

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VALVE CORPORATION,
Petitioner,

v.

IMMERSION CORPORATION,
Patent Owner.

Case No. IPR2024-00582
Patent No. 11,175,738

**DECLARATION OF GREGORY F. WELCH, Ph.D.
IN SUPPORT OF PETITION FOR
INTER PARTES REVIEW OF U.S. PATENT NO. 11,175,738**

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I, Gregory F. Welch, declare:

I. INTRODUCTION

A. Engagement

1. I have been retained on behalf of Valve Corporation (“Valve” or “Petitioner”) as an independent technical expert in the above-captioned IPR proceeding (“the IPR”). This document provides certain of my opinions concerning the patentability of claims in U.S. Patent No. 11,175,738 (EX. 1001, “the ’738 patent”), specifically claims 1-6, 14-16, and 19 (the “Challenged Claims”). I make this Declaration in support of Valve’s petition in the IPR.

2. For my work as an expert in this matter, I am being compensated for my services at a rate of \$600/hour, plus actual expenses. My hourly compensation is based solely on the amount of time that I devote to activity related to this case and is in no way contingent on the nature of my findings, the presentation of my findings in testimony, or the outcome of this or any other proceeding. I have no other personal or financial stake or interest in the outcome of the present proceeding. I do not have any expectation or promise of additional business with the Petitioner in exchange for the positions explained herein.

3. I make this Declaration based on my personal knowledge, including my education, training, research, and professional experience.

B. Background and Qualifications

4. My curriculum vitae (“CV”) detailing my educational background, professional experience, and list of publications is provided as EX1005. For ease of reference, I have highlighted certain information below.

5. I received my B.S. degree in Electrical Engineering Technology from Purdue University (with *Highest Distinction*) in May 1986, my M.S. in Computer Science from the University of North Carolina at Chapel Hill in May 1995, and my Ph.D. degree in Computer Science from the University of North Carolina at Chapel Hill in May 1997.

6. I am currently a Pegasus Professor and the AdventHealth Endowed Chair in Healthcare Simulation at the University of Central Florida (“UCF”) with appointments in the Computer Science Department in the College of Engineering & Computer Science, the Institute for Simulation and Training in the School of Modeling, Simulation, and Training, and the College of Nursing. I began teaching at UCF in 2011. In 2020, I was awarded a Pegasus Professor Award by UCF, the highest academic award a professor can receive at UCF, recognizing faculty excellence in teaching, research, and service.

7. Previously I was a Research Professor and Adjunct Professor at the University of North Carolina at Chapel Hill. I also was a Senior Engineer at Northrop-Grumman’s Defense Systems Division where I worked on the AN/ALQ-

135 electronic countermeasures system for the U.S. Air Force F-15 Eagle aircraft. I was also a member of the technical staff of NASA's Jet Propulsion Laboratory, where I worked on the Voyager Spacecraft project.

8. My current research interests include human-computer interaction, virtual and augmented reality, human motion tracking systems, three-dimensional (3D) telepresence, projector-based graphics, computer vision, and medical applications of computers for training, assessment, and practice in domains such as healthcare and defense. I have co-authored over 200 peer-reviewed publications in these areas—one with over 27,000 citations, and I am a co-inventor on 26 issued patents with one pending and several more in prosecution. I currently supervise over \$7 million in research funding and am jointly responsible for over \$35 million in grants overall since 1996. Examples of grantors for my research include the Office of Naval Research (ONR), the National Science Foundation (NSF), The National Institutes of Health National Library of Medicine (NIH-NLM), the Defense Advanced Research Projects Agency (DARPA), the Department of Energy (DOE), and private companies—all involving multi-disciplinary and multi-institutional projects.

9. I have co-chaired major academic conferences. For example, I am presently co-chairing the IEEE Virtual Reality conference to be held in Orlando (FL) in March 2024. I recently co-chaired EuroXR 2023 in Rotterdam (NL), and

previously the International Symposium on Mixed and Augmented Reality in 2012 and the IEEE Virtual Reality conference in 2013. I have also co-organized multiple international workshops and research retreats in these areas. I have served on numerous program committees, co-chaired workshops, and serve as a peer reviewer for many conferences and journals. I am an Associate Editor for the journal *Presence: Virtual and Augmented Reality* and an Associate Editor for the journal *Frontiers in Virtual Environments*.

10. I am a Fellow of the Institute of Electrical and Electronics Engineers (“IEEE”), a Fellow of the National Academy of Inventors (“NAI”), an inaugural member of the IEEE VGTC Virtual Reality Academy, a member of the Association for Computing Machinery (“ACM”), an ACM Special Interest Group on Computer Graphics and Interactive Techniques (“SIGGRAPH”) Pioneer, a member of the International Virtual Reality Healthcare Association, a member of Vision Sciences Society (“VSS”), a member of European Association for Computer Graphics (“Eurographics”), a member of the Southern Nursing Research Society (“SNRS”), a member of the International Nursing Association for Clinical Simulation & Learning (“INACSL”), and a member of the Society for Simulation in Healthcare (SSH).

11. My personal awards include the IEEE and NAI Fellow elevations (above), the IEEE VGTC Virtual Reality Technical Achievement Award in 2018, a

UCF Luminary Award in 2017, a UCF Research Incentive Award in 2017, an ISMAR Rock StAR Award in 2016, and an Excellence in Teaching Award at UNC in 2007. Shared awards include multiple awards for papers and demos. With co-authors Prof. Ramesh Raskar, Prof. Henry Fuchs, and Deepak Bandyopadhyay I was awarded the Long Lasting Impact Paper at ISMAR 2016.

12. As a computer scientist and engineer, my activities and expertise span both software and hardware, including software systems and interfaces. Much of my academic work since the early 1990s has focused on research and associated development related to human-computer interaction, including real-time and on-line human motion sensing, input and output controls, signal processing, and motion-related event processing, employing a variety of hardware systems including a various sensors, input and output devices, general purpose computers, embedded systems, and custom circuitry.

13. A prime example is the HiBall Tracking system that I co-developed in the 1990s. The system served to track the six degree-of-freedom (6DOF) position and orientation of a target such as a head, hand, or handheld device in a three-dimensional (3D) space. The HiBall Tracking system is an implementation of my Ph.D. work at UNC in the mid-1990s, where I introduced a new approach to sense and track a user's position and orientation using a sequence of single sensor measurements, described in my Ph.D. dissertation titled "SCAAT: Incremental

Tracking with Incomplete Information.” A key realization for this approach is that the single sensor observations provide some information about the user’s state, and thus can be used to incrementally improve a previous estimate. By recursively applying this principle, incorporating new sensor measurement data as soon as it is measured, a user’s pose can be estimated more frequently, with less latency, and with improved accuracy.

14. I have incorporated tactile (haptic) feedback in multiple research projects. A relatively recent example is work I refer to broadly as “tactile telepresence for isolated patients.” Conceived of during the COVID-19 pandemic, this work is aimed at providing an isolated patient and remote visitors (e.g., loved ones) with visual interactions that are augmented by touch—a perception of being touched for the isolated patient and a perception of touching for the visitors. We do so via linear resonate actuators embedded in a headband and arm bands placed on the patient, to allow the patient to feel the sensation of the remote visitor’s touch, and the vibrotactile devices in tablet computers to provide tactile feedback to the remote visitor. We presented a poster on this work at a conference in 2020. (Nafisa Mostofa, Indira Avendano, Ryan P. McMahan, and Greg Welch. Tactile Telepresence for Isolated Patients. In A. Kulik, M. Sra, K. Kim, and B.-K. Seo, editors, ICAT-EGVE 2020 - International Conference on Artificial Reality and Telexistence and Eurographics Symposium on Virtual Environments — Posters

and Demos, pages 7–8. The Eurographics Association, 2020.) This work has also resulted in two issued patents so far: U.S. Patent No. 11,287,971 (“Visual-Tactile Virtual Telepresence”) and U.S. Patent No. 11,106,357 (“Low Latency Tactile Telepresence”), both with Ryan McMahan and Gerd Bruder.

15. Another example is something we refer to as *smart moulage* in 2019–2022. In the context of medical simulation, *moulage* refers to a tangible pliable (e.g., silicon based) model of a wound that can be attached to a human body to simulate the shape, feel, and appearance of a wound. Our smart moulage is pliable moulage with sensors and actuators embedded inside to simulate the physical (tactile and haptic) characteristics of the wound, and passive or active features that facilitate tracking for the use of Augmented Reality to simulate the appearance of the wound. For example, the moulage can be used to sense when a trainee applies pressure to the wound, so that a physiological simulation can adjust the patient's blood pressure, and the moulage can provide vibratory feedback to simulate the pulsing sensation associated with an arterial wound. This work has resulted in two issued patents so far: U.S. Patent No. 10,854,098, (“Adaptive Visual Overlay Wound Simulation”) and U.S. Patent No. 10,803,761 (“Multisensory Wound Simulation”), both with Joseph LaViola II, Francisco Guido-Sanz, Gerd Bruder, Mindi Anderson, and Ryan Schubert.

16. Another example is our physical-virtual patient bed. These are patient simulators that, among other things, incorporate tactile feedback in several locations over the patient simulator to provide the sensation of a pulse at those points on the body, e.g., the neck, groin, wrists, and ankles. The strength and timing of the tactile feedback can be varied to simulate a strong or weak (“thready”) pulse. This work has resulted in several publications, e.g., a 2020 article in the journal *Simulation in Healthcare*. (Salam Daher, Jason Hochreiter, Ryan Schubert, Laura Gonzalez, Juan Cendan, Mindi Anderson, Desiree A. Diaz, and Greg Welch, “The Physical-Virtual Patient Simulator: A Physical Human Form with Virtual Appearance and Behavior. *Simulation in Healthcare*,” 15(2):115–121, 2020.) It has also resulted in three issued patents so far: U.S. Patent No. 10,410,541 (“Physical-Virtual Patient Bed”) and U.S. Patent No. 9,679,500 (“Physical-Virtual Patient Bed”), both with Karen Aroian, Steven Talbert, Kelly Allred, Patricia Weinstein, Arjun Nagendran, and Remo Pillat; and U.S. Patent No. 10,380,921 (“Physical-Virtual Patient Bed System”) with Arjun Nagendran, Mary Lou Sole, and Laura Gonzalez.

17. We have also incorporated environmental tactile feedback into various Virtual Reality or Augmented Reality simulations, e.g., to simulate the feeling of someone walking nearby, the dropping/landing of an object nearby, or the vibrations of a simulated moving platform. (Kendra Richards, Nikhil

Mahalanobis, Kangsoo Kim, Ryan Schubert, Myungho Lee, Salam Daher, Nahal Norouzi, Jason Hochreiter, Gerd Bruder, and Greg Welch, “Analysis of Peripheral Vision and Vibrotactile Feedback During Proximal Search Tasks with Dynamic Virtual Entities in Augmented Reality.” In Proceedings of the ACM Symposium on Spatial User Interaction (SUI), page 9, New Orleans, LA, October 19, 2019. Association of Computing Machinery, ACM; Myungho Lee, Gerd Bruder, Tobias Hollerer, and Greg Welch, “Effects of Unaugmented Periphery and Vibrotactile Feedback On Proxemics with Virtual Humans In AR.” IEEE Transactions on Visualization and Computer Graphics, 24(4):1525–1534, April 2018; Myungho Lee, Gerd Bruder, and Greg Welch. Exploring the Effect of Vibrotactile Feedback Through the Floor on Social Presence in an Immersive Virtual Environment. Proceedings of IEEE Virtual Reality 2017, pages 105–111, March 2017; Myungho Lee, Gerd Bruder, and Greg Welch, “The Virtual Pole: Exploring Human Responses to Fear of Heights in Immersive Virtual Environments,” *Journal of Virtual Reality and Broadcasting*, 14(2017)(6), 2019.)

18. My work related to embedded systems, input devices handling input and output signals, and associated event processing can be traced back to the 1980s, with my work on the “Easy Chair,” a microprocessor-based user input and control system for a motorized wheelchair for children with Cerebral Palsy. Codeveloper James Williams and I received an “Outstanding Senior Design

Project” award for the project in 1986. One of my core contributions to this wheelchair-related project was the development of a novel customizable touch pad to be used by children to control their wheelchairs. The touch pad that combined analog and digital signals and control information associated with the pressure-sensitive hardware into a common data stream sent to a host through a common port. (James Williams and Greg Welch, “The pressure sensitive touch-pad,” Purdue University, E.E.T. 454 Project Report, April 30, 1985.) We also developed an optical version of the touch pad that multiplexed LEDs and photo sensors to detect the intersection of a point on the touch pad. The control signals and touch results were communicated to a computer through a common port. (Greg Welch, “The infrared touch-pad,” Purdue University, E.E.T. 421 Report, February 26, 1986.) We designed the Easy Chair controller and touchpad to emulate the joysticks of the original motorized wheelchair, i.e., to take over for them when in use, and to revert to the joystick control otherwise. We also developed safety controls, including speed and distance sensing and responses. For example, we developed “ultrasonic bumper” technology that slowed (or stopped) the wheelchair as it approached nearby objects. The complete functioning wheelchair, including touch pad, motor controls, safety sensors, and all user-interface aspects is described in our preliminary and final project reports. (Greg Welch and James P. Williams, “The easy chair: A microprocessor-controlled wheelchair for children

with muscular disorders,” Purdue University, E.E.T. 490/491 Senior Design Project, Preliminary Report, December 1985; Greg Welch and James P. Williams, The easy chair: A microprocessor-controlled wheelchair for children with muscular disorders, Purdue University, E.E.T. 490/491 Senior Design Project, Final Report, May 1986.)

C. Bases of My Opinions and Materials Considered

19. I have reviewed the '738 patent, its prosecution history, and the prior art and other documents and materials cited herein. For ease of reference, the full list of documents that I have considered is included in Appendix A. I have also considered the documents cited and referenced herein, even if not included in Appendix A. Each of these materials is a type of document that experts in my field would have reasonably relied upon when forming their opinions and would have had access to either through the applicable patent office and/or well-known libraries, conferences, publications, organizations, and websites in the field as further discussed herein.

20. My opinions in this Declaration are based on my review of these documents, as well as upon my education, training, research, knowledge, and experience. When developing the opinions set forth in this declaration, I assumed the perspective of a person having ordinary skill in the art (“POSA”), as set forth in Section III below.

21. The opinions and comments formulated during this assessment are based on observations and information available at the time of this investigation. If additional information becomes available, for example in materials submitted by the Patent Owner, I would be happy to consider such additional information and offer my thoughts thereon if requested to do so.

D. My Understanding of Patent Law

22. In developing my opinions, I discussed various relevant legal principles with Petitioner's attorneys. I have relied upon such legal principles, as explained to me, while forming the opinions set forth in this declaration. My understanding in this respect is as follows:

23. I understand that *inter partes* review ("IPR") is a proceeding before the United States Patent & Trademark Office ("USPTO") 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, Valve has the burden of proving that the challenged claims of the '738 patent are unpatentable by a preponderance of the evidence. I understand that a "preponderance of the evidence" means that the evidence establishes that a fact or conclusion is more likely true than not true.

25. I understand that patent claims can be independent or dependent. I understand that a dependent claim must reference a claim previously set forth, and

then must specify a further limitation of the claimed subject matter. I also understand that a dependent claim is treated as incorporating by reference all limitations of the claim(s) from which it depends. I understand that an independent claim does not usually reference or incorporate limitations from other claims.

26. I understand that, in IPR proceedings, claim terms in a patent are given their ordinary and customary meaning as understood by a POSA in the context of the entire patent and the prosecution history pertaining to the patent. I discuss the qualifications of the POSA relevant to the '738 patent in Section III below. I understand that if the patent specification provides a special definition for a claim term that differs from the meaning the term would otherwise possess, the specification's special definition takes precedence. I have applied these standards in preparing the opinions in this Declaration.

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

1. Anticipation

28. I understand that, for a patent claim to be "anticipated" by the prior art (and therefore not novel), each and every claim limitation must be disclosed, actually or inherently, in a single prior-art reference. I understand that a claim

limitation is disclosed for the purpose of anticipation if a POSA would have understood the reference to disclose the limitation based on inferences that a POSA would reasonably be expected to draw from the explicit teachings in the reference when read in the context provided by the POSA's knowledge and experience.

29. 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 POSA recognized the presence of that limitation in the prior art.

2. Obviousness

30. I understand that a patent claim may be unpatentable if it would have been obvious to a POSA in view of a single prior art reference or a combination of prior art references.

31. 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 claimed subject matter, as a whole, would have been obvious to a POSA 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 POSA; and, if present, any "secondary considerations" of non-obviousness. At this stage I am unaware of the Patent Owner identifying any alleged secondary considerations of non-obviousness

with respect to the '738 patent, but if any secondary considerations are later presented, I would be happy to evaluate and comment thereon if asked to do so.

32. I understand that for a claimed invention to be obvious, a POSA 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.

33. I have also been informed that in considering whether a combination of elements recited in a patent claim would have been obvious, I may assess whether there are apparent reasons to combine known elements in the prior art in the manner claimed in view of interrelated teachings of multiple prior art references, the effects of demands known to the design community or present in the marketplace, and/or the background knowledge possessed by a POSA. I have been informed that other principles may be relied upon in evaluating whether a claimed invention would have been obvious, and that these principles include the following:

- A combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results;
- When a device or technology is available in one field of endeavor, design incentives and other market forces can prompt variations of

it, either in the same field or in a different one, so that if a POSA can implement a predictable variation, the variation is likely obvious;

- If a technique has been used to improve one device, and a POSA would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond a POSA's skill;
- An explicit or implicit reason to modify a prior art reference or to combine two prior art references to arrive at the claimed invention may demonstrate obviousness, and this reason may come from a prior art reference or from the knowledge or common sense of a POSA;
- Market demand, rather than scientific literature, can drive design trends and may show obviousness;
- In determining whether the subject matter of a patent claim would have been obvious, neither the particular motivation nor the avowed purpose of the named inventor controls;
- One consideration supporting obviousness of a patent claim is if there existed at the time of invention a known problem for which there was an obvious solution encompassed by the claim;

- Any need or problem known in the field of endeavor at the time of invention can provide a reason for combining the elements in the manner claimed;
- Common sense teaches that familiar items may have obvious uses beyond their primary purposes, and in many cases a POSA will be able to fit the teachings of multiple patents together like pieces of a puzzle;
- A POSA is also a person of ordinary creativity, and is not an automaton;
- A patent claim may be obvious if the claimed combination of elements was “obvious to try,” particularly when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions such that a POSA would have had good reason to pursue the known options within his or her technical grasp; and
- One should be cautious of using hindsight in evaluating whether an alleged invention would have been obvious.

34. I understand that obviousness requires a POSA to have a reasonable expectation of success in combining multiple prior art references. I understand that a reasonable expectation of success refers to the likelihood of success in combining

references to meet the limitations of the claimed invention. I understand that in evaluating a combination, a predictable result means not only that the prior art elements are capable of being physically combined, but also that the combination would have worked for its intended purpose.

3. Claim Interpretation

35. I understand that determining whether a claimed invention is novel and non-obvious requires comparing the prior art to the challenged claim. In this Section, I discuss the interpretations that I applied to certain claim terms in my analysis.

36. I have been informed that patent claims are construed from the viewpoint of a person of ordinary skill in the art at the time of the alleged invention. I have been informed that patent claims generally should be interpreted consistent with their plain and ordinary meaning as understood by a person of ordinary skill in the art in the relevant time period (i.e., at the time of the purported invention, or the so called “effective filing date” of the patent application), after reviewing the patent claim language, the specification and the prosecution history (i.e., the intrinsic record).

37. I have further been informed that a person of ordinary skill in the art must read the claim terms in the context of the claim itself, as well as in the context of the entire patent specification. I understand that in the specification and

prosecution history, the patentee may specifically define a claim term in a way that differs from the plain and ordinary meaning. I understand that the prosecution history of the patent is a record of the proceedings before the U.S. Patent and Trademark Office, and may contain explicit representations or definitions made during prosecution that affect the scope of the patent claims. I understand that an applicant may, during the course of prosecuting the patent application, limit the scope of the claims to overcome prior art or to overcome an examiner's rejection, by clearly and unambiguously arguing to overcome or distinguish a prior art reference, or to clearly and unambiguously disavow claim coverage.

38. In interpreting the meaning of the claim language, I understand that a person of ordinary skill in the art may also consider "extrinsic" evidence, including expert testimony, inventor testimony, dictionaries, technical treatises, other patents, and scholarly publications. I understand this evidence is considered to ensure that a claim is construed in a way that is consistent with the understanding of those of skill in the art at the time of the alleged invention. This can be useful for technical terms whose meaning may differ from its ordinary English meaning. I understand that extrinsic evidence may not be relied on if it contradicts or varies the meaning of claim language provided by the intrinsic evidence, particularly if the applicant has explicitly defined a term in the intrinsic record.

39. I understand that determining whether a claimed invention is novel and non-obvious requires comparing the prior art to the challenged claim. In this Declaration, I apply the above standards to the terms in the challenged claims. The meanings of specific terms are discussed below in connection with evaluating the disclosure in the priority documents.

II. DESCRIPTION OF THE RELEVANT FIELD AND THE RELEVANT TIME FRAME

40. I have reviewed the '738 patent (Ex. 1001) and its prosecution history (Ex. 1002).

41. I understand that the '738 patent issued from U.S. Patent Application Ser. No. 15/377,096 ("the '096 application"), filed on December 13, 2016. Ex. 1001 (Fields 21 & 22). I understand that the '738 patent does not claim the benefit of any earlier filing date.

42. I have been instructed by counsel to assume the relevant timeframe for my analysis of the prior art in this Declaration is on or before December 13, 2016.

43. Based on my review of this material, I believe that the relevant general fields for the purposes of the '738 patent are hardware and software designs for electronic devices that provide haptic feedback to a user.

44. Haptic feedback refers to an effect or sensation that a user can perceive via the user's sense of touch—in other words, providing touch-based

sensations. The word “haptic” means relating to a sense of touch, and sometimes is used synonymously with the word “tactile.” “Tactile” is also used to refer to fine grain sensations like texture, friction, etc.

45. Generally speaking, electronic devices may use different types of cues tied to different senses (such as visual, auditory, and haptic cues) to deliver information to a user—for example, to indicate that the user has touched a screen at a particular location. Haptic feedback can enhance the experience of a user by providing cues that do not require the user to see or hear the device. A vibrational alert from a mobile phone is one example. Haptic feedback is not limited to vibration, and includes a wide range of sensations, including forces exerted by the devices and changes in the texture of a device’s surface.

III. PERSON HAVING ORDINARY SKILL IN THE ART

46. My opinions are based on what a person of ordinary skill in the art (“POSA”) in the technical field of the alleged invention would have understood at the time of the alleged invention of the Challenged Claims. As I explained above, the relevant timeframe in the analysis in this Declaration is on or before December 13, 2016 (i.e., the date when the ’738 Patent was filed). I have been informed and understand that the contents of a patent and prior art references thereto should be understood the way a POSA would have understood the subject matter at the time of the alleged invention.

47. I was asked to provide an opinion as to the level of skill for a person of ordinary skill in the art pertinent to the subject matter set forth in the Challenged Claims of the '738 patent on December 13, 2016. I understand that factors to be considered in evaluating the level of ordinary skill in the art include the types of problems encountered in the art, the prior art solutions to those problems, the rapidity with which innovations in the field are made, the sophistication of the technology, and the educational level and professional capabilities of workers in the field.

48. As of December 13, 2016, and in the context of the '738 patent and the prior art, it is my opinion that the POSA to whom the patent is addressed would have a bachelor's degree in electrical engineering, computer science, or a related field, plus at least two years of industry experience or graduate-level academic experience in human-computer interaction. More education could substitute for experience, and *vice versa*. This person would have been capable of understanding and applying the teachings of the '738 Patent and the prior-art references discussed in this Declaration.

49. The basis for my familiarity with the level of ordinary skill is my own technical experience and my interaction with students and professionals who fit the characteristics of a POSA around December of 2016. I actively taught and carried out research with such students and professionals in the years leading up to 2016.

For example, in the late 1990s I taught a graduate-level course at the University of North Carolina at Chapel Hill called Exploring Virtual Worlds, and course coverage included the perceptual and technical aspects of haptics, tactile sensations, and force feedback. The course also included a final project, and various related devices and techniques were sometimes used in the projects. In the early 2000s I collaborated on a multidisciplinary project to develop a 3D Force Microscope. The 3DFM included some elements of haptic feedback associated with the forces on a magnetically controlled / sensed bead freely suspended in liquid. My experience informs the conclusion I just articulated about the level of ordinary skill in the art.

50. In reaching this opinion as to the hypothetical person of ordinary skill in the art, 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.

51. As summarized above regarding my qualifications and experience, I possessed at least the level of skill of a person of ordinary skill in the art at the time of the alleged invention of the '738 patent.

52. I have worked with many people who fit the characteristics of the POSA, and I am familiar with their level of skill in and around December 2016.

When developing the opinions set forth in this declaration, I assumed the perspective of a POSA as set forth above.

53. Even though I had greater than the ordinary level of skill in the art as of 2016 (since I earned my Ph.D. in 1997 and had about 19 years of post-Ph.D. experience by 2016), I am able to apply the POSA standard in this Declaration because I have long been familiar with, and have worked extensively with (including before December 2016) people having an ordinary level of skill and experience in the field of the '738 patent, including most of the students I have advised or co-advised.

54. Except as noted below whenever I offer an opinion in this declaration about the knowledge of a POSA, the manner in which a POSA would have understood the claims of the '738 patent or its description, the manner in which a POSA would have understood the prior art, or what a POSA would have been led to do based on the prior art, I am referencing the December 2016 timeframe, even if I do not say so specifically in each case.

IV. THE '738 PATENT

A. Summary of the '738 Patent

55. The '738 patent is titled "Systems and Methods For Proximity-Based Haptic Feedback." EX1001, cover.

56. The '738 patent is directed to “a touch-sensitive device” and methods for receiving two sensor signals—a “first sensor signal” registering a “non-contact interaction” with the touch-sensitive device and a “second sensor signal” registering a “touch” on the touch-sensitive device—and then “generat[ing] a haptic output signal based at least in part on” the “first and second sensor signals.” *Id.*, Abstract.

57. The Background section of the '738 patent acknowledges that “touch-sensitive input device[s]” were known and included by “[m]any modern devices.” *Id.*, 1:14-15. According to the patent, however, these touch-sensitive input devices “may be difficult or confusing to operate” for users not “look[ing] at the device during use.” *Id.*, 1:14-20. The '738 patent proceeds to disclose an apparatus and related method with a processor configured to receive a first signal from a proximity sensor and a second signal from a touch sensor, and “generate a haptic output signal based at least in part on” both sensor signals, then “transmit the haptic output signal to a haptic output device, which then outputs the haptic effect.” *Id.*, 1:27-53.

58. The '738 patent discloses that this outputted haptic effect may, for example, be “associated with a particular control on a user interface element” and “confirm ‘pushing’ on a virtual button.” *Id.*, 11:32-40. This example is referring to the embodiment in FIG. 5.

59. In an “illustrative embodiment,” the ’738 patent notes that the device may include a “dual-mode sensor” capable of detecting both “a user’s finger in proximity to but not in contact with a touch-sensitive device” as well as when “the user’s finger is in contact with the touch-sensitive device.” *Id.*, 2:35-43. This dual-mode sensor may be “a capacitance sensor.” *Id.*, 2:42-67; *see also id.*, 7:33-40 (describing “a dual proximity and touch sensor for sensing both a contact and non-contact interaction”).

B. Challenged Claims

60. I have reproduced claims 1-6, 14-16, and 19 of the ’738 patent at the end of this declaration as Appendix B. Throughout this declaration when I refer to a claim element, I mean claim language associated with a particular claim element reference as provided in the claim list in Appendix B.

C. Prosecution History

61. I have reviewed the prosecution history of the ’738 patent (Ex. 1002). Initially, I note that all pending claims of the ’096 Application (the application leading to the ’738 patent) were rejected by the examiner over a prior art reference Choe (EX1015), with the examiner also relying on secondary references (in addition to Choe) when rejecting certain dependent certain dependent claims. EX1002, 53-61. For example, the examiner rejected claim 5 (requiring “an integrated sensor” comprising both “the proximity sensor and the touch sensor”)

and claim 7 (further dependent from claim 5, and requiring that the integrated sensor comprise “an electroactive polymer”) among others as obvious over Choe in view of Rosenberg ’166 (EX1021). Similarly, the examiner rejected claim 6 (further dependent from claim 5, and requiring that the integrated sensor also comprise “the haptic output device”) as obvious over Choe in view of Rosenberg ’166 and Rosenberg ’848 (EX1022). The examiner likewise rejected claim 14 (requiring that the touch sensor of claim 1 be “capable of detecting a pressure and wherein the haptic output signal is based at least in part on the detected pressure”) as obvious over Choe in view of Rosenberg ’848.

62. In applicants’ remarks filed in response to the rejections of the independent claims, applicants stated that Choe’s haptic effect was “based only on proximity,” whereas the pending claims required “generat[ing] a haptic signal based at least in part on the *first and second sensor signals*,” meaning “determining a haptic effect based on signals from the proximity sensor and the touch sensor.” EX1002, 158-159 (emphasis original).

63. After the examiner was not persuaded and maintained the rejection, applicants appealed to the Patent Trial & Appeal Board (“Board”). In their appeal brief, the applicants maintained that the examiner had never established “that Choe determines the haptic effect based on signals received from ***both*** ‘a proximity sensor capable of detecting a non-contact interaction and a ‘touch sensor capable

of detecting a touch with the touch-sensitive device,’ as is required by claim 1.”

Id., 1032 (emphasis original). In the appeal brief, applicants maintained that Choe at best concerned two **distinct** haptic effects — one based on proximity and the other based on contact. *See e.g. id.*, 1034 (“at best [the paragraphs of Choe cited by the examiner] describe determining a first haptic effect 225 based on proximity and a second haptic effect 226 based on contact,” and “at best [these cited paragraphs] describe determining two distinct haptic effects, 225 and 226.”); *see also id.*, 1036 (“[T]hese figures show **distinct** haptic effects.”) (emphasis original). In their reply brief, applicants reiterated that Choe at most described outputting two different haptic effects “sequentially” and **not** at “overlapping times.” *Id.*, 1075-76.

64. In its decision on appeal (“Decision”), the Board reversed the examiner’s rejection and agreed with the applicants concerning Choe’s disclosures. *Id.*, 1091. The Board explained in the Decision that it agreed with applicants that Choe disclosed “two separate haptic effects,” with “the first...based only on a proximity signal, and the second...based only on a touch signal,” whereas the claims required “**both** touch and proximity signals be used to generate each haptic effect.” *Id.*, 1089-90. The Board also observed that Choe discloses a haptic effect “generated based on a touch of the user, *or* the approach of the user’s finger, but not both.” (emphasis original). *Id.*, 1091. The Board further agreed with applicants that Choe described “outputting effects sequentially” and did not teach the

“specific signals 225 and 226 described by Choe,” namely the touch and proximity signals could be “combined.” *Id.*, 1091.

65. The '096 Application was allowed by the examiner after the Decision. *Id.*, 1093-94.

D. European Counterpart Prosecution History

66. I have reviewed the prosecution history of the European counterpart application (“EP Counterpart”) to the '738 patent. (Ex. 1003).

67. The EP Counterpart was filed on December 8, 2017, listed Immersion Corporation as Applicant in field 7-1, and made a declaration of priority for the '096 Application in the U.S. in field 25. *Id.*, 1, 2.

68. When it was originally filed, the EP Counterpart listed three independent claims (1, 13 and 15). *Id.*, 33-35. Aside from the appearance of numerical reference numbers in parenthesis such as (101) and (132), these independent claims in the EU Counterpart were identical to corresponding independent claims originally filed in the '096 Application in the U.S. *Compare id.*, with EX1002, 21-23. The independent claims in the EU Counterpart were also almost identical to those in the issued '738 patent in the United States., as illustrated in the comparison table below of claim 1 of the EU Counterpart and the '738 patent as issued:

Independent claims of EU Counterpart (EX1003, 33-35)	Independent claims of '738 patent (EX1001)
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1. A device (101) comprising: a proximity sensor (132) capable of detecting a non-contact interaction with a touch sensitive device and outputting a first sensor signal; a touch sensor (108) capable of detecting a touch with the touch-sensitive input device and outputting a second sensor signal; a haptic output device (118) configured to receive a haptic output signal and output a haptic effect in response to the haptic output signal; and a processor (102) configured to: receive the first sensor signal and the second sensor signal; generate a haptic output signal based at least in part on the first and second sensor signals; and transmit the haptic output signal to the haptic output device (118).	1. A device comprising: a proximity sensor capable of detecting a non-contact interaction with a touch-sensitive device and outputting a first sensor signal; a touch sensor capable of detecting a touch with the touch-sensitive input device and outputting a second sensor signal; a haptic output device configured to receive a haptic output signal and output a haptic effect in response to the haptic output signal; and a processor configured to: receive the first sensor signal and the second sensor signal; generate a haptic output signal based at least in part on the first and second sensor signals; and transmit the haptic output signal to the haptic output device.
13. A method comprising: detecting, by a proximity sensor, a non-contact interaction with a touch-sensitive device; detecting, by a touch sensor (108), a touch on the touch-sensitive input device; transmitting a first sensor signal associated with the non-contact interaction to a processor (102); transmitting a second sensor signal associated with the touch to a processor	15. A method comprising: detecting, by a proximity sensor, a non-contact interaction with a touch-sensitive device; detecting, by a touch sensor, a touch on the touch-sensitive device; transmitting a first sensor signal associated with the non-contact interaction to a processor; transmitting a second sensor signal associated with the touch to a

(102); receiving, by the processor (102), the first and second sensor signals; generating, by the processor (102), a haptic output signal based at least in part on the first and second sensor signals; transmitting, by the processor (102), the haptic output signal to a haptic output device (118); and outputting, by the haptic output device (118), a haptic effect in response to the haptic output signal.	processor; receiving, by the processor, the first and second sensor signals; generating, by the processor, a haptic output signal based at least in part on the first and second sensor signals; transmitting, by the processor, the haptic output signal to a haptic output device; and outputting, by the haptic output device, a haptic effect in response to the haptic output signal.
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69. The as-filed dependent claims in the EP Counterpart also closely tracked those in the ‘096 Application in the U.S., as illustrated in the comparison table below of dependent claims of the EU Counterpart and the corresponding claims in the ’096 Application that ultimately led to the issued dependent device claims being challenged in this proceeding:

Claims of EU Counterpart (EX1003, 33-35) (emphasis added)	Claims of ‘096 Application (EX1002, 21-23) (emphasis added)
2. The device of claim 1, wherein the proximity sensor (132) is <i>integrated into the touch sensitive input device</i> .	2. The device of claim 1, wherein the proximity sensor is <i>integrated into the touch-sensitive input device</i> .

3. The device of claim 1 or claim 2, wherein the <i>proximity sensor comprises one of a capacitive sensor or an optical sensor</i> , and preferably wherein where the proximity sensor comprises an optical sensor, the optical sensor comprises one of a laser, an infra-red emitter, or a photo-resistor.	3. The device of claim 1, wherein the <i>proximity sensor comprises one of a capacitive sensor or an optical sensor</i> .
4. The device of any preceding claim, wherein <i>the haptic output signal is designed to direct a user to contact the touch-sensitive device at a particular location</i> .	4. The device of claim 1, wherein <i>the haptic output signal is designed to direct a user to contact the touch-sensitive device at a particular location</i> .
5. The device of any preceding claim, wherein an <i>integrated sensor</i> (202) <i>comprises the proximity sensor</i> (132) <i>and the touch sensor</i> (108).	5. The device of claim 1, wherein the <i>an integrated sensor comprises the proximity sensor and the touch sensor</i> .
6. The device of claim 5, wherein the <i>integrated sensor</i> (202) <i>further comprises the haptic output device</i> (118).	6. The device of claim 5, wherein the <i>integrated sensor further comprises the haptic output device</i> .
12. The device of any preceding claim, wherein the <i>touch sensor</i> (108) <i>is capable of detecting a pressure and wherein the haptic output signal is based at least in part on the detected pressure</i> .	14. The device of claim 1, <i>wherein the touch sensor is capable of detecting a pressure and wherein the haptic output signal is based at least in part on the detected pressure</i> .

70. In a European search opinion dated April 25, 2018, the independent claims were objected to as “not new” in view of reference D1 (EP 2141580A2). EX1003, 95-96. I have reviewed EP 2141580A2 (EX1014) and understand that it is the European counterpart application to U.S. Patent No. 8,531,319 (“Ku”,

EX1008). For example, both EP 2141580A2 and Ku list the same inventors, and the same priority information to application KR 20080062800, filed on June 30, 2008. *Compare* EX1014, cover, *with* EX1008, cover. Both documents also have identical figures with identical text with respect to description of the figures. EX1014, EX1008. I will discuss Ku in more detail below in Sections VI.B (concerning Ground 2) and VI.C (concerning Ground 3).

71. The April 25, 2018 European search opinion further objected to the dependent claims 2-12, 14 as not meeting the requirements of “novelty and/or inventive step.” EX1003, 96. For example, as to claim 2 (requiring the proximity sensor be integrated into the touch sensitive input device), claim 5 (requiring “an integrated sensor” comprising both the “proximity sensor” and “touch sensor”) and claim 6 (further requiring that the integrated sensor also comprise the “haptic output device”), the opinion notes that “it is customary practice in the art of computing devices to implement multiple components (sensors, actuators) in an integrated manner.” *Id.*, 96-97. As to claim 3 (requiring that the proximity sensor comprises one of a capacitive sensor or an optical sensor), the opinion notes that EP 2141580A2 (i.e., the European counterpart application to Ku, as I discussed above) discloses capacitive proximity sensor 46. *Id.*, 97. Furthermore, as to claim 4 (requiring that “the haptic output signal is designed to direct a user to contact the touch-sensitive device at a particular location”), the opinion notes that the haptic

effects of Ku’s European counterpart (i.e., “D1” as referenced in the opinion) “can be said to be designed to direct a user to contact the device at a particular location.”

72. Applicant Immersion Corporation filed a response to the European search opinion on March 25, 2019. *Id.*, 110-122. The response did not dispute that that originally-filed claim 1—including “generat[ing] a haptic output signal based at least in part on the first and second sensor signals” (*id.*, 33) was not novel over D1 (*id.*, 111-112). Instead, Applicant amended independent claim 1 with additional language to require an “integrated sensor” and argued that D1 “does not describe an integrated sensor to comprise the proximity sensor, touch sensor and haptic output device.” *Id.*, 112-116.

73. The European Patent Office nevertheless rejected amended claim 1 for multiple reasons — that claim 1 lacks novelty over several alternative references (D3, D4 or D5), and that claim 1 lacks an inventive step over “any of D1 and D2” because “the only distinguishing feature, namely the integration of the proximity sensor, touch sensor and haptic output device, is known.” *Id.*, 140.

74. In a subsequent response, Applicant further amended the claims with additional language to require the integrated sensor to comprise “an *optical* sensor.” *Id.*, 157. When the European Patent Office continued to maintain its rejection, Applicant wrote to inform the patent office that they will not be filing any submissions nor attending any oral proceedings. *Id.*, 166-169. The European

Patent Office ultimately refused to grant a European patent based on the EP Counterpart because Applicant did not file any comments or amendments in reply to the latest rejection. *Id.*, 176. Separately, I note that none of the claims I was asked to assess here require an optical sensor.

75. To summarize: after considering the European counterpart application to Ku, the European Patent Office refused to issue any claims in the European application corresponding to Immersion's '738 Patent—even after Immersion added additional limitations to make the European claims under consideration (and ultimately rejected by the European Patent Office) narrower than any of the claims I have considered here.

V. CLAIM INTERPRETATION

76. In accordance with the standards for interpreting patent claim terms discussed in Section I.D.3 above, I have interpreted the terms in the claims in accordance with their ordinary and customary meaning as understood by a POSA in the context of the '738 Patent (including the descriptions in the specification) and its prosecution history. In my opinion, and as explained further in Section VI, the prior art references I discuss herein disclose all elements of the challenged claims under any plausible construction. For that reason, it is not necessary for me to discuss the outer boundaries of what particular claim elements cover.

VI. GROUNDS FOR UNPATENTABILITY

A. Ground 1: Pratt Anticipates and/or Renders Obvious Claims 1-3, 5-6, 11, 14-15, and 19

1. Pratt (EX1006)

77. I refer to U.S. Patent Application Publication 2012/0249474A1 (EX1006) as “Pratt.” Pratt’s cover page reflects that it was published on Oct. 4, 2012. I understand from counsel that Pratt qualifies as indisputable prior art to the ‘738 Patent because it was published more than one year before the ‘738 Patent’s filing date of December 13, 2016.

78. Pratt is directed to “haptic effect generation techniques based on proximity, touch, and/or force detection.” *Id.*, [0002]. Pratt provides a mobile device with a capacitive-based touchscreen sensor capable of detecting proximity, touch, and force in parallel with processor 112 using “classification module[s]” (“proximity classification module 112.1,” “touch classification module 112.2,” and “force classification module 112.3”). *Id.*, [0021]-[0023].

79. I reproduced FIG. 1(a) of Pratt below. It shows a block diagram of a “haptic-enabled display device” that includes user interface controller 110 with processor 112 and “touch screen (TS) sensor 142,” which sends “TS sensor results” to processor 112—allowing it to “calculate proximity, touch, and/or force interaction events.” *Id.*, [0015]-[0016].

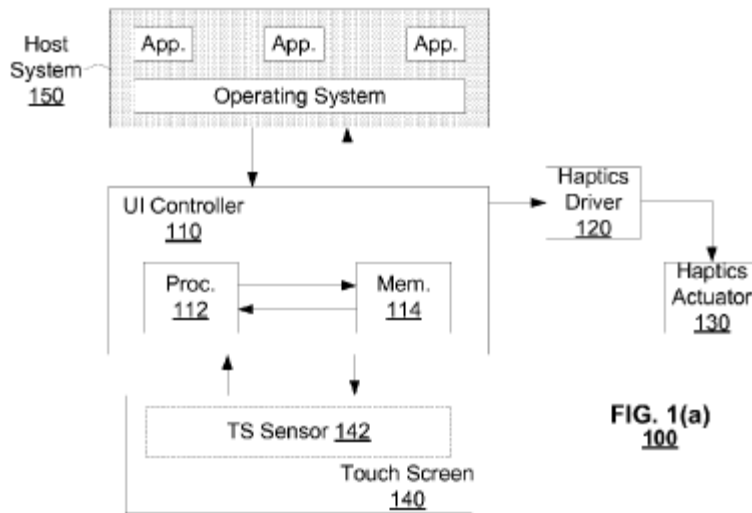
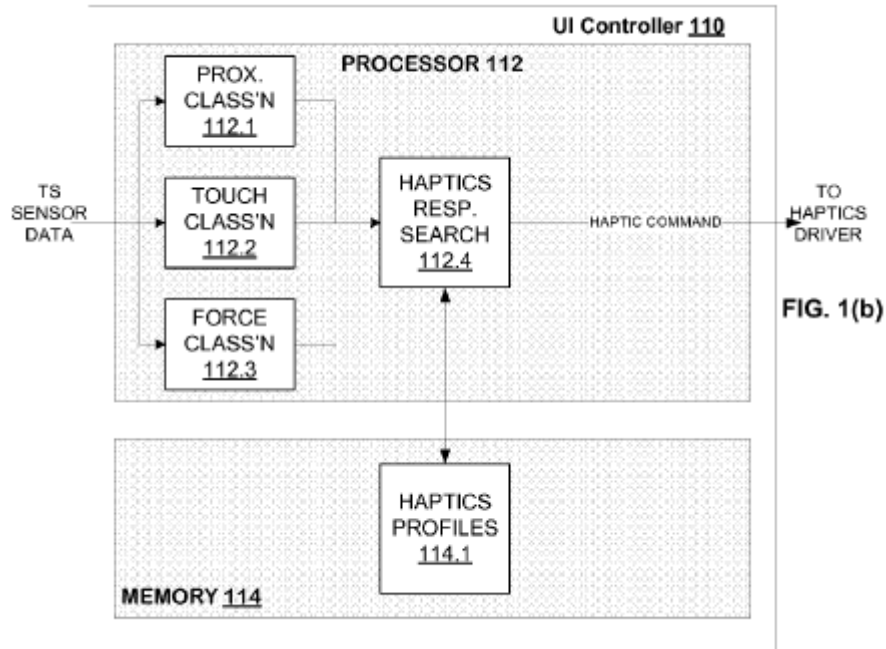


FIG. 1(a)
100

80. According to Pratt, haptic generation (via haptics driver 120 and haptics actuator 130) can “be linked to these proximity, touch, and/or force events” to improve “efficiency and precision.” *Id.*, [0015]-[0016]. In particular, “haptic generation may be dynamically changed and/or adjusted based on detected proximity, touch, and/or force events.” *Id.*, [0016].

81. I reproduced FIG. 1(b) of Pratt below. It shows a block diagram of UI controller 110 that includes a processor 112. *Id.*, [0020]. Processor 112 incorporates “haptic response search module 112.4,” which “may receive proximity, touch, and/or force events as calculated by the modules 112.1-112.3, and may generate a haptic command based on” that data. *Id.*, [0024].



82. Pratt’s mobile device can generate haptic effects “based on proximity, touch, and/or force detection.” *Id.*, [0002]. One example of such haptic effects is a “click” effect—also known as a “bubble” effect—to simulate the feel of a pressing a button as the user’s finger touches the screen. *Id.*, [0049]-[0050].

83. In the bubble effect example, Pratt discloses that the effect is generated only if Pratt’s capacitive-based touchscreen (TS) sensor 142 outputs both a proximity signal (as the user’s finger approaches the screen) **and** a touch signal (once the finger makes contact). *Id.*, [0049]-[0050]; *see also id.*, [0002]; [0021]-[0023].

84. The bubble effect is one of multiple different applications—in other words, various different use scenarios—that Pratt discloses using both proximity and touch signals together to generate a single haptic effect. In this respect, Pratt is

significantly different from the Choe prior art considered by the USPTO during prosecution. As I discussed in Section IV.C above, the USPTO determined that Choe disclosed two *distinct* haptic effects—one based on a proximity signal and the other based on a touch signal. By contrast, Pratt describes two different ways (i.e., two different embodiments) in which Pratt outputs a single haptic effect at a particular time if and only if Pratt’s processor receives both a proximity signal *and* a touch signal. For example, Pratt discloses a bubble effect in which both proximity and touch signals are based upon to generate a single haptic effect, which is then output based on the “haptic command” sent from Pratt’s processor. I address these various disclosures concerning these two different embodiments below.

2. Claim 1

a. [1PRE]: “A device comprising:”

85. Pratt meets [1PRE]. Pratt repeatedly describes its invention as a “device.” For example, paragraphs 14 and 15 refer to “a device including a haptic driver,” which may be “embodied as a consumer electronic device such as a cell phone.” *Id.*, [0014]-[0015]. Pratt’s claims 1-8 also expressly recite a “device.”

b. [1A]: “a proximity sensor capable of detecting a non-contact interaction with a touch-sensitive device and outputting a first sensor signal;”

86. Pratt meets [1A].

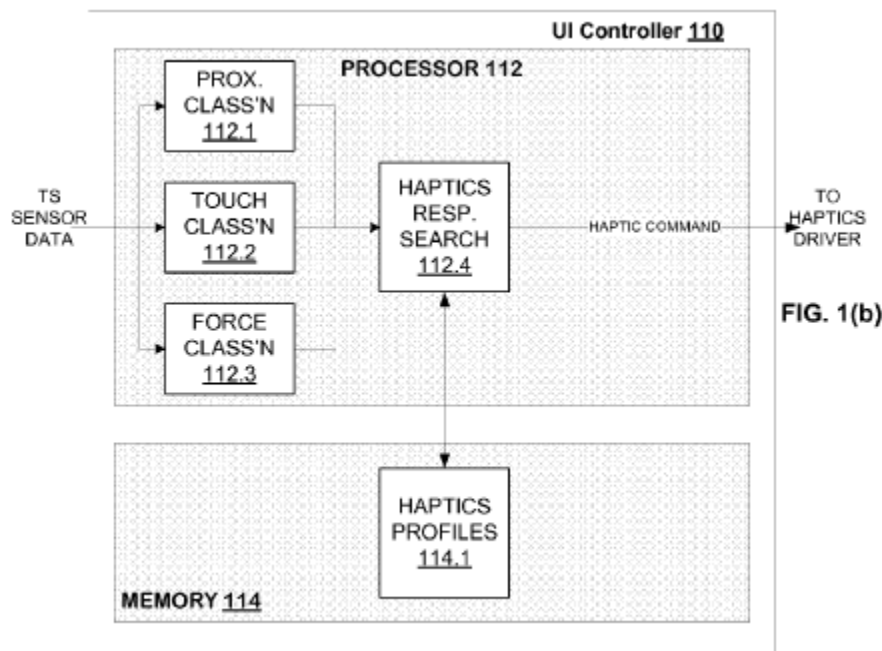
87. Initially, Pratt discloses a proximity sensor—in particular “TS Sensor 142” incorporated within touch screen 140. *Id.*, [0015]. Pratt’s touch screen 140 is sensitive to touch, as the TS Sensor in the touch screen also detects touch interactions (e.g. “user touch(es) on the touch screen 140 and the touch(es) characteristics”). *Id.*, [0022]. Therefore, a POSA would understand the touch screen is a “touch-sensitive device.”

88. A POSA would regard TS Sensor 142 as a “proximity sensor” because it is a sensor that may “detect user interaction with the touch screen within a predetermined range above the touch screen,” namely within a proximity of the touch screen. *Id.*, [0014]-[0015]. A POSA would also come to this conclusion (i.e., that TS Sensor 142 is a proximity sensor) given Pratt’s references “TS sensor results” and “proximity sensor results” in the same context. For example, Pratt discloses that “the TS sensor results” allow UI controller 112 to “calculate proximity...user interaction events” (*id.*, [0016]) and that Pratt’s device can determine a user’s finger’s “coordinates based on the proximity sensor results” (*id.*, [0043]).

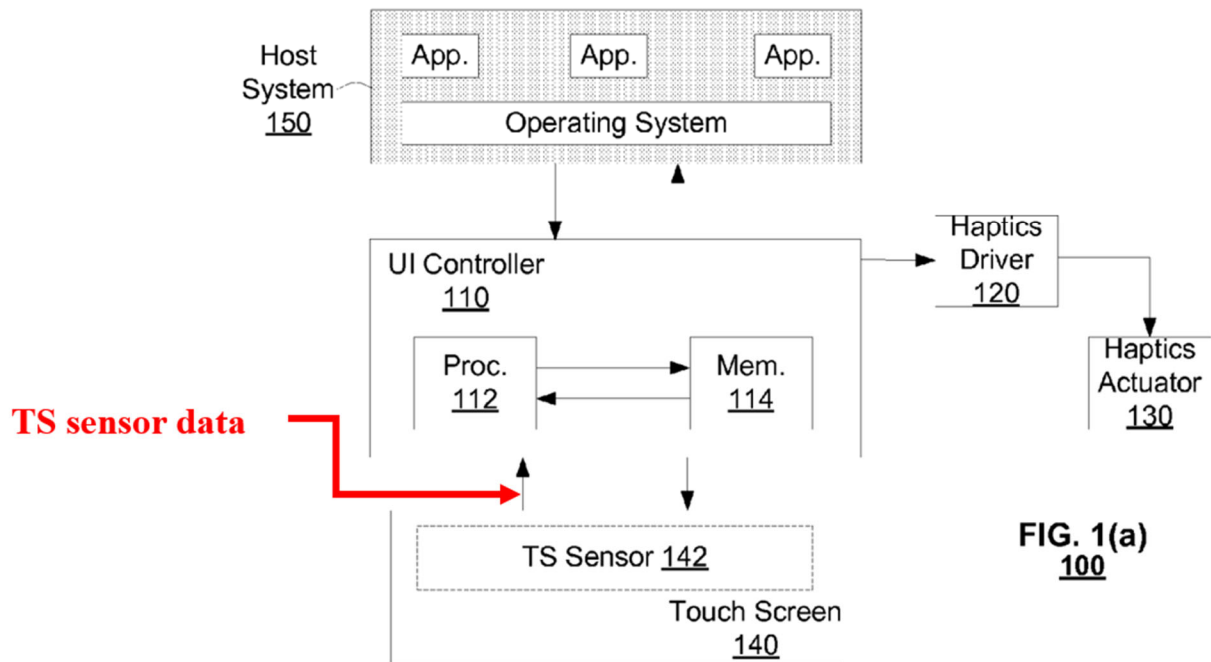
89. As another example, when describing a series of sensors 220 for tracking user interactions with the screen as a whole, Pratt notes that each of these “capacitive sensors 220 may detect proximity events.” *Id.*, [0032]. Furthermore, Pratt’s TS Sensor 142 may be provided as a “grid of capacitive sensors,” as

illustrated in Figure 2. *Id.*, [0022], [0029—[0031]. These “capacitive sensors 220 may detect proximity events.” *Id.*, [0032]. In other words, TS Sensor 143 may take the form of a sensor grid detecting proximity events. I note that the ’738 patent likewise refers interchangeably to “sensor 132” and “one or more proximity sensors 132.” EX1001, 4:62-64; *see also* 5:8-11 (“In some embodiments, the processor 102 may be in communication with a single sensor 132 and, in other embodiments, the processor 102 may be in communication with a plurality of sensors 132.”).

90. In addition, FIG. 1(b), which I have reproduced below, illustrates how “TS sensor data” is received by Pratt’s processor 112—including “proximity classification module 112.1.” EX1006, [0020].



91. A POSA would understand that Pratt's TS sensor data is received from its TS sensor. In other words, the TS sensor is capable of outputting the TS sensor data. I have annotated FIG. 1(a), reproduced below, to illustrate the TS sensor data outputted from the TS sensor:



92. This “TS sensor data” (which Pratt also interchangeably refers to as “TS sensor results,” *see e.g.* EX1006, [0016], [0025]) includes a sensor signal output by the TS sensor. The ordinary meaning of “signal” is “intelligence, message, or effect to be conveyed over a communication system.” EX1029, 1929. A POSA would therefore understand that Pratt's TS sensor data includes a sensor signal because it includes a message conveyed from the TS sensor such that “[t]he proximity classification module 112.1 may calculate user proximity [] based on proximity associated TS sensor data.” EX1006, [0021]. The understanding that

sensor data includes a sensor “signal” is also consistent with the ‘738 patent’s disclosure that:

The proximity sensor 132 may be a capacitance sensor that senses a change in capacitance as the user’s finger approaches the sensor. The proximity sensor next transmits a proximity sensor signal to the processor 102.

EX1001, 10:33-36. Particularly given the word “next,” a POSA would understand that the signal sent from the proximity sensor to the processor may be in the form of capacitance values.

93. Just like the sensor signal described in the ‘738 patent, Pratt’s TS sensor data (when used for proximity detection) also reflects capacitance, which Pratt’s processor (as discussed in more detail further below) can use to determine the distance of a finger from the TS sensor. For example, I have noted above Pratt’s disclosure that TS Sensor 142 may be provided as a “grid of capacitive sensors.” Pratt’s capacitive sensors 220 include cross points, or CS, each of which can “generate a bit code result” reflecting “a change from normal (i.e., without user presence”). EX1006, [0033]. I reproduced Figure 2(c) below, which illustrates a scenario when Pratt’s capacitive sensors are in use for “proximity detection.” *Id.*, [0034]. Figure 2(c) shows that when a finger hovers above CS 1.1, it causes C.S. 1.1 to “detect a larger presence in its capacitive field as compared to [the]

neighboring CS 1.2”—yielding a higher code change. *Id.*, [0034]; EX1001, 2:54-63.

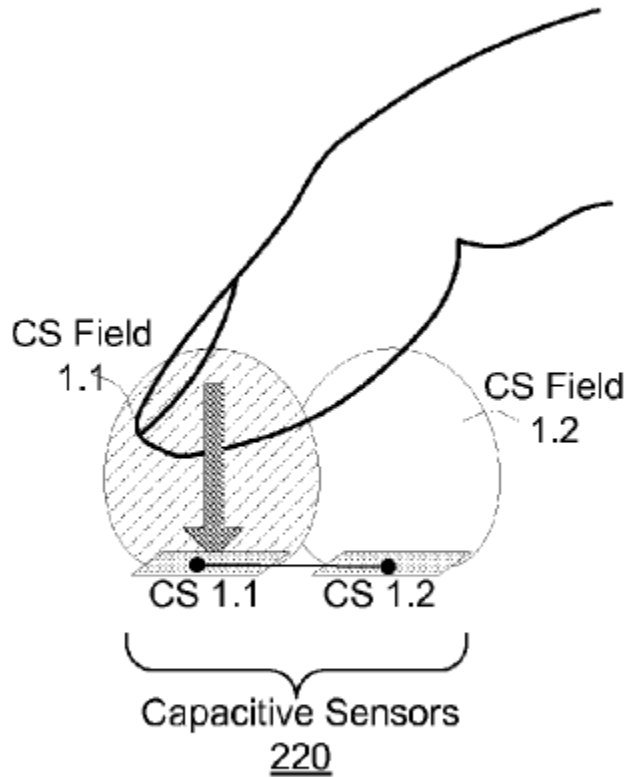


FIG. 2(c)

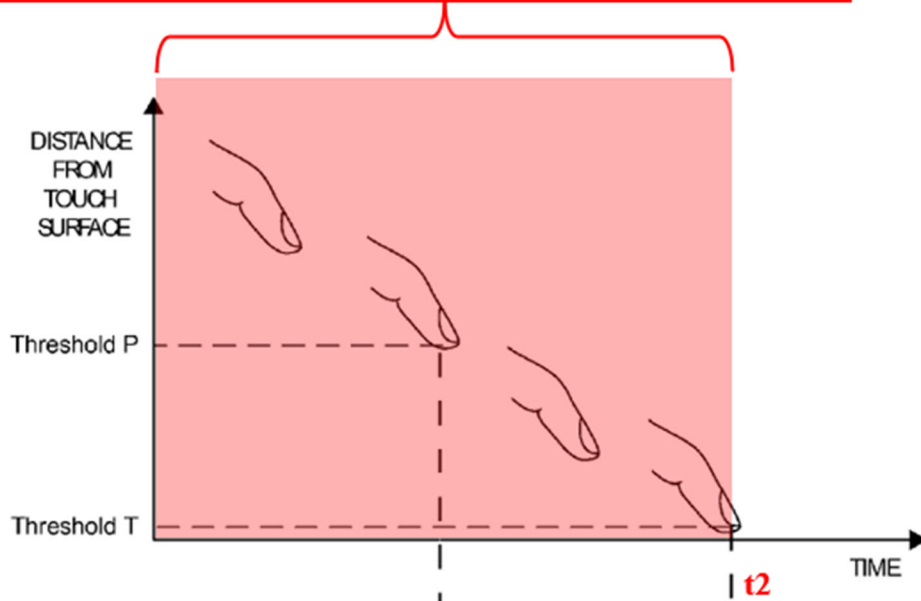
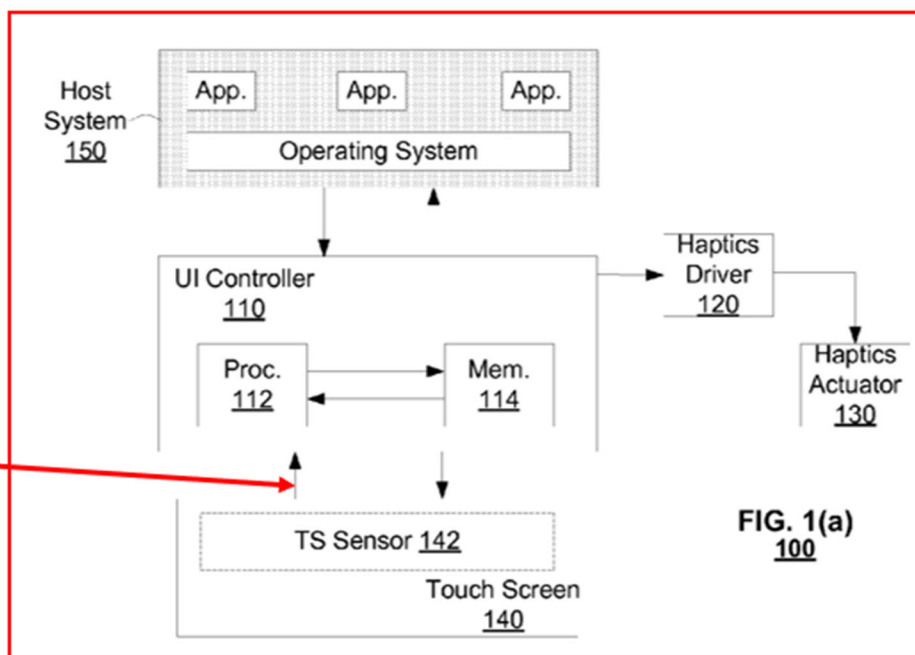
In other words, Pratt’s proximity sensor (i.e., TS Sensor 142, which may take the form of Capacitive Sensors 220), obtains data in the form of capacitance values, which constitute a sensor signal.

94. Pratt’s sensor data when the sensor is used for proximity detection, or as Pratt sometimes refers to as “proximity associated TS sensor data,” EX1006,

[0021] or “proximity sensor results,” *id.*, [0043], is the “first sensor signal” as claimed.

95. A POSA would also understand that Pratt’s TS sensor is capable of detecting a non-contact interaction with the touch screen, because the TS sensor provides TS sensor data (in the form of capacitance values) “before contact is made.” *Id.*, [0021]. In the diagram below, I have annotated Pratt’s FIG. 1(a) and the upper panel of Fig. 4 which a POSA would understand illustrates an exemplary non-contact interaction before the finger depicted in Figure 4 “mak[es] contact with the touch surface” at time t2. *Id.*, [0039]. In this example, the “proximity associated TS sensor data” outputted by TS sensor when there is a non-contact interaction before t2 is a “first sensor signal” as claimed. *Id.*, [0021].

**Proximity
associated TS
sensor data**



96. In view of the above, in my opinion Pratt's device includes a "a proximity sensor capable of detecting a non-contact interaction with a touch-sensitive device and outputting a first sensor signal," as claimed.

c. [1B]: “a touch sensor capable of detecting a touch with the touch-sensitive input device and outputting a second sensor signal”

97. Pratt meets [1B] as Pratt’s device includes a “touch sensor capable of detecting a touch with the touch-sensitive input device and outputting a second sensor signal.” As explained in detail below, Pratt’s TS Sensor 142 (i.e., the same sensor discussed above in connection with [1A] and the “proximity sensor” requirement) also constitutes a “touch sensor” capable of detecting a touch with the touch-sensitive input device and outputting a second sensor signal. Pratt’s disclosure indeed parallels the ’738 patent’s disclosure that the “touch sensor” and “proximity sensor” may be “integrated.” EX1001, 11:22-23; *see also id.*, 7:33-45 (noting that “touch sensor” and “proximity sensor” may be “combined into a single component”). Moreover, and as noted further below, I understand that using the terms “first” and “second” is a common convention in patent claim drafting to distinguish between repeated instances of an element or limitation.

98. Pratt’s “touch screen (TS) sensor 142” is incorporated within touch screen 140 (EX1006, [0015]), and touch screen 140 constitutes a touch-sensitive input device for the reasons I discussed in the preceding section and also the additional disclosures discussed here. A POSA would understand that the TS sensor 142 constitutes a “touch sensor,” as Pratt discloses that “the TS sensor results” allow UI controller 112 to “calculate...touch...user interaction events”

with the touch screen. *Id.*, [0014]-[0016]. This is also confirmed by Pratt's description of TS sensor as a "capacitive sensor" for "detecting touch events." *Id.*, [0022]. These "touch events" include "user touch(es) on the touch screen," *Id.*, [0022]. As another example, when describing a series of sensors 220 for tracking user interactions with the screen as a whole, Pratt says that each of these "capacitive sensors 220 may detect [] touch events." *Id.*, [0032].

99. I already explained above (in connection with [1A]) that Pratt's touch screen 140 is a "touch-sensitive device." While [1B] refers to "the touch-sensitive input device" rather than simply a "touch-sensitive device," a POSA would understand the extra word "input" reflects a typographical error and that the phrase refers to the "touch-sensitive device" recited in [1A] and throughout other claims. I note that the originally-filed claims 1 and 2 (i.e., in the patent application the inventors filed with the USPTO) recite "the touch-sensitive input device." EX1002, 21. In a first office action, the examiner noted the discrepancy of the use of "the touch-sensitive input device" with "a touch-sensitive device" in claim 1. *Id.*, 53. In response, applicants amended claim 1 to remove the word "input" from "touch-sensitive input device." *Id.*, 155. The Patent Office promptly acknowledged this amendment. *Id.*, 172. After this amendment, I cannot find any re-appearance of "the touch-sensitive input device" in claim 1 throughout the prosecution history including in the last amendment filed after the notice of

allowance and entered by the examiner. *Id.*, 183, 1041, 1106, . Based on the prosecution history, it would be apparent to a POSA that the appearance of the extra word “input” in “the touch-sensitive input device” in claim 1 is a typographical error when the ‘738 patent was issued.

100. Accordingly, Pratt’s TS sensor is a touch sensor capable of detecting a touch with a touch-sensitive input device (i.e., the touch-sensitive device recited in [1A]).

101. When Pratt’s capacitive sensors are for “touch detection,” Pratt discloses that the “sensor results” enable determination of “X,Y coordinates and the time of the touches,” EX1006, [0035]. In another example, when “the device may detect the finger touching the touch surface,” Pratt describes “generating X,Y coordinates based on the touch sensor results.” *Id.*, [0044]. I have explained above that Pratt’s sensor data or sensor result constitutes a sensor signal. Pratt’s sensor results when the sensor is used for touch detection, or the “touch sensor results,” is therefore the “second sensor signal” as claimed. A POSA would understand that Pratt’s “touch sensor results” are touch associated TS sensor data. In the diagram below, I have annotated Pratt’s FIG. 1(a) and the upper panel of Fig. 4 which a POSA would understand illustrates an exemplary touch at or after time t2. *Id.*, [0039]. In this example, the “touch associated TS sensor data”

outputted by TS sensor when a finger is touching at or after t_2 is a “second sensor signal” as claimed. *Id.*, [0044].

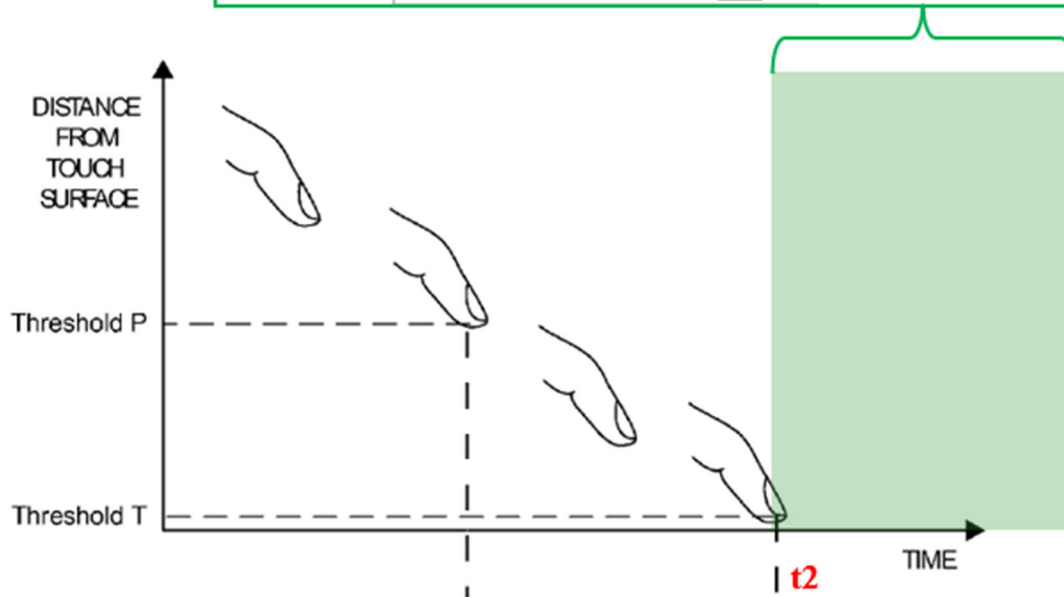
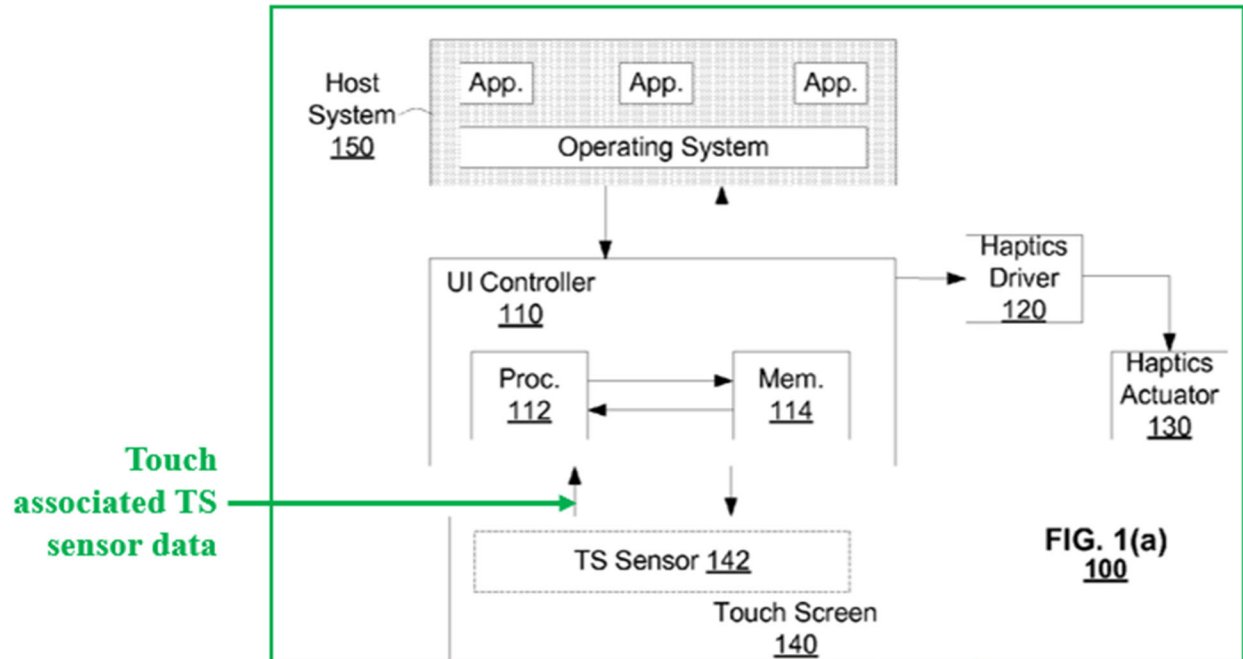


Fig. 4 (upper panel)

In the above example, data and the corresponding signal reflecting the touch at time t_2 is generated during a different (i.e., later in time) scan of the capacitive

sensors 220 than the data and corresponding signal reflecting the finger's proximity to the screen at an earlier time. *Id.*, [0032] (noting that “capacitive sensors 220 may be scanned at a scanning frequency,” such as 100 or 120 Hz—in other words, 100 or 120 times per second—and further that the “scanning frequency may increase as the rate of approach increases”).

102. As noted above, I understand that using the terms “first” and “second” is a common convention in patent claim drafting to distinguish between repeated instances of an element or limitation. Under that understanding, the initial scan (at threshold P, before time t₂) constitutes a first scan generating a “first signal” and the subsequent scan (at threshold T, at time₂) constitutes a second scan generating a second signal. The first signal (i.e., the “proximity sensor results”) allows for generation of “X, Y, Z coordinates” (*id.*, [0043]), while the second signal (i.e., the “touch sensor results”) allows for generation of only “X,Y coordinates” because Z = 0 (*id.*, [0044]). While both scans may themselves generate data in the same format (e.g., “a 14 bit result” reflecting capacitance values, *id.*, [0033]), the results still constitute a “first signal” and a “second signal”) under my understanding of the above-noted convention.

103. Similarly, the '738 patent does not distinguish between the “first” and “second” signals beyond the claim language requiring that the “first” signal be associated with “a non-contact” interaction and the “second” signal from a

“touch.” For example, in the integrated capacitance sensor embodiment of the ’738 patent I noted above, the sensor transmits “a touch sensor signal” “when [it] detects a user’s finger contacting a touch-sensitive surface,” EX1001, 11:17-19, 11:24-25, or as the ’738 patent calls it “during contact [] interactions.” *Id.*, 7:44-45. It follows that the same sensor in the ’738 patent transmits a “proximity signal” at other times during “non-contact interactions.” *Id.*, 7:40-45, 11:29-32. A signal received by the processor reflecting a touch (for example, a capacitance value and related row/column address of the CS)—received by the processor separately from the signal reflecting a non-contact interaction (for example, a different capacitance value and related row/column address of the CS)—therefore constitutes a “second” signal even if it is (1) in the same format as the “first” signal reflecting the non-contact interaction and (2) derived from a repetition of the same scan that yielded that “first signal.”

104. Indeed, the ’738 Patent discloses that:

[T]he proximity sensor 132 may be a capacitance sensor that senses a change in capacitance as the user’s finger approaches the sensor. The proximity sensor next transmits a proximity sensor signal to the processor 102.... [T]ouch sensor 108 may be a capacitance sensor that senses a change in capacitance as the user’s finger touches the sensor 108. The touch sensor 108 may be integrated with the proximity

sensor 132 and/or with the haptic output device 118. The touch sensor next transmits a touch sensor signal to the processor 102.

Id., 10:32-35 & 11:20-25. As a POSA would understand from these disclosures in the context of claim 1 of the '738 patent, the "proximity sensor signal" is the "first signal" while the "touch sensor signal" is the "second signal," and both may be in the form of capacitance values (although the actual values will be different given the different positions of the finger). As a POSA would also understand, while these signals do not themselves provide the location of the user's finger, they include the data that allows the processor to determine such position. Indeed, the '738 patent discloses that "[t]he ***processor receives the sensor signal and determines*** the position of the [user's] finger." *Id.*, 3:1-2; *see also id.*, 8:2-5 ("[T]he processor 102 may receive sensor signals from the proximity sensor 132 and determine that a user's finger is near the touch sensitive surface 116."). A POSA would understand that the sensor signals need not actually include coordinates or other positional data reflecting the proximity or touch. Instead, such calculations may be performed by the processor. The "first" sensor signals need only contain data from which the processor can determine the proximity to the screen, while the "second" sensor signal need only contain data from which the processor can determine the occurrence and location of an actual touch.

105. Indeed, nothing in claim 1 or otherwise in the '738 patent requires the signals to take any particular form so long as they are generated as a consequence of the non-contact and touch interactions and include data from which a processor can determine such proximity or touch.

106. Pratt's "proximity sensor results" associated with a proximity event (i.e. a first sensor signal as I discussed in §VI.A.2.b) and "touch sensor results" associated with a touch event (i.e. a second sensor signal) are described differently in Pratt in several ways that mirror how the '738 patent describes the first and second sensor signals.

107. First, during proximity detection the '738 patent's "sensor signal...may include data that reflects [] Z component of the finger's location" (i.e., "the distance of the finger from the surface of the touch-sensitive device") when the finger is away "from the surface" (i.e., in proximity), and "may also include data that reflects [] the X and Y components of the finger's location" (i.e., "the location of the finger...in contact with the surface." EX1001, 2:54-67. Likewise, Pratt's "sensor results" include "bit code result" (i.e. data) that reflects "Z location" for "proximity detection," EX1006, [0033]–[0034], and "X,Y coordinates and the time of the touches" for "touch detection." *Id.*, [0035]. See also [0021] of Pratt (*id.*), describing "The proximity classification module 112.1 may calculate user proximity to a touch screen 140, for example before contact is made, based on

proximity associated TS sensor data,” and [0043] (“The device, consequently, may be generating X,Y,Z coordinates based on the proximity sensor results.”). The ’738 patent describes that a “processor receives the sensor signal and determines the position of the finger.” EX1001, 3:1-2. Pratt likewise uses the “classification module” in the processor 112 to “calculate corresponding proximity, touch [[event(s),” and to generate “X,Y,Z coordinates” during “proximity detection” and “X,Y coordinates” during “touch detection.” EX1006, [0020], [0034], [0035].

While it is Pratt’s processor rather than the sensor that actually generates the coordinates (much like it is the ’738 patent’s processor that “determines the position of the finger,” EX1001, 3:1-2), this does not alter my conclusion that Pratt’s TS sensor outputs a “second sensor signal” corresponding to the touch detection (as well as the “first sensor signal” discussed in Section VI.A.2.b concerning [1A] and corresponding to the non-contact interaction detection).

108. In particular, Pratt’s FIG. 1(b) illustrates how the “TS sensor data” is received by processor 112, which includes touch classification module 112.2. EX1006, [0020]. As I explained above with regards to [1A], a POSA would understand that Pratt’s TS sensor is capable of outputting the TS sensor data, which includes a sensor signal. The TS sensor data is a “second sensor signal” when it is outputted by the TS sensor in response to touch events. *Id.*, [0022].

d. [1C]: “a haptic output device configured to receive a haptic output signal and output a haptic effect in response to the haptic output signal; and”

109. Pratt’s FIG. 1(a) discloses that Pratt’s “display device” (*id.*, [0007]) includes “haptics driver 120” and “haptics actuator 130.” Pratt discloses that “the haptics driver 120 may be coupled to the haptics actuator 130.” *Id.*, [0026]. Pratt’s FIG. 1(b) shows that “haptic response module 112.4” within processor 112 sending a “haptic command” to the “haptics driver.” *Id.*, [0015]-[0020], [0026]. “Based on the haptic command,” the “haptic driver 120 may generate a corresponding drive signal” and “transmit the drive signal to the haptics actuator 130 causing it to vibrate according to the drive signal properties.” *Id.*, [0025]-[0026].

110. In my opinion Pratt meets [1C] in at least two different ways. For one, Pratt’s haptics actuator 130 itself constitutes “a haptic output device.” In addition, the haptics actuator 130 in combination with haptics driver 120 constitutes “a haptic output device.”

111. In the first way, Pratt’s actuator 130 constitutes *a haptic output device* according to [1C] because it receives the drive signal (i.e., “*a haptic output signal*”) and vibrates accordingly—indicating to a POSA that it is configured to receive a haptic output signal and output “a haptic effect.” The annotation in Pratt’s FIG. 1(a) below illustrates this “haptic output device” in Pratt.

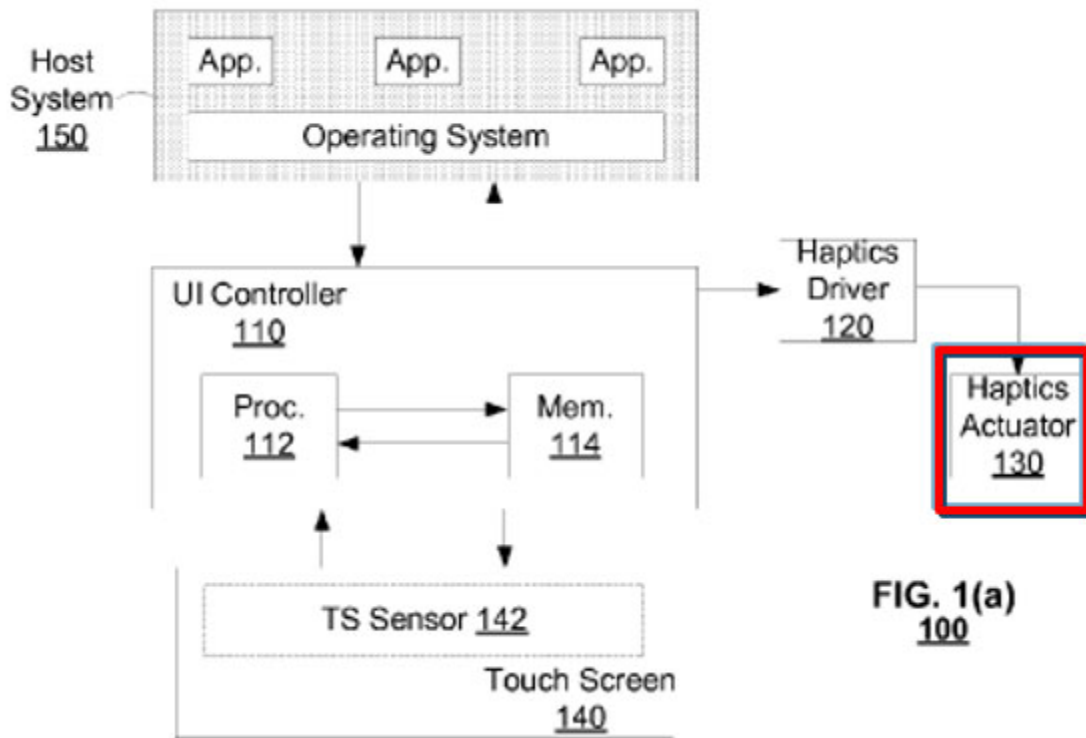


FIG. 1(a)
100

112. I also note that Pratt’s description of actuator 130 is similar to the ’738 patent’s description of the “haptic output device. Pratt describes that “actuator 130 may include a...motor that vibrates to generate the desired haptic effect.” *Id.*, [0027]. The ’738 patent similarly discloses that the “haptic output device” may comprise an “actuator” “such as an electric motor.” EX1001, 5:45-47. Pratt’s actuator 130 receives a “drive signal” from haptics driver 120 “[b]ased on the haptic command” received “from the UI controller,” which is “coupled to the driver.” EX1006, [0025]. This drive signal received by actuator 130 from driver 120 is just a translated version of Pratt’s haptic command that is received by the driver. For example, Pratt explains that its drive signal is “a corresponding

drive signal” generated by haptic driver 120 “[b]ased on the haptic command from the UI controller 110,” and the “drive signal may be an analog signal, and the drive signal may be a current or voltage signal.” *Id.*, [0025]. A POSA would understand that Pratt is describing using the driver to simply translate instructions in the haptic command which is typically in a digital form into the analog drive signals (analog current or analog voltage waveforms) to operate e.g. a motor in Pratt’s actuator 130.

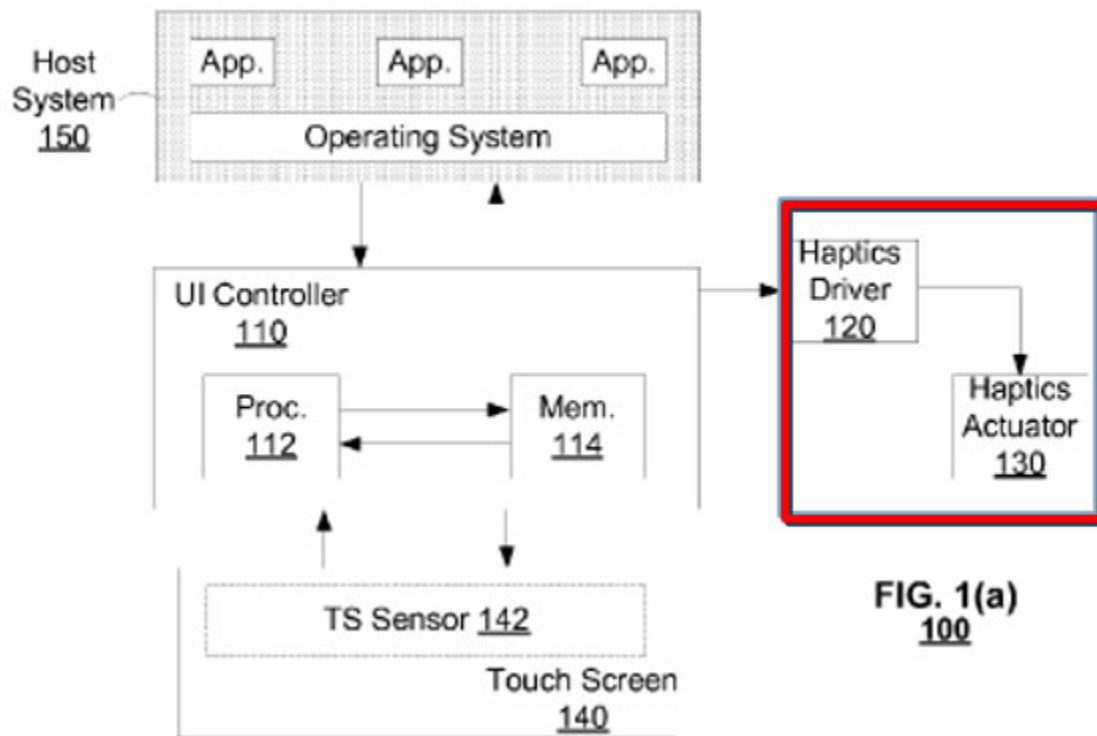
113. With respect to element [1C]’s requirement of “*a haptic output signal*,” I note that element [1F]—which I discuss in Section VI.A.2.g below—uses this same phrase (“generate *a haptic output signal*”) when describing the required functionality of the claimed “processor” in element [1D]. I also note that element [1G]—which I discuss in Section VI.A.2.h below—likewise requires the processor be configured to “translate the haptic output signal to the haptic output device.” Based on this consistent usage, a POSA would understand that [1G] concerns transmitting the “haptic output signal” generated in [1F] to be received by the haptic output device recited in [1C]. In other words, a POSA would understand that the “haptic output signal” generated by “a processor” in [1F] is received by the haptic output device recited in [1C].

114. In the context of claim 1 and the ’738 patent as a whole, a POSA would also understand that while the “haptic output signal” may be received by the

haptic output device directly from the processor, the claim also encompasses configurations in which the haptic output device (e.g., Pratt’s actuator 130) receives the signal via some other component—such as haptic driver 120 in the case of Pratt. Nothing in claim 1 or otherwise in the ’738 patent’s specification requires that the haptic output signal be sent “directly” from the processor to the haptic output device (i.e., without any translation or passing through other components). In fact, it would be well known and routine for a POSA to apply transformations and / or conditioning of signals from processors before sending the transformed and / or conditioned signals to such output devices. Moreover, in the particular context of Pratt, a POSA would also understand Pratt’s “corresponding drive signal” (sent from the haptics drive 120 to the haptics actuator 130 when the haptics driver 120 receives the “haptic command” from Pratt’s processor) is a representation of the “haptic command,” e.g. an analog signal translated from a digital haptic command which the haptics actuator receives from the UI controller. EX1006, [0025].

115. In a second way Pratt meets [1C], Pratt’s haptics driver 120 and haptics actuator 130 together constitute “a haptic output device” that receives “a haptic output signal” (i.e., Pratt’s “haptic command,” *Id.*, [0025]) from Pratt’s processor (i.e., Pratt’s UI controller, as I discuss in §VI.A.2.e) and outputs “a

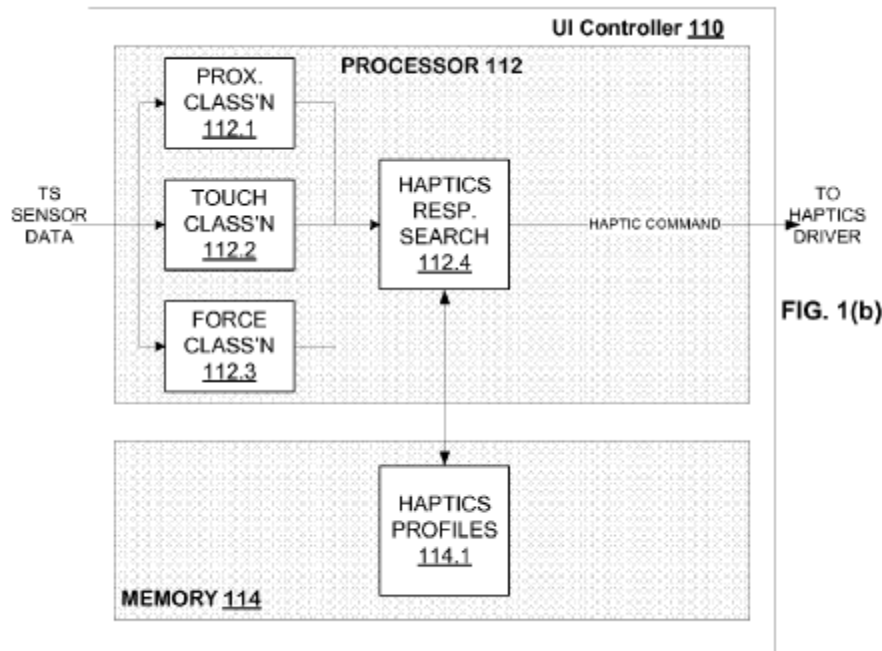
haptic effect” such as vibration generated by actuator 130 (EX1006, [0026]). The annotation in Pratt’s FIG. 1(a) below illustrates this “haptic output device” in Pratt.



116. A POSA would understand that the term “device” ordinarily can mean something that includes multiple hardware modules. Nothing in the ’738 patent that limits the haptic output device to any particular form or otherwise limits it to a single component. Accordingly, the combination of driver 120 and actuator 130 receives the “haptic command” and accordingly outputs a haptic effect, such as causing the actuator to vibrate.

117. I have reproduced FIG. 1(b) below, which shows that “haptic response module 112.4” within processor 112 sends a “haptic command” to the “haptics

driver.” *Id.*, [0015]-[0020]. Initially, as I explained above with regards to [1A], a command means a message conveyed over a communication system, which a POSA would understand is a “signal.” In the context of Pratt’s disclosure, a POSA would understand that the “haptic command” is a control signal that is output by the processor that contains information about high level parameters (e.g. magnitude, frequency, and/or duration) of a haptic profile. This is consistent with other teachings such as those in Grant (EX1023) and Gregorio (EX1024). For example, Grant is directed to a method of generating a haptic effect in response to a presence detection from a proximity sensor. Grant, Abstract. Grant discloses a processor that “*outputs the control signals* to drive circuit 16 ... to cause the desired haptic effects” “based on high level parameters” that “define a particular haptic effect,” which include “magnitude, frequency and duration.” EX1023, [0015]-[0016] (emphasis added); *see also* EX1024, [0014]-[0015]. Therefore, a POSA would understand Pratt’s “haptic command” constitutes “a haptic output signal” received by the “haptic output device.”



118. Pratt further discloses that “[b]ased on the haptic command,” the “the haptic driver 120 may generate a corresponding drive signal” and “transmit the drive signal to the haptics actuator 130 causing it to vibrate according to the drive signal properties.” EX1006, [0025]-[0026]. This vibration constitutes “a haptic effect in response.”

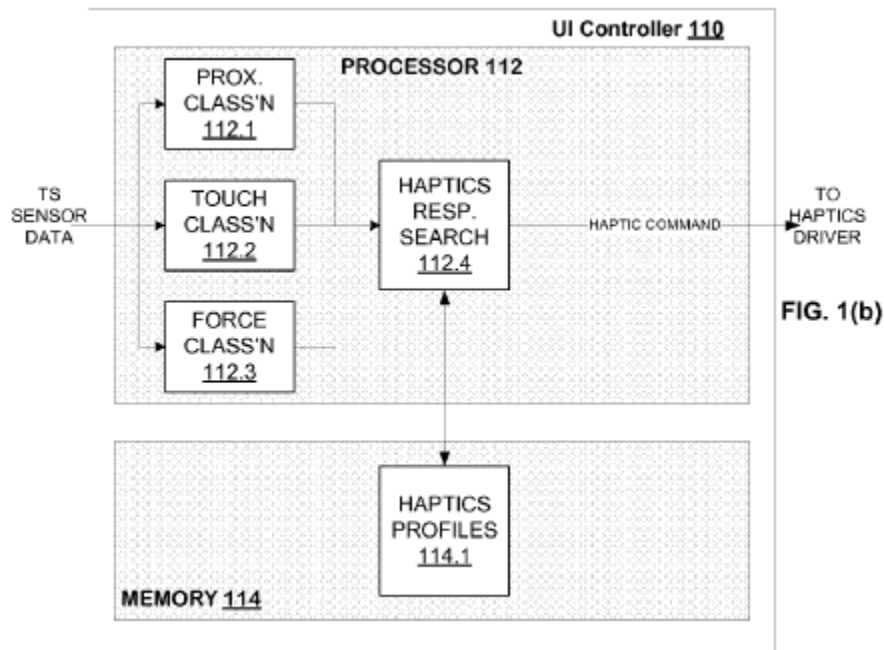
e. [1D]: “a processor configured to:”

119. Pratt discloses a processor. For example, FIG. 1(b) of Pratt illustrates a “processor 112” within UI controller 110. *Id.*, [0020]. See also [0017] (describing that “UI controller 110 may include the processor 112.”). FIG. 1(a) shows the same. *Id.*, [0015]. Pratt meets [1D] as Pratt’s processor 112 is “a processor configured to” perform the rest of the claim elements [1E]-[1G]. I will

explain each of these elements (concerning the functions claim 1 requires the processor to be configured to perform) below.

f. [1E]: “receive the first sensor signal and the second sensor signal”

120. Pratt’s processor 112 is configured to “receive the first sensor signal” from the proximity sensor and the “second sensor signal” from the touch sensor as claimed. I have reproduced FIG. 1(b) below, which illustrates that the “TS sensor data” is received by processor 112 (including proximity classification module 112.1 and touch classification module 112.2). The “TS sensor data” includes both the proximity-related first sensor signal and the touch-related second sensor signal.



121. As I explained above in Section VI.A.2.b, processor 112 receives “proximity sensor results” or “proximity associated TS sensor data” output by the proximity sensor, which is the “first sensor signal” as claimed. This sensor signal may be received “before contact is made.” EX1006, [0021]. In the example scenario of Pratt’s “proximity detection” shown in FIG. 2(c), the proximity “sensor results” received by processor 112 includes at least a “code change of CS 1.1” when CS 1.1 “detect[s] a larger presence in its capacitive field as compared to it’s neighboring CS 1.2.” *Id.*, [0034]. A POSA would understand that in the time frame as shown in FIG. 2(c), i.e. when a finger hovers above CS 1.1, the TS sensor data received by processor 112 includes at least a “code change” from CS 1.1 that reflects the distance of the user’s finger from CS 1.1, and the “first sensor signal” received by processor 112 would include this code change of CS 1.1 (along with code changes at other CSs that detected the presence of a hovering finger in the scenario as shown in FIG. 2(c)). In fact, Pratt describes multiple scenarios when a user’s finger approaches but does not touch any location (or any CS) of the touch screen. For example, FIG. 3(b) illustrates a time t1 in which “the user’s finger is a certain distance above the workspace 310,” and time t2 in which “the user finger may be slightly above the button 330.” *Id.*, [0037]. Similarly, FIG. 4 illustrates a time t1 when “the finger [is] at a predetermined distance [] from the touch surface.” *Id.*, [0038]-[0039]. A POSA would understand that TS sensor data

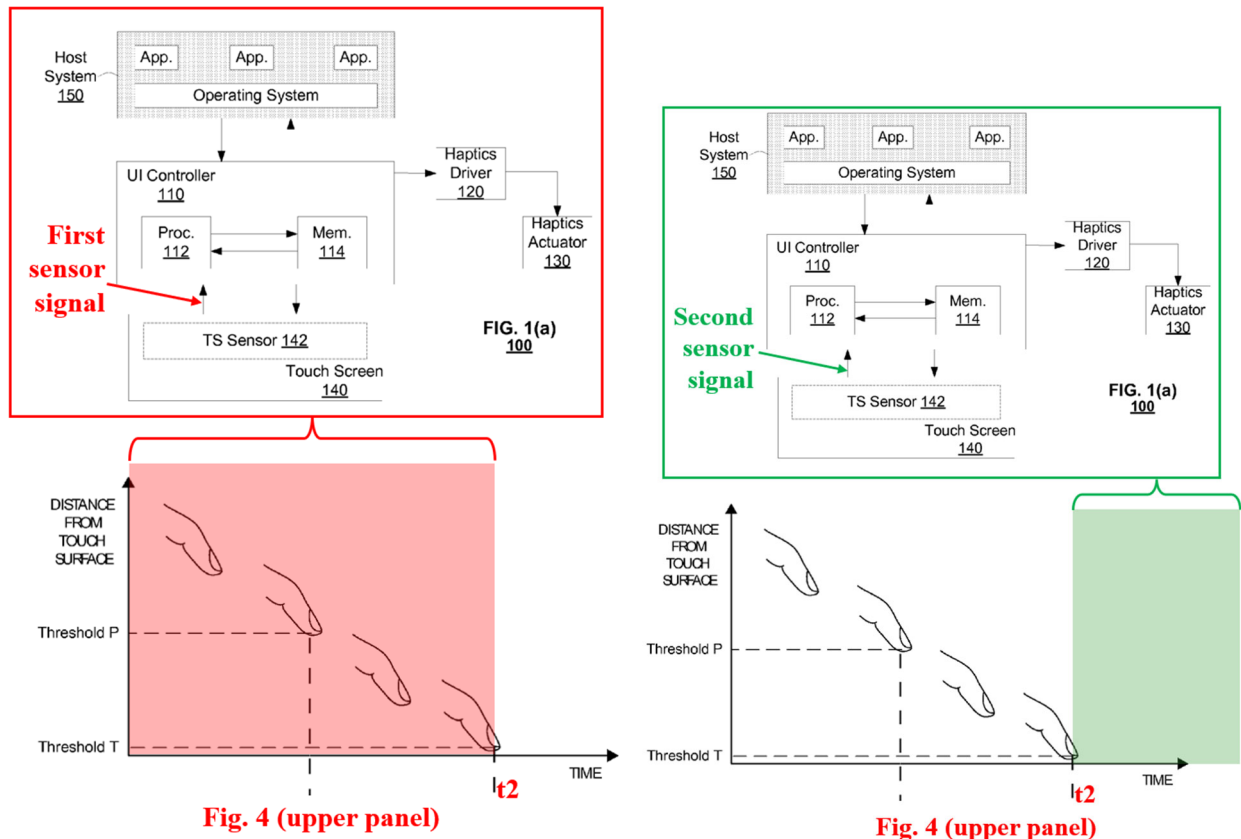
received by processor 112 during these time frames comprise the “first sensor signal” outputted by the proximity sensor.

122. As I explained above in Section VI.A.2.c concerning [1B], processor 112 receives “touch sensor results” output by the touch sensor, which is the “second sensor signal” as claimed. This may be, for example, when the TS sensor data is outputted in response to the “user touch[ing] on the touch screen” or the user’s “finger touching the touch surface.” EX1006, [0020]-[0022], [0044]. A POSA would understand that in the time frame after a finger comes into contact with one or more Pratt’s touch sensor, for example at or shortly after time t3 as shown in FIG. 3(b) when the user finger “touch[es] the screen at button 320,” *Id.*, [0037], the TS sensor data received by processor 112 includes at least “sensor results” that reflect a touch with the CS associated with the location of button 320 in FIG. 3(b). *Id.*, [0035]. FIG. 4 illustrates another example of a time t2 when “the device may detect the finger making contact with the touch surface.” *Id.*, [0039]. A POSA would understand that TS sensor data received by processor 112 during these time frames comprise the “second sensor signal” outputted by the touch sensor.

123. Furthermore, Pratt explains that when its “capacitive sensors” are used to detect proximity events and touch events, the sensors “may be scanned at a scanning frequency” of e.g. 100 Hz and that “a bit code result” is generated “[i]n a

scan.” *Id.*, [0032], [0033]. A scanning frequency of 100 Hz means that a new scan will be performed about 10 milliseconds after the previous scan. This typically means for each CS in the grid of CSs in Pratt’s capacitive sensors (such as CS 1.1 shown in FIG. 3(b)), the sensor result is outputted serially, that is, Pratt’s TS sensor data includes a stream of sensor result for a particular location from the capacitive sensor CS at that location that is sampled at different points in time. For one CS (while Pratt would repeat the sampling for all the CS in the array of capacitive sensors), there cannot be simultaneous touch and non-touch or proximity events because a touch by definition is different from a non-touch interaction. Put another way, a given interaction with a screen is either touch or non-touch; it could not be both simultaneously. Therefore, for one CS, Pratt’s processor receives the touch-related signal at a different time from the proximity-related signal, e.g. during different repetitions of the “scan,” with the signal received during touch being a “second” sensor signal, and the signal received during non-touch a “first” sensor signal. *Id.*, [0032], [0033]. The difference between such “first” and “second” sensor signal associated with this CS is based on the physical reality of the user’s finger being in contact or in proximity (but not in contact) with the portion of the touch screen where this CS is located. In the diagrams below (which I have discussed above in relation to limitations [1A] and [1B]) I have annotated the first sensor signal and second signal in Pratt as one example. Indeed, as I noted in

paragraph 102, I understand that using the terms “first” and “second” is a common convention in patent claim drafting to distinguish between repeated instances of an element or limitation.



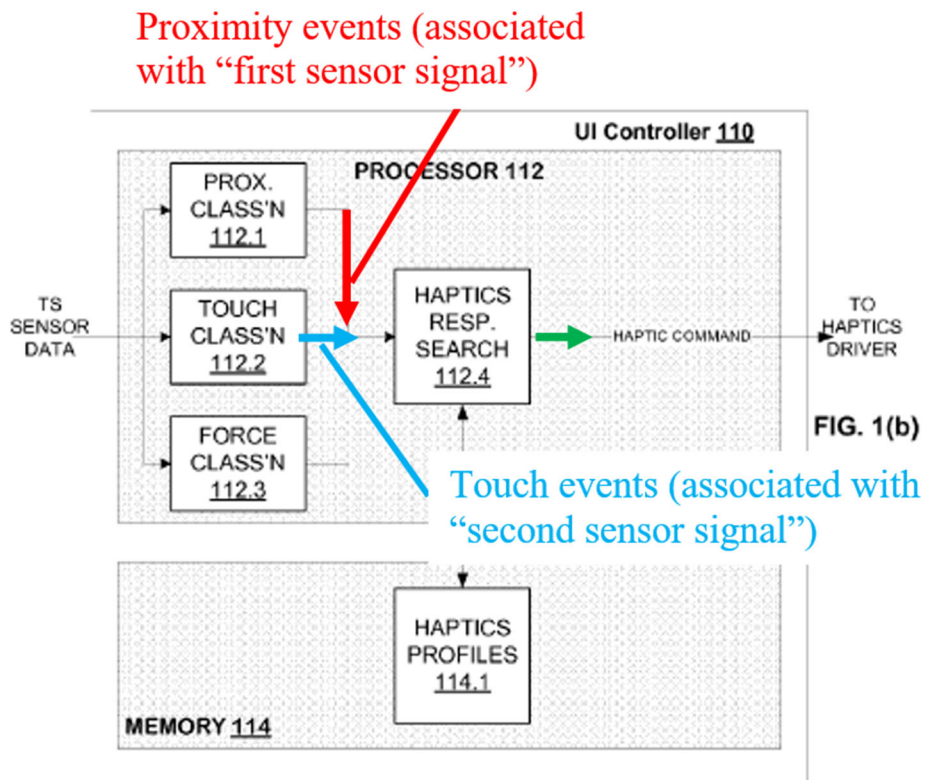
g. [1F]: “generate a haptic output signal based at least in part on the first and second sensor signals; and

124. Pratt’s processor 112 is configured to “generate a haptic output signal based at least in part on the first and second sensor signals” as claimed. As discussed in connection with Section VII.A.2.d concerning [1C], a POSA would understand that the “haptic output signal” generated in [1F] concerns the same “haptic output signal” referenced in [1C] (reciting “a haptic output signal” be received by “a haptic output device”).

125. As I explained in Section VI.A.2.d above, the “haptic command” shown in Pratt’s FIG. 1(b) constitutes a “haptic output signal” as claimed. Pratt teaches that the haptic command is generated by processor 112. For example, FIG. 1(b) illustrates a “haptics response search module 112.4” within processor 112 that generates a single “haptic command.” EX1006, [0024].

126. According to Pratt, haptics response search module 112.4 “may receive proximity, touch, and/or force events as calculated by the modules 112.1-112.3, and may generate a haptic command.” *Id.*, [0024]. I have already explained in Section VI.A.2.b that “proximity . . . user interaction events” calculated by proximity classification module 112.1 are associated with “a first sensor signal” outputted by the TS sensor, and in Section VI.A.2.c that “touch events” calculated by touch classification module 112.2 are associated with “a second sensor signal” outputted by the TS sensor. A POSA would therefore understand that FIG. 1(b) illustrates haptics response search module 112.4 in communication with both proximity and touch classification modules 112.1 and 112.2 to process the first and second sensor signals, respectively.

127. I have annotated FIG. 1(b) below to represent how the haptics response search module 112.4 generates a single “haptic command,” and processes the first and second sensor signals.



128. Pratt further describes how the “haptic command” is generated based on the first and second sensor signals.

129. Pratt describes a UI controller 110 that includes processor 112, which “control[s] the operations of the UI controller.” EX1006, [0016]-[0017]. UI controller 110 “may calculate proximity, touch, and/or force user interaction events,” and link “[h]aptic generation...to these proximity, touch, and/or force events.” *Id.*

130. Pratt also describes that “haptic response search module 112.4 may receive proximity, touch, and/or force events as calculated by the modules 112.1-112.3, and may generate a haptic command based on the haptics profile data

114.1,” which is stored in memory 114 linked to the processor 112. *Id.*, [0020], [0024]. Specifically, Pratt’s haptics profiles data 114.1 “may be stored as look-up-tables (LUTs).” *Id.*, [0020]. I note that Pratt’s implementation using LUTs to generate a haptic command parallels the ’738 patent, which teaches “lookup tables usable by the processor 102 to determine a haptic effect.” EX1001, 7:62-65.

131. In particular, Pratt’s haptics response search module “may match the calculated proximity, touch, and/or force event data to a stored haptic profile and may generate a haptic command associated with the matched haptic profile.” EX1006, [0024]. Pratt also describes that “different types of haptic events may be selected based in part on proximity, touch, and/or force events.” *Id.*, [0042].

132. In my opinion, a POSA would understand based on these teachings in Pratt that Pratt’s device is configured to determine a haptic command (i.e., “*the haptic output signal*”) based in part on a proximity event (the “first” sensor signal) and also in part on a touch event (the “second” signal).

133. More specifically, it is my opinion that in at least two separate and independent embodiments, Pratt discloses a “haptic output signal” that is based on both proximity and touch-related inputs as [1F] requires. Alternatively, and at minimum, such a single haptic output signal would have been obvious in view of at least these two embodiments.

134. The following subsections will explain the two embodiments in detail and how Pratt generates a haptic output effect at a particular time that is dependent on both the “first sensor signal” (originating from the proximity sensor) and the “second sensor signal” (originating from the touch sensor). While these signals originate based on different scans of the capacitive sensors 220 at different points in time, each of Pratt’s two embodiments below rely on both of the signals (the first generated based on the proximity of a user’s finger, the other generated based on the touch of the user’s finger) to dictate what haptic effect is generated following the touch. This is consistent with the ’738 patent, which discloses that:

The method 500 begins at step 502 when the touch sensor 108 of the computing device 101 detects a user's finger contacting a touch-sensitive surface 116. For instance, the touch sensor 108 may be a capacitance sensor that senses a change in capacitance as the user's finger touches the sensor 108. The touch sensor 108 may be integrated with the proximity sensor 132 and/or with the haptic output device 118. The touch sensor 108 next transmits a touch sensor signal to the processor 102.

The method continues at step **504**, where the touch sensor **108** generates a signal and transmits the signal to the processor **102**. At step **506** the processor **102** receives the touch sensor signal. The method **500** continues at step **508** when the processor **102** determines a haptic effect based at least in part on the touch sensor signal and on the proximity signal. For instance, the processor **102** may be

configured to output a particular haptic effect associated with a particular control on a user interface element displayed on the touch sensitive surface **116**. Such a haptic effect may further be modified or combined with another haptic effect based on the proximity sensor signal. In some embodiments, the haptic effect can include one or more haptic effects. For example, the haptic effect can include a haptic effect meant to confirm “pushing” on a virtual button.

EX1001, 11:17-40. A POSA would understand this passage to contemplate the approach of a single finger, such that the “proximity signal” is generated earlier in time than the “touch sensor signal.” Nothing in this passage or otherwise in the ’738 patent discusses alternative “multi-touch” scenarios in which one finger may be in contact with a screen while another finger is hovering above it. Notably, moreover, the passage offers the example of a haptic effect to confirm “pushing” on a virtual button, which a POSA would understand the patent describes as an example of a haptic effect based on both the proximity sensor signal and the touch sensor signal. This is analogous to Pratt’s “haptic bubble effect,” which I discuss immediately below as Pratt’s “first embodiment.”

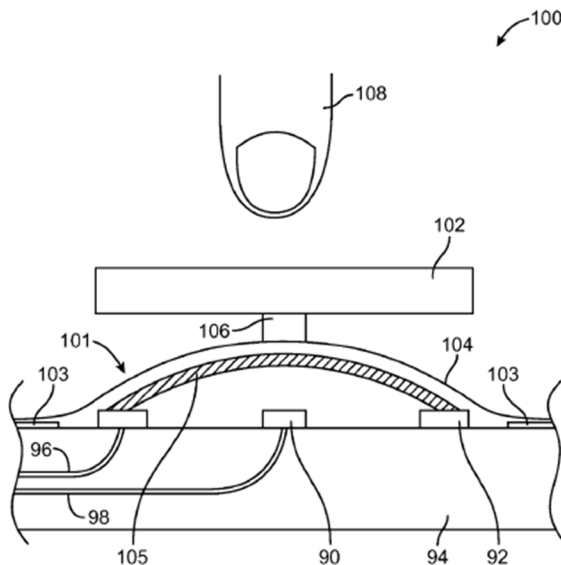
i. First embodiment

135. Pratt's FIGs. 7(a)-7(d) illustrate a "haptic bubble effect generation operation, according to an embodiment" EX1006, [0013]. Pratt describes the haptic effect in this embodiment is a "mechanical compression effect (i.e., the 'bubble' effect)." *Id.*, [0050]. The "bubble" effect "may correspond to stimulating a clicking functionality using haptic effects"—in particular, effects that "may be precharged and driven before the user touch based on proximity detection." *Id.*, [0049]. While paragraph [0049] refers to FIGs. "4(a)-4(d)," a POSA would recognize this as a typographical error given the subsequent more detailed discussion in paragraph [0050] concerning "FIG. 7(a)," "FIG. 7(b)," "FIG. 7(c)," and "FIG. 7(d)." In particular, a POSA would understand that the typographical error arose from the conversion of Pratt's provisional (U.S. Patent Application Ser. No. 61/470,764) which is incorporated by reference in Pratt. *Id.*, [0001]. I have reviewed Pratt's provisional (EX1007), which includes FIGs. 4(a)-4(d) that correspond to Pratt's FIGs. 7(a)-7(d). EX1007.

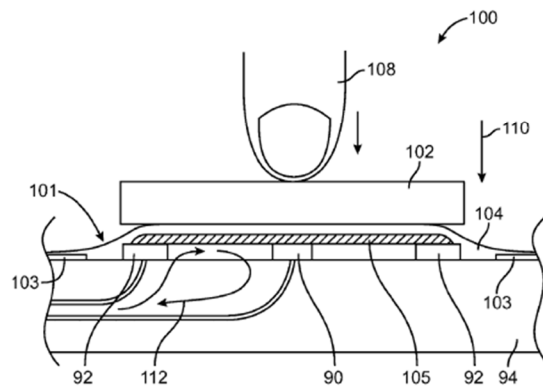
136. Earlier in Section IV.A I explained that the '738 patent is directed to solving the short-coming of prior art touch-sensitive input devices being "difficult or confusing to operate" for users not "look[ing] at the device during use." EX1001, 1:14-20. To that end, the '738 patent discloses a "haptic effect meant to confirm 'pushing' on a virtual button," *id.*, 11:38-40, which may be used in

applications such as a user “muting the radio [button in a touch-sensitive interface] without taking her eyes off the road.” *Id.*, 3:19-24. A POSA would understand that sometimes when a user’s finger approaches but does not touch a mute button, or touches lightly below a detection threshold of a touch sensor, the user may be confused and may need to look at the display to confirm whether or not an input to mute the radio has been registered. This confirmatory button push haptic effect described in the ’738 patent solves this problem as the user can tell from the sensation from the haptic effect whether the user successfully pressed the mute button, without taking eyes off the road. Likewise, Pratt’s “bubble” effect is “stimulating a clicking functionality” by emulating the sensation of physically depressing a dome switch conventionally used to implement a button in a portable electronic device—an effect a POSA would understand is comparable to the confirmatory button push haptic effect in the ’738 patent because the sensation of physically depressing a button would allow a user to confirm that a button is successfully clicked on without looking. Indeed, Pratt’s “bubble” effect is an example of what the ’738 patent describes as “an electro-tactile effect a surface deformation (e.g., a deformation of a surface associated with the computing device 101”). *Id.*, 5:23-25.

137. A POSA would understand that a portable electronic device may include “conventional buttons based upon dome switches,” as corroborated by Mittleman (U.S. Patent No. 7,902,474, EX1025) at 1:18-21, 6:40. Mittleman’s FIG. 5 illustrates such a conventional dome switch 100 with dome 101 (made of PET, a polymer material) in an “unactuated or relaxed position.” *Id.*, 7:8-15. Mittleman’s FIG. 6 likewise illustrates the dome switch in an “actuated or collapsed position” in which “dome 101 is compressed and collapsed,” such that conductive layer 105 under dome 101 makes contact with fixed contact 90. *Id.*, 7:23-31. The dome in a dome switch is also called a “bubble.” *Id.*, 6:40-42.



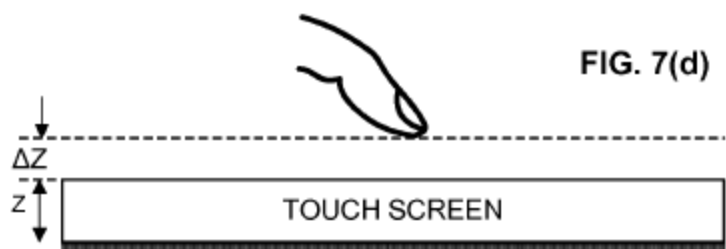
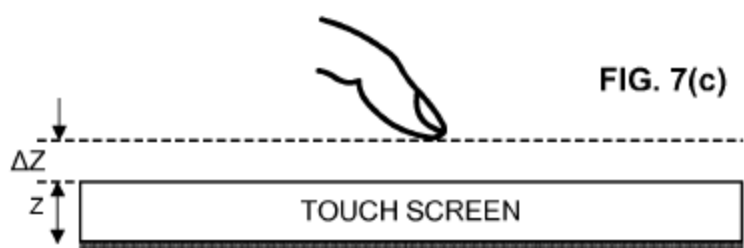
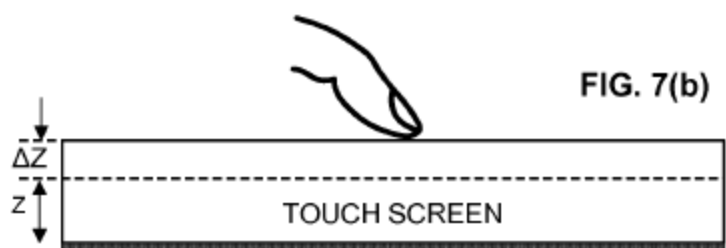
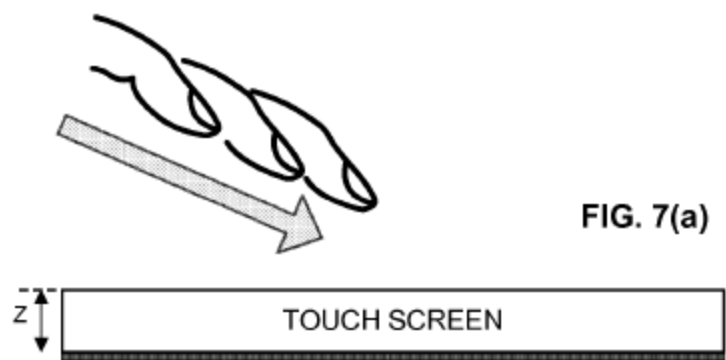
EX1025, FIG. 5



EX1025, FIG. 6

138. Pratt explains the steps to implement its “bubble” effect. Pratt first uses the “proximity sensor” (TS Sensor 142, as I explained in Section VI.A.2.b) to

identify a “user’s finger approaching the touch screen,” at which point the “haptics driver may pre-charge a haptics actuator to cause the touch screen to deflect toward the user’s finger by the time it makes contact with the touch screen.” EX1006, [0050]. I have reproduced below FIGs. 7(a)-7(d). As shown in FIG. 7(b), the “bubble” effect begins when the actuator deflects towards the user’s finger upon detection of the user’s finger approaching the touch screen. This initial deflection toward the finger is by a predetermined amount, shown as ΔZ in FIGS. 7(a)-(d). *Id.*, [0050].



139. Then as shown in FIG. 7I, when the “touch sensor [also TS Sensor 142, as I explained in Section VI.A.2.c] determines the user’s finger has made contact, it may initiate the haptic effect,” to simulate a “mechanical button click...by removing the pre-charge effect and inducing the touch screen to return to its default level (shown as ‘Z’).” EX1006, [0050].

140. FIG. 7(d) shows that after the touch screen is retracted to the default “Z level,” the finger continues to move toward the touch screen to “fall to the surface of the screen at the Z level.” *Id.*, [0050]. The sequence of steps is then complete.

141. During the sequence as shown in FIGs. 7(a)-(d), the user first feels “mechanical resistance at the first point of contact with the screen deflected forward (FIG. 7(b)).” *Id.* This simulates a bubble or dome in the unactuated position and the finger touching the unactuated bubble, as references such as Mittleman further confirm. For example, to actuate the dome switch in Mittleman, a user’s finger 108 begins by making contact with the dome 101 in the “unactuated [] position” via button 102. EX1025, 7:8-22; FIG. 5. Mittleman further describes “closing the switch” when the dome is “pushed downwardly” (again via button 102) such that dome 101 is “collapsed” and “[c]onductive underside 105 [of dome 101] comes into contact with fixed center contact 90” to “form [a] completed circuit.” EX1025, 7:23-31; FIG. 6. Likewise, in Pratt, after the finger makes

contact, the bubble “collapses” as the screen retracts (FIG. 7(c)). EX1025, 7:23-31. A second “mechanical resistance” is felt when the finger subsequently makes contact “at the second point of contact with the screen at the rest position (FIG. 7(d)).” EX1006, [0050]. The feeling of mechanical resistance at the two different points of contact may “induce” a click effect, and “simulates a mechanical compression effect.” *Id.*, [0050]. Essentially, the “bubble” effect in this embodiment simulates a finger making contact with a dome switch, then pressing down on the dome switch until the dome or bubble is compressed to actuate contact. EX1025, 7:23-31.

142. A POSA would understand that generating this effect requires both (1) a signal generated by the proximity sensor (a “first” sensor signal per [1A], identified by processor 112’s proximity classification module 112.1) and (2) a signal generated by the touch sensor (i.e., a “second” sensor signal per [1B], identified by touch classification module 112.2). The first sensor signal prepares the bubble in a “unactuated or relaxed position,” while the second sensor signal triggers the bubble to collapse and simulate an actuated dome switch.

143. Simply put, the singular “bubble effect” requires both simulating a bubble in a unactuated position by deflecting the screen toward the approaching finger (FIG. 7(b)) and simulating collapsing the bubble (FIG. 7(c)) by retracting the screen after the finger makes contact.

144. A POSA would understand that a haptic command for the “bubble effect” would cause both the deflection and retraction stages of the screen. Indeed, a POSA would understand that the processor’s haptic response search module 112.4” (linked with the proximity and touch classification modules) would only generate a haptic command for this “bubble” effect if it receives **both** signals.

145. While Pratt mentions the “haptic effect” is “initiat[ed]” once “the touch sensor determines that the user’s finger has made **contact**,” Pratt at the same time describes it as an example of “**proximity**-based deflection operations.” EX1006, [0050]-[0051]. The “proximity-based deflection operations” is further confirmation to a POSA that Pratt’s processor is configured per [1F] to generate haptic outputs based on **both** proximity and contact-based signals. *Id.*, [0050]-[0051]. Pratt is also explicit that the “bubble” effect is a single effect, as FIGs. 7(a)-7(d) “illustrate **a** bubble effect generation operation” relying on both signals. *Id.*, [0049]. In particular, a user would only experience the bubble effect if Pratt detects both proximity and contact-based signals.

146. There are at least two benefits for such a bubble effect generation based on both proximity and touch. First, because the screen is already deflected at the moment of the touch, the effect of pressing down on a dome switch results in the user promptly feeling the haptic effect without “prolonged latency in the haptic response” causing a “temporal disconnect” that can result in “poor user

experience.” *Id.*, [0004]. Second, the bubble effect would be more accurate when the proximity location (e.g. the Z-location) is incorporated into the haptic command to cause an appropriate amount of deflection, which may be a non-linear function depending on how high the Z-position of the finger is.

147. Therefore, in my opinion FIGs. 7(a)-7(d) and the accompanying disclosures disclose [1F]. Pratt’s processor only generates a haptic command directing a bubble effect at a particular point in time if Pratt’s processor has received both first (proximity-related) and second (contact-related) signals.

ii. Second embodiment

148. I have reproduced paragraph 41 of Pratt below:

[0041] In an embodiment, haptic selection may also be based on sensor measurements. For example, haptic effect types may be selected based on the rate of approach of the user’s finger as it moves toward a touch screen—a first haptic effect may be selected in response to a relatively “fast” velocity and a second haptic effect may be selected in response to a relatively “slow” velocity.

149. The embodiment described in paragraph 41 of Pratt is separate and independent from FIGs. 7(a)-7(d). In the embodiment described in paragraph 41, Pratt describes how “haptic effect types may be selected based on the rate of approach of the user’s finger as it moves toward a touch screen,” with one effect following a “fast” approach and a different effect following a “slow” approach. *Id.*. A POSA would understand that the rate of approach is based on signals from the proximity sensor, e.g. based on the time rate of change of the “Z” coordinate

generated from the proximity sensor results. *Id.*, [0034]. While the type of haptic effect is selected based on the proximity sensor signal, a POSA would understand that the actual “haptic selection” referenced in paragraph 41 does not occur until after the user’s finger touches the touch screen, such that the haptic output signal is based on signals from both the proximity *and* touch sensors. In particular, preceding paragraph 39 describes generating a haptic effect “upon touch screen contact,” but after having pre-charged the actuator based on a proximity signal to “reduc[e] latency between the user touching the screen and feeling the corresponding haptic effect.” a POSA would understand that the “embodiment” described in paragraph 41 is one particular embodiment of the “pre-charging haptic generation operation described in paragraph 39 of Pratt and illustrated in Figure 4. If the proximity signal reflects a fast rate of approach at time t1, and the user’s finger then makes contact with the touch surface at time t2, Pratt’s processor would send a haptic output command calling for one particular haptic effect. Alternatively, if the proximity signal reflects a slower rate of approach at time t1, and the user’s finger later makes contact with the touch surface, Pratt’s processor would send a haptic output command calling for a different haptic effect. By contrast, if the user’s finger changed direction and did not contact the screen, Pratt’s processor would not send a haptic output command at all (despite having previously pre-charged the actuator as described in paragraph 39 in preparation for

the anticipated touch. Indeed, a POSA would understand that both of the haptic effects described in paragraph 41 (one reflecting a “fast” rate of approach as the finger approaches the screen and the other a comparatively “slow” approach) were intended to be produced only after the finger actually touches because otherwise the finger would not feel the haptic effect.

150. At minimum, it would have been obvious to implement paragraph 41 this way (in other words, incorporating Pratt’s pre-charging operation as described in paragraph 39). Such a combination would differentiate between touches based on quick movements versus touches based on slower movements during approach (as discussed in paragraph 41) while minimizing the amount of latency between when the user’s finger makes contact and when the user feels the haptic effect (as described in paragraph 39). Indeed, Pratt teaches that its “embodiments may be implemented [] in combination.” *Id.*, FIG. 1(b), [0016]-[0017], [0053].

151. For the reasons I have explained, it is my opinion that paragraphs 39-41 disclose or at minimum render obvious [1F].

h. [1G]: “transmit the haptic output signal to the haptic output device.”

152. Pratt meets [1C] as Pratt’s processor 112 is configured to “transmit the haptic output signal to the haptic output device” as claimed.

153. FIG. 1(b) shows the processor sending a “haptic command” (i.e. the haptic output signal, based on the first and second sensor signals as I explained

above in Section VI.A.2.g) to haptics driver 120. Based on this “haptic command...haptic driver 120 may generate a corresponding drive signal” causing “haptics actuator 130...to vibrate according to the drive signal properties.” EX1006, [0025]-[0026]. As I explained in Section VI.A.2.d, a POSA would recognize the “haptics driver 120” and “haptics actuator 130” together as the “haptic output device,” such that said haptic output device receives the haptic output signal. Also as I explained in Section VI.A.2.g, Pratt’s processor is configured to generate such a haptic output signal based on both the proximity signal (first sensor signal) and the touch signal (second sensor signal).

3. Claim 2: “wherein the proximity sensor is integrated into the touch-sensitive device”

154. As I explained in Section VI.A.2.b, Pratt’s TS sensor 142 is a “proximity sensor,” while touch screen 140 is a “touch-sensitive device.” FIG. 1(a) shows “a touch screen 140 with a touch screen (TS) sensor 142,” (EX1006, [0015]), which a POSA would understand as teaching that TS sensor 142 is integrated into “touch screen 140.” Furthermore, Pratt discloses an example in which the touch screen 140 is “a capacitive touch screen,” and the TS sensor 142 is a “corresponding capacitive sensor.” *Id.*, [0021]-[0022]. A POSA would understand that capacitive sensor for a capacitive touch screen is integrated into the capacitive touch screen. This is confirmed by Pratt in Fig. 2(b), which illustrates “an *integrated* touch screen sensor grid.” *Id.*, [0008]. Pratt therefore meets

“wherein the proximity sensor is integrated into the touch-sensitive device” as claimed.

155. While Pratt references plural “capacitive sensors 220” “arranged in [a] grid with multiple columns and rows” (*id.*, FIGs. 2(a)-2(c), [0029]-[0031]), this is consistent with the reference to TS sensor 142 as a singular “sensor.” In particular, a POSA would understand a grid of multiple capacitive sensors may be collectively referred to as a singular “sensor” in the context of detecting proximity events or touch events. For example, in Pratt, the “TS sensor” can be used to detect “proximity events such as location.” *Id.*, [0016]. Pratt explains how such proximity location can be detected using “X,Y location [that] may correspond to the location of the [cross point](s) in the grid that detected the presence” of “a user’s finger hovering over the touch screen.” *Id.*, [0034]. Therefore, a POSA would understand that Pratt’s TS sensor may be implemented as a grid of capacitive sensors.

4. Claim 3: “the proximity sensor comprises one of a capacitive sensor or an optical sensor”

156. As I explained in Section VI.A.2.b, Pratt’s “proximity sensor” is “TS Sensor 142,” which Pratt discloses can comprise a “capacitive sensor” as claimed. EX1006, [0021].

157. Separately, I note that in Pratt’s provisional (EX1007) which is incorporated by reference in (EX1006, [0001]), Pratt discloses that in addition to

the conventional “touch sensor” for detecting proximity within a certain distance from the screen (e.g., “typically about 5 cm”), the device “may include an optical sensor system to detect objects at farther distances from the device” (EX1007, 13 (internal page no. 10 of 13)).

5. Claim 5: “an integrated sensor comprises the proximity sensor and the touch sensor”

158. As I explained in Section VI.A.2.b, Pratt’s “TS Sensor 142” detects both proximity and touch. Pratt therefore includes an “integrated sensor compris[ing] the proximity sensor and the touch sensor” as claimed.

159. That Pratt’s sensor includes an integrated sensor is further confirmed by Pratt’s disclosure that TS Sensor 142 can be a “capacitive sensor,” because capacitive sensors were known to be capable of detecting both proximity (making them “proximity sensors”) and touch (making them “touch sensors”). This can be corroborated by e.g. Bernstein (EX1018), which is directed to “improved capacitive touch and hover sensing” in “an integrated touch screen,” *Id.*, [0001], [0002], and in particular discloses “a capacitance of sensor array 901” can be measured for “touch sensing” and “hover sensing.” *Id.*, [0053], FIG. 9. Jiang (EX1010) is another example, which discloses “an array of EMP [electromechanical polymer] sensors provided on [] a graphical display of [] a mobile device,” EX1010, [0008], [0035], FIG. 8, that may both “serve as a proximity sensor” as its capacitance changes according to the relative location of a

finger to the EMP sensor, *Id.*, [0025], as well as detect if an “EMP sensor [] is contacted.” *Id.*, [0017], [0029]. Furthermore, Rimon (EX1019) discloses a touch screen “digitizer system” formed of “a grid based sensor” “overlaid” on a screen, EX1019, FIGs. 5A, 5B, 6A, 6B, 10:1-14 and a “capacitive junction touch method” that can distinguish between “hover event” from a “touch event.” *Id.*, 12:47-50, 13:38-55.

160. I also note that Pratt’s above-discussed disclosure parallels the ’738 patent, which merely states that the “sensor may comprise a dual-mode sensor” using “capacitance” to detect both “proximity” and “contact.” EX1001, 2:35-43.

6. Claim 6: “the integrated sensor further comprises the haptic output device”

161. Pratt discloses that “TS Sensor 142” (the “integrated sensor,” as I explained in Section VI.A.5) along with the haptics driver and the haptics actuator are housed in a single handheld housing. This is illustrated in FIG. 1(a), which shows a “block diagram of *a display device*” 100 (EX1006, [0015]) that includes TS Sensor 142, Haptics Driver 120, and Haptics Actuator 130. Moreover, as I explained in Section VI.A.2.d, haptics actuator 130 constitutes the “haptic output device” both individually and in combination with haptics driver 120.

Accordingly, a POSA would understand that Pratt’s Figure 1 illustrates the “*integrated sensor*” and the “*haptic output device*” together in the same handheld housing.

162. I have also reviewed patent owner’s infringement contentions in co-pending litigation (EX1013), where the patent owner asserts the accused Valve Index Controllers satisfy claim 6 because they “include an HD LRA for Haptics.” *Id.*, 21. A POSA would understand LRA stands for linear resonant actuators.

Claim 6	Valve's Accused Instrumentalities								
6. The device of claim 5, wherein the integrated sensor further comprises the haptic output device.	Valve's Accused VR Instrumentalities include the device of claim 5, wherein the integrated sensor further comprises the haptic output device. For example, the Valve Index Controllers include an HD LRA for Haptics:¹⁵ Tech specs <table><tr><th>Inputs</th><th>Ergonomics</th><th>Connections</th><th>Haptics</th></tr><tr><td>A Button, B Button, System Button, Trigger, Thumbstick, Track Button with Force Sensor, Grip Force Sensor, Finger Tracking, IMU</td><td>Adjustable strap with pivot, antimicrobial tech fabric</td><td>USB-C, 2.4GHz Wireless</td><td>HD LRA</td></tr></table>	Inputs	Ergonomics	Connections	Haptics	A Button, B Button, System Button, Trigger, Thumbstick, Track Button with Force Sensor, Grip Force Sensor, Finger Tracking, IMU	Adjustable strap with pivot, antimicrobial tech fabric	USB-C, 2.4GHz Wireless	HD LRA
Inputs	Ergonomics	Connections	Haptics						
A Button, B Button, System Button, Trigger, Thumbstick, Track Button with Force Sensor, Grip Force Sensor, Finger Tracking, IMU	Adjustable strap with pivot, antimicrobial tech fabric	USB-C, 2.4GHz Wireless	HD LRA						

Patent Owner’s infringement contentions (claim 6) (*Id.*, 21).

163. Patent owner’s only apparent basis for concluding that the accused handheld Controllers satisfy claim 6 is that they contain LRAs and sensors (see *Id.*, 19) in a single handheld housing. If one applied the assumptions patent owner apparently applied in its infringement contentions (and in particular patent owner’s apparent understanding of “integrated sensor”) to Pratt, Pratt would meet claim 6: just like the accused Controllers in Patent Owner’s infringement contention, Pratt’s display device includes a haptic output device that may be “LRAs” (EX1006, [0026]).

7. Claim 14

a. [14A] “the touch sensor is capable of detecting a pressure”

164. Pratt meets [14A] because Pratt’s “TS Sensor 142” (the “touch sensor,” as I explained in Section VI.A.2.c) is “capable of detecting a pressure.” Pressure is simply force per unit area. For example, “pressure” is defined by the New Oxford American Dictionary as “the force exerted per unit area” (EX1026, 1383), and by the American Heritage Dictionary of the English Language as “[f]orce applied uniformly over a surface, measured as force per unit area” (EX1027, 1395). Pratt’s “force detection operation” “detect[s] force applied to a touch screen” when “a user may press the touch screen [] with his/her finger” that “may register a greater area of contact,” EX1006, [0012], [0047], FIG. 6., which a POSA would understand detects a value of force over a contact area—and therefore capable of detecting a value of force exerted per unit contact area, namely pressure from the above-noted definition. Therefore, a POSA would understand Pratt’s touch sensor (i.e., TS Sensor 142) is capable of detecting a pressure.

165. Pratt discloses detecting a value of force corresponding to a user’s touch. For example, Pratt discloses that “[b]ased on the TS sensor results, the UI controller 112 may calculate...force user interaction events.” *Id.*, [0016]. Processor 112’s “force classification module 112.3,” indeed can “calculate an amount of force corresponding to a user touch on the touch screen 140.” *Id.*,

[0023]. Moreover, Pratt discloses with respect to FIGs. 6(a)-(b) “a force detection operation,” *Id.*, [0012]. Pratt also discloses a “calculated area” of the “point of contact” as “a circle having radius R.” *Id.*, [0047]. See also the labels “R1” and “R2” in FIGs. 6(a), 6(b), respectively, which a POSA would understand represent a lateral extent of a calculated contact area when the finger touches the touch screen. Pratt further explains that “the touch sensor may use [a greater area of contact registered by user’s touching finger] to derive a corresponding higher value of force”. *Id.*, [0047]. Because Pratt discloses measuring both a contact area as well as the value of the force exerted over the corresponding contact area, a POSA would understand that Pratt’s sensor is capable of detecting pressure, which is just force divided over the corresponding area as noted in the preceding paragraph. I have used this very method to estimate pressure with optical touch systems.

166. While Pratt’s paragraph 23 mentions a “force sensor 160,” without further details, it is clear to a POSA that Pratt teaches that when TS sensor 142 is a capacitive sensor, force may be detected based on “changes in respective capacitive fields [of TS sensor 142].” *Id.*, [0023]. I previously explained in Section VI.A.2.b that Pratt’s TS sensor may be a “capacitive sensor” that constitutes a touch sensor. Pratt also discloses scanning “each cross point CS (or each row or each column)” of the capacitive sensors 220 to “generate a bit code result,” which “may be used to calculate the [] force [] of the user interaction.” *Id.*, [0032]-[0033].

A POSA would understand that the row and column locations of different CS in Pratt's capacitive sensors that generate a bit code indicative of a touch may be used to calculate an area of the touch. At minimum, a POSA would understand Pratt teaches detecting pressure either with TS sensor 142, in addition to or as alternative to force sensor 160.

b. [14B] “the haptic output signal is based at least in part on the detected pressure”

167. Pratt meets [14B] because Pratt discloses embodiments in which the above-discussed “haptic output signal is based at least in part on the detected pressure.” *See, e.g., id.* [0016] (“[H]aptic generation may be dynamically changed and/or adjusted based on detected proximity, touch, and/or force events.”)

168. In particular, Pratt's device generates a haptic effect corresponding to “amount of force”—“for example...an alert to the user that he/she is pressing too hard on the touch screen.” *Id.*, [0045]. At minimum, it would have been obvious for a POSA to incorporate this haptic-based warning into either (1) the “haptic bubble effect generation operation” (concerning Pratt's paragraphs 49-50) I discussed in § VI.A.2.g.i or (2) the combination of Pratt's paragraphs 39 and 41 I discussed in § VI.A.2.g.ii. For example, Pratt teaches that its “embodiments may be implemented [] in combination.” EX1006, FIG. 1(b), [0053].

169. In connection with the haptic bubble effect, incorporating the pressure-based warning into the bubble effect would be desirable to ensure that

users do not press the simulated button too hard. In particular, it would have been obvious to simulate one type of “mechanical button click” (*id.*, [0050]) if Pratt’s device detected a pressure below a certain threshold (within the screen’s tolerance parameters) and a different type of click effect if Pratt’s device detected a pressure above the threshold.

170. Similarly, in connection with Pratt’s reliance on the speed of a finger’s approach to select the particular haptic effect upon contact with the screen (paragraphs 39 and 41), it would have been obvious to vary the haptic effect depending on whether Pratt’s device detected a pressure above the threshold corresponding to a risk of screen damage.

171. Pratt’s design is fully compatible with this approach, as confirmed by Pratt’s disclosure that “haptic response search module 112.4” within Pratt’s processor “may receive proximity, touch, and/or force events” and “match the calculated proximity, touch, and/or force event data to a stored haptic profile and may generate a haptic command associated with the matched haptic profile.” *Id.*, [0024].

172. Separately, in my opinion it would have been obvious to generate Pratt’s bubble effect (as described in *id.*, [0049]-[0050]) or other haptic effect (as described in *id.*, [0039]-[0041]) only if there is a detected pressure that exceeds a given threshold. *Id.*, [0023]. Doing so would be applying a well-known technique

to distinguish between intentional versus inadvertent touches. *See* EX1016, [0087] (“pressure threshold...to avoid accidental actuation”); EX1017, [0035] (“predetermined pressure or greater” to “reduce the occurrence of erroneous input due to the user mistakenly touching the touch surface”). Doing so would also have been routine. For example, Pratt already programming touch classification module 112.2 to “differentiate between true positives for desired user touch events and false positives.” EX1006, [0023]. It would have been routine to program Pratt’s force classification module to apply a similar differentiation algorithm to differentiate true positive touches based on a detected pressure value being higher than a predetermined threshold. I already discussed above Pratt’s touch sensor is capable of detecting pressure because it measures both a contact area as well as the value of the force exerted over the corresponding contact area. It would have been routine for Pratt’s processor to perform a division operation between the measured force and contact area to determine the detected pressure.

8. Claim 15

173. Pratt meets claim 15 as follows.

174. Claim 15 recites a method with elements corresponding to those in apparatus claim 1, and is met by Pratt based on the same disclosures discussed above and further explained below.

175. In my opinion, Pratt’s FIGs. 7(a)-7(d) illustrates a method using Pratt’s device and satisfying all of claim 15’s steps via the “bubble effect generation operation” as I explained in Section VI.A.2.g.1 concerning [1F].

176. The combination of Pratt’s paragraphs 39 and 41 (discussed in Section VI.A.2.g.1 concerning [1F]) also satisfies all of claim 15’s steps.

a. [15PRE]: “A method comprising”

177. Pratt meets [15PRE] because Pratt discloses a “method.”

178. For example, Pratt’s FIGs. 7(a)-(d) illustrate a method in the form of a “a bubble effect generation operation.” EX1006, [0013]; [0049]-[0050].

179. Separately, Pratt’s paragraphs 39-41 describe a method in which the user only feels haptic feedback upon touching the screen, but the nature of that feedback depends on the “rate of approach” detected by the proximity sensor. [0039]-[0041],

b. [15A]: “detecting, by a proximity sensor, a non-contact interaction with a touch-sensitive device”

180. Pratt meets [15A] as claimed.

181. As I explained in Section VI.A.2.g.i, Pratt’s FIG. 7(a) illustrates using Pratt’s “proximity sensor” to identify the non-contact interaction of a “user’s finger approach[ing] the touch screen.” EX1006, [0050]. This method was practiced using Pratt’s device as detailed in Section VI.A.2—including “TS Sensor 142” as the proximity sensor.

182. Separately, with respect to the method described in Pratt’s paragraphs 39-41, a POSA would understand that this process relies on Pratt’s “proximity sensor” (TS Sensor 142) to generate data for determining the “rate of approach of the user’s finger as it moves toward a touch screen.” *Id.*, [0041]

c. [15B]: “detecting, by a touch sensor, a touch on the touch-sensitive device”

183. Pratt meets [15B] as claimed.

184. As I explained in Section VI.A.2.g.i, Pratt’s FIG. 7(b) illustrates using Pratt’s “touch sensor [to] determine[] that the user’s finger has made contact” with the screen. EX1006, [0050]. This method was practiced using Pratt’s device as detailed in Section VI.A.2—including “TS Sensor 142” as the touch sensor.

185. Separately, a POSA also would understand that the method described in Pratt’s paragraphs 39-41 relies on Pratt’s “touch sensor” (TS Sensor 142) “to detect the finger making contact with the touch surface.” EX1006, [0039].

d. [15C]: “transmitting a first sensor signal associated with the non-contact interaction to a processor”

186. Pratt meets [15C] as claimed. A POSA would understand that Pratt’s determination concerning the approach of the user’s finger as I explained regarding [15A] above is made pursuant to the design of FIG. 1(b), which illustrates how “TS sensor data” is received by processor 112—including proximity classification module 112.1. *Id.*, [0020].

187. For example, paragraph 50 (concerning the “bubble effect”) discusses Figure 7(a) and notes that the “user’s finger...is identified by the proximity sensor” as the “finger approaches the touch screen.” *Id.*, [0050]. a POSA would understand from Pratt’s design (as I discussed in Section VI.A.2.b above concerning [1A]) that the proximity sensor (i.e., Pratt’s “TS Sensor 142”) transmits a first sensor signal associated with this non-contact interaction to Pratt’s processor.

188. Separately, paragraph 39 discusses Figure 4 and notes that Pratt’s “device may detect the finger at a predetermined distance (Threshold P) from the touch surface.” *Id.*, [0039]. This is another example of a non-contact interaction, and a POSA would understand from Pratt’s design (as I discussed in Section VI.A.2.b above concerning [1A]) that Pratt’s “TS Sensor 142 transmits a first sensor signal associated with this non-contact interaction to Pratt’s processor.

e. [15D]: “transmitting a second sensor signal associated with the touch to a processor”

189. Pratt meets [15D] as claimed for the reasons explained below. As an initial matter, I note that while [15D] refers to “a processor” rather than “the processor,” a POSA would understand that claim 15 encompasses methods in which the first sensor signal of [15C] and the second sensor signal of [15D] are transmitted to the same “processor” referenced in both claim elements. This is consistent with the subsequent requirement in [15E] of “receiving, by the

processor” both the “first sensor signal” (transmitted to the “processor” per [15C]) and the “second sensor signal” (transmitted to the “processor” per [15D]). It is also consistent with the further requirement in [15F] of “generating, by the processor, a haptic output signal based at least in part on the first and second sensor signals”

190. A POSA would understand that Pratt’s determination in [15B] (as I explained above) that the user’s finger made contact with the screen is made pursuant to the device design of FIG. 1(b), which illustrates how “TS sensor data” is received by processor 112 and in particular touch classification module 112.2. EX1006, [0020].

191. For example, paragraph 50 (concerning the “bubble effect”) discusses Figure 7(b) and notes that “the user’s finger makes contact with the touch screen ...” (*id.*, [0050]) a POSA would understand from Pratt’s design (as I discussed in Section VI.A.2.c above concerning [1B]) that Pratt’s “TS Sensor 142” transmits a second sensor signal associated with this touch to Pratt’s processor.

192. Separately, paragraph 39 discusses Figure 4 and notes that Pratt’s “device may detect the finger making contact with the touch surface via Threshold T.” *Id.*, [0039]. This is another example of a touch, and a POSA would understand from Pratt’s design (as I discussed in Section VI.A.2.c above concerning [1B]) that

Pratt's "TS Sensor 142" transmits a second sensor signal associated with this touch to Pratt's processor.

f. [15E]: "receiving, by the processor, the first and second sensor signals"

193. Pratt meets [15E] as claimed. A POSA would understand that Pratt's determinations concerning non-contact interactions (as I discussed above in connection with [15A] and [15C]) and touch interactions (as I discussed above in connection with [15B] and [15D]) are made pursuant to the device design of FIG. 1(b), which illustrates how the "TS sensor data" is received by processor 112.

g. [15F]: "generating, by the processor, a haptic output signal based at least in part on the first and second sensor signals"

194. As I explained in Section VI.A.2.g regarding [1F], Pratt discloses two different embodiments (the bubble effect described in paragraphs 49-50, as well as the separate embodiment described in paragraph 39-41) generating a haptic output signal based in part on the first and second sensor signals. Pratt therefore meets [15F] as claimed.

h. [15G]: "transmitting, by the processor, the haptic output signal to a haptic output device"

195. Pratt meets [15G] as claimed. For example, the bubble haptic effect described in Pratt's paragraphs 49-50 is generated by Pratt's haptic output device (haptics driver 120 either alone or considered together with haptics actuator 130, as I explained in Section VI.A.2.h regarding [1G]) based on the haptic output signal

sent by the Pratt's processor. Paragraph 50 specifically references Pratt's "haptics driver," and a POSA would understand that the driver receives the "haptic command" from processor 112 per FIG. 1(b). EX1006, [0050].

i. [15H]: "outputting, by the haptic output device, a haptic effect in response to the haptic output signal"

196. Pratt meets [15H]. The haptic effects that I discussed in Section VI.A.2.g are generated by Pratt's haptic output device (haptics driver 120 and haptics actuator 130, per Section VI.A.2.h) based on the haptic output signal sent by the processor per FIGs. 1(a)-1(b). For example, a POSA would understand that Pratt's haptics actuator generates the bubble haptic effect illustrated in FIGs. 7(a)-7(d).

9. Claim 19

197. Pratt meets claim 19 as follows.

198. Claim 19 requires a "*computer-readable non-transitory medium encoded with executable program code*" for executing certain of the steps recited in the method of claim 15. In particular, claim 19 has elements that parallel all steps of claim 15 aside from the absence of an element corresponding to [15H]:

[19A]: "program code for detecting, by a proximity sensor, a non-contact interaction with a touch-	[15A]: "detecting, by a proximity sensor, a non-contact interaction with a touch-
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sensitive device”;	sensitive device”
[19B]: “program code for detecting, by a touch sensor, a touch on the touch-sensitive device”	[15B]: “detecting, by a touch sensor, a touch on the touch-sensitive device”
[19C]: “program code for transmitting a first sensor signal associated with the non-contact interaction to a processor”	[15C]: “transmitting a first sensor signal associated with the non-contact interaction to a processor”
[19D]: “program code for transmitting a second sensor signal associated with the touch to a processor”	[15D]: “transmitting a second sensor signal associated with the touch to a processor”
[19E]: “program code for receiving, by the processor, the first and second sensor signals”	[15E]: “receiving, by the processor, the first and second sensor signals”
[19F]: “program code for generating, by the processor, a haptic output signal based at least in part on the first and second sensor signals”	[15F]: “generating, by the processor, a haptic output signal based at least in part on the first and second sensor signals”
[19G]: “program code for transmitting the haptic output signal to a	[15G] “transmitting, by the processor, the haptic output signal to a haptic

haptic output device”	output device”
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199. In my opinion, claim 19 is anticipated by or at minimum obvious over Pratt for the same reasons as I explained above for claim 15. My opinion is further confirmed by Pratt’s teaching that “embodiments may be implemented, for example, using a computer-readable medium or article which may store an instruction or set of instructions that, if executed by a machine, may cause the machine to perform a method.” EX1006, [0055]. Pratt also discloses that examples of such media that are non-transitory. *Id.* A POSA would have understood that these teachings applied to both of the embodiments discussed in Section VI.A.8 (i.e., paragraphs 49-50, as well as paragraphs 39-41).

B. Ground 2: Pratt-Ku Renders Claims 1-6, 14-16, and 19 Obvious

1. Ku (EX1008)

200. I refer to U.S. Patent No. 8,531,319 (EX1008) as “Ku.” Ku’s cover page reflects that it was patented on Sep. 10, 2013. I understand from counsel that Ku qualifies as prior art to the ’738 Patent.

201. Ku is directed to “systems and methods” to “distinguish between different types of touch signals and proximity signals that are detected by a mobile terminal” *Id.*, 1:32-34. In one embodiment, Ku discloses generating “a combined

vibration signal corresponding to the proximity signal and the touch signal” if both inputs come from the same on-screen location on a touch screen (*id.*, 1:61-2:5).

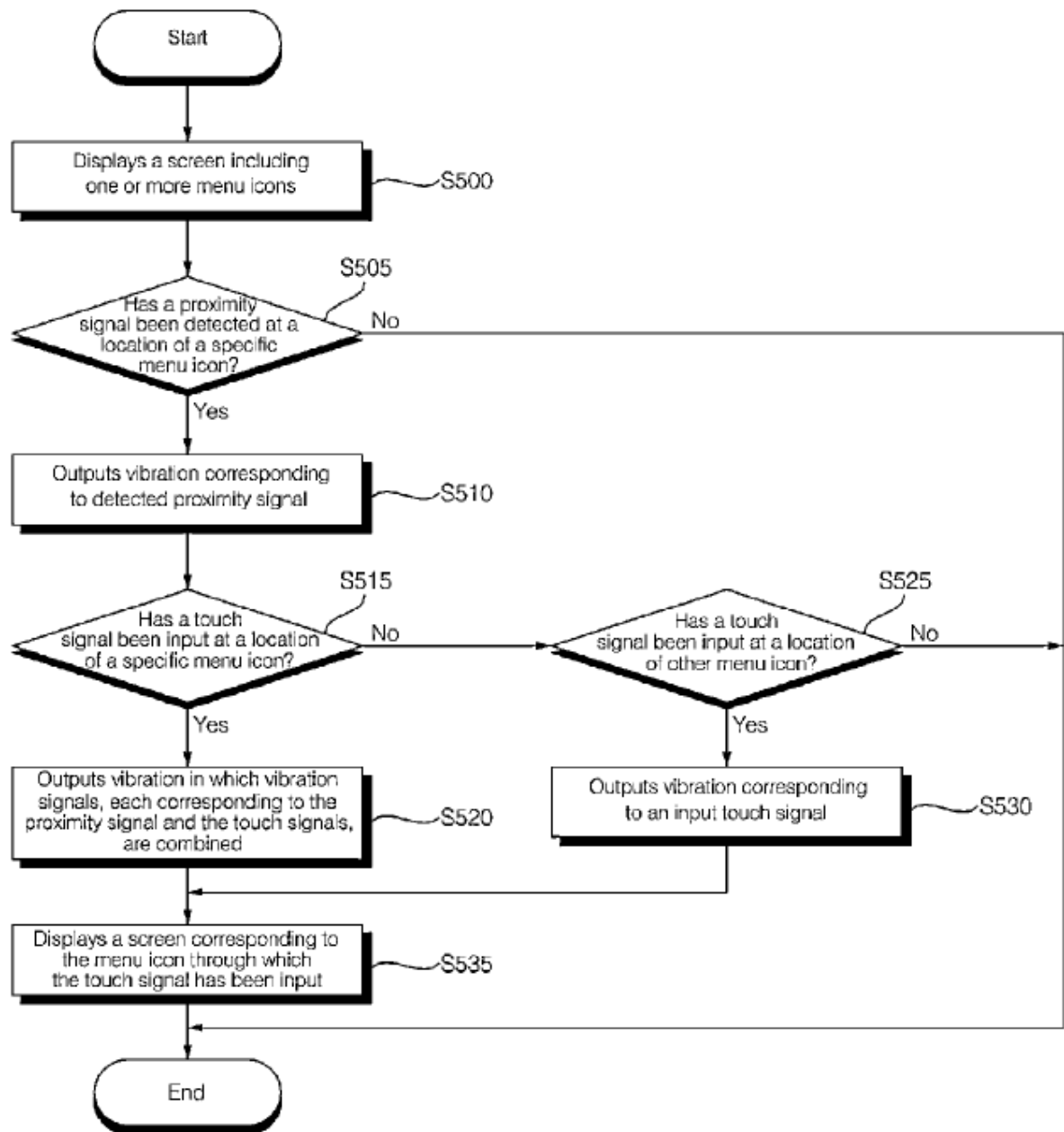
202. Ku’s mobile terminal with a touch screen is shown in FIG. 12(a), which I have reproduced below. FIG. 12(a) shows a touch screen 700 displaying a plurality of “menu icons” (e.g., “Messaging,” “Call history,” “Camera”) “for menu selection.” *Id.*, 16:8-10. The menu selection may depend on detection of input signals including a “proximity signal and a touch signal.” *Id.*, 16:10-16. A POSA would understand from FIG. 12(a) that the input for menu selection may come from movement of a user’s finger relevant to an on-screen location, for example by moving the finger towards and contacting the “Messaging” menu icon on the touch screen. The finger may move perpendicularly to the screen, for example from far away to be in closer proximity; the finger may also move in a non-perpendicular fashion, for example laterally along the surface of the screen to locations of different menu icons.



EX1008, FIG. 12(a)

203. I have reproduced Ku's FIG. 7 below, which illustrates a method of distinguishing input signals inputted from different display locations. *Id.*, 2:62-64. In this method, different haptic effects are generated depending on whether the input signals correspond to the same menu icon (e.g., if the user's finger first approaches a particular menu icon, then subsequently moves in a relatively perpendicular fashion towards the screen to make contact with the same menu

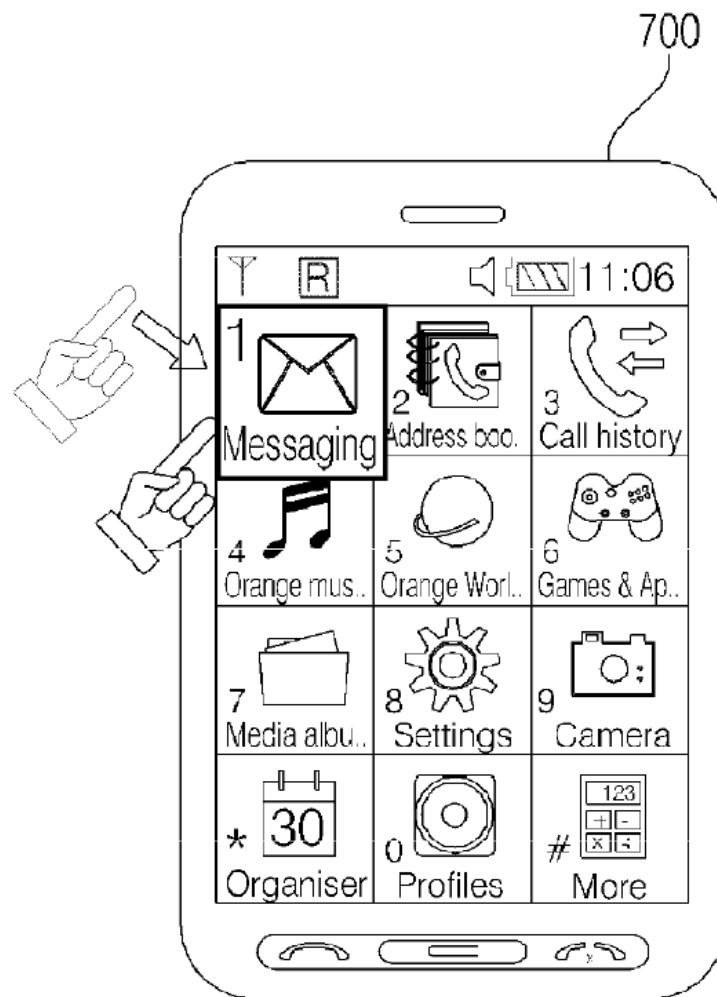
icon) or instead to different icons (e.g., if the finger first approaches a particular menu icon, but then moves towards the screen in a non-perpendicular angle such that there is a lateral shift in the finger's position when the finger makes contact, and the location of finger contact being in a different menu icon than the original menu icon the finger was approaching).



Ku, FIG. 7.

204. In the method described in Ku's FIG. 7, if a *proximity* signal is detected at a location of a particular icon ("Yes" in step S505), a vibration signal is output (step S510) through a haptic module. *Id.*, 11:60-64. For example, in Ku's

FIG. 12(a), each menu icon on the screen is associated with different “proximity area” above the menu icon. *Id.*, 10:28-37. While Ku does not expressly tie together Figures 7 and 12, a POSA would understand that the user interface illustrated in Figure 12 is applicable to Figure 7 and indeed a good example of a scenario in which Figure 7’s method would be particularly useful given the abundance of different on-screen icons:

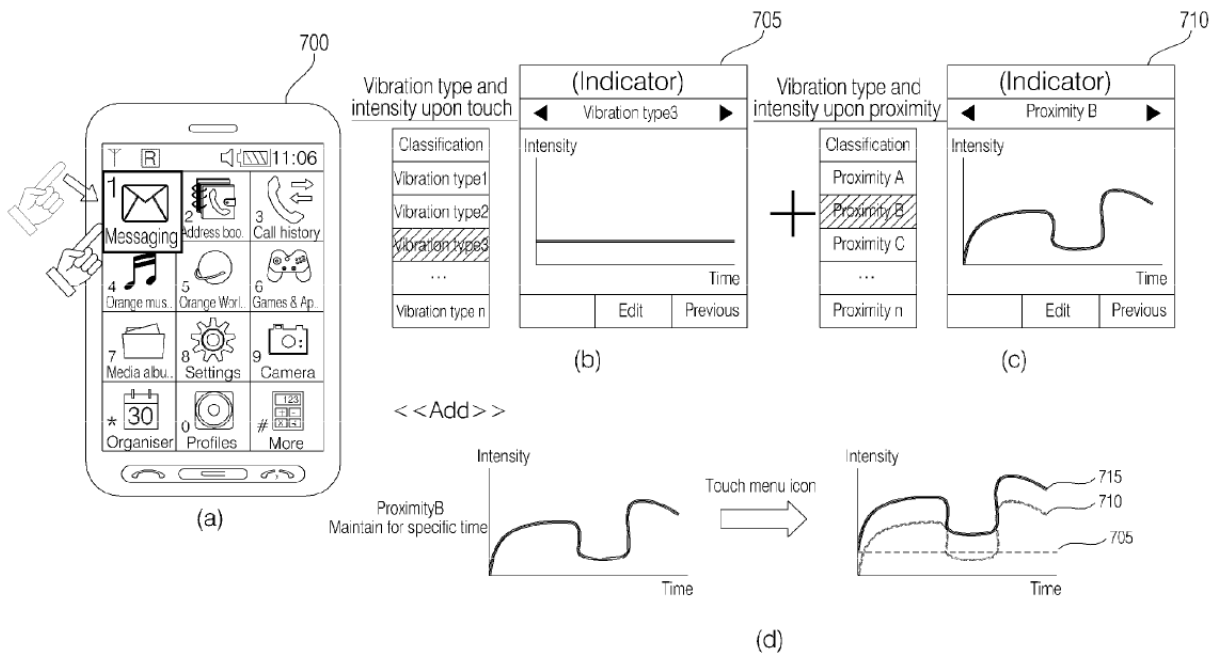


EX1008, FIG. 12(a)

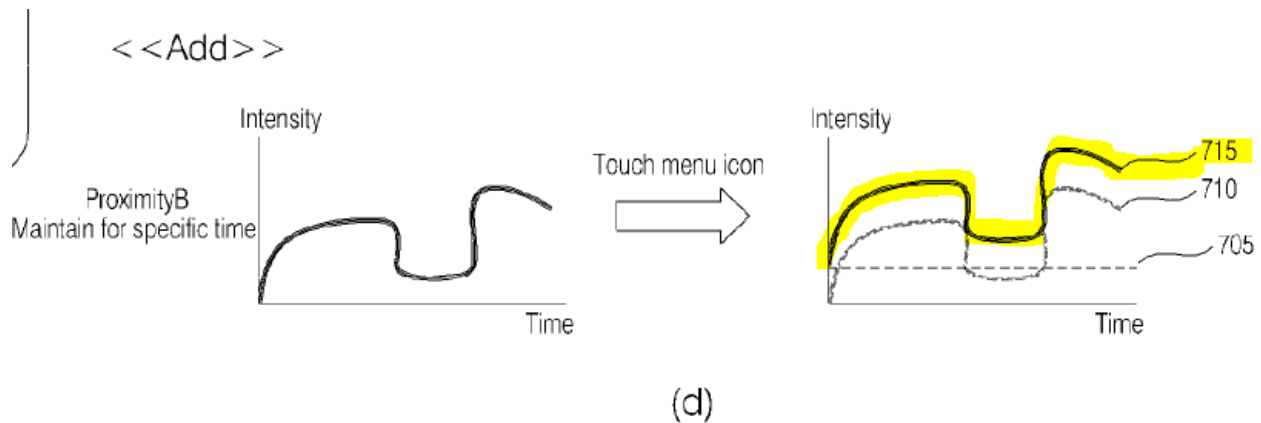
205. As described in Ku's Figure 7, a controller then determines whether a *touch* signal has been input through that same "specific menu icon of the location where the proximity signal was detected" (i.e., the determination in step S515). *Id.*, 11:66-12:3. The "touch signal may be input through a touch screen." *Id.* Using FIG. 12(a) above as an example, a user seeking to tap the "messaging" icon could position a finger above that icon (causing the proximity sensor to detect a proximity signal associated with the icon), then move the finger downward (causing the touch sensor to detect a touch signal associated with the icon). In that scenario—with both the proximity and touch signals detected at the location of the same icon (i.e., detected from a single portion of the screen on which the icon is displayed), "vibration signals" corresponding to both signals are "combined through the haptic module 157 (S520)" such that both "vibration signals may be added or subtracted and then output as vibration." *Id.*, 12:18-28.

206. While the flow chart diagram in FIG. 7 illustrates an exemplary method, Ku's FIG 12 illustrates a related embodiment in which vibration signals are likewise added (as previously contemplated in Figure 7):

FIG. 12



207. In relation to FIG. 12, Ku describes that if a “proximity signal is maintained for a specific period of time” and then “a menu icon is touched,” vibration 715 is output. *Id.*, 16:22-27. Vibration 715 is the sum of two different vibrations signals—one (710) “set with respect to the proximity signal” (*id.*, 16:19-20) and the other (705) “set with respect to the touch signal” (*id.*, 16:17-18). I have enlarged and highlighted a portion of FIG. 12(d) below to illustrate how touching the menu icon leads to 705 and 710 being “**added** is output” (*id.*, 16:26):



The user experiences vibration 715 only if the system detects both a proximity input *and* a touch input.

208. In FIG. 12(d), a POSA would understand that at each point of time in the “Time axis” of the highlighted 715, the intensity of vibration 715 equals to the sum or addition of the intensity values of vibration signals 705 and 710, respectively, as evidenced by the upward shift in Figure 12(d)—reflecting the superimposition of 705 and 710. See also the “+” sign between FIGs. 12(b) and 12(c), and by the notation “<<ADD>>” in FIG. 12(d). A POSA would understand that Ku discloses that vibration 715 is result of a combination (and in particular, a mathematical addition) of the vibration signals 705 (based on a proximity signal) and 710 (based on a touch signal). This is fundamentally different from the Choe reference applied during prosecution as I discussed in § IV.C above. As the Board noted, Choe disclosed “outputting effects sequentially” rather than teaching the touch and proximity signals could be “combined.” EX1002, 1091. By contrast, Ku expressly discloses a “*combined*” vibration signal corresponding to the

proximity signal and the touch signal” EX1008, 2:2-3. A POSA would understand Ku’s FIG. 12 details one particular embodiment of such combination.

209. In my opinion Ku’s FIG. 12 offers far more detail concerning how a combination of vibration signals based on both proximity signal and touch signal than what the ’738 patent describes. The ’738 patent merely states that haptic effects associated with proximity and touch signals can be “combined.” EX1001, 11:35-37). Ku’s FIG. 12 builds upon Ku’s FIG. 7 and illustrates a particular way in which a combined haptic effect can be output if—and only if—the device’s processor has received both a first sensor signal associated with the non-contact interaction and a second sensor signal associated with the touch.

2. The Pratt-Ku Combination

210. As I discussed in the section immediately above, Ku discloses a single combined vibration signal generated based on both a proximity signal and a touch signal. In my opinion, a POSA would have found it obvious to modify Pratt's teaching to implement Ku, as an additional use scenario that Pratt's device meets the claim, in addition to the two specific embodiments disclosed in Pratt itself I discussed in Section VI.2.g above. Even aside from those embodiments, however, a POSA would have had reason to modify Pratt in view of Ku’s teachings to send a haptic output signal to Pratt’s haptic output device calling for a single haptic effect reflecting both the proximity and touch signals.

211. Pratt's FIG. 4 illustrates a "pre-charging haptic generation operation." EX1006, [0038]. When the device's proximity sensor detects a finger at a "predetermined distance (Threshold P) from the touch surface," Pratt begins "pre-charging the haptic actuator...according to a haptic profile for the anticipated time and location of the touch." *Id.*, [0039]. If the device later (at time t2) detects the finger making contact, the device generates the haptic profile "faster" than otherwise would have been possible. *Id.* I have reproduced FIG. 4 of Pratt below. I note that while FIG. 4 does not label time t1 and time t2, a POSA reading paragraph 39 (which concerns Figure 4) would understand that time t1 is associated with when the finger is at "Threshold P" from the touch surface, and time t2 is associated with "Threshold T." In the figure below I have annotated t1 and t2 accordingly.

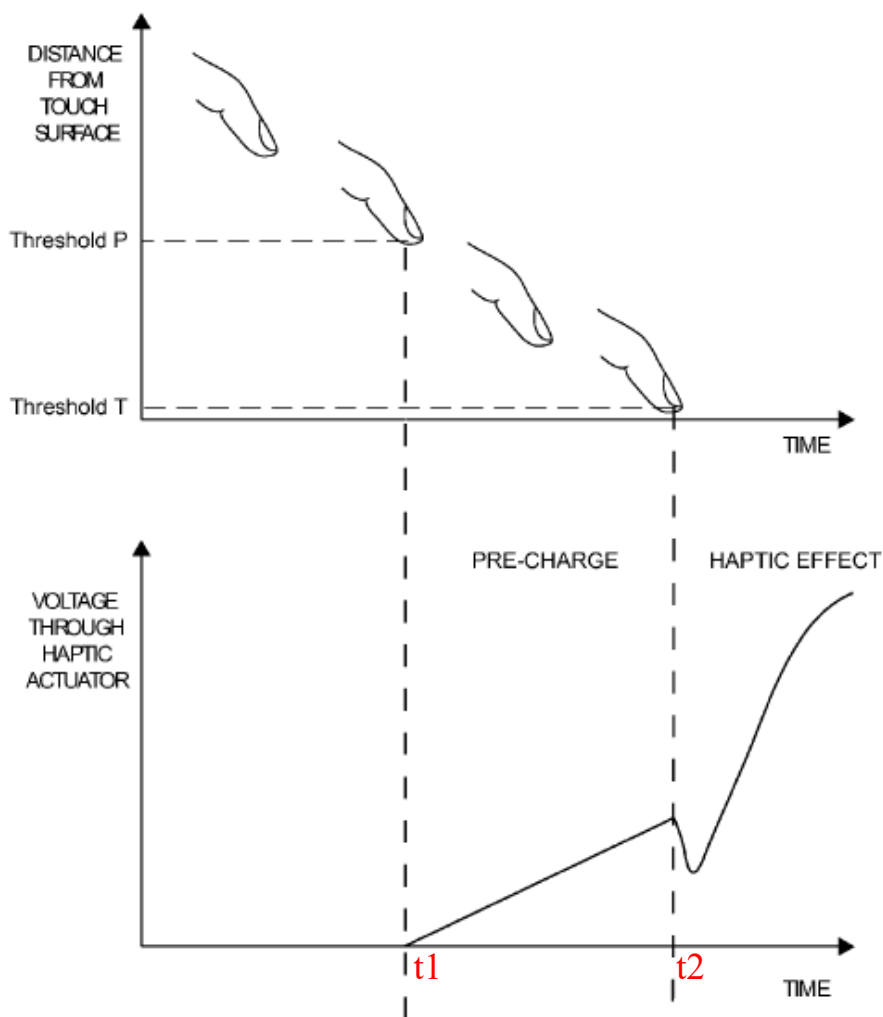


FIG. 4

Pratt, FIG. 4 (annotated to show t1 and t2).

212. While Pratt thereby reduces latency between the user touching the screen and feeling the haptic effect, a POSA would have viewed it as ready for improvement by using Ku’s method of “distinguishing input signals.” EX1008, 1:15-17. Pratt itself does not address the problem solved by Ku’s FIG. 7 (and further illustrated by Ku’s FIG. 12 as I explained in the previous section)—that is, distinguishing whether input signals are from different menu icons or the same

menu icon. In view of Ku, however, a POSA would have had reason to use Pratt's device to practice Pratt's FIG. 4 such that one "haptic effect" (as illustrated in Ku's FIG. 12(d), and as I explained in the previous section) is output if Pratt detects proximity and touch signals associated with the same menu icon (per step S520 in Ku's FIG. 7) and a different "haptic effect" is output otherwise (per Ku's step S525). For example, in FIGs. 3(a), 3(b), Pratt discloses a device with a user interface including multiple icons:

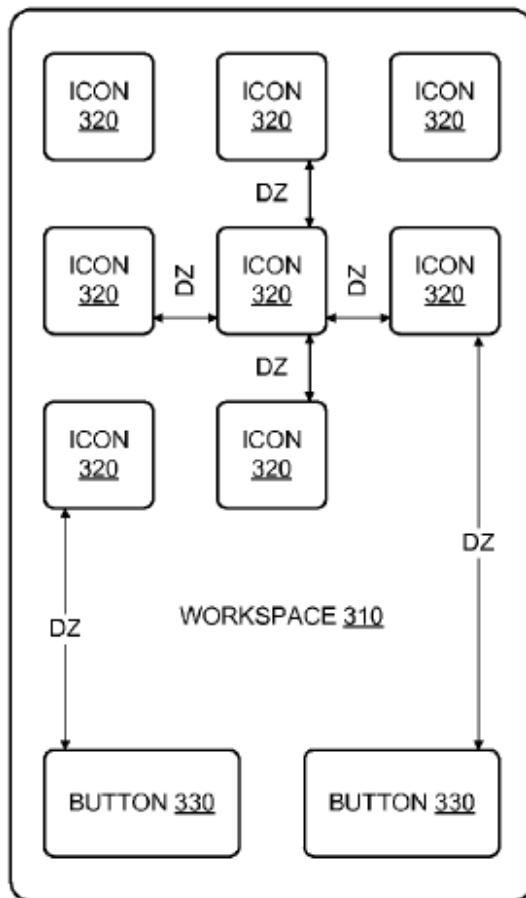


FIG. 3(a)

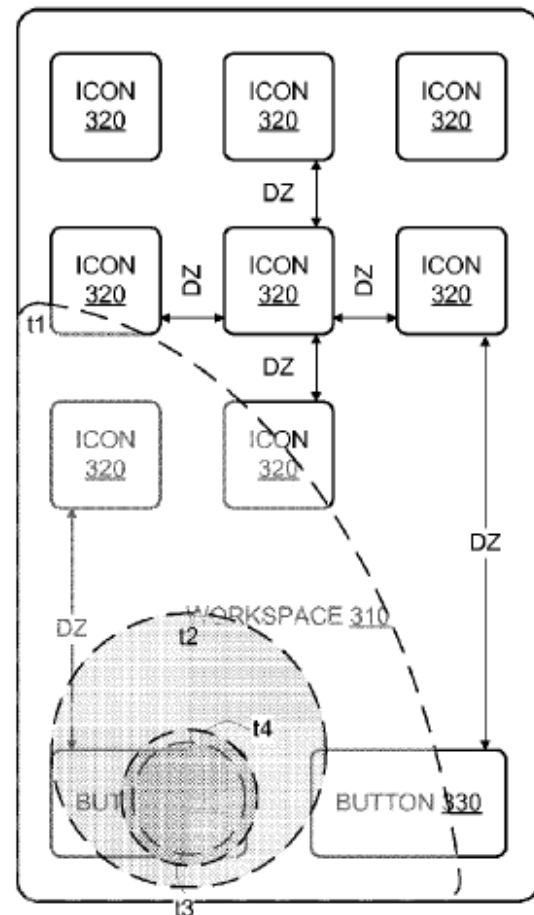
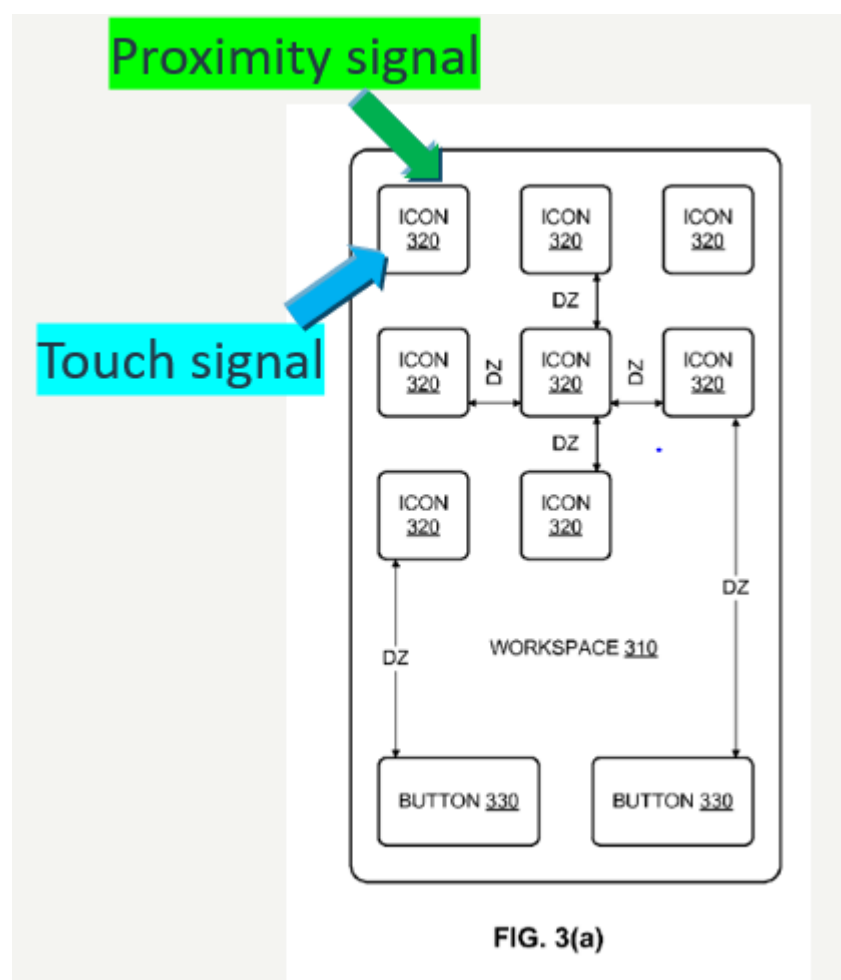
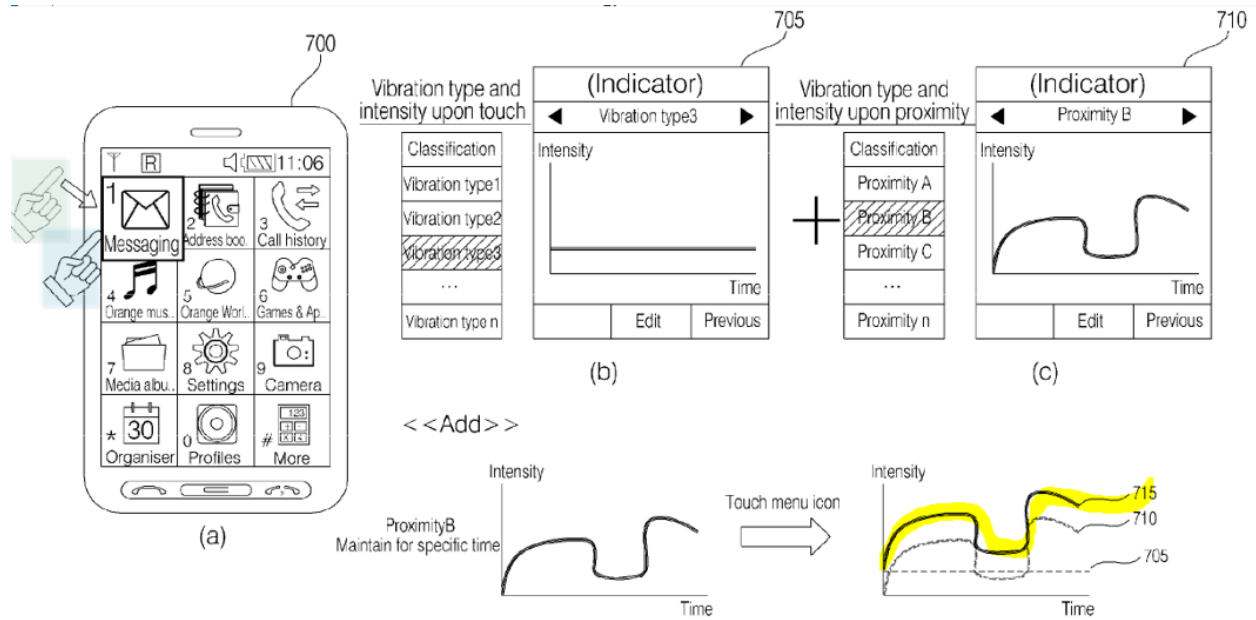


FIG. 3(b)

EX1006, FIGs. 3(a), 3(b); [0036]. When implemented according to Ku's teachings, the combination (which I refer to as "Pratt-Ku") would have output Ku's vibration 715 if the device detected both proximity and touch signals from the portion of the screen associated with the same icon. For example, the annotation below in Pratt's FIG. 3(a) concerning Pratt's workspace 310 illustrates the close parallel with the corresponding user interface of Ku's device 700 in Ku's FIG 12(a):



EX1006, FIG. 3(a), annotated.



EX1008, FIG. 12, annotated.

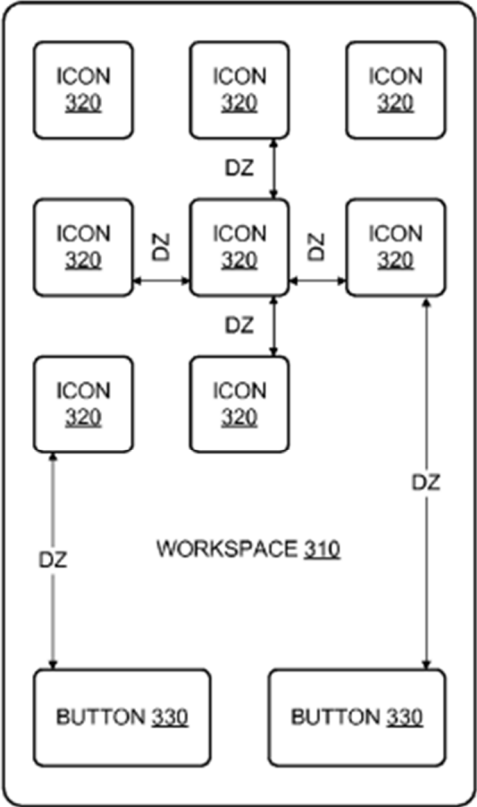
This combination would allow a user to confirm whether he has touched the specific menu icon he has been approaching and intending to touch (e.g. “Messaging” in Ku’s FIG. 12), or his finger has moved laterally between approaching and the actual touch such that he has touched a different menu icon (e.g. “Address book” in Ku’s FIG. 12). Accordingly, a POSA would have recognized that such an alert as suggested in Ku (that is, whether the user’s finger made contact with the portion of the screen over which the finger had previously been hovering) would be desirable to indicate whether the user touched the on-screen icon the user intended to touch. Relatedly, I note that the description in Ku concerning Ku’s Figure 12 does not actually require the proximity and touch signals to originate from the same portion of the touch screen (i.e., corresponding

to a single icon). Instead, Ku simply discloses that if “the proximity signal is maintained for a specific period of time” and “a menu icon is then touched, vibration 715” is output reflecting the addition of 705 and 710. EX1008, 16:22-25. However, a POSA would understand that FIG. 12 could be implemented consistently with FIG. 7—that is, combining 705 and 710 only if the touch signal originates from the same portion of the touch screen (corresponding to the same icon) as the preceding proximity signal. This combination would have been particularly useful in connection with practicing Pratt because it includes the detail of FIG. 12 while offering the benefit of distinguishing whether input signals are from different menu icons or the same menu icon (as contemplated by FIG. 7).

213. Pratt-Ku would have yielded a mobile device with Pratt’s reduced latency and Ku’s ability to distinguish input signals—quickly alerting users the moment they touch the portion of the screen where their finger had previously been hovering. A POSA would have recognized that such an alert was desirable in order to indicate to users whether they touched the icon they intended to touch (as opposed to a different portion of the screen).

214. A POSA would have had a reasonable expectation of success when practicing Pratt to implement Pratt-Ku. As I will explain below, Ku and Pratt are fully consistent and complementary in all relevant respects—including both hardware and software designs.

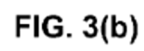
215. First, both Pratt and Ku implement a touch screen user interface with icons displayed at different locations. This is evident from Pratt's FIG. 3(a) as well as Ku's Figure 12, which as I discussed in paragraph 204 above is also applicable to Ku's Figure 7 given that the "screen 700" shown in Figure 12 with a "plurality of menu icons" (EX1008, 16:9-10) reflects a user environment in which Figure 7's "method of distinguishing input signals inputted from different display locations" (*id.*, 2:62-63). Accordingly, Ku's Figures 7 and 12—relying on proximity and touch signals associated with the on-screen locations of particular icons—illustrate processes that would have been suitable for incorporation into Pratt. For example, Pratt's device includes a host system 150 that "manage[s] content of the display, providing icons and softkeys thereon to solicit user input thru the touch screen 140." EX1006, [0018]. These "icons" and "buttons" are illustrated in the two-dimensional "workspace" or "UI map" 310 in Pratt's FIG. 3(a). *Id.*, [0036]. UI means user interface. Similarly, Ku's method of "distinguishing input signals associated with different display locations" disclosed in FIG. 7 is implemented in a screen including menu icons displayed on a display unit. EX1008, 11:46-53. Ku's UI is shown in FIG. 12(a) (EX1008, 16:8-10), which I have reproduced below along with Pratt's FIG. 3(a) (EX1006 [0009], [0036]).

 FIG. 3(a)	 (a)
Pratt, FIG. 3(a).	Ku, FIG. 12(a).

216. Second, Ku uses a controller 180 to determine if a proximity signal has been detected at the location of a specific menu icon (EX1008, 11:54-57, step S505 of FIG. 7) and to determine if a touch signal has been input at the same location (*id.*, 11:66-12:3, step S515 of FIG. 7). A POSA would have recognized that Pratt’s processor—with the proximity and touch classification modules—was suitable for implementing Ku’s decisional steps such as S505, S515 of Ku’s FIG.

7. For example, Pratt’s proximity classification module 112.1 may “calculate

location” of the “user movement (e.g., finger, stylus, pen, etc.) as it hovers over the touch screen 140.” EX1006, [0021]. Furthermore, Pratt’s “touch classification module 112.2” may “calculate user touch(es) on the touch screen 140,” “icon selection,” and the “location” of the user touch. *Id.*, [0022]. Pratt also teaches that “[t]he sensors detection may become more localized as the user finger approaches and touches the screen.” *Id.*, [0037]. As a result, Pratt teaches that a finger may be detected as approaching one menu icon, and subsequently be detected as touching a different menu icon. This is illustrated in Pratt’s FIG. 3(b), which I have reproduced below. Pratt’s FIG. 3(b) illustrates different “workspace detection area[s]” during a time sequence as a user’s finger approaches a screen at time t2 “above the button 330,” which I annotated below in blue, while at time t3 the finger “may touch the screen at button 320,” and “at time t4, the detection area may increase detecting a larger amount of force as compared to time t3 touch which I annotated below in red. *Id.*, [0037].



217. Third, a POSA would have recognized that Pratt's haptics driver 120 and haptics actuator 130 were suitable for generating the combined haptic effect illustrated in Ku's FIG. 12 to implement the Ku's method in FIG. 7. As I explained in §VI.A.2.d, Pratt's haptics actuator constitutes a haptic output device within the meaning of the '738 Patent both alone and when considered together with the haptics driver 130.

218. For example, as I explained above in Section VI.B.1, Ku's FIG. 12(d) illustrates an "Intensity" versus "Time" plot of combined vibration signal 715. As I explained above in Section VI.A.2.d, a POSA would have understood that Pratt's haptics driver 120 and haptics actuator 130 allows a controller to send haptic commands to specify the intensity and duration of a desired haptic effect. The haptic commands of Pratt are consistent with the vibration signal 715 in FIG. 12 of Ku. It would be a routine engineering task to implement either of Ku's algorithms in Pratt's hardware.

3. Claims 1-3, 5-6, 14-15, and 19

219. I have explained in Section VI.A above how claims 1-3, 5-6, 14-15, and 19 are anticipated by or at minimum obvious over Pratt. In my opinion these claims would also have been obvious over Pratt-Ku. Even if it were determined—despite my analysis and opinions detailed in connection with Ground 1 as described in Section VI.A above—that Pratt does not disclose or render obvious

[1F], [15F], and [19F], Ku's FIG. 7 together with FIG. 12 plainly discloses an implementation that meets [1F], [15F], and [19F]. It would have been obvious to implement Ku's FIG. 7 and/or FIG. 12 in Pratt (as I explained in Section VI.B.2 above) such that Pratt's processor would be configured to "*generate a haptic output signal based at least in part on the first and second sensor signals*" as claimed.

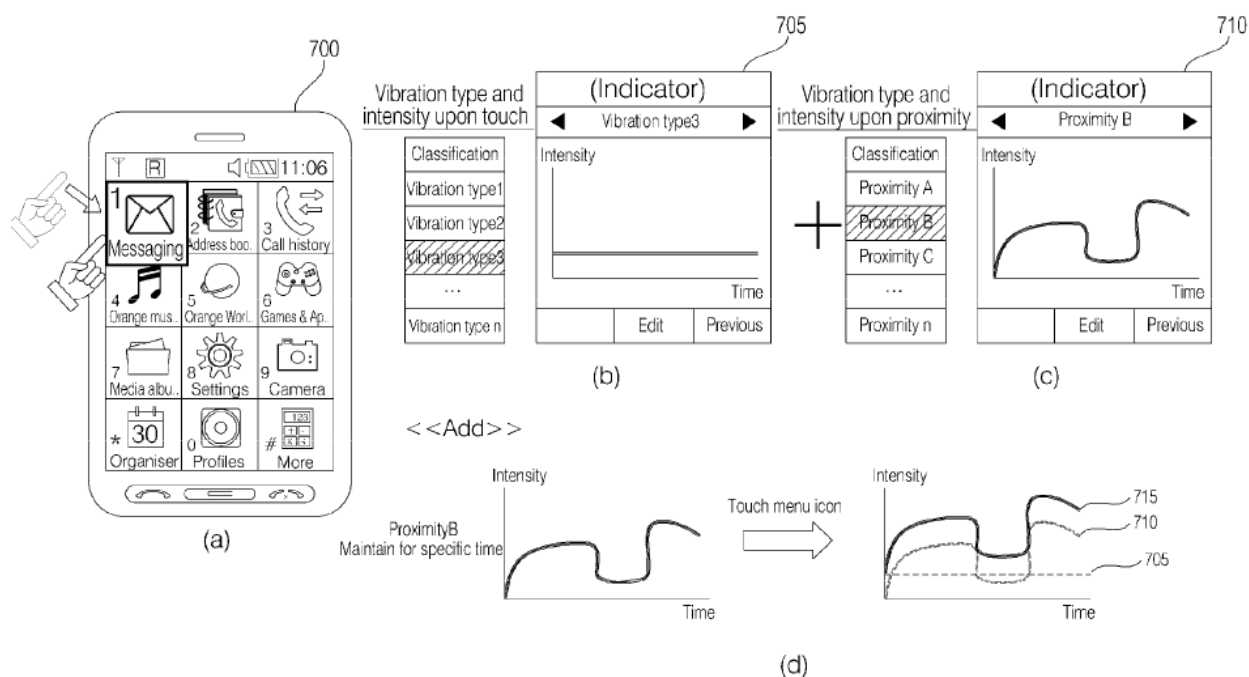
220. I will explain below how Ku's FIG. 7 together with FIG. 12 plainly discloses an implementation that meets [1F], [15F], and [19F].

221. Ku's FIG. 7 illustrates how "if, as a result of the determination in S515, the touch signal has been input through the specific menu icon, the controller 180 outputs vibration in which a vibration signal corresponding to the proximity signal...and a vibration signal corresponding to the touch signal...***are combined through the haptic module 157 (S520).***" EX1008, 12:18-26 (emphasis added). Ku similarly discloses in (*id.*, 20:25-47) a claimed "method of distinguishing input signals detected by a mobile terminal," including "outputting a third vibration that is a combination of the first vibration and the second vibration" if the "location...at which the proximity touch is received" is the "same" as the "location...at which the touch input is received[.]" When implemented in Pratt, a POSA would understand that Ku's FIG. 7 would rely on Pratt's haptic response search module 112.4 within processor 112; module 112.4 would receive data from proximity and

touch classification modules 112.1 and 112.2, then generate a “haptic command” “based at least in part on the first and second sensor signals.” As I explained above in Section VI.A.2.d, Pratt’s “haptic command” constitutes “a haptic output signal.”

222. Ku’s FIG. 12 illustrates one such combination of a first proximity-related vibration signal (710) and a second touch-related vibration signal (705). Together, the combined first and second vibration signals constitute vibration signal 715:

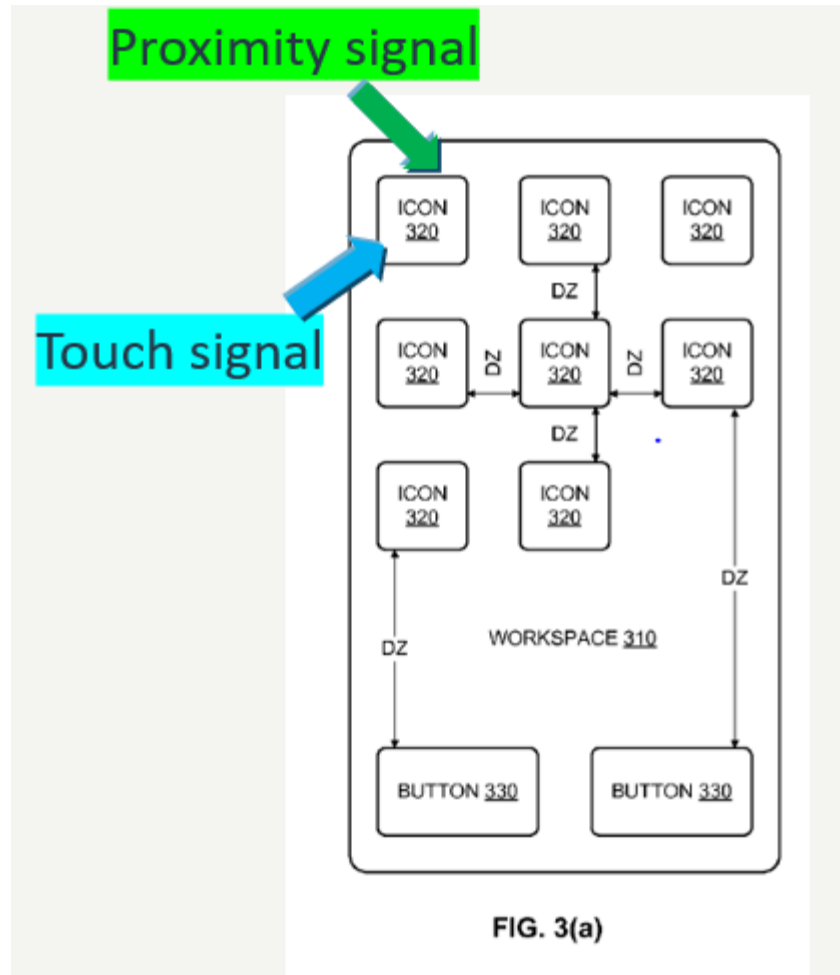
FIG. 12



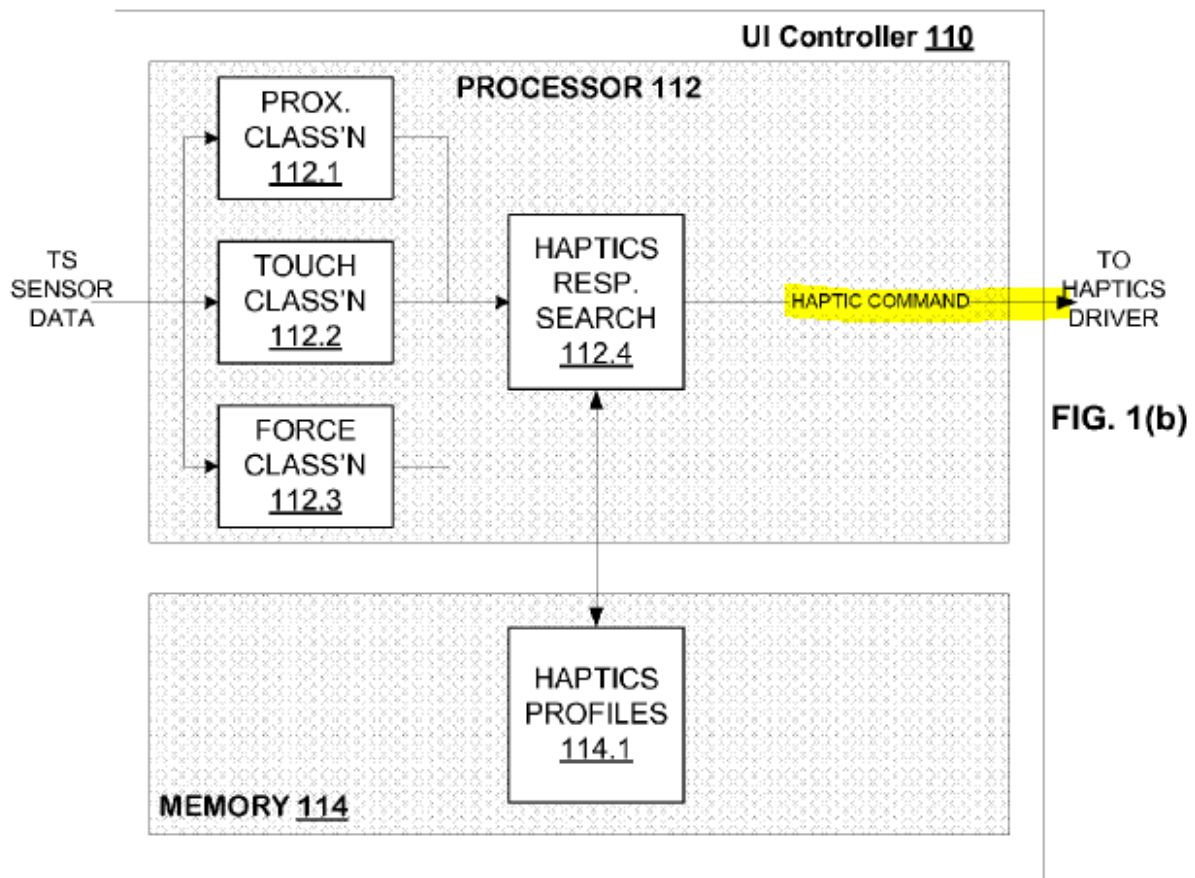
223. A POSA would understand that FIG. 12’s disclosure of how vibration signals 705, 710 are selected and combined illustrate one natural way to implement the method of FIG. 7, while there could be other specific ways to implement FIG.

7. At minimum, the algorithms in both FIG. 12 (as illustrated) and FIG. 7 are similar in that both involve distinguishing whether a subsequent touch differs from an earlier proximity signal.

224. Ku's FIG. 12(d) illustrates how vibrations 705 and 710 are output at the same time—thus combined into vibration 715 that has a higher intensity than either vibration 710 or 705 at a given point on the time axis (which a POSA would understand is consistent with step S520 in FIG. 7, and further associated with the “third vibration” per Ku's claims 1 and 21). As implemented in Pratt, Ku's vibration 715 would be output only if Pratt-Ku's processor determined that “after the proximity signal is maintained for a specific period of time, a menu icon [i.e., one of Pratt's icons 320] is touched.” EX1008, 16:22-25. As one non-limiting example, a POSA could further integrate Ku's teachings in FIG. 7 into FIG. 12 such that Pratt-Ku output vibration 715 only if the proximity and touch signals were detected from a single portion of the screen (as suggested by the illustration of FIG. 12(a) itself, in which both signals are associated with the same icon). This is illustrated by the annotated version of Pratt's FIG. 3(a) below:



225. To trigger vibration 715, Pratt-Ku would send a single haptic output signal (i.e., a single “haptic command” in Pratt’s terminology) from processor 112 to the haptics driver. This is illustrated by the annotation in Pratt’s FIG. 1(b) below:



226. Generating a single “haptic output signal” calling for Ku’s vibration 715 based on both the proximity and touch signals (i.e., the “first and second sensor signals” as required by [1F], [15F], and [19F]) and sending to the haptics driver indeed would have been more efficient and flexible than sending multiple haptic output signals to the haptics driver and requiring the driver to process them into a single output. A POSA would have recognized the benefits of such consolidation based on teachings such as that in Tierling (published in 2005), which discloses a “haptic device controller 130” “within [a] processor,” EX1020, FIG. 1, [0045]-[0046], that outputs “a control signal” to “control[] the tactile

output [] of the haptic device 124.” *Id.*, FIG. 2, [0048]. Controller 130 includes an “effect combiner/sequencer 308” that can “combine [] multiple effects” using “summation.” *Id.*, FIG. 3B, [0062].

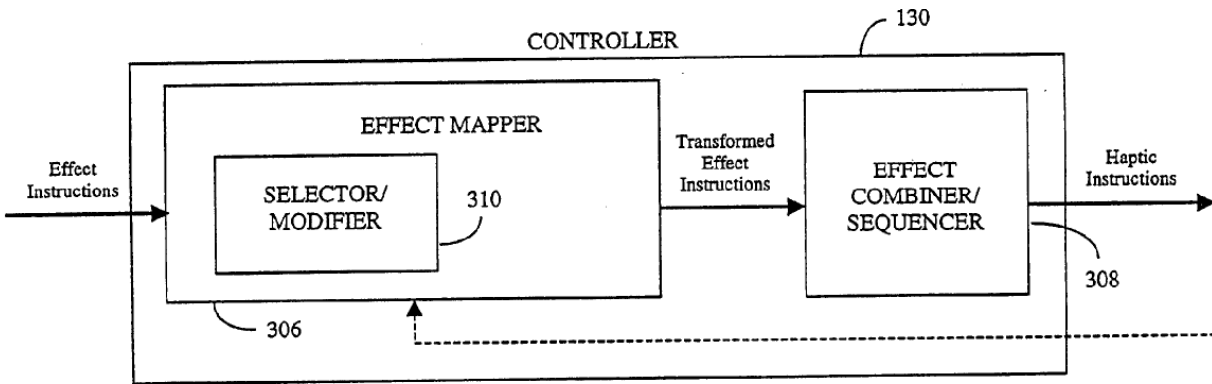


Fig. 3B

Sending a single haptic output signal to generate vibration 715 would also simplify the design requirements for Pratt’s haptics driver 120 and haptics actuator 130. For example, Tierling teaches that that the “effect combiner/sequencer 308...saves synthesizer and/or processor resources.” *Id.*, [0062]. Tierling also discloses “code to: superimpose multiple haptic instructions...to create at least one superimposed haptic instruction” associated with a “haptic signal.” *Id.*, claim 6. A POSA would have recognized the utility of Tierling’s code in implementing Ku’s Figure 12 and in particular outputting from Pratt’s processor a single “superimposed haptic instruction” calling for Pratt’s haptic output device to generate a combined vibration as illustrated in Ku’s FIGS. 7 and 12. *Id.*

227. Moreover, the reasons why Pratt satisfies the other claim elements (other than [1F], [15F], and [19F]) remain unchanged when using Ku’s FIGS. 7

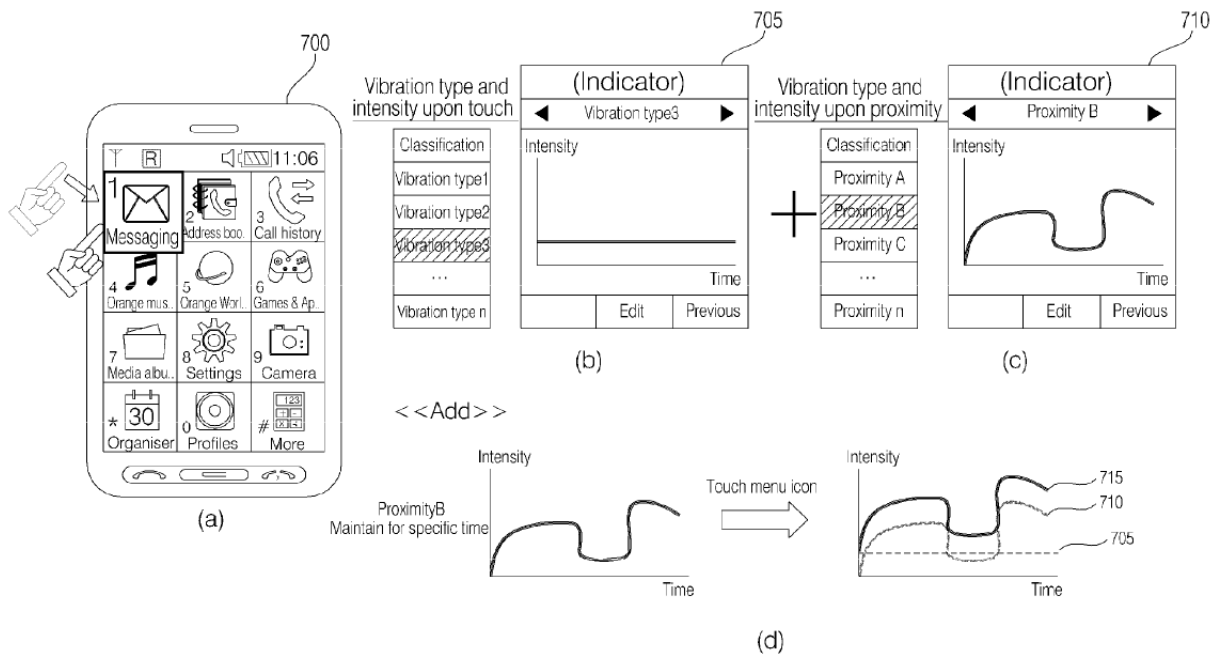
and 12 to implement the “haptic effect” reflected in Pratt’s FIG. 4 and thereby distinguishing different touch inputs. I have explained how Pratt meets these elements above in Section VI.A. In particular, it is my opinion that Pratt-Ku would satisfy the claimed “haptic output device” based on (1) Pratt’s haptics actuator 130 alone; and separately (2) the combination of driver 120 and actuator 130, which a POSA would have understood as a single haptic output device. See Section VI.A.2.d.

4. Claims 4 and 16: “the haptic output signal is designed to direct a user to contact the touch-sensitive device at a particular location”

228. In my opinion, Pratt-Ku renders claims 4 and 16 obvious as the haptic signal generated per Ku’s FIGs. 7 and 12 (incorporated into Pratt-Ku as I explained above in Section VI.B.2) “*is designed to direct users to contact the touch-sensitive device at a particular location*” as claimed. Ku’s signal directs users to a particular “menu icon,” as the haptic output signal is generated only if based on “the determination in S515” [i.e., step S515 in EX1008, FIG. 7)] it is determined that the touch signal received by the controller 180 corresponds to the same icon associated with the proximity signal. *Id.*, 11:54-12:26. This is further illustrated in FIG. 12, with a combined haptic output based on a user contacting the “messaging” icon displayed on a touch-sensitive device after the user’s finger previously

registered a proximity signal based on proximity to that same icon (as evident from the two differently shaded finger graphics in the vicinity of the “Messaging” icon).

FIG.12



EX1008, FIG. 12.

While the accompanying description in Ku’s text concerning FIG. 12 does not expressly require the proximity and touch signals to be associated with the same icon (unlike FIG. 7), a POSA would understand that the particular implementation illustrated in FIG. 12 was a particularly desirable approach given the indication it provides to users whether they have touched the screen in the intended place without needing to actually look at the screen.

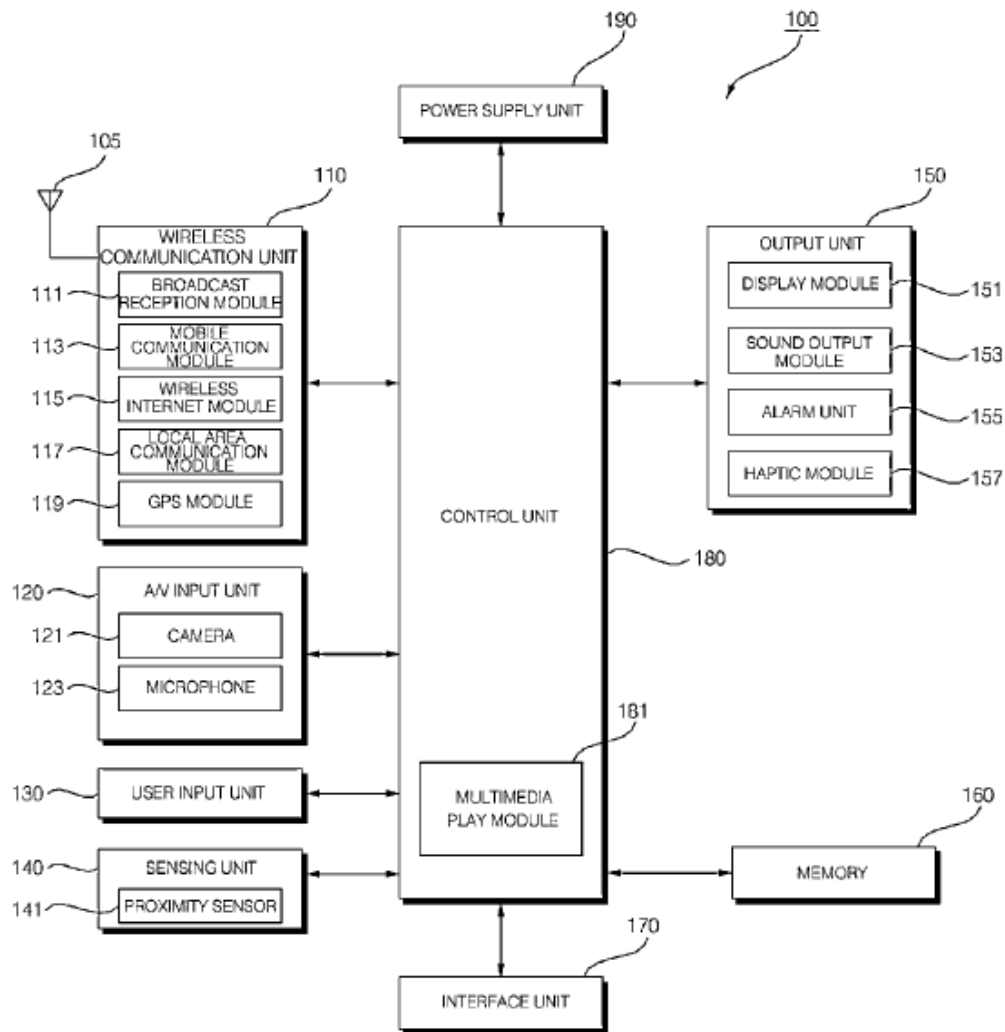
229. Under the approach illustrated in FIG. 7 and FIG. 12, if the touch signal instead corresponds to a different icon, Pratt's device outputs a vibration corresponding to just the touch signal at S530 without combining the two vibration signals, thereby indicating that the specific menu icon associated with the proximity signal was not touched. EX1008, 11:54-12:17; FIG. 7. This approach would help alert the user when their finger accidentally misses or slides off the icon they intended to press and mistakenly activates a neighboring icon. If the user does not experience the combined vibration, the user would know to try again and tap the screen at the particular intended location corresponding to the desired icon.

C. Ground 3: Ku Renders Claims 1-5, 14-16, and 19 Obvious

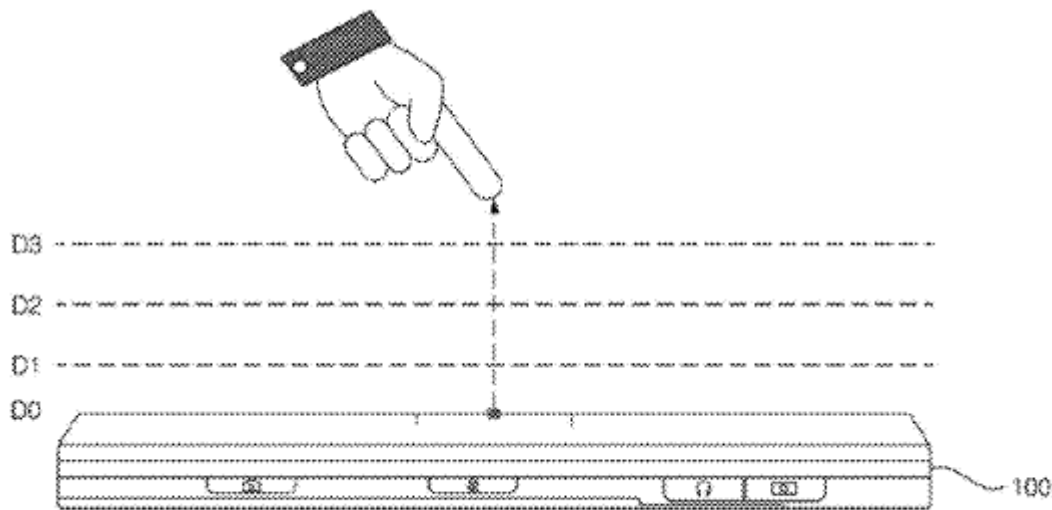
230. This ground is based on Ku. In my opinion, claims 1, 3-4, 14-16, and 19 are obvious over Ku in view of a POSA's knowledge. As I discussed above in Section VI.B.1, Ku's FIGs. 7 and 12 disclose generating a haptic effect based on two different sensor signals—tracking Ku's disclosure of outputting “a *combined* vibration signal corresponding to the proximity signal and the touch signal” if the proximity and touch inputs correspond to the same on-screen location (EX1008, 1:61-2:5).

231. Ku also discloses a mobile terminal 100 for implementing FIGs. 7 and 12. The mobile terminal 100 is illustrated in FIG. 1:

FIG. 1



232. Terminal 100 includes proximity sensor 141, which works by monitoring capacitance changes. *Id.*, 5:39-44. The proximity sensor’s operation is also illustrated in FIG. 4, which I reproduced below. *See also id.*, 2:55-56. If the proximity sensor senses the approach of a user’s finger, it outputs a “proximity signal.” *Id.*, 10:3-10.



233. Ku’s terminal also includes output unit 150 with display unit 151, which may comprise a “touch screen panel” functioning as a touch sensor— “monitor[ing] whether there is a touch input and, [if so], send[ing] corresponding signals to the touch screen panel controller.” *Id.*, 5:59-6:4. The controller “processes” such signals and “transmits the corresponding data to the controller 180,” which determines “whether there has been a touch input.” *Id.*, 6:4-9.

234. Ku’s terminal further includes haptic module 157, which “generates a variety of haptic effects” such as a “vibration signal,” which may include “different pieces” (i.e., of vibration). *Id.*, 6:45-52. As I explained above in Section VI.B.1, the “vibration signal” described in this passage refers to a vibration effect that can be felt by a user as a vibration sensation with certain intensity, pattern, etc. This disclosure in Ku is consistent with Ku’s descriptions of FIGs. 7 and 12. For example, EX1008, 6:51-52 states that “different pieces of vibration signals [that

refer to vibration effect] may be composed or output or sequentially output,” which a POSA would understand that teaches different vibration effects may be “sequentially output” in different time frames, or alternatively output in a single time frame just as the combined vibration signal 715 as shown in FIG. 12(d) is output as a single vibration effect having the same time duration (as I discussed above in Section VI.B.1).

235. Notably, when I compare the Choe reference (EX1015) applied during prosecution to Ku, I find that Choe lacks disclosures comparable to Ku’s FIGs. 7 and 12, but is otherwise comparable to Ku and includes at least one overlapping inventor (Seon Hwi Cho, Seoul (KR)). Ku’s FIG. 1 indeed is essentially identical to Choe’s FIG. 1 (with the only differences being the addition of a “Multimedia Play Module 181” , “Sound Output Module 153,” “Alarm Unit 155” in Ku versus “Audio Output module 153,” “Alarm Module 155” in Choe). And aside from claim elements [1F], [15F], and 19[F] (requiring a haptic output signal based on first **and** second sensor signals, as explicitly disclosed in Ku’s FIGs. 7 and 12 but absent from Choe), the Office repeatedly determined (and applicants never disputed) during prosecution that Choe disclosed or rendered obvious all claim elements.

1. Claim 1

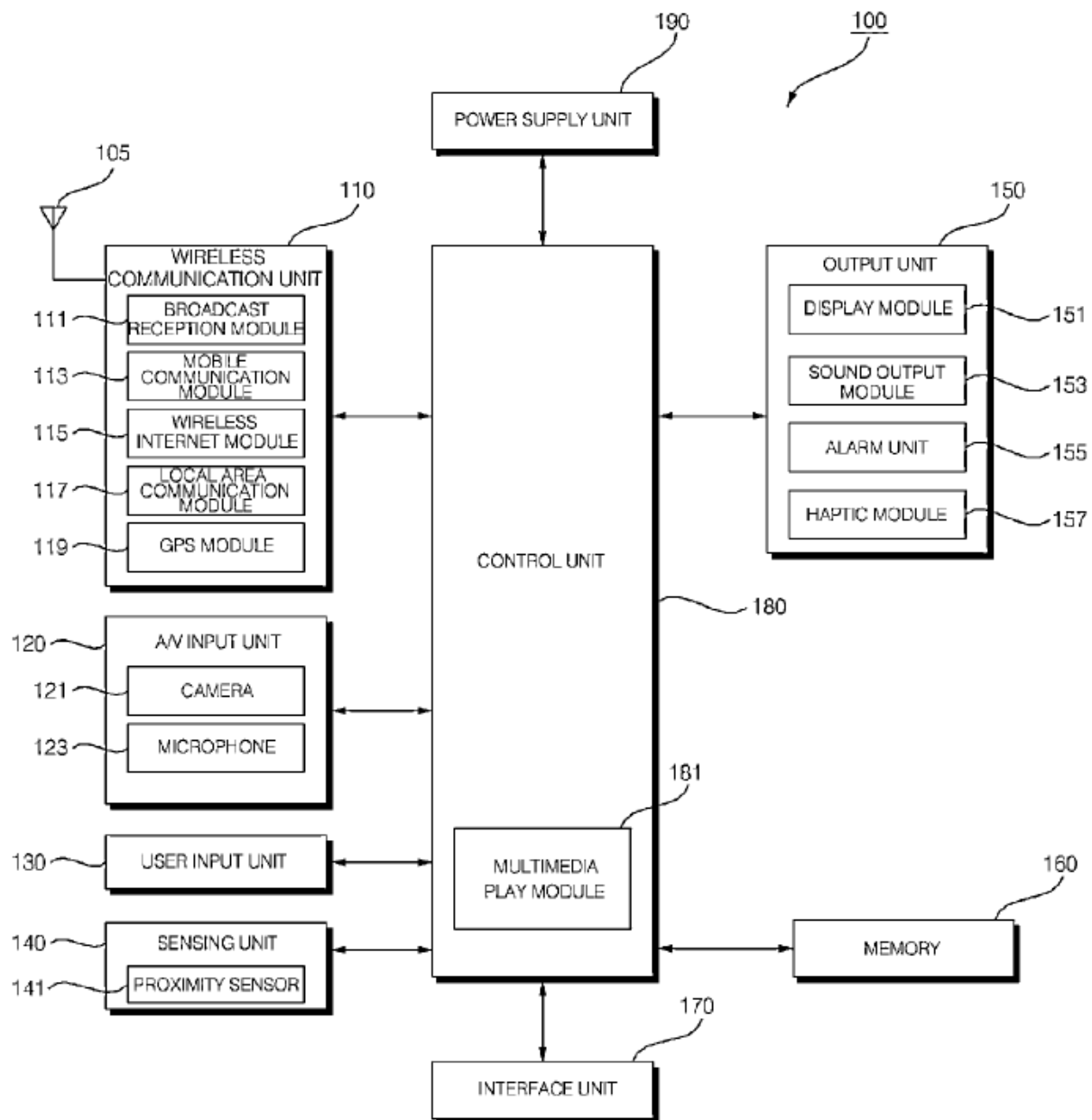
a. [1PRE]: “A device comprising:”

236. If the preamble is limiting, Ku meets it as Ku discloses a “*device*” as claimed.

237. For example, Ku describes a “mobile terminal” for implementing “[a] method of distinguishing input signals.” EX1008, Abstract. Ku also describes “present invention relates generally to mobile terminals.” *Id.*, 1:15-17. Ku’s FIG. 1 illustrates such a terminal, which a POSA would understand as a “device.” Moreover, Ku describes examples of its “mobile terminals” as “mobile phones, smart phones,” (*id.*, 3:43-47), which are consistent with what the ’738 patent describes as a “computing device” (e.g. “a mobile device,” “smartphone”). EX1001, 3:60-61.

b. [1A]: “a proximity sensor capable of detecting a non-contact interaction with a touch-sensitive device and outputting a first sensor signal;”

238. Ku meets this limitation as Ku’s terminal 100 includes “a proximity sensor capable of detecting a non-contact interaction with a touch-sensitive device and outputting a first sensor signal” as claimed. For example, FIG. 1 shows that the terminal includes proximity sensor 141 as well as display unit 151, which “operates as a touch screen” (EX1008, 8:27-30). A POSA would understand a touch screen is a “*touch-sensitive device*.”



239. Ku's proximity sensor 141 can "detect an approaching object...without mechanical contact." *Id.*, 5:39-42.

240. FIG. 4 illustrates how "when a user's finger approaches the display area 151, the proximity sensor 141 senses such approach and outputs a proximity

signal” (the “*first sensor signal*”). *Id.*, 10:3-7. This “proximity signal” may reflect the distance from the finger to display unit 151, such that it reflects a non-contact interaction. *See also id.*, 11:54-58 (discussing “proximity signal” in connection with FIG. 7). A POSA would also understand that Ku’s claim 21 covers an implementation of the embodiment in FIG. 7, and confirms that Ku meets [1A] based on claim 21’s disclosure of “a proximity sensor for detecting a proximity touch[.]” *Id.*, 22:47-54.

c. [1B]: “a touch sensor capable of detecting a touch with the touch-sensitive input device and outputting a second sensor signal”

241. Ku meets this limitation given that Ku’s mobile terminal 100 includes “a touch sensor capable of detecting a touch with the touch-sensitive input device and outputting a second sensor signal,” as claimed. I have already explained above in Section VI.A.2.c (concerning [1B] in connection with the Pratt-based ground) that a POSA would understand the “the touch-sensitive input device” contains a typographical error with an extra word “input,” and that the phrase refers to the “touch-sensitive device” recited in [1A].

242. As I previously noted, display unit 151 constitutes a touch-sensitive input device. It may “comprise a touch screen panel, a touch screen panel controller, or other touch screen component.” EX1008, 5:64-66; *see also id.*, 5:66-6:1. The panel “monitor[s] whether there is a touch input and, when there is a

touch input, sends corresponding signals to the touch screen panel controller.” *Id.*, 6:1-6:4. The panel controller processes those “signals received from the touch screen panel and transmits the corresponding data to the controller 180,” which assesses “whether there has been a touch input[.]” *Id.*, 6:4-9.

243. The panel and its controller together constitute a “touch sensor” outputting a signal (“*second sensor signal*”) as “data” transmitted by the touch screen panel controller to controller 180. As disclosed in Ku’s FIG. 7, that second sensor signal permits controller 180 to determine “whether a touch signal has been input through the specific menu icon of the location where the proximity signal was detected in step S505.” *Id.*, 11:64-12:3. The controller determines this based on a signal (the “*second sensor signal*”). A POSA would also understand that Ku’s claim 21 confirms that Ku meets [1B] based on claim 21’s disclosure of “a touch screen for detecting the touch input.” *Id.*, 22:51-56.

244. Understanding the panel and its controller together as the “touch sensor” is consistent with the ’738 patent, which describes how “touch sensor 108 may detect” various types of information...then “***incorporate this information into the signal*** transmitted to the processor 102.” EX1001, 4:39-41 (emphasis added). The touch sensor signal (“*second sensor signal*” as claimed) sent by the “touch sensor” thus may be pre-processed by the touch sensor rather than constituting raw

data (e.g., capacitance values, although such capacitance values would also constitute the second sensor signal as discussed in Section VI.A.2.c above).

245. Ku’s terminal 100 would also satisfy [1B] even if one assumed—despite the lack of any such indication in the patent—that the “second sensor signal” required raw data. The ’738 patent discloses that FIG. 5 (concerning a touch sensor signal) “may be implemented by a group of processors.” EX1001, 11:9-11; *see also id.*, 13:21-57 (“In one embodiment, a computer may comprise a processor or processors.... The processor, and the processing, described may be in one or more structures, and may be dispersed through one or more structures.”). Consistent with such an understanding as indicated in the ’738 patent, a POSA would understand Ku’s touch screen panel constitutes the “touch sensor” and Ku’s touch screen panel controller together with controller 180 constitutes the “processor” as addressed below in [1D].

d. [1C]: “a haptic output device configured to receive a haptic output signal and output a haptic effect in response to the haptic output signal; and”

246. Ku meets this limitation as Ku’s terminal 100 includes “a haptic output device configured to receive a haptic output signal and output a haptic effect in response to the haptic output signal” as claimed. As an initial matter, I note (as I previously explained in Sections VI.A.2.d and VI.A.2.g above concerning Pratt as applied to [1C] and [1F]) that a POSA would understand that the “haptic output

signal” generated in [1F] concerns the “haptic output signal” referenced in [1C] (reciting “a haptic output signal” be received by “a haptic output device”).

247. Ku’s “haptic module 157 generates a variety of haptic effects,” which a POSA would understand is a “*haptic output device*.” (EX1008, 6:45-48). FIG. 1 shows that haptic module 157 is linked to controller 180, which per FIG. 7 “outputs a vibration signal, corresponding to the detected proximity signal[.]” *Id.*, 11:60-66. Ku’s controller then “determines whether a touch signal has been input through the specific menu icon of the location where the proximity signal was detected,” in which case “controller 180 outputs vibration in which a vibration signal corresponding to the proximity signal” detected in the earlier step “and a vibration signal corresponding to the touch signal, which has been input in step S515, are combined through the haptic module 157 (S520),” such that “[t]he respective vibration signals may be added or subtracted and then output as vibration.” *Id.*, 11:66-12:28; *see also* Section VI.C.1.g (concerning “haptic output signal” per [1F]).

248. Moreover, the haptic module is configured such that said “third vibration” is generated based on a “haptic output signal” the haptic module receives from controller 180. “[C]ontroller 180 typically controls the operation of each of the elements and controls an overall operation of the mobile terminal.” *Id.*, 7:31-33.

249. Consistent with these disclosures, Ku's claim 21 discloses "a haptic module for...outputting a third vibration that is a combination of the first vibration and the second vibration in response to determining that the first location and the second location are the same." *Id.*, 22:47-63. Said "third vibration" constitutes a "haptic effect" output by the haptic module.

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

250. A POSA would have implemented Ku's terminal 100 with a "*processor configured to*" perform claim 1's remaining requirements, as I will discuss further below specifically in connection with Ku's FIGs. 7 and 12.

251. FIG. 1 illustrates mobile terminal 100 including "control unit 180." Ku elsewhere refers to "controller 180." *E.g., id.*, 3:57 (referencing FIG. 1); *id.*, 6:4-9. A POSA would understand "control unit 180" and "controller 180" as the same component. For example, in connection with FIG. 7 as I discussed above, "controller 180 determines whether a proximity signal has been detected at the location of a specific one of the one or more menu icons through the proximity sensor 141." *Id.*, 11:54-57. The controller also "determines whether a touch signal has been input through the specific menu icon of the location where the proximity signal was detected" in the earlier step. *Id.*, 11:66-12:2. Indeed, I discussed these same disclosures above in connection with [1C]. Ku further discloses that "controller 180 typically controls the operation of each of the elements and

controls an overall operation of the mobile terminal 100.” *Id.*, 7:31-33. Ku also discloses “memory 160” that “may store programs necessary to process and control the controller 180.” *Id.*, 7:1-5.

252. While Ku does not expressly describe “controller 180” as a “processor,” a POSA would have known that processors were an expedient and flexible means for implementing the control unit and thus would have had reason to make such selection. Numerous other prior art references teach this same approach. For example, Pratt (EX1006) describes sending “TS [touch screen] sensor results” to processor 112 within controller 110, which allows processor 112 to “calculate proximity, touch, and/or force interaction events.” *Id.*, [0015]-[0016]. As another example, Ullrich (EX1028) discloses “a controller or tactile mapping logic 118” that “may be a general-purpose or specific-purpose processing device” and “the same instrumentation may be utilized as processor 116 and tactile mapping logic 118.” *Id.*, [0023], [0026]. As a further example, Grant (EX1023) discloses a “processor 12” that “can decide what haptic effects are to be played and the order in which the effects are played” and “outputs the control signals to drive circuit.” *Id.*, FIG. 1, [0015]-[0016].

253. A POSA further would have had a reasonable expectation of success given their awareness that such processors (e.g., CPUs) could readily perform Ku’s specified functions and indeed were routinely incorporated in mobile electronic

devices. For example, Pratt is directed to “electronic devices incorporating haptics” such as “cell phones,” and discloses using “processor 112” to “control the operations of the UI controller 110 according to instructions stored in the memory 114.” EX1006, [0002], [0003], [0017]. As another example, Grant is directed to “portable electronic devices, such as cellular telephones” that uses a “memory 20” to “store[] instructions executed by processor 12.” EX1023, [0004], [0016]. Implementing the algorithms reflected in Ku’s Figures 7 and/or 12 (as discussed above) in Pratt’s device would have been a routine engineering task.

f. [1E]: “receive the first sensor signal and the second sensor signal”

254. Ku meets [1E] as Ku’s controller 180 (which would at minimum have been obvious to implement as a processor, as I explained in Section VI.A.2.e) is configured to “*receive the first sensor signal*” (from the proximity sensor, as I explained in Section VI.C.1.b) as well as the “*second sensor signal*” (from the touch sensor, as I explained in VI.C.1.c) as claimed.

255. Concerning the first signal, “controller 180 determines whether a proximity signal has been detected at the location of a specific one of the one or more menu icons through the proximity sensor 141.” EX1008, 11:54-57. A POSA would understand that Ku’s controller makes this determination based on a signal (i.e., the “first sensor signal”) that Ku’s controller receives from the proximity sensor.

256. Concerning the second signal, the touch screen panel controller (part of the touch sensor that I discussed in Section VI.C.1.c) transmits “data to the controller 180, so that the controller 180 may determine[] whether there has been a touch input.” EX1008, 6:1-9. The “data” sent to the controller constitutes the “second sensor signal” (based on input from the touch sensor). I also note Section VI.C.1.c, in which I explained based on the ’738 patent’s disclosures why the “*second sensor signal*” may be sent after initial signal conditioning or other processing and alternatively why the “processor” may be distributed.

g. [1F]: “generate a haptic output signal based at least in part on the first and second sensor signals; and”

257. Ku meets [1F] as Ku’s controller 180 is configured to “*generate a haptic output signal based at least in part on the first and second sensor signals*” as claimed. As an initial matter, I note (as I previously explained in Sections VI.A.2.d and VI.A.2.g above concerning Pratt as applied to [1C] and [1F]) that a POSA would understand that the “haptic output signal” generated in [1F] concerns the same “haptic output signal” referenced in [1C] (reciting “a haptic output signal” be received by “a haptic output device”).

258. The discussion in Section VI.B.3 concerning Ku’s FIGs. 7 and 12 in connection with Pratt-Ku is fully applicable here; the only difference is that Ku’s controller 180 rather than Pratt’s processor 112 generates the haptic output signal.

259. In particular, I note the discussion in Section VI.B.3 (including paragraph 226) explaining that generating a single “haptic output signal” calling for Ku’s vibration 715 based on both the proximity and touch signals (i.e., the “first and second sensor signals” as required by [1F], [15F], and [19F]) and sending to the haptics driver indeed would have been more efficient than sending multiple haptic output signals to the haptics driver and requiring a more sophisticated driver to process them into a single output. That discussion—including my analysis of the related teachings in Tierling (EX1020) applies to Ku itself for the same reasons it applies to Pratt-Ku, which as explained above relies on Ku’s disclosures for [1F]. Accordingly, Ku at minimum renders [1F] obvious given that generating a single haptic output signal would have been a desirable means for Pratt’s controller 180 to call for outputting the vibration of S520 in Figure 7 (“Outputs vibration in which vibration signals, each corresponding to the proximity signal and the touch signals, are combined”) and also for outputting vibration 715 in Figure 12 (i.e., reflecting the addition of 710 corresponding to the proximity signal and 705 corresponding to the touch signal). EX1006, FIG 7.

h. [1G]: “transmit the haptic output signal to the haptic output device.”

260. Ku meets [1G] as Ku’s controller 180 is configured to “*transmit the haptic output signal to the haptic output device*” as claimed.

261. Initially, as I noted in Section VI.C.1.d, FIG. 1 shows that haptic module 157 is linked to controller 180 by a bidirectional arrow. A POSA would understand that the arrow pointing from controller 180 to output unit 150 represents an output signal transmitted from controller 180 to the haptic module 157. *See* EX1008, 5:47–50.

262. In describing FIG. 7, Ku describes how a “vibration signal corresponding to the proximity signal” along with “a vibration signal corresponding to the touch signal...are combined through the haptic module” and ultimately “output as vibration.” *Id.*, 12:20-26. Moreover, the mobile terminal of Ku’s claim 21 includes a controller together with “a haptic module for...outputting a third vibration that is a combination of the first vibration and the second vibration.” *Id.*, 22:57-64. These disclosures in Ku track my explanation in paragraph 259 why at minimum it would have been obvious to implement Ku’s Figures 7 and 12 by sending a single haptic output signal from controller 180 to the haptic module (haptic output device) rather than sending two different data signals from the controller to the haptic module. Ku also consistently describes the controller as outputting “combined vibration signals through the haptic module 157.” *Id.*, 11:43-47. The haptic module (*haptic output device*) outputs this third vibration as I explained in Section VI.C.1.d based on a haptic output signal the controller sends to the haptic device.

2. Claim 2: “proximity sensor...integrated into the touch-sensitive device”

263. Ku renders claim 2 obvious and teaches that the “*proximity sensor is integrated into the touch-sensitive device*” as claimed. Ku’s FIG. 4 illustrates how “when a user’s finger approaches the display unit 151, the proximity sensor 141 senses such as approach and outputs a proximity signal.” EX1008, 10:3-7. As I explained in detail above, Ku’s display unit 151 is a “*touch-sensitive device*” as claimed. Moreover, a POSA would have understood that Ku’s proximity sensor is integrated into the touch sensitive device to enable detection of approaching fingers. If Ku’s proximity sensor were (hypothetically) not integrated into the touch-sensitive device, it would not be able to sense reliably “when a user’s finger approaches the display unit 151.” *Id.* Put another way, integrating the proximity sensor into the touch-sensitive device ensures accuracy in detecting a proximity signal at the location of a specific menu icon, all of which are displayed on “a screen,” within “display unit 151.” *Id.*, 11:49-50

3. Claim 3: “proximity sensor comprises one of a capacitive sensor or an optical sensor”

264. Ku renders claim 3 obvious and teaches that the “*proximity sensor comprises one of a capacitive sensor or an optical sensor*” as claimed.

265. Ku teaches that the proximity sensor 141 may detect objects based on “the rate of capacitance” (*Id.*, 5:42-44)—in other words, changes in capacitance

fields detected by the sensor as a finger approaches the screen in which the sensor is embedded. A POSA would have understood that this teaching in Ku was applicable to the methods illustrated in Ku's FIG. 7 and FIG. 12 as discussed above. Capacitance-based sensors were well known in the art as a reliable means for detecting proximity interactions. *See e.g.* EX1006, [0021]-[0022]; *see also* EX1018, [0053], FIG. 9; EX1019, FIGs. 5A, 5B, 6A, 6B, 10:1-14, 13:38-55.

4. Claim 4: “haptic output signal is designed to direct a user to contact the touch-sensitive device at a particular location”

266. Ku renders claim 4 obvious and teaches that the above-discussed haptic signal “*is designed to direct users to contact the touch-sensitive device at a particular location*” as claimed. My analysis in Ground 2 in Section VI.B.4 concerning FIGs. 7 and 12 (including how Ku's signal directs users to a particular icon) applies equally to Ku itself rather than Pratt-Ku.

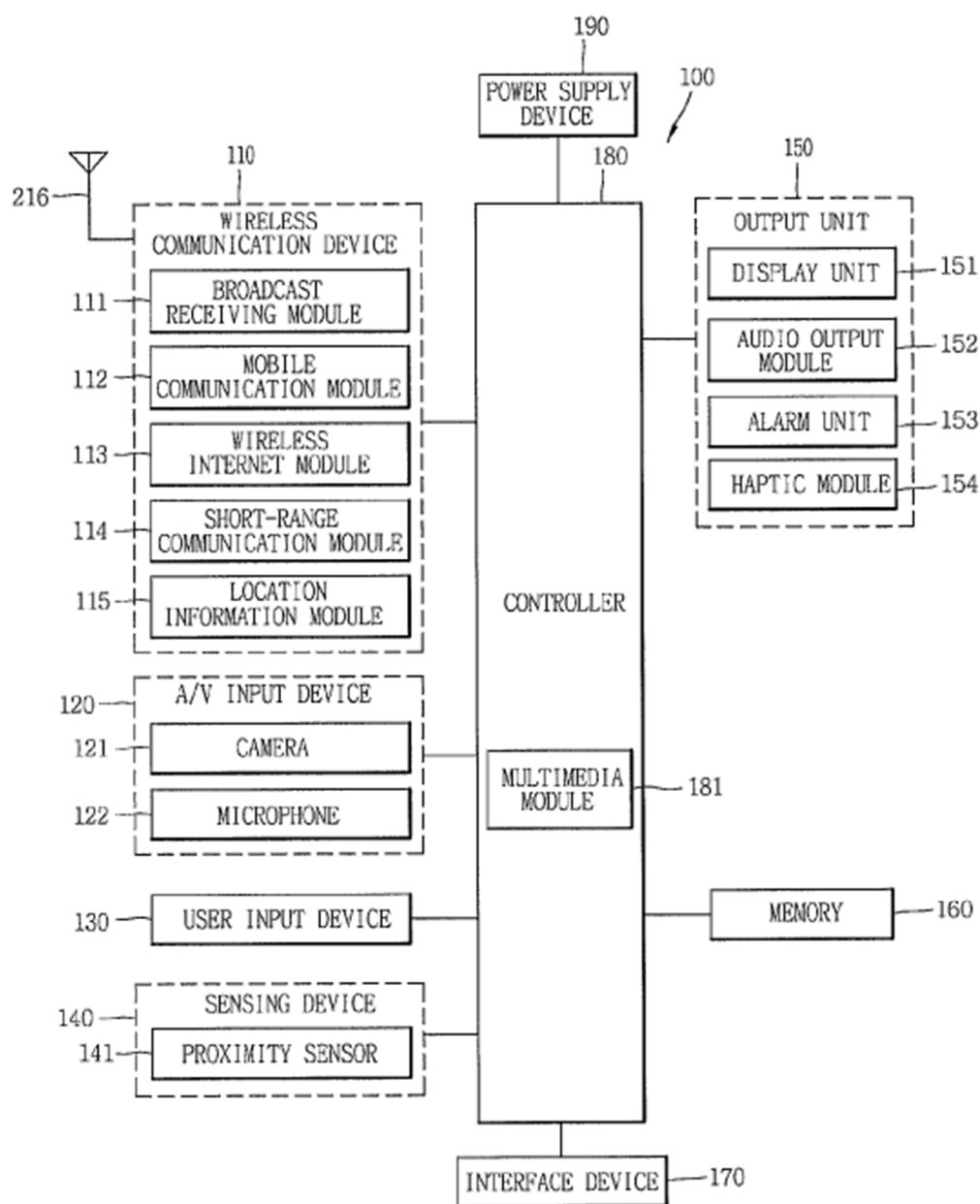
5. Claim 5: “integrated sensor comprises the proximity sensor and the touch sensor”

267. Ku discloses a capacitive sensor that serves as the proximity sensor, as I discussed above in §VI.C.3. It would have been obvious to implement Ku's capacitive sensor to also serve as a touch sensor in view of a POSA's knowledge. The sensor in implementation would constitute an “*integrated sensor*” that “*comprises the proximity sensor and the touch sensor.*”

268. It was well known that capacitive sensors could reliably enable detection of both non-contact (i.e., proximity) and contact events involving users' fingers as I explained above in §VI.A.5. *See e.g.* EX1006, [0021]-[0022]. *See also* EX1018, [0053], FIG. 9; EX1019, FIGs. 5A, 5B, 6A, 6B, 10:1-14, 13:38-55. Relying on such a capacitive sensor as both the proximity sensor and the touch sensor would reduce costs and design complexity, and increase flexibility, while leaving the user experience unchanged. In particular, while the algorithms in Ku's FIGs. 7 and 12 rely on both proximity and touch signals, they do not require any required source for those signals. Instead, Ku's FIGs. 7 and 12 are agnostic as to their source. A POSA would have recognized that the algorithms illustrated in FIGs. 7 and 12 are fully compatible with an integrated sensor as the source for both the proximity and touch signals.

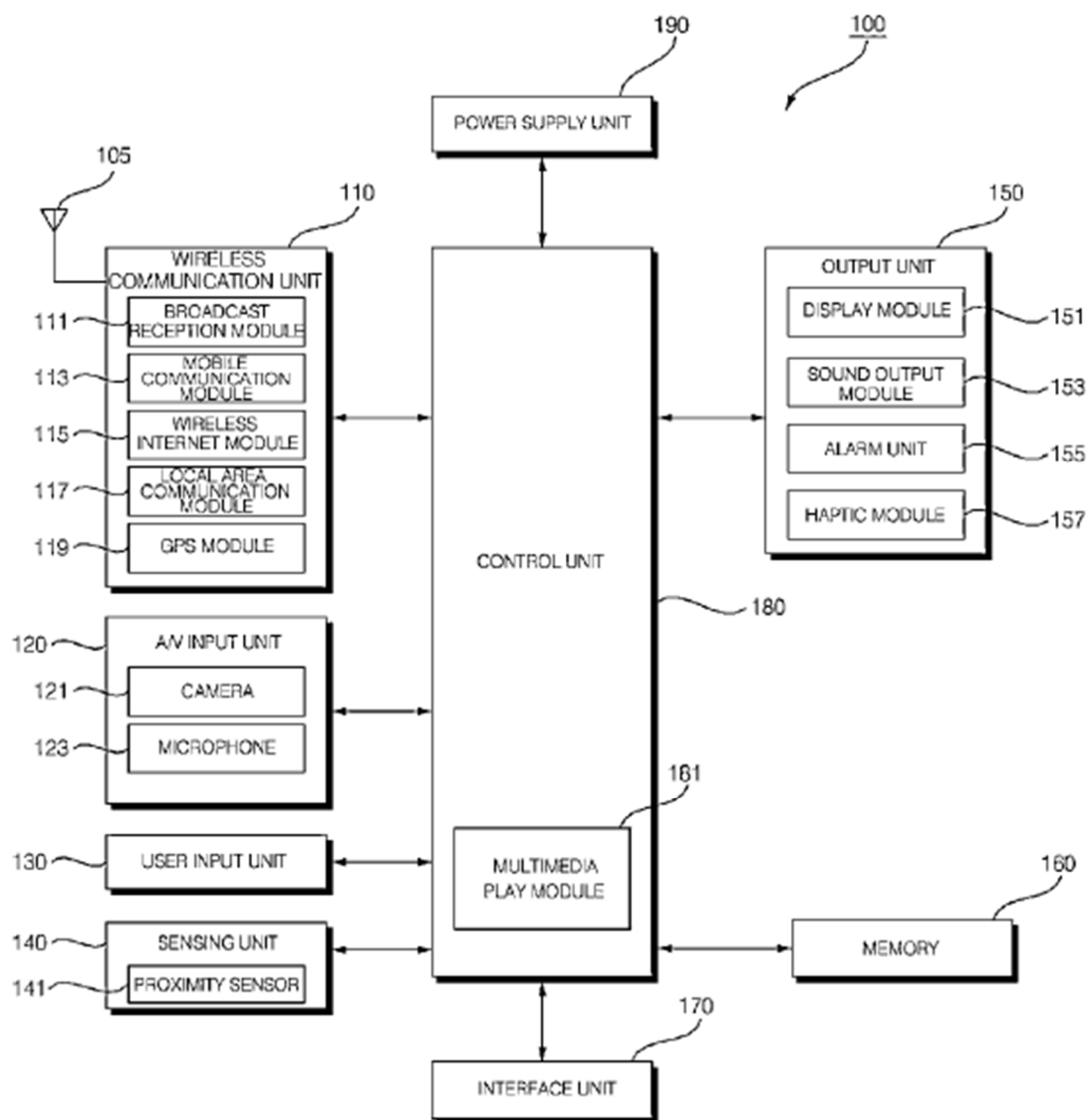
269. A POSA would have had a reasonable expectation of success in implementing Ku with an integrated sensor in view of Lee (EX1009). Lee is similar to Ku in many respects. For example, Lee's Figure 1 is essentially identical to Ku's Figure 1. I have compared both figures below.

FIG. 1



EX1009, FIG. 1.

FIG. 1

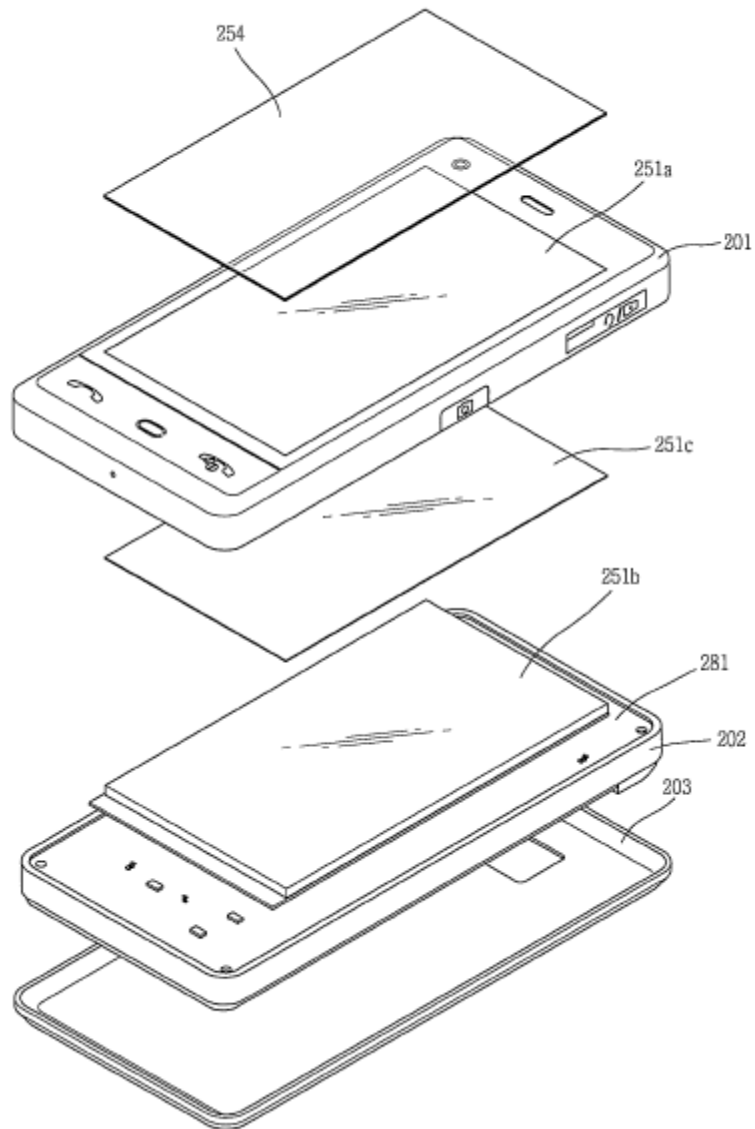


EX1008, FIG. 1.

Like Ku, Lee describes a proximity sensor 141. Lee explains that its proximity sensor 141 (which is the same component as Ku, *compare* EX1008, FIG. 1 *with* EX1009, FIG. 1) can be implemented as a capacitive sensor. *Id.*, [0048] (“When

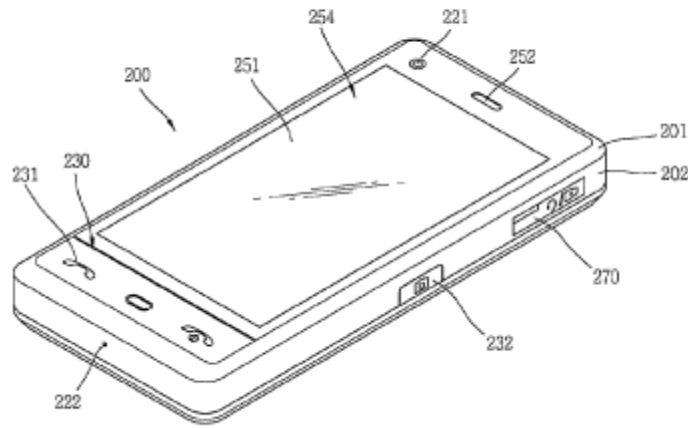
the touch screen is implemented as a capacitance type, proximity of a pointer to the touch screen may be sensed by changes in an electromagnetic field. In this case, the touch screen (touch sensor) may be categorized as a proximity sensor.”) Lee also describes a “touch sensor.” *Id.*, [0044]. Lee’s touch sensor (a “touch sensitive sensor”) may be integrated with display 151 to constitute “a touch screen.” *Id.*, [0044]. This touch screen is illustrated in Lee’s FIG. 4, which I reproduced below.

FIG. 4



In FIG. 4, “touch sensor 251c for sensing a touch may overlap with the display 251b” and the “window 251a, the touch sensor 251c, and the display 251b may together form the display module 251[.]” *Id.*, [0090]. This display module 251 is also illustrated in Lee’s FIG. 3A:

FIG. 3A



270. Lee's touch screen may be "implemented as a capacitance type," such that it also serves as a "proximity sensor." *Id.*, [0048]. And like Ku, Lee indeed distinguishes between "proximity" versus "contact" touches. *Id.*, [0049]; *see also id.*, [0090]. Lee's device also includes haptic module 154, which can generate tactile effects such as "vibration." *Id.*, [0039]; [0053]-[0054]; *see also id.*, [0006].

271. Lee's disclosures therefore further confirm that a POSA would have had a reasonable expectation of success that Ku's FIGs. 7 and 12 could be implemented in a version of Ku's device incorporating an integrated capacitive sensor comprising both a proximity sensor and a touch sensor.

6. Claim 14

a. [14A] “touch sensor...capable of detecting a pressure”

272. Ku’s touch sensor “*is capable of detecting a pressure,*” and at minimum it would have been obvious to ensure such capability. In particular, Ku discloses that “different vibration signals may be assigned touch signals...input with a specific pressure.” EX1008, 11:13-15. While this particular quotation comes in connection with Ku’s FIG. 6, it confirms that Ku’s touch sensor was capable of detecting a pressure. Capacitive sensors (as Ku discloses) indeed were capable of detecting pressures. *See, e.g.* EX1006, [0047] (Pratt); EX1012, 1:48-51 (Kwon).

273. Furthermore, Ku’s claim 1 recites a method of use for the mobile terminal of Ku’s claim 21 corresponding to Ku’s FIG. 7 and further illustrated in Ku’s FIG. 12. Ku’s claim 20 also recites that “the touch inputs are received with different pressures at the touch screen.” EX1008, 22:45-46.

b. [14B] “haptic output signal is based at least in part on the detected pressure”

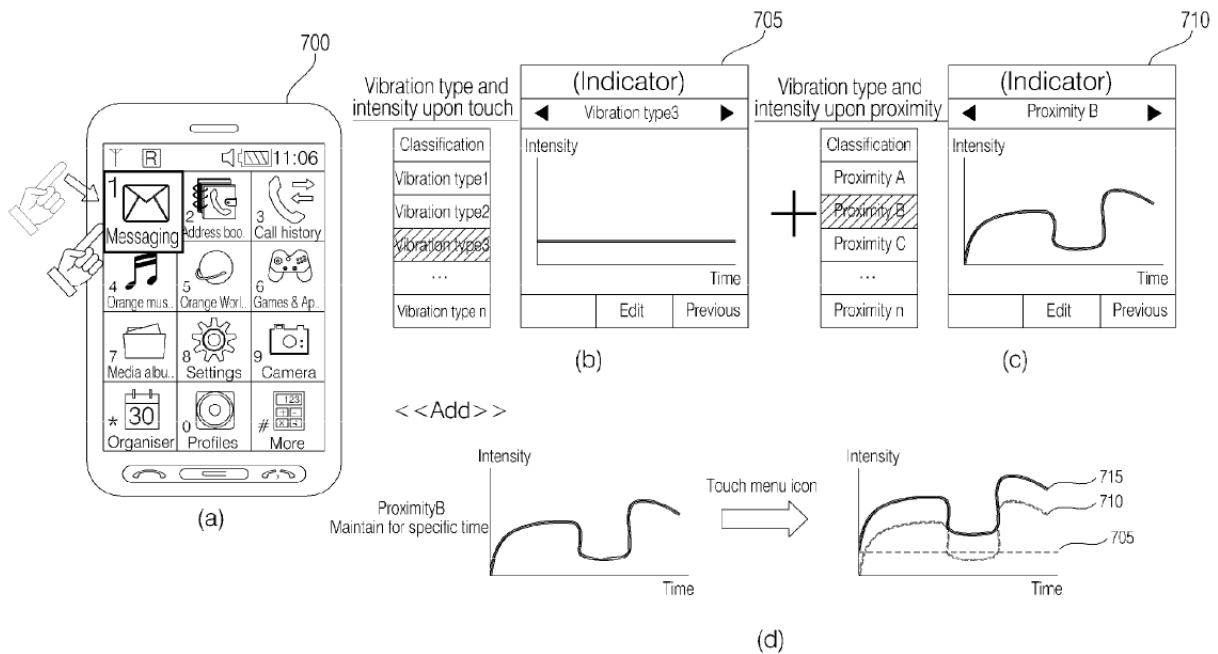
274. It would have been obvious to implement Ku’s FIG. 7 such that “*the haptic output signal is based at least in part on the detected pressure*” as claimed.

275. Before the ‘738 patent, it was well known to distinguish between intentional versus inadvertent touches by defining a threshold pressure below which the touch signal would not trigger a response. EX1016, [0087] (“pressure

threshold...to avoid accidental actuation”); EX1017, [0035] (“predetermined pressure or greater” to “reduce the occurrence of erroneous input due to the user mistakenly touching the touch surface”).

276. When implementing Ku’s FIG. 7, it would have been obvious to combine the “vibration signals, each corresponding to the proximity signal and the touch signals” and output the combined “vibration” (per S520) only if a threshold pressure is reached—thereby distinguishing inadvertent touches. Similarly, when implementing Ku’s FIG. 12, it would have been obvious to send a haptic output signal calling for vibration 715 if and only if a user taps the portion of the screen corresponding to the “Messaging” icon with sufficient force—generating a pressure beyond a defined threshold value—to indicate the user intentionally rather than inadvertently tapped this icon.

FIG.12



EX1008, FIG. 12.

277. In this obvious implementation of Ku, the “haptic output signal is based at least in part on the detected pressure” because no such haptic output signal calling for vibration 715 would be sent if the pressure fails to exceed a defined threshold value.

7. Claim 15

278. Claim 15 recites a method with elements tracking those in apparatus claim 1. Claim 15 would have been obvious based on Ku’s above-discussed disclosures as well as Ku’s claim 1, which recites a “method of distinguishing input signals detected by a mobile terminal” and has elements paralleling those of

Ku's above-cited claim 21, which recites a "mobile terminal." EX1008, 20:25-51, 22:47-23:7.

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

279. If the preamble is limiting, Ku discloses a "*method*" as claimed. Ku's claim 1 recites a "method of distinguishing input signals detected by a mobile terminal." *Id.*, 20:25-51. FIG. 7 likewise illustrates such a method. *Id.*, 11:46-48.

b. [15A]: "detecting, by a proximity sensor, a non-contact interaction with a touch-sensitive device"

280. Ku discloses [15A] as claimed. FIG. 7 discloses using "proximity sensor 141" to "determine[] whether a proximity signal has been detected at the location of the specific one of the one or menu icons" on a touch screen (a touch-sensitive device). *Id.*, 11:54-57. I also note my explanation above in Section VI.C.1.b (concerning [1A]) & 20:27-32 ("detecting a proximity touch...received at the mobile terminal" and "determining a first location on a touch screen of the mobile terminal at which the proximity touch is received").

c. [15B]: "detecting, by a touch sensor, a touch on the touch-sensitive device"

281. Ku discloses [15B] as claimed. FIG. 7 discloses using a touch sensor (as I discussed in Section VI.C.1.c concerning [1B]) to determine whether a touch was received at the same menu icon as the proximity signal or instead at a different portion of the touch screen. EX1008, 12:11-20; *see also* 20:27-34 ("detecting a...

touch input received at the mobile terminal” and “determining a...second location on the touch screen at which the touch input is received”).

d. [15C]-[15G]

282. Ku renders [15C]-[15G] obvious as claimed. For the reasons I explained in Section VI.C.1.e, it would have been obvious to practice Ku using a “processor” as control unit 180. (As I previously explained in Section VI.A.8.e concerning Pratt, I note that while [15D] refers to “a processor” rather than “the processor,” a POSA would understand that claim 15 encompasses methods in which the first sensor signal of [15C] and the second sensor signal of [15D] are transmitted to the same “processor” referenced in both claim elements.) I discuss below the individual limitations in order:

283. [15C] FIG. 7’s S505 (“Has a proximity signal been detected at a location of a specific menu icon”) involves “*transmitting a first sensor signal associated with the non-contact interaction to*” Ku’s controller.

284. [15D] FIG. 7’s S515 (“Has a touch signal been input at a location of a specific menu icon”) involves “*transmitting a second sensor signal associated with the touch to*” Ku’s controller.

285. [15E] As I discussed in Section VI.C.1.f, Ku’s controller is configured to “*receive the first sensor signal*” (from the proximity sensor) and “*second sensor signal*” (from the touch sensor).

286. [15F] As I discussed in Section VI.C.1.g, controller 180 is configured to “*generate a haptic output signal based at least in part on the first and second sensor signals*. Ku’s method claim 1 includes outputting a “third vibration” combining the “first vibration” associated with the proximity signal with the “second vibration” associated with the touch signal. EX1008, 20:25-51. This third vibration was associated with a haptic output signal generated by controller 180 based on those first and second signals.

287. [15G] As I discussed in Section VI.C.1.h, Ku’s controller is configured to “*transmit the haptic output signal to the haptic output device*.” Ku’s claim 1 recites a method involving outputting a “third vibration” (per [15F]) “via a haptic module,” wherein “the third vibration results from an addition or subtraction of signals respectively corresponding to the first vibration [associated with the proximity signal] and the second vibration [associated with the touch signal].” EX1008, 20:38-47. This third vibration was associated with a haptic output signal generated by controller 180 and transmitted by the controller to the haptic module.

e. [15H]: “outputting, by the haptic output device, a haptic effect in response to the haptic output signal”

288. Ku discloses “*outputting, by the haptic output device, a haptic effect in response to the haptic output signal*” as claimed. FIG. 7 illustrates “output[ting] vibration in which vibration signals, each corresponding to the proximity signal

and the touch signals, are combined” (S520). Ku’s haptic module 157 performed this step of generating the actual vibration based on a haptic output signal.

8. Claim 16: “direct a user to contact the touch-sensitive device at a particular location”

289. Ku’s “haptic output signal” of method claims 15-16 is “*designed to direct a user to contact the touch-sensitive device at a particular location*” for the same reason as the “haptic output signal” of product claims 1 and 4. *See* Section VI.C.4. Claim 16 is therefore unpatentable as obvious over Ku for the same reasons as claim 4.

9. Claim 19

290. As I discussed in paragraph 198 (by reference to an accompanying comparative table), Claim 19 recites a computer-readable medium with program code for executing the steps recited in the method of claim 15 (all except for the absence of a corresponding [15H]).

291. Claim 19 is obvious over Ku for the same reasons I explained above concerning claim 15. Further, I note Ku’s teaching that “the invention may be implemented as computer program product accessible from a computer-usable or computer-readable medium providing program code for use by or in connection with a computer or other instruction execution system.” EX1008, 19:52-56. Ku also teaches that many examples of such media that are nontransitory. *Id.*, 19:62-20:4. A POSA would have understood that these teaching applied to Ku’s above-

discussed FIGs. 7 and 12. A POSA would have recognized that algorithms corresponding to FIGs. 7 and 12 could readily be implemented in a computer-readable medium providing program code for use by or in connection with a computer or other instruction execution system.

D. Ground 4: Ku-Jiang Renders Claims 1-6, 14-16, and 19 Obvious

292. Claims 1-6, 14-16, and 19 are obvious under over Ku in view of Jiang.

1. Jiang (EX1010)

293. Jiang discloses “a type of EMP [electromechanical polymer]-based sensors [] suitable for use in a haptic response, e.g., in a handheld or mobile device.” EX1010, [0002]. Jiang’s “EMP sensor” includes “a [] set of EMP layers provided between a first electrode and a second electrode forming a capacitor,” while the EMP layers can be “activated by application of a voltage across the first and second electrodes.” *Id.*, Claim 1. Jiang’s EMP sensor “may serve as a proximity sensor” as its capacitance changes according to the relative location of a finger to the EMP sensor. *Id.*, [0025]. It can distinguish whether it is being “touched” and at the same time “serve as an EMP actuator, when a voltage is applied to the EMP layers through the sensing electrode[.]” *Id.*, FIG. 5, [0029]-[0030]. Furthermore, Jiang describes that “transparent EMP devices” can be formed using transparent electrodes, and “formed on top of a graphical display of a mobile device, for example, to form a keyboard that provides data input and haptic

feedback at the same time.” *Id.*, FIG. 8, [0035]. In short, the EMP sensor itself doubles as a haptic output device.

294. I note that Jiang incorporates by reference the entirety of a co-pending application Ser. No. 13/683,990, published as Ramstein (EX1011, cover), which further details EMP-based sensors and actuators. EX1010, [0023].

2. The Ku-Jiang Combination (“Ku-Jiang”)

295. A POSA would have had reason to implement Ku’s touch screen (as I discussed above) using Jiang’s transparent EMP sensors formed on top of a graphical display. *See* EX1010, FIG. 8, which I have reproduced below.

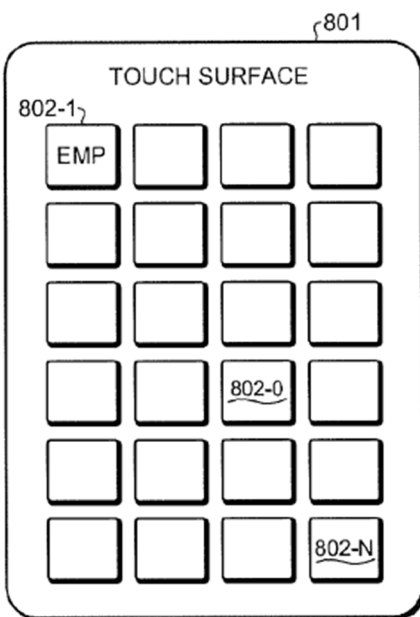


Fig. 8

296. While Ku's mobile terminal may include "a plurality of haptic modules 157," Ku does not detail how such modules are arranged. EX1008, 6:67-7:1.

297. Jiang, however, discloses such an arrangement and teaches that a traditional "haptics system which typically vibrates the entire electrical device []is often rigid," while Jiang's EMP actuator "provide[s] a 'localized' haptics feedback"—selectively activating only the actuator under the touch. EX1011, [0028]. This is because Jiang's EMP sensor "can be made very small," such that "tactile feedback in response to touch by a human finger may be localized to an area in the immediate vicinity of the touch stimulus." *Id.*, [0024]. For example, Jiang uses the same pair of "sensing electrodes" to sense input *and* drive actuation of the EMP sensor—reducing the device's footprint. EX1010, [0030], FIG. 5.

298. A POSA would have been motivated to implement localized haptics feedback in Ku's mobile terminal such that instead of vibrating the entire device, the tactile feedback may be "concentrate[d]" "to a localized zone under the user finger" to "reduce the device's power requirement," and to "offer[] a stronger sensation and a finer resolution." EX1011, [0024].

299. In my opinion a POSA would also have had a reasonable likelihood of success in implementing Ku's touch screen with Jiang's EMP sensor to serve as actuator. For example, a POSA would understand that Jiang's EMP sensor is an

integrated capacitive sensor because the same EMP sensor both serves as “a proximity sensor” and can measure “when the key implemented by EMP sensor 101 is contacted,” namely a single component serving as both a proximity sensor and a touch sensor. EX1010, [0025], [0029]. I have explained above that it would have been obvious to incorporate an integrated sensor in Ku. Jiang’s EMP sensor would serve the same function of the integrated sensor in Ku. Furthermore, Jiang’s EMP sensor can be caused to “vibrate” based on an “output signal,” EX1011, [0036]. See also EX1008 (Ku), claim 12 (“activates the second set of EMP layers to provide a vibration as a haptic response”), which a POSA would recognize could be used to implement Ku’s haptic output device implementing Ku’s teachings in FIGs. 7 and 12.

3. Claim 1

a. [1PRE]: “A device comprising:”

300. In the following I’ll refer to Ku as modified by implementing Ku’s touch screen with Jiang’s EMP sensor as “Ku-Jiang.” If the preamble is limiting, the mobile terminal in Ku-Jiang’s mobile terminal is a “*device*” as claimed. See Section VI.D.3.a.

- b. **[1A]: “a proximity sensor capable of detecting a non-contact interaction with a touch-sensitive device and outputting a first sensor signal;”**

301. As I discuss in Section VI.D.2, below, Ku-Jiang includes a touch screen with a capacitance-based EMP sensor as disclosed in Jiang. The EMP sensor is a “*proximity sensor capable of detecting a non-contact interaction*” as claimed because it detects a “change in voltage” when a finger moves into the proximity of the sensor and thus also touch screen of which the sensor is a part. EX1010, [0025]; *see also* EX1010, FIGS. 1(c) and 1(d). The EMP sensor outputs the result of the detection as a signal (i.e., the “*first sensor signal*”).

- c. **[1B]: “a touch sensor capable of detecting a touch with the touch-sensitive input device and outputting a second sensor signal”**

302. Ku-Jiang’s EMP sensor constitutes a “*touch sensor capable of detecting a touch with the touch-sensitive input device*” as claimed because different “noise amplitudes” are measured from the EMP sensor’s “sensor output signal” based on whether a finger “touched” the EMP sensor (incorporated in the touch-sensitive input device) deployed as a “key.” EX1010, FIG. 5. [0029]. The “sensor output signal” is the “*second sensor signal*” as claimed. EX1010, [0029].

- d. **[1C]: “a haptic output device configured to receive a haptic output signal and output a haptic effect in response to the haptic output signal; and”**

303. Ku-Jiang’s EMP sensor can be caused to “vibrate” based on an “output signal” (namely, “*haptic output signal*” as claimed). EX1011, [0036]; *see*

also claim 12 of Jiang (“activates the second set of EMP layers to provide a vibration as a haptic response”). The EMP sensor is a “*haptic output device*” as claimed. Furthermore, all of the discussions of Ku per Section VI.C are equally applicable to Ku-Jiang.

e. [1D]-1[G]

304. Ku-Jiang includes elements [1D] (“a processor configured to”), [1E] (“receive the first sensor signal and the second sensor signal”), [1F] (“transmit the haptic output signal to the haptic output device”), and [1G] (“transmit the haptic output signal to the haptic output device”) for the same reasons detailed above in Section VI.D.3 regarding Ku. The only difference between Ku and Ku-Jiang is Jiang’s EMP sensor, which doubles as the haptic output device. The processor and associated signals are identical.

4. Claim 5: “an integrated sensor comprises the proximity sensor and the touch sensor”

305. Ku-Jiang includes an “*integrated sensor compris[ing] the proximity sensor and the touch sensor.*” As I discussed in Sections VI.D.3.b-VI.D.3.c, Ku-Jiang includes a capacitance-based EMP sensor—a single component serving as both a proximity sensor and a touch sensor.

5. Claim 6: “the integrated sensor further comprises the haptic output device”

306. Ku-Jiang’s “*integrated sensor further comprises the haptic output device.*” As I discussed in Section VI.D.3.d, Ku-Jiang’s EMP sensor comprises a capacitor formed of one or more electromechanical polymer layers between two or more electrodes that serve as a proximity sensor, a touch sensor and an actuator—just like the ’738 patent’s “integrated sensor” featuring a “dual proximity sensor and haptic actuator” in which “non-contact capacitive and contact pressure based sensor are integrated into a smart material haptic actuator 202.” EX1001, 2:3-5, 9:1-4, 9:59-66.

6. Other Challenged Claims

307. Ku-Jiang meets the additional limitations of claims 2-4, 14, 15-16, and 19 for the same reasons I explained in Section VI.C concerning why Ku discloses or renders obvious all elements of those claims.

VII. CONCLUSION

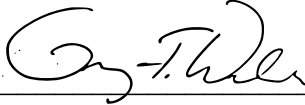
308. I reserve the right to supplement my opinions in the future to respond to any arguments that Patent Owner or its expert(s) may raise and to account for new information as it becomes available to me.

* * *

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: 14 FEB 2024



Gregory F. Welch, Ph.D.

APPENDIX A: MATERIALS CONSIDERED

Exhibit	Description
1001	U.S. Patent No. 11,175,738
1002	Prosecution History of U.S. Patent No. 11,175,738
1003	Prosecution History of European Counterpart to U.S. Patent No. 11,175,738
1004	Declaration of Dr. Gregory Welch (“Welch”)
1005	CV of Dr. Gregory Welch
1006	U.S. Patent Application Publication 2012/0249474A1 (“Pratt”)
1007	U.S. Provisional Patent Application No. 61/470,764 (<i>incorporated by reference in Pratt</i>)
1008	U.S. Patent No. 8,531,319 (“Ku”)
1009	U.S. Patent Application Publication 2013/0147728 (“Lee”)
1010	U.S. Patent Application Publication 2015/0061703 (“Jiang”)
1011	U.S. Patent Application Publication 2014/0139329 (“Ramstein”) (<i>incorporated by reference in Jiang</i>)
1012	U.S. Patent No. US 8,970,513 (“Kwon”)
1013	Exhibit G to Immersion’s Preliminary Infringement Contentions
1014	EP 2141580A2 (Ku’s European Counterpart)
1015	U.S. Patent Application Publication 2010/0004033 (“Choe”)
1016	U.S. Patent Application Publication 2008/0024459 (“Poupyrev”)
1017	U.S. Patent Application Publication 2018/0356891 (“Murakami”)
1018	U.S. Patent Application Publication 2011/0007021 (“Bernstein”)
1019	U.S. Patent No. 9,069,417 (“Rimon”)
1020	U.S. Patent Application Publication 2005/0134561 (“Tierling”)
1021	U.S. Patent Application Publication 2017/0300166 (“Rosenberg ’166”)
1022	U.S. Patent Application Publication 2017/0285848 (“Rosenberg ’848”)
1023	U.S. Patent Application Publication 2009/0106655 (“Grant”)
1024	U.S. Patent Application Publication 2011/0102162 (“Gregorio”)
1025	U.S. Patent No. 7,902,474 (“Mittleman”)
1026	New Oxford American Dictionary, Third Edition (2010), definition of “pressure”
1027	American Heritage Dictionary of the English Language, Fifth Edition (2011), definition of “pressure”

Exhibit	Description
1028	U.S. Patent Application Publication No. 2012/0143182 (“Ullrich”)
1029	McGraw-Hill Dictionary of Scientific and Technical Terms, Sixth Edition (2002), definition of “signal”

APPENDIX B: U.S. PATENT NO. 11,175,738 CLAIM LIST

Claim 1
[1PRE] A device comprising:
[1A] a proximity sensor capable of detecting a non-contact interaction with a touch-sensitive device and outputting a first sensor signal;
[1B] a touch sensor capable of detecting a touch with the touch-sensitive input device and outputting a second sensor signal;
[1C] a haptic output device configured to receive a haptic output signal and output a haptic effect in response to the haptic output signal; and
[1D] a processor configured to:
[1E] receive the first sensor signal and the second sensor signal;
[1F] generate a haptic output signal based at least in part on the first and second sensor signals; and
[1G] transmit the haptic output signal to the haptic output device.
Claim 2
The device of claim 1, wherein the proximity sensor is integrated into the touch-sensitive device.
Claim 3
The device of claim 1, wherein the proximity sensor comprises one of a capacitive sensor or an optical sensor.
Claim 4
The device of claim 1, wherein the haptic output signal is designed to direct a user to contact the touch-sensitive device at a particular location.
Claim 5
The device of claim 1, wherein an integrated sensor comprises the proximity sensor and the touch sensor.
Claim 6
The device of claim 5, wherein the integrated sensor further comprises the haptic output device.
Claim 14
[14PRE] The device of claim 1, wherein

[14A] the touch sensor is capable of detecting a pressure and wherein
[14B] the haptic output signal is based at least in part on the detected pressure.
Claim 15
[15PRE] A method comprising:
[15A] detecting, by a proximity sensor, a non-contact interaction with a touch-sensitive device;
[15B] detecting, by a touch sensor, a touch on the touch-sensitive device;
[15C] transmitting a first sensor signal associated with the non-contact interaction to a processor;
[15D] transmitting a second sensor signal associated with the touch to a processor;
[15E] receiving, by the processor, the first and second sensor signals;
[15F] generating, by the processor, a haptic output signal based at least in part on the first and second sensor signals;
[15G] transmitting, by the processor, the haptic output signal to a haptic output device; and
[15H] transmitting, by the processor, the haptic output signal to a haptic output device; and
Claim 16
The method of claim 15, wherein the haptic output signal is designed to direct a user to contact the touch-sensitive device at a particular location.
Claim 19
[19PRE] A computer-readable non-transitory medium encoded with executable program code, the computer-readable medium comprising:
[19A] program code for detecting, by a proximity sensor, a non-contact interaction with a touch-sensitive device;
[19B] program code for detecting, by a touch sensor, a touch on the touch-sensitive device;
[19C] program code for transmitting a first sensor signal associated with the non-contact interaction to a processor;
[19D] program code for transmitting a second sensor signal associated with the touch to a processor;

[19E] program code for receiving, by the processor, the first and second sensor signals;

[19F] program code for generating, by the processor, a haptic output signal based at least in part on the first and second sensor signals;

[19G] program code for transmitting the haptic output signal to a haptic output device