POSITA would understand that a control which is not operational cannot be “active.”

8. Claim 5: “The method of claim 1, further comprising determining whether to generate a vibrotactile signal.”

248. Because the “vibrotactile signal” in Wang-Ichinose is generated by the processor when a user manipulates a virtual control (Wang at 2:15-17; 2:30-3:2; 6:13-26; 8:9-11), the system “*determin[es] whether to generate a vibrotactile signal,*” as claimed by determining whether and how the virtual control is manipulated by the user.

9. Claim 6: “The method of claim 5, wherein determining whether to generate a vibrotactile signal is based at least in part on a status of the system to be manipulated.”

249. The ’042 Patent explains that the “status of [a] system” can be simply whether it is on or off. EX1001, 11:49-52.

250. For a POSITA, an obvious implementation of Wang-Ichinose would have been one in which the system does not generate a vibrotactile signal when the system to be manipulated, e.g., the car’s radio, is turned off because the lack of a vibrotactile signal would indicate to the user that the system is off, and functioning otherwise would be confusing and undesirable. (See also discussion on this point above in Ground 1 for Claim 6).

10. Claim 7: “The method of claim 1, further comprising determining one of a plurality of virtual detents to generate.”

251. As I discussed above for [1B], Wang-Ichinose’s “control device/indicators library 20” stores “associated properties,” *i.e.*, “*detent profiles,*” for “all possible controls and indicators that are available for a given dashboard

system.” Wang at 10:7-15; *see also* Wang at 16:15-17:2 (explaining how a user can change which virtual controls are presented on the virtual device panel, *e.g.*, from “Environmental”-related controls to “Entertainment”-related controls). The library thus stores a “*plurality of virtual detents*,” as claimed, and the command processor determines which of those “*virtual detents*” to generate based on which virtual “control” a user is manipulating and how it is manipulated.

252. For example, if a user is manipulating a virtual slider for a HVAC system, the command processor accesses the “associated properties” for that virtual control and accesses separate “associate properties” for manipulation of a virtual knob associated with a radio.

11. Claim 8: “The method of claim 1, wherein the detent profile comprises a first detent profile, and further comprising receiving a second detent profile.”

253. As I discussed above for claim 7, Wang’s system includes “control devices/indicator library 20,” which stores “*detent profiles*,” for the controls on the dashboard. Wang at 10:7-15. The “*detent profiles*” for first and second controls (for example, a volume control virtual slider and an environmental control virtual rotary dial) (Wang at 2:29-3:7; 6:15-26; 8:9-11; 16:8-14; 16:28-17:2) meet “first” and “second” “*detent profiles*,” as claimed. See above Section XI.B.4 (discussing limitation [1B] and “*detent profiles*”).

12. Claim 9

a. [9PRE]: “A method comprising:”

254. Limitation [9PRE] is identical to limitation [1PRE] and is thus met by Wang-Ichinose for the same reasons that the combination met limitation [1PRE].

b. [9A]: “detecting a change in position of an input device configured to control one of a plurality of systems, wherein the input device comprises a touchpad,”

255. Wang-Ichinose meets [9A] for largely the same reasons it meets [1A].

256. As I explained in Ground 1, the lone difference between the two limitations is the fact that limitation [9A] requires “*detecting a change in position of*” the touchpad, whereas limitation [1A] requires “*receiving an input signal comprising information associated with a manipulation of*” the touchpad (emphasis added). In other words, [9A] requires detecting a change in the “position” of the touchpad whereas [1A] requires receiving information associated with a user’s “manipulation,” *i.e.*, touching, of the touchpad.

257. As I discussed above in Ground 1, I understand that Patent Owner takes the position that the “*change in position*” recited in [9A] is movement of a user’s finger on the touchpad. Under that interpretation, Wang-Ichinose’s system performs that additional step.

258. As discussed above at Section XI.B.3, a POSITA would have had reason, in view of Ichinose, to implement Wang’s input device 16 as a touchpad that

manipulates virtual controls such as a virtual knob. For example, in Wang-Ichinose's system "a series of detents [is emulated] as [a virtual] knob rotates." Wang at 8:29-30; *see also* Wang at 7:21-22 ("detent effects encountered while rotating the dial") (emphasis added).

259. To detect that a knob is "rotating," Wang's "command processor" detects a change in position of the haptic input device, *e.g.*, a user moves her finger clockwise from one point to another. Wang at 6:15-26 (describing use of haptic device to manipulate virtual controls); Wang at 11:27-29 ("As the user moves the haptic device 16 in the Y direction, the virtual slider 15b moves and the recorded slider position changes. The slider position is sent to the supervisory computer/processor 12..."); *see also* Ichinose, 4:36-40 ("The touchpad 10 generates an input signal 84 indicative of user interaction with the touchpad 10. A command processor 86 of the software module 20 processes the input signal 84. The command processor 86 generates an output, signal 88 according to the input signal 84 and communicates the output signal 88 to the display 34."). Wang-Ichinose's system thus "*detect[s] a change in position of an input device,*" *i.e.*, a change associated with rotation of a knob or linear movement of a slider.

- c. **[9B]: “receiving a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent; and”**

260. Limitation [9B] is identical to limitation [1B] and is thus met by Wang-Ichinose for the same reasons that the combination met limitation [1B].

- d. **[9C]: “generating a detent signal based at least in part on the detent profile and the change in position, the detent signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent, the vibrotactile effect based at least in part on the detent signal.”**

261. Wang-Ichinose meets [9C] for largely the same reasons it meets [1C].

262. As I explained in Ground 1, the difference between the two limitations is the fact that [9C] requires “*generating*” “the detent signal” based on, not only the “*detent profile*,” but also “*the change in position*” of the touchpad. Wang-Ichinose’s system performs that additional step.

263. For example, as I discussed above for [9A], Wang’s devices “emulate detents” in part based on a “*change in position*” of a user’s finger on the haptic input device.

13. Claim 10

264. Claim 10 is reproduced below with labels added for ease of reference:

Claim 10
[10PRE] A non-transitory computer-readable medium on which is encoded program code, the program code comprising:

[10A] program code for receiving an input signal comprising information associated with the manipulation of an input device configured to control one of a plurality of systems, wherein the input device comprises a touch-pad;
--

[10B] program code for receiving a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent; and

[10C] program code for generating a detent signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent.
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265. As seen above, Claim 10 recites a computer-readable medium with program code “for” performing each step of method claim 1, which steps Ichinose-Levin performs as discussed for claim 1. More specifically, [10A] corresponds to [1A], [10B] correspond to [1B], and [10C] corresponds to [1C].

266. In Wang-Ichinose, Wang’s “supervisory computer/processor” “is responsible for controlling the entire dashboard system.” Wang at 5:2-7. To control the system, Wang’s processor accesses “control devices/indicator library 20” which “includes various software representing all possible controls and indicators that are available for a given dashboard system.” Wang at 10:7-16. Library 20, which “represent[s] all possible controls,” is either stored in “external memory” or is stored in the processor, *i.e.*, in “supervisory processor memory.” Wang at 10:14-21; FIG. 1. Either form of memory is a computer-readable medium, and therefore Wang discloses a computer-readable medium that stores program code, *i.e.*, library 20, for performing each step of claim 1.

- 14. Claim 11: “The computer-readable medium of claim 10, further comprising program code for generating a system signal associated with a system to be manipulated, the system signal based at least in part on the input signal.”**

267. Claim 11 recites a computer-readable medium with program code “for” performing each step of method claim 2. Wang-Ichinose discloses claim 11 for the same reasons it discloses claims 2 and 10.

- 15. Claim 12: “The computer-readable medium of claim 10, further comprising program code for determining whether to generate a detent signal.”**

268. Claim 12 recites a computer-readable medium with program code “for determining whether to generate a detent signal.” Wang-Ichinose discloses claim 12 for the same reasons it discloses claims 5 and 10.

- 16. Claim 13: “The computer-readable medium of claim 10, further comprising program code for determining a virtual detent to generate.”**

269. Claim 13 recites a computer-readable medium with program code “for determining a virtual detent to generate.” Wang-Ichinose discloses claim 13 for the same reasons it discloses claims 7 and 10.

17. Claim 14

270. Claim 14 is reproduced below with labels added for ease of reference:

Claim 14
[14PRE] A non-transitory computer-readable medium on which is encoded program code, the program code comprising:

[14A] program code for detecting a change in position of an input device configured to control one of a plurality of systems, wherein the input device comprises a touch-pad;

[14B] program code for receiving a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent; and

[14C] program code for generating a detent signal based at least in part on the change in position, the detent signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent, the vibrotactile effect based at least in part on the detent signal.

271. As seen above, Claim 14 recites a computer-readable medium with program code “for” performing each step of method claim 9, which steps Wang-Ichinose performs as discussed for claim 9. More specifically, [14A] corresponds to [9A], [14B] correspond to [9B], and [14C] corresponds to [9C].

272. As I explained above for claim 10, Wang-Ichinose’s “supervisory computer/processor” “is responsible for controlling the entire dashboard system.” Wang at 5:2-7. To control the system, Wang’s processor accesses “control devices/indicator library 20” which “includes various software representing all possible controls and indicators that are available for a given dashboard system.” Wang at 10:7-16. Library 20, which “represent[s] all possible controls,” is either stored in “external memory” or is stored in the processor, *i.e.*, in “supervisory processor memory.” Wang at 10:14-21; FIG. 1. Either form of memory is a computer-readable medium, and therefore Wang discloses a computer-readable

medium that stores program code, *i.e.*, library 20, for performing each step of claim 9.

18. Claim 15

a. [15PRE]: “A system comprising:”

273. Wang-Ichinose is an implementation of Wang’s “haptic vehicle control system.” Wang, 2:23-24.

b. [15A]: “an input device configured to control one of a plurality of systems, wherein the input device comprises a touch-pad;”

274. As I discussed above for [1A], Wang-Ichinose’s system includes Wang’s haptic device implemented as a touchpad such as Ichinose’s touchpad 10. For the same reasons I discussed above for [1A], “touchpad 10” is configured “*to control one of a plurality of systems,*” as claimed.

c. [15B]: “a processor in communication with the input device,”

275. As I discussed above for [1A], Wang-Ichinose’s system includes Wang’s “supervisory/computer processor.” For the same reasons I discussed above for [1A], “touchpad 10” is “*in communication with*” the supervisory/computer processor.

- i. **[15B1] “the processor configured to receive an input signal and a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent,”**

276. For the same reasons I discussed above for [1A] and [1B], the supervisory/computer processor in Wang-Ichinose is configured “*to receive an input signal and a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent,*” as claimed

- ii. **[15B2] “the processor further configured to generate a detent signal; and”**

277. Limitation [15B2] is substantively identical to limitation [1C], which supervisory/computer processor performs in Wang-Ichinose for the reasons I discussed above with respect to [1C].

278. The lone difference between the two limitations is the fact that [15B2] uses the term “*detent signal,*” whereas [1C] uses the term “*vibrotactile signal.*”

279. The '042 Patent describes a “*detent signal*” as the signal that the processor generates to cause an actuator to output a vibrotactile effect. *See, e.g.,* EX1001 at 4:35-39 (“The processor 106 may generate a signal, such as a detent signal, to the actuator 108. The detent signal may be configured to cause an actuator 108 to produce a vibrotactile effect in the form of a virtual detent on the input device 102.”). The “detent signal” thus performs the same function as the “*vibrotactile signal*” recited in [1C]. Inasmuch as the '042 Patent teaches explicitly that the detent

signal may be configured to cause a vibrotactile effect in the form of a virtual detent, a POSITA would have understood the '042 Patent to be using the two terms in an equivalent manner.

280. The signal that Wang-Ichinose's supervisory/computer processor sends to an actuator in Wang-Ichinose meets both limitations [15B2] and [1C] for the reasons discussed in above regarding [1C].

- d. **[15C]: “at least one actuator coupled to the input device, the at least one actuator configured to receive the detent signal and produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent.”**

281. As I discussed above for [1C], Wang-Ichinose's system includes one or more actuators built into the housing of Wang's haptic input device (implemented as a touchpad) and which are actuated to “emulate detents,” *i.e.*, “*virtual detents*,” as claimed.

282. As the actuator(s) is/are built into Wang's touchpad, it is “*coupled to*” the touchpad and/or that would have been a conventional way to implement the actuator so that it could output haptic feedback onto the touchpad. Wang, 7:26-29 (“In Fig. 4, a haptic feedback mechanism, for example, actuators or motors, required to generate the force effects in each of the active degrees-of-freedom can be contained within the housing (not shown) of the haptic device 16.”) (emphasis added). Indeed, as I explained in Ground 1 when discussing Limitation [15C] in the

context of Ichinose, Ichinose explicitly depicts an actuator coupled to its touchpad. Maintaining that design when Ichinose's touchpad is used in Wang-Ichinose would have been the obvious use of a known technique (coupling an actuator to a touchpad) to improve similar devices (touchpads) in the same way (providing a means for the touchpad to output vibrotactile feedback to a user).

19. Claim 16: “The system of claim 15, wherein the processor is further configured to control a system based at least in part on a manipulation of the input device.”

283. As I discussed above for claim 2, Wang-Ichinose's “supervisory/computer processor,” i.e., “*the processor*,” as claimed, “*is further configured to control a system based at least in part on a manipulation of the input device*,” as claimed, because manipulation of Wang's haptic device i.e., Ichinose's touchpad that is used as “the input device,” is “transformed into a commanded reference signal” that “is in a format that is recognized by the vehicle subsystem being controlled.” Wang at 11:30-12:17; *see also* Wang at 13:27-14:10.

20. Claim 17: “The system of claim 15, wherein the processor is further configured to determine whether to generate a detent signal.”

284. As I discussed above with respect to claim 5, Wang-Ichinose's system includes a “supervisory/computer processor” that “*determine[s] whether to generate a detent signal*.”

21. Claim 18: “The system of claim 15, wherein the at least one actuator is coupled to a housing of the input device.”

285. As I discussed above with respect to limitation [15C], Wang-Ichinose’s system includes an “*actuator*,” that is coupled a housing touchpad 10.

22. Claim 19: “The system of claim 15, wherein the input device comprises a sensor.”

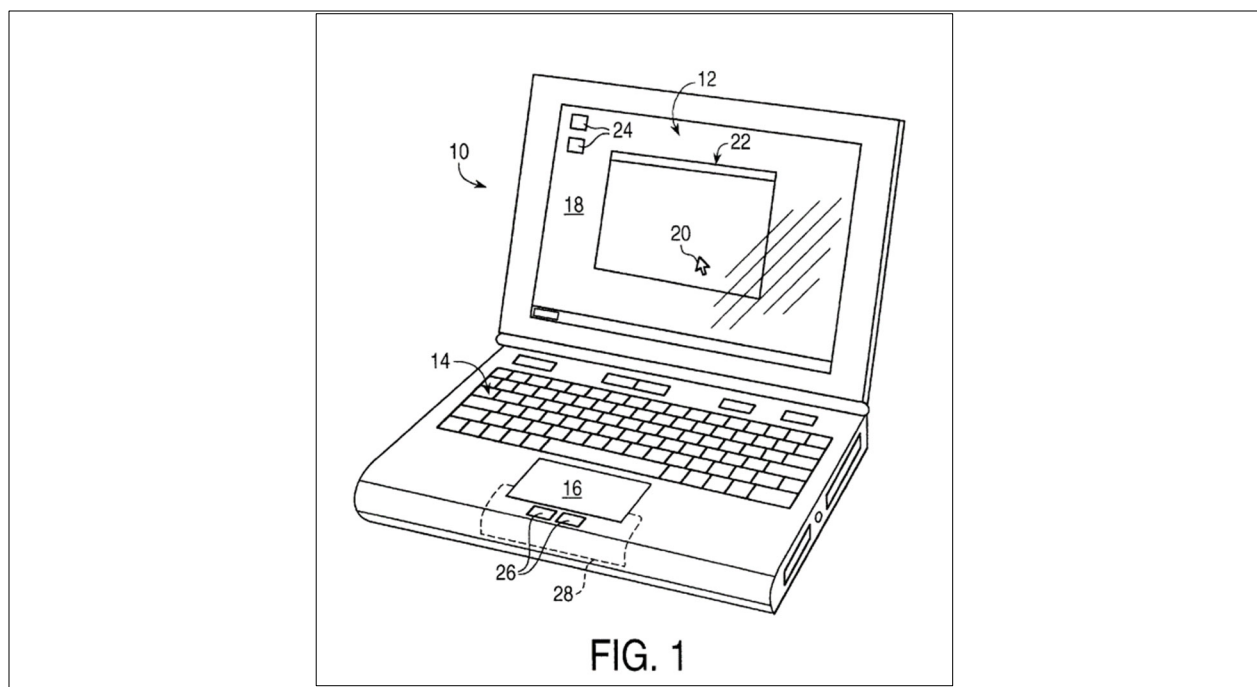
286. As I discussed above for [1A], Wang’s “haptic device 16” is a touchpad, and a POSITA understood touchpads include a “sensor,” *e.g.*, a capacitive or resistive sensor, to sense a touch on the pad’s surface. See my discussion above at §XI.A.22 where I discussed claim 19 in the context of Ground 1.

C. Ground 3: Claims 1-19 Are Anticipated by and/or Obvious Over Rosenberg-I

1. Rosenberg-I (EX1009)³⁶

287. Rosenberg-I discloses a touchpad with an actuator that outputs haptic sensations such as vibrations. Abstract. Rosenberg-I’s “touchpad 16” can be part of a laptop computer as seen below in Figure 1:

³⁶ Unless otherwise noted, citations in Section XI.C are to Rosenberg-I.



Rosenberg at 1:65-2:5, 3:31-63.

288. The touchpad sends position data to a processor indicating where a user is touching its surface. 4:5-8. An actuator coupled to the touchpad outputs “haptic sensations” to the user touching the pad. 5:11-14. The “haptic sensations” include vibrations and are “computer-controlled” because a processor “control[s] the magnitude and/or direction of the force output of the actuator(s).” 5:11-22; *see also* 6:24-54.

289. Rosenberg-I’s touchpad “operates similarly to existing touchpads, where the speed of the fingertip on the touchpad correlates to the distance that the cursor is moved in [a] graphical environment.” 4:43-49. Haptic sensations are “output on the pad based on interactions of the controlled cursor with the graphical

environment” (11:22-26), and “[d]ifferent types of graphical objects can be associated with tactile sensations” (12:5-6).

290. Rosenberg-I discloses several haptic sensations that mimic mechanical detents:

[W]hen a rate control or scrolling function is performed with the touchpad (through use of the cursor), a vibration can be displayed on the device to indicate that scrolling is in process. When reaching the end of a numerical range that is being adjusted (such as volume), a pulse can be output to indicate that the end of the range has been reached. Pulse sensations can be used to indicate the location of the “ticks” for discrete values or settings in the adjusted range. A pulse can also be output to inform the user when the center of the range is reached. Different strength pulses can also be used, larger strength indicating the more important ticks.

12:50-61.

291. Rosenberg-I also incorporates by reference another document that discloses additional details about haptic feedback. Specifically, Rosenberg-I says:

Architectures and control methods that can be used for reading sensor signals and providing haptic feedback for a device are described in greater detail in U.S. Pat. No. 5,734,373 and copending application Ser. Nos. 60/156,354, 60/133,208, 09/376,649, and 60/160,401, all incorporated herein by reference.

6:49-54 (emphasis added).

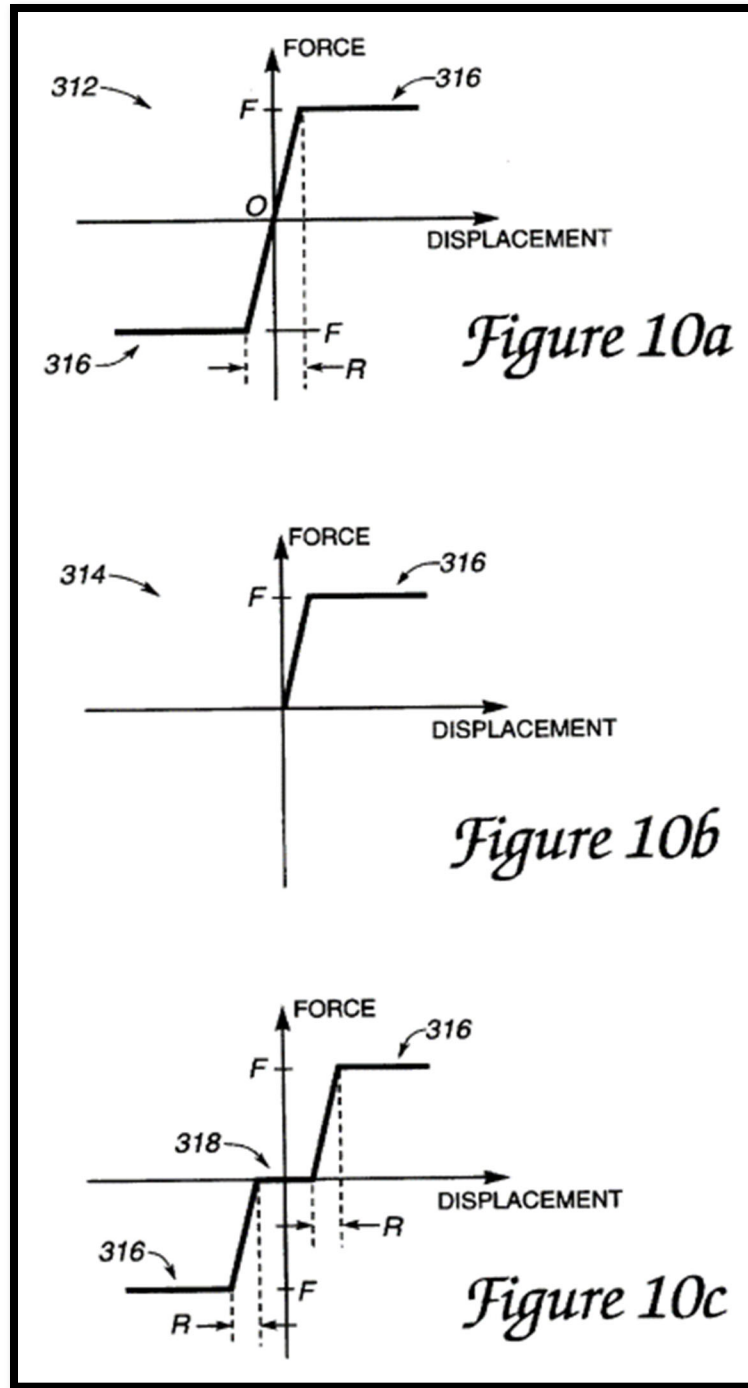
292. U.S. Patent No. 5,734,373 (EX1010) is another patent that lists “Louis B. Rosenberg” as a named inventor. I refer to U.S. Patent No. 5,734,373 as “Rosenberg-II” in the remainder of my declaration.

293. As the block quote indicates, Rosenberg-I identifies Rosenberg-II as a reference that provides “greater detail” on “[a]rchitectures and control methods that can be used for reading sensor signals and providing haptic feedback.” 6:49-53. A POSITA thus would have understood Rosenberg-I to be incorporating those particular teachings in Rosenberg-II that relate to “architectures and control methods that can be used for reading sensor signals and providing haptic feedback.” 6:49-53.

294. On this point, Rosenberg-II teaches techniques for providing “force feedback using an interface device manipulated by a user.” Rosenberg-II, Abstract. Rosenberg-II’s disclosed techniques include using “force values that have been previously calculated or sampled and stored as a digitized ‘force profile’ in memory or other storage device.” Rosenberg-II at 18:46-50; *see also* Rosenberg-II at 4:10-14 (describing how a processor “read[s] force profiles of predetermined force values from a storage device”); 23:16-19; 24:54-57; claim 41.

295. Rosenberg-II’s Figures 10-13 and 15-16 depict various force “profiles,” including one that provides a “detent sensation.” Rosenberg-II at 5:48-62, 38:1-3. As seen in Rosenberg-II Figures 10a to 10c below, the profiles are “force versus displacement profiles.” Rosenberg-II at 32:33-34; *see also* Rosenberg-II at 33:28-29; 35:12-13 (“FIGS. 13a-13b are graphs illustrating force versus time profiles for a vibration force.”). In other words, the profiles contain force and displacement data

that a processor uses to instruct an actuator to output a certain amount of force when an input device has been displaced a predetermined amount. A POSITA would thus understand that Rosenberg-II's "profiles" are substantively identical to the "virtual detent profiles" depicted in Figures 9A to 9H in the '042 Patent.



296. A POSITA would have understood Rosenberg-I to incorporate Rosenberg-II's disclosures regarding force "profiles" because those particular

disclosures are ways to implement Rosenberg-I's "control method[s]" for "providing haptic feedback." Rosenberg-I 6:49-54.

2. Claim 1

a. [1PRE]: "A method comprising:"

297. Rosenberg-I discloses a "method for providing haptic feedback to a touch input device." Rosenberg-I at claim 37.

b. [1A]: "receiving an input signal comprising information associated with a manipulation of an input device configured to control a plurality of systems, wherein the input device comprises a touch-pad;"

298. The processor in Rosenberg-I's computer 10 *"receiv[es] an input signal comprising information associated with a manipulation of an input device configured to control a plurality of systems, wherein the input device comprises a touch-pad, wherein the input device comprises a touch-pad,"* as claimed.

299. To start, Rosenberg-I's touchpad "inputs a position signal to a processor of [a] computer based on a location of user contact on the touch surface." Rosenberg-I at Abstract; *see also* Rosenberg-I at 2:8-12 (describing a "planar touch surface operative to input a position signal to a processor of [a] computer based on a location of user contact on the touch surface"); 4:6-8 ("touchpad 16 inputs coordinate data to the main microprocessor(s) of the computer 10 based on the sensed location of an object on (or near) the touchpad"); 6:24-27; 15:27-34; claims 1, 37. The "position signal" that the touchpad sends to the processor is *"an input*

signal comprising information associated with a manipulation of an input device,” as claimed. On this point, a POSITA would know that the “*manipulation*” in this context where the input device is a touchpad is the position/movement of a user’s finger on the touchpad.

300. Next, Rosenberg-I touchpad is also “*configured to control a plurality of systems*” under the interpretation of that phrase that I understand Patent Owner is advancing in the pending district court litigation. Specifically, I understand that Patent Owner has taken the position that “*a plurality of systems*” includes two different software applications running on the same device, *e.g.*, a web-browsing application and gaming application running on one videogame device. EX1021 at 2.

301. Patent owner’s apparent interpretation of “*a plurality of systems*” is inconsistent with the language of the claims—which plainly requires at least two distinct electromechanical systems such as the separate HVAC and radio systems in a car. Regardless, under Patent Owner’s interpretation of “*a plurality of systems*,” Rosenberg-I’s “touch pad 16” is “*configured to control a plurality of systems*” because computer 10 runs multiple different software applications, including a web-browser and a gaming application, and the touchpad controls the user’s interaction with each application. Rosenberg-I at 6:7-23 (describing the “wide variety” of “host application program(s)” that computer runs including a “video or computer game”

and a “browser that implements HTML,” each of which “utilizes input from the touchpad 16”); Abstract; 4:43-64.

302. Rosenberg-I thus meets [1A] under Patent Owner’s interpretation of the term “*a plurality of systems.*”

c. [1B]: “receiving a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent; and”

303. In operation, Rosenberg-I’s processor “*receiv[es] a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent,*” as claimed.

304. To start, Rosenberg-I discloses that its touchpad outputs haptic feedback using an actuator(s) that is coupled to the touchpad. *See, e.g.,* Rosenberg-I at 2:54-55 (“invention...provides haptic feedback to...a touchpad”); 4:65-67 (“touchpad 16 is provided with the ability to output haptic feedback”). This haptic feedback includes vibrations or pulses, *i.e.,* vibrotactile effects. *See, e.g.,* Abstract (“Output haptic sensations on the touch input device can include pulses, vibrations, and spatial textures.”); 2:41-44 (“haptic sensations, such as a pulse, vibration, or spatial texture”).

305. A POSITA would understand that a “pulse” is simply a short duration vibration of a particular magnitude. Rosenberg-I at 11:29-33 (“For example, a jolt or ‘pulse’ sensation can be output, which is a single impulse of force that quickly

risers to the desired magnitude and then is turned off or quickly decays back to zero or small magnitude.”). A pulse is thus a type of “*vibrotactile effect*.” Indeed, the ’042 Patent says as much: “For example, the actuator may be configured to generate vibrotactile feedback with different frequencies, amplitudes, or waveforms. In one embodiment, the virtual detent may comprise a simulated click generated through a single pulse. In a second embodiment, the virtual detent may comprise a click-and-release effect generated by a double pulse.” EX1001 at 6:13-19.

306. Rosenberg-I’s haptic feedback mimics a mechanical detent, *i.e.*, “*a virtual detent*,” as claimed. For example, column 12 describes the use of “[p]ulse sensations...to indicate the location of the ‘ticks’ for discrete values or setting in [an] adjusted range,” *e.g.*, volume. Rosenberg-I at 12:57-59; *see also* Rosenberg-I at 12:29-32 (describing “pulses” output when a user scrolls through a menu of items). Rosenberg-I’s “ticks” correspond with what the ’042 Patent calls a “click effect virtual detent.” EX1001, 11:55-63; *see also* EX1001, 13:47-53, FIG. 9A. It also aligns with a “*virtual detent*” that Patent Owner identifies in the related district court litigation. Specifically, in the district court litigation, Patent Owner identifies “Scroll Wheel” behavior as a “*virtual detent*.” EX1021, 8. The “Scroll Wheel” behavior Patent Owner appears to be referring to would be the typical click-click detent sensation that a user experiences as they scroll a mouse’s scroll wheel back and forth.

307. Rosenberg-I also describes outputting a “pulse...to indicate the end of [a] range,” *e.g.*, volume, “has been reached.” Rosenberg-I at 12:53-57.

308. Rosenberg-I also discloses that the “strength and/or frequency of a vibration can be correlated with the adjustment of a control to indicate current magnitude of the volume or other adjusted value.” Rosenberg-I at 12:61-64. In other words, the vibration increases as the adjustment value (*e.g.*, audio setting) increases. This corresponds to the “hill virtual detent” depicted in the ’042 Patent’s Figure 9C. EX1001, 13:63-14:5.

309. As I explained above, Rosenberg-I also incorporates by reference Rosenberg-II and its description of additional “*virtual detents*.” For example, Rosenberg-II discloses a “barrier force” effect that corresponds with what Rosenberg-II calls the “hard stop virtual detent” and “hill virtual detent.” Compare Rosenberg-II, 39:13-34; FIG. 16 (depicting “a barrier force profile”); with EX1001, 13:45-14:5; FIGS. 9B-9C. Rosenberg-II also discloses a “groove force” that “provides a linear detent sensation.” Rosenberg-II, 38:1-14; FIG. 15. This latter “virtual detent” aligns with the detents depicted in the ’042 Patent’s Figure 9A.

310. Rosenberg-I thus discloses haptic feedback in the form of “*virtual detents*,” as claimed, and does so in multiple ways.

311. Rosenberg-I does this at least via incorporation by reference of Rosenberg-II’s teachings regarding “force profiles” that I discussed above,

Rosenberg-I also discloses that its haptic feedback, *i.e.*, simulated detents, is generated using “force profiles” (emphasis added) stored in memory, each of which comprises a “sequence of command parameters representing a force level to be applied to [an] actuator,” *i.e.*, “*haptic data*,” and each profile would have been associated with one of the mimicked mechanical detents discussed above “associated with” one or more systems that Rosenberg-I controls, e.g., a “tick” detent for changing the volume of a video game or a “pulse” detent for indicating the end of the web page has been reached in a browser and each profile would have been associated with one of the mimicked mechanical detents discussed above. Rosenberg-II at claims 41-43; 18:46-67 (describing “force values that have been previously calculated or sampled and stored as a digitized ‘force profile’ in memory or other storage device”); 35:42-46; FIGS. 10a-16 (depicting various “force profiles”).

312. Even if Rosenberg-II’s disclosures regarding “force profiles” are not considered explicitly incorporated by reference into Rosenberg-I, then a POSITA nonetheless had multiple reasons to use Rosenberg-II’s “force profiles” in Rosenberg-I.

313. First, Rosenberg-I explicitly refers to Rosenberg-II for its disclosures of “control methods” for “providing haptic feedback” (Rosenberg-I, 6:49-54), giving a POSITA explicit reason to use Rosenberg-II’s force profiles to implement

Rosenberg-I. Put simply, Rosenberg-I tells a POSITA to use Rosenberg-II's "[a]rchitectures and control methods" for "providing haptic feedback," and a POSITA would have found it obvious to follow that explicit instruction.

314. Second, using Rosenberg-II's "force profiles" to create the vibrotactile effects that Rosenberg-I describes would have involved nothing more than the use of a known technique (Rosenberg-II's force profiles) to improve a similar device (haptic-feedback input device) in the same way to achieve predictable results (providing the device with a set of pre-defined vibrotactile effects). The use of such a "known technique" would have been obvious to a POSITA.

315. In operation, Rosenberg-I's processor receives a particular "force profile" stored in memory on the computer in response to a user interaction with a software program being controlled and uses that profile to command an actuator to output a particular virtual detent. Rosenberg-I, 6:32-41 (touchpad "carr[ies] out force commands received from the host, such commands including...the type of haptic sensation and parameters describing the commanded haptic sensation"); 15:11-17 (explaining user preferences, *e.g.*, desired haptic effects, can be "stored on the computer"); Rosenberg-II at claims 41-43 ("command parameters" in the form of "a digitized force profile" are provided to the "microprocessor" from memory and "applied to [an] actuator by said microprocessor"), claim 58. Although Rosenberg-I does not explicitly state that laptop 10 includes memory for storing computer

programs like Rosenberg-I's "force profiles," the use of memory in laptops for that purpose was conventional as of 2006, as Rosenberg-II reinforces. Rosenberg-II at 6:46-57 ("Host computer system 12 preferably includes a host microprocessor 16, random access memory (RAM) 17, read-only memory (ROM) 19...Microprocessor preferable retrieves and stores instructions and other necessary data from RAM 17 and Rom 19, as is well known to those skilled in the art.").

316. For example, when a user uses the touchpad to increase the volume of a videogame that computer 10 is controlling, the processor accesses a force profile associated with that system (*i.e.*, the videogame), and the force profile has haptic data associated with a virtual detent such as "[p]ulse sensations...used to indicate the location of the 'ticks' for discrete values or setting in the adjusted [volume] range," *i.e.*, a mechanical detent-type "tick" would be felt as each discrete volume level is passed. Rosenberg-I at 12:52-59; *see also* Rosenberg-I at 11:28-29 ("Forces are preferably associated with the interactions of the cursor with displayed graphical objects."); 12:5-6 ("Different types of graphical objects can be associated with tactile sensations."); 12:27-49; 13:18-20 ("The user or developer can also preferably associate particular graphical objects with customized haptic sensations."); 15:19-23. See also my discussion in Ground 1 for limitation [1B] where I explained a POSITA would have seen benefits to associating particular vibrotactile effects with one or more systems.

317. Rosenberg-I's processor thus "*receiv[es] a detent profile associated with one of the systems,*" i.e., a "*force profile*" associated with a particular function (e.g., volume) for a particular system (e.g., a videogame), "*comprising haptic data associated with a virtual detent,*" as claimed.

- d. [1C]: **"generating a vibrotactile signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent."**

318. Rosenberg-I's processor "*generat[es] a vibrotactile signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent,*" as claimed.

319. The processor sends a "command signal," i.e., the claimed "*vibrotactile signal,*" to the actuator(s) coupled to the touchpad, causing the actuator to produce a vibrotactile effect comprising one of the virtual detent effects that I discussed above for limitation [1B], e.g., a "pulse sensation" that marks a mechanical "tick." Rosenberg-I at 5:18-22 ("[F]orces output on the touchpad 16 are considered 'computer-controlled' since a microprocessor...is controlling the magnitude and/or direction of the force output of the actuator(s) using electronic signals."); 6:24-27 (touchpad "process[es] command signals from the host's microprocessor"); claim 1 ("actuator outputs said force based on force information output by said processor"); claim 37. I also note that the '042 Patent explains that a single pulse is a virtual detent vibrotactile effect. EX1001, 6:16-17.

320. Rosenberg-I's processor thus meets [1C].

3. **Claim 2: "The method of claim 1, further comprising generating a system signal associated with a system to be manipulated, the system signal based at least in part on the input signal, and wherein generating a system signal and generating the vibrotactile signal occur substantially simultaneously."**

321. Rosenberg-I's computer perform claim 2's method when, for example, it performs the rate control or scrolling functions described in Rosenberg-I.

322. For example, "when" computer 10 perform a "rate control or scrolling function...with the touchpad (through the use of the cursor)," *e.g.*, scrolling through a menu list or adjusting volume, "a vibration can be displayed on the device to indicate that scrolling is in process." Rosenberg-I at 12:50-53. The use of the word "when" would be understood by a POSITA to mean that the rate control or scrolling function happens at "substantially" the same time as the vibration is felt. *See also* Rosenberg-I at 12:54-66 (describing additional virtual detents associates with a "rate control or scrolling function," including "ticks" for "discrete values" within a range); 14:27-31 (discussing "rate control task[s]").

323. For the "rate control" or scrolling function to occur in the system being controlled, Rosenberg-I's processor would "*generat[e] a system signal associated with [the] system to be manipulated,*" *e.g.*, a volume control signal associated with the videogame that is being "rate controlled" by having its volume adjusted.

324. The generated “*signal*” is “*based at least in part on the input signal*” that the Rosenberg-I’s processors receives from the touchpad. Rosenberg-I at 12:50-53 (“rate control or scrolling function is performed with the touchpad (through the use of the cursor)”) (emphasis added); 15:26-44 (“The computer can interpret the coordinates and, based on the location of the user contact, can interpret the touchpad input signal as a cursor control signal or a different type of signal, such as rate control, button function, etc.”) (emphasis added).

325. Because the vibration occurs “when” the “rate control or scrolling function” is occurring, a POSITA would understand Rosenberg-I to teach that its devices generate the “*system signal and...vibrotactile signal...substantially simultaneously*,” as claimed.

4. Claim 3: “The method of claim 1, wherein the vibrotactile signal is based at least in part on the input signal.”

326. As discussed for claims 1-2, Rosenberg-I’s computer performs a “rate control or scrolling function” that triggers “*the vibrotactile signal*” I discussed above for limitation [1C], and that signal is “*based at least in part on the input signal*,” as claimed, because the “rate control or scrolling function” is based on the “touchpad input signal.” Rosenberg-I at 15:26-44; *see also* 12:50-66 (describing rate control and scrolling functions that occur due to “cursor” movement); 5:11-18 (“Forces output on the pad can be at least in part based on the location of the finger on the pad....”).

5. Claim 4: “The method of claim 1, wherein the vibrotactile signal is further based in part on the status of the input device.”

327. As explained above in Ground 1 when previously discussing claim 4, the '042 Patent does not explain what “*the status of the input device*” is but I understand that Patent Owner has taken the position that claim 4 is met when the touchpad is simply used in a manner that causes a vibrotactile effect to occur. EX1021 at 15 (“On information and belief, using the touchpad with a given behavior, such as ‘As Mouse’ or ‘As Joystick,’ requires maintaining state that reflect the status of the input device.”).

328. Rosenberg-I’s “*vibrotactile signal*” that I identified for limitation [1C] is generated when a user is touching the touchpad in a manner that causes a rate control or scrolling function to be selected. Rosenberg-I at 5:11-18 (“Forces output on the pad can be at least in part based on the location of the finger on the pad”). Because the “*vibrotactile signal*” is generated when a user is contacting the pad in a manner indicative of a rate control function, the signal is “*based in part on the status of the input device*,” that is, how the touchpad is being used. *See also* Rosenberg-I at 16:62-17:6 (explaining that “when no objects are contacting the [touchpad],” then “haptic feedback” can “be stopped (actuators ‘turned off’).”).

329. Moreover, the only reference to “status” in the '042 Patent is its disclosure that a vibrotactile signal “may be based at least in part on a status of a

system to be manipulated. In one embodiment, a signal is not generated if a system is off.” EX1001 at 11:49-53. The patent thus teaches that “status” can be as simple as whether something is on or off.

330. Implementing Rosenberg-I such that it would base the vibrotactile signal at least in part on whether the input device (*i.e.*, touchpad) is operational or not (*e.g.*, powered-off or simply broken) would have been an obvious implementation to a POSITA as it would ensure that a user would not be misled by vibrotactile signals being generated when the device is not operational. For example, a POSITA would simply have the system produce no vibrotactile signals, or perhaps produce a persistent haptic effect, indicating the mode of the device³⁷ (in this case, non-functional).

6. Claim 5: “The method of claim 1, further comprising determining whether to generate a vibrotactile signal.”

331. Rosenberg-I teaches that when performing a scrolling function on a list of menu items, “currently-disabled menu choices can have a weaker pulse, *or no*

³⁷Although a POSITA would find this a matter of common sense, such indication of mode would be known from references such as EX1081 (U.S. Patent Appl. No. 2003/0122779) at [0087].

pulse^[38], to indicate that the menu choice is not enabled at that time.” 12:36-38 (emphasis added). Rosenberg-I’s devices thus “*determin[e] whether to generate a vibrotactile signal,*” as claimed, because it assesses whether a menu choice is disabled and determines whether to generate a vibrotactile signal based on that assessment.

332. Likewise, Rosenberg-I teaches that the vibrotactile effects associated with a rate control or scrolling, *e.g.*, “pulse sensations” occurs “when a rate control or scrolling function is performed” (Rosenberg-I at 12:50-53), which a POSITA would understand means that Rosenberg-I’s processor determines whether to output a “pulse sensation” by determining whether rate control or scrolling is occurring. Put simply, if the processor determines that rate control or scrolling is not occurring—for example, a user is using the touchpad to perform some other function—then the processor determines not to generate the vibrotactile signal associated with rate control or scrolling.

³⁸As noted previously, a POSITA would understand pulse are vibrotactile sensations, certainly when produced via burst of vibrations, as known in the art.

7. Claim 6: “The method of claim 5, wherein determining whether to generate a vibrotactile signal is based at least in part on a status of the system to be manipulated.”

333. As I explained immediately above for claim 5, Rosenberg-I’s computer determines whether to generate a vibrotactile signal in part based on whether a menu item presented to the user is “currently-disabled.” Whether a menu item that a system presents is disabled is “*a status of the system to be manipulated*,” as claimed, and thus Rosenberg-I’s computer perform claim 6’s method. Indeed, it was a well-known practice to “grey out” menu items for systems that were unavailable or disabled. EX1082 (Leonard, “Windows XP Hacks and Mods For Dummies”) at 201.

8. Claim 7: “The method of claim 1, further comprising determining one of a plurality of virtual detents to generate.”

334. Rosenberg-I teaches that when performing rate control or scrolling functions, its computer can perform different vibrotactile effects that depend on the function being performed. Rosenberg-I at 12:50-66. I discussed Rosenberg-I’s various rate control or scrolling functions above when I discussed limitation [1B].

335. For example, when adjusting a range such as the volume level of a videogame being played on computer 10, Rosenberg-I’s computer outputs “[p]ulse sensations...to indicate the location of the ‘ticks’ for discrete values or settings in the adjusted range,” and it also separately “output[s]” a different “pulse...to indicate that the end of the range has been reached.” Rosenberg-I at 12:50-66.

336. Rosenberg-I's computer thus determine whether to impulse "tick"-type "pulse sensations" or an "end of the range"-type pulse sensation depending on the rate control or scrolling function being performed.

9. Claim 8: "The method of claim 1, wherein the detent profile comprises a first detent profile, and further comprising receiving a second detent profile."

337. As I discussed immediately above for claim 7, Rosenberg-I's computer generate different vibrotactile effects depending on, *e.g.*, what rate control or scrolling function is being performed. To generate those different effects, the computer's processor "*receiv[es]*" from memory the particular "force profiles," *i.e.*, the claimed "*detent profile[s]*," corresponding to each particular effect.

10. Claim 9

a. [9PRE]: "A method comprising:"

338. Limitation [9PRE] is identical to limitation [1PRE] and is thus met by Rosenberg-I for the same reasons that limitation [1PRE] is met.

b. [9A]: "detecting a change in position of an input device configured to control one of a plurality of systems, wherein the input device comprises a touch-pad,"

339. Rosenberg-I meets [9A] for largely the same reasons it meets [1A].

340. As I explained in Ground 1, the lone difference between the two limitations is the fact that limitation [9A] requires "*detecting a change in position of*" the touchpad, whereas limitation [1A] requires "*receiving an input signal comprising information associated with a manipulation of*" the touchpad. In other

words, [9A] requires detecting a change in the “position” of the touchpad whereas [1A] requires receiving information associated with a user’s “manipulation,” *i.e.*, touching, of the touchpad.

341. As I discussed above in Ground 1 with respect to [9A], I understand that Patent Owner takes the position that the “change in position” recited in [9A] is movement of a user’s finger on the touchpad. Under that interpretation, Rosenberg’s computer performs that additional step.

342. Rosenberg-I’s computer performs “a rate control or scrolling function...with the touchpad (through use of the cursor).” Rosenberg-I at 12:50-51. Rosenberg-I teaches that this functionality is initiated “through use of the cursor” (*id.*) or when a user contacts a particular part of the touchpad (Rosenberg-I at 15:26-44). *See also* Rosenberg-I at 4:46-48 (explaining “cursor” movement correlates to fingertip movement on touchpad); 5:11-18 (“Forces output on the pad can be at least in part based on the location of the finger on the pad”); 11:23-26 (“forces to be output on the pad based on interactions of the controlled cursor with the graphical environment”); 12:5-15 (“Tactile sensations can output on the touchpad 16 based on interaction between a cursor and a window.”).

343. Because Rosenberg-I’s “rate control or scrolling function” is performed based on the position and/or movement of a user’s finger on the touchpad, Rosenberg-I’s computer “*detect[s] a change in position of an input device,*” *i.e.*,

from a position that does not initiate the “rate control or scrolling function” to one that initiates those function(s).

- c. **[9B]: “receiving a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent; and”**

344. Limitation [9B] is identical to limitation [1B] and is thus met by Rosenberg-I for the same reasons that Rosenberg-I met limitation [1B]

- d. **[9C]: “generating a detent signal based at least in part on the detent profile and the change in position, the detent signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent, the vibrotactile effect based at least in part on the detent signal.”**

345. Rosenberg-I meets [9C] for largely the similar reasons it met [1C].

346. As I explained in Ground 1, the difference between the two limitations is the fact that [9C] requires “*generating*” “the detent signal” based on, not only the “*detent profile*,” but also “*the change in position*” of the touchpad. Wang-Ichinose’s system performs that additional step.

347. For example, as discussed above for [9A], Rosenberg-I’s computer initiates a “rate control or scrolling function” in part based on a “*change in position*” of a user’s finger on the touchpad, *i.e.*, the finger moves in a manner indicative of a scrolling or rate control selection being made.

11. Claim 10

348. Claim 10 is reproduced below with labels added for ease of reference:

Claim 10
[10PRE] A non-transitory computer-readable medium on which is encoded program code, the program code comprising:
[10A] program code for receiving an input signal comprising information associated with the manipulation of an input device configured to control one of a plurality of systems, wherein the input device comprises a touch-pad;
[10B] program code for receiving a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent; and
[10C] program code for generating a detent signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent.

349. As seen above, Claim 10 recites a computer-readable medium with program code “for” performing each step of method claim 1, which steps Rosenberg-I’s computer (via its processor) performs as discussed for claim 1. More specifically, [10A] corresponds to [1A], [10B] correspond to [1B], and [10C] corresponds to [1C].

350. Rosenberg-I’s method is “computer-controlled” and performed by the processor of computer 10. Rosenberg-I at 5:18-22; 3:51-53; *see also* my discussion of [1A] above. A POSITA would have understood that Rosenberg-I’s processor performs the methods of claim 1 by executing instructions (“*program code*”) stored in memory (a “*non-transitory computer-readable medium*”) because that is how processors worked by 2006. Rosenberg-II (the teachings of which Rosenberg-I incorporates by reference as I explained above), explicitly discloses that electronic

devices perform haptic feedback based on “program instructions” stored on a “computer readable medium.” Rosenberg-II, 42:35-56.

351. If considered not to be disclosed by Rosenberg-I, storing program code for performing Rosenberg-I’s haptic feedback method in a computer-readable medium would have been the conventional and obvious way to implement Rosenberg-I’s processor, as Rosenberg-II teaches. Rosenberg-II at 42:40-47 (“The use of program instructions to perform operations on a microprocessor is well known to [POSITA], and can be stored on a ‘computer readable medium.’”).

12. Claim 11: “The computer-readable medium of claim 10, further comprising program code for generating a system signal associated with a system to be manipulated, the system signal based at least in part on the input signal.”

352. Claim 11 recites a computer-readable memory with program code “for” performing each step of method claim 2. Rosenberg-I discloses claim 11 for the same reasons it discloses claims 2 and 10.

13. Claim 12: “The computer-readable medium of claim 10, further comprising program code for determining whether to generate a detent signal.”

353. Claim 12 recites a computer-readable medium with program code “for determining whether to generate a detent signal.” Rosenberg-I discloses claim 12 for the same reasons it discloses claims 5 and 10.

14. Claim 13: “The computer-readable medium of claim 10, further comprising program code for determining a virtual detent to generate.”

354. Claim 13 recites a computer-readable medium with program code “for determining a virtual detent to generate.” Rosenberg-I discloses claim 13 for the same reasons it discloses claims 7 and 10.

15. Claim 14

355. Claim 14 is reproduced below with labels added for ease of reference:

Claim 14
[14PRE] A non-transitory computer-readable medium on which is encoded program code, the program code comprising:
[14A] program code for detecting a change in position of an input device configured to control one of a plurality of systems, wherein the input device comprises a touch-pad;
[14B] program code for receiving a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent; and
[14C] program code for generating a detent signal based at least in part on the change in position, the detent signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent, the vibrotactile effect based at least in part on the detent signal.

356. As seen above, Claim 14 recites a computer-readable medium “for” performing each step of method claim 9, which steps Ichinose-Levin performs as discussed for claim 9. More specifically, [14A] corresponds to [9A], [14B] correspond to [9B], and [14C] corresponds to [9C].

357. As I explained above for claim 10, Rosenberg-I’s method is “computer-controlled” and performed by the processor of computer 10. Rosenberg-I at 5:18-

22; 3:51-53; *see also* my discussion of [1A] above. A POSITA would have understood that Rosenberg-I's processor performs the methods of claim 9 by executing instructions ("*program code*") stored in memory (a "*non-transitory computer-readable medium*") because that is how processors worked by 2006. Rosenberg-II (the teachings of which Rosenberg-I incorporates by reference as I explained above), explicitly discloses that electronic devices perform haptic feedback based on "program instructions" stored on a "computer readable medium." Rosenberg-II at 42:35-56.

358. If considered not to be disclosed by Rosenberg-I, storing program code for performing Rosenberg-I's haptic feedback method in a computer-readable medium would have been the conventional and obvious way to implement Rosenberg-I's processor, as Rosenberg-II teaches. Rosenberg-II at 42:40-47 ("The use of program instructions to perform operations on a microprocessor is well known to [POSITA], and can be stored on a 'computer readable medium.'").

16. Claim 15

a. [15PRE]: "A system comprising:"

359. Rosenberg-I's touchpad, processor, and actuator together form a haptic-feedback "computer system." Rosenberg-I at 1:65-67 ("The present invention is directed to a haptic feedback planar touch control used to provide input to a computer system."); claim 1.

- b. [15A]: “an input device configured to control one of a plurality of systems, wherein the input device comprises a touch-pad,”**

360. Rosenberg-I’s system includes a touchpad that is used as an input device. See above limitation [1A].

361. As discussed above for limitation [1A], Rosenberg-I’s system includes a “touchpad 16” that is “*configured to control one of a plurality of systems,*” under Patent Owner’s interpretation of the phrase.

- c. [15B]: “a processor in communication with the input device”**

362. As I discussed above for limitation [1A], Rosenberg-I’s computer 10 include a “processor” that is “*in communication with*” the touchpad.

- i. [15B1] “the processor configured to receive an input signal and a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent,”**

363. For the same reasons I discussed above for [1A] and [1B], the processor in Rosenberg-I is configured “*to receive an input signal and a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent,*” as claimed.

ii. [15B2] “the processor further configured to generate a detent signal; and”

364. Limitation [15B2] is substantively identical to limitation [1C], which computer 10’s processor performs in Rosenberg-I for the reasons I discussed above with respect to [1C].

365. The lone difference between the two limitations is the fact that [15B2] uses the term “*detent signal*,” whereas [1C] uses the term “*vibrotactile signal*.”

366. The ’042 Patent describes a “*detent signal*” as the signal that the processor generates to cause an actuator to output a vibrotactile effect. *See, e.g.*, EX1001 at 4:35-39 (“The processor 106 may generate a signal, such as a detent signal, to the actuator 108. The detent signal may be configured to cause an actuator 108 to produce a vibrotactile effect in the form of a virtual detent on the input device 102.”). The “detent signal” thus performs the same function as the “*vibrotactile signal*” recited in [1C]. Inasmuch as the ’042 Patent teaches explicitly that the detent signal may be configured to cause a vibrotactile effect in the form of a virtual detent, a POSITA would have understood the ’042 Patent to be using the two terms in an equivalent manner.

367. The signals that Rosenberg’s processor sends to an actuator coupled to touchpad 16 in Rosenberg-I meets both limitations [15B2] and [1C] for the reasons discussed in above regarding [1C]

- d. **[15C]: “at least one actuator coupled to the input device, the at least one actuator configured to receive the detent signal and produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent.”**

368. As I discussed above for limitation [1C], Rosenberg-I’s computer 10 includes an actuator(s) “*coupled to*” the touchpad to produce a vibrotactile effect comprising a “*virtual detent*.” Rosenberg-I at Abstract; 3:10-11 (“one or more actuators coupled to the underside of the touchpad”); 2:14-19; 3:9-15; FIG. 3-4.

- 17. **Claim 16: “The system of claim 15, wherein the processor is further configured to control a system based at least in part on a manipulation of the input device.”**

369. As I discussed above for claim 2, Rosenberg-I’s computer 10 performs a rate control or scrolling operation that controls an aspect of a system (*e.g.*, volume) based on a user contacting the touchpad in a manner that indicates a rate control or scrolling operation is occurring, for example, dragging a finger up or down the touchpad to move a cursor in a graphical environment in a manner that increases or decreases volume. The user’s interaction with the touchpad is “*manipulation*” of the touchpad (“*input device*”) as claimed.

- 18. **Claim 17: “The system of claim 15, wherein the processor is further configured to determine whether to generate a detent signal.”**

370. As I discussed above with respect to claim 5, Rosenberg-I’s processor “*determine[s] whether to generate a detent signal*.”

19. Claim 18: “The system of claim 15, wherein the at least one actuator is coupled to a housing of the input device.”

371. As I discussed above with respect to limitation [15C], Rosenberg’s system includes an “actuator” that is coupled to touchpad 16.

20. Claim 19: “The system of claim 15, wherein the input device comprises a sensor.”

372. Rosenberg-I’s touchpad includes “sensors...to report the position of the user’s finger on the touch pad.” Rosenberg-I at 6:24-29; *see also* 1:46-49; 9:15-17; claim 37.

D. Ground 4: Claims 1-19 Would Have Been Obvious Over Rosenberg-I and Goldenberg

373. If the Patent Owner argues that Rosenberg-II’s disclosure regarding “force profiles” are not incorporated into Rosenberg-I and/or would not have been obvious to implement in Rosenberg-I, implementing Rosenberg-I to use a “*detent profile*,” as claimed, would have been obvious in view of Goldenberg.

1. Goldenberg (EX1007)

374. Goldenberg discloses an input device, with its exemplary input device being a control knob for a “home computer.” Goldenberg at Abstract (“The present invention provides haptic sensations for a haptic feedback device and especially for a rotational device such as a knob.”); *see also* 3:66-4:39 (describing devices the knob can control, including a “home computer”). “The knob 26 is preferably provided

with force feedback” that can “have the tactile feel of detents” which “affords a cleaner, richer user experience.” Goldenberg at 6:56-67.

375. “A basic force sensation” that Goldenberg outputs “is force detents that are output at particular predefined or regularly-spaced rotational positions of the knob to inform the user how much the knob has rotated and/or to designate a particular position of the knob.” Goldenberg at 13:14-17 (emphasis added); *see also* Goldenberg at 16:11-19 (describing use of “standard detent force effects” when knob is used to move between menu items); claim 2 (“causing a detent force to be output when said cursor moves from one of said menu items to a different one of said menu items”).

376. Goldenberg teaches that “different sets of detent force 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 or other controller in the device.” Goldenberg at 13:31-34 (emphasis added). Goldenberg describes other force sensations that also simulate a mechanical detent such as a “spring effect,” a “hill force effect,” and a “barrier effect.”

377. Force profiles for these latter effects are depicted in Figures 3-5, with “the horizontal axis represent[ing] the position of the knob...and the vertical axis represent[ing] the force magnitude on the knob in the rotary degree of freedom.” Goldenberg at 14:50-54. A POSITA would have recognized that Goldenberg’s

“force detent profiles” are substantively the same as the “virtual detent profiles” depicted in Figures 9A to 9H of the ’042 Patent; each profile includes data that can be used to cause an actuator to output a particular magnitude of force when an input device is at a particular location.

378. Although Goldenberg’s exemplary input device is a knob, Goldenberg confirms that its effects “can be used in a variety of force feedback devices besides rotational [*i.e.*, knob] devices.” Goldenberg at 25:57-62; *see also* Goldenberg at 12:19-22 (“non-rotational contexts”). By 2006, a POSITA would have recognized that one “non-rotational” input device for which Goldenberg’s simulated detent feedback would be useful is a touchpad: this fact is confirmed at least by Rosenberg-I and Ichinose.

2. The Rosenberg-Goldenberg Combination(s)

379. A POSITA would have had multiple reasons to implement Rosenberg-I’s computer 10 such that its processor accesses Goldenberg’s “detent force profile[s]” from memory to generate vibrotactile feedback that simulates the detents disclosed by Goldenberg, *e.g.*, when performing Rosenberg-I’s rate control or scrolling functionality.

380. First, Goldenberg provides motivation the combination because it teaches that its “force detents” provide “a cleaner, richer user experience,” and a

POSITA would have sought such user experiences in Rosenberg-I's devices using detect force profiles as Goldenberg teaches. Goldenberg at 6:56-67.

381. Second, Goldenberg provides specific details on how to simulate detents for rate control or scrolling functions like those Rosenberg-I's devices perform.

382. For example, Goldenberg discloses a "standard detent force effect" where detents are output when scrolling through "successive item[s] in a linear menu." Goldenberg at 16:11-25; FIG. 4; 2:40-42 ("A detent force can be output when cursor moves from one menu item to a different menu item."); 21:15-22:16 (discussing "detent model" and "scrolling list force model"); FIG. 6. This "standard detent force effect" aligns with Rosenberg-I's description in column 12 of "[p]ulse sensations [that] can be used to indicate the location of the 'ticks' for discrete values or settings in the adjusted range." Rosenberg-I at 12:56-59.

383. Goldenberg likewise discloses "a jolt force"³⁹ that is "stronger in magnitude than normal detents, [and] which informs the user that the end of a value range or other range has been reached." Goldenberg at 19:27-33. This "jolt" effect aligns with Rosenberg-I's description in column 12 that "[w]hen reaching the end of

³⁹As discussed above, a POSITA would understand a "jolt" to be a vibrotactile sensation, especially when generated by a burst of vibration.

a numerical range that is being adjusted (such as volume), a pulse can be output to indicate that the end of the range has been reached.” 12:53-56.

384. A POSITA would have understood that Goldenberg’s “detent” effects would work with Rosenberg’s rate control function and scrolling functions, and therefore a POSITA would have looked to Goldenberg to provide details regarding how to simulate mechanical detents for Rosenberg-I’s rate control and/or scrolling functions.

385. Third, applying Goldenberg’s technique for simulating mechanical detents—*i.e.*, the use of “force detent profiles”—to Rosenberg-I’s computer that also simulates mechanical detents is no more than the combination of familiar elements according to known methods and thus obvious because a POSITA would have understood the combination to yield the predictable result of input devices that simulate mechanical detents.

386. The Rosenberg-Goldenberg combination stores Goldenberg’s “force detent profiles” in memory on Rosenberg-I’s computer so that Rosenberg-I’s processor accesses the stored profiles to generate a command signal to send to the actuator(s) coupled to the touchpad, the command signal causing the actuator to simulate a mechanical detent in accordance with the particular “force detent profile” that is accessed. Goldenberg at 11:32-36 (describing host computer with memory); 13:31-34 (explaining that “detent force profiles” are stored in memory).

387. When a user performs one of the rate control or scrolling operations Rosenberg-I describes (e.g., scrolling through a list or adjusting volume) using Rosenberg-I's touchpad, the computer's processor receives from memory a "force detent profile" as taught by Goldenberg that is "associated with" the system operation being controlled (e.g., the profile for a "standard detent force effect[]" used when scrolling a menu on a web browser). Goldenberg at 16:11-19.

388. A POSITA would have reasonably expected success in implementing the Rosenberg-Goldenberg combination because Goldenberg's "force detent profiles" can be used when controlling a device such as a "home computer," such as Rosenberg-I's computer; Goldenberg, 4:21-39. Moreover, Goldenberg's "force detent profiles" are accessed and executed by a processor, such as the processors in Rosenberg-I's computer, and can be output by an actuator(s), which Rosenberg-I's computer includes. Goldenberg at 9:7-27 (identifying exemplary known processors); *see also* 10:11-30 (listing suitable actuators); Rosenberg-I at 2:29-30 (describing exemplary actuators).

389. Goldenberg's teachings are useful in "force feedback devices besides rotational devices" (Goldenberg at 25:57-62), which a POSITA understood encompasses Rosenberg-I's touchpad. Goldenberg's teaching is consistent with a POSITA's understanding that vibrotactile detents can be output to touchpads, like Rosenberg-I's, using conventional actuators. On this latter point, I note that the '042

Patent itself provides no details on how its actuator provides virtual detents to a touchpad, underscoring that such implementations details were known. EX1001 at 6:32-45.

3. Claims 1-19

390. The lone distinction between Ground 3 and Ground 4 is the latter's use of Goldenberg's "force detent profiles," which is relevant in limitations [1B], [10B], [14B], and [15B1]. For every other limitation in claims 1-19 the Rosenberg-Goldenberg combination meets those limitations for same reasons Rosenberg-I alone does. See above VII.A.

391. For limitations [1B], [10B], [14B], and [15B1], in Rosenberg-Goldenberg, Rosenberg-I's processor accesses (and thus receives) from memory the "force detent profiles" taught in Goldenberg that correspond with the rate control or scrolling function(s) Rosenberg-I's device is performing for a particular application. For example, when adjusting the volume in a videogame or scrolling through a menu list presented on an Internet browser, Rosenberg-I's processor would receive from memory the Goldenberg "force detent profile[s]" associated with that function. Goldenberg at 2:40-42 ("A detent force can be output when the cursor moves from one menu item to a different menu item."); 16:11-19 (describing "standard detent force effects" associated with scrolling a menu list); 21:38-34 ("Scrolling List

Model”); 22:48-23:13 (describing Slider Model used for volume control and which “output[s]” “detents”).

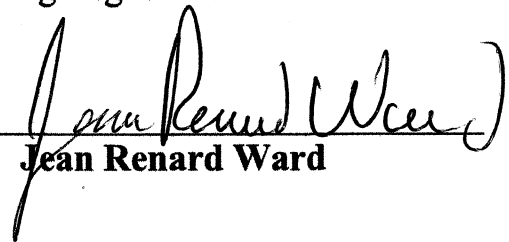
392. Goldenberg’s “force detent profile[s]” map the magnitude of a vibrational force to a position of the input device as shown by Goldenberg’s common “force detent profiles” in Figures 4A-4D. Goldenberg at 13:14-34, 14:48-15:55; 16:15-25. When implemented in a touchpad, the position of the input device corresponds to movement of the user’s finger on the touchpad, *e.g.*, moving from point A to point B on the touchpad.

393. A POSITA would have understood the force magnitude and position information included in Goldenberg’s “force detent profile” to be “*haptic data associated with a virtual detent*,” as claimed. Therefore, in operation, the “processor” of Rosenberg-Goldenberg “*receiv[es] a detent profile associated with one of the systems*,” as recited in [1B], [10B], [14B], and [15B1], *i.e.*, a Goldenberg “force detent profile” for a scrolling or rate control function associated with a particular program Rosenberg-I’s computer is running such as a videogame or Internet browser. *See* my earlier discussion for [1B] where I explain that Rosenberg-I uses “profiles” that are associated with different systems; Rosenberg-I at 11:28-29; 12:5-6; 12:27-49; 13:18-20; 15:19-23.

I declare that all statements made herein of my own knowledge are true, that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

I declare under penalty of perjury that the foregoing is true and correct.

Dated: 18 January 2024



Jean Renard Ward

U.S. PATENT NO. 9,430,042 CLAIM LIST

Claim 1
[1PRE] A method comprising:
[1A] receiving an input signal comprising information associated with a manipulation of an input device configured to control a plurality of systems, wherein the input device comprises a touch-pad;
[1B] receiving a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent; and
[1C] generating a vibrotactile signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent.
Claim 2
The method of claim 1, further comprising generating a system signal associated with a system to be manipulated, the system signal based at least in part on the input signal, and wherein generating a system signal and generating the vibrotactile signal occur substantially simultaneously.
Claim 3
The method of claim 1, wherein the vibrotactile signal is based at least in part on the input signal.
Claim 4
The method of claim 1, wherein the vibrotactile signal is further based in part on the status of the input device.
Claim 5
The method of claim 1, further comprising determining whether to generate a vibrotactile signal.
Claim 6
The method of claim 5, wherein determining whether to generate a vibrotactile signal is based at least in part on a status of the system to be manipulated.
Claim 7
The method of claim 1, further comprising determining one of a plurality of virtual detents to generate.
Claim 8
The method of claim 1, wherein the detent profile comprises a first detent profile, and further comprising receiving a second detent profile.

Claim 9

[9PRE] A method comprising:

[9A] detecting a change in position of an input device configured to control one of a plurality of systems, wherein the input device comprises a touch-pad;

[9B] receiving a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent; and

[9C] generating a detent signal based at least in part on the detent profile and the change in position, the detent signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent, the vibrotactile effect based at least in part on the detent signal.

Claim 10

[10PRE] A non-transitory computer-readable medium on which is encoded program code, the program code comprising:

[10A] program code for receiving an input signal comprising information associated with the manipulation of an input device configured to control one of a plurality of systems, wherein the input device comprises a touch-pad;

[10B] program code for receiving a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent; and

[10C] program code for generating a detent signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent.

Claim 11

The computer-readable medium of claim 10, further comprising program code for generating a system signal associated with a system to be manipulated, the system signal based at least in part on the input signal.

Claim 12

The computer-readable medium of claim 10, further comprising program code for determining whether to generate a detent signal.

Claim 13

The computer-readable medium of claim 10, further comprising program code for determining a virtual detent to generate.

Claim 14

[14PRE] A non-transitory computer-readable medium on which is encoded program code, the program code comprising:

[14A] program code for detecting a change in position of an input device configured to control one of a plurality of systems, wherein the input device comprises a touch-pad;

[14B] program code for receiving a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent; and

[14C] program code for generating a detent signal based at least in part on the change in position, the detent signal configured to cause an actuator to produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent, the vibrotactile effect based at least in part on the detent signal.

Claim 15

[15PRE] A system comprising:

[15A] an input device configured to control one of a plurality of systems, wherein the input device comprises a touch-pad;

[15B] a processor in communication with the input device,

[15B1] the processor configured to receive an input signal and a detent profile associated with one of the systems, the detent profile comprising haptic data associated with a virtual detent,

[15B2] the processor further configured to generate a detent signal; and

[15C] at least one actuator coupled to the input device, the at least one actuator configured to receive the detent signal and produce a vibrotactile effect to the input device, the vibrotactile effect comprising the virtual detent.

Claim 16

The system of claim 15, wherein the processor is further configured to control a system based at least in part on a manipulation of the input device.

Claim 17

The system of claim 15, wherein the processor is further configured to determine whether to generate a detent signal.

Claim 18

The system of claim 15, wherein the at least one actuator is coupled to a housing of the input device.

Claim 19

The system of claim 15, wherein the input device comprises a sensor.