

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GOOGLE LLC,

Petitioner,

v.

DDC TECHNOLOGY, LLC,

Patent Owner.

IPR2023-00707

U.S. Patent 9,420,075

DECLARATION OF BOB MACKEY

I. Introduction

1. I have been retained by DDC Technology, LLC (“Patent Owner”) as a technical expert in connection with the proceeding identified above. I submit this declaration in support of the Patent Owner’s Response to the Petition for Inter Partes Review of U.S. Patent No. 9,420,075 (“the ’075 patent”). I have been retained to provide a technical opinion concerning the ’075 patent with respect to the challenges presented by the Petitioner.

2. I am being compensated for my time working on this matter at my customary hourly rate for consulting work of this nature. I have no personal stake nor interest in the outcome of the present proceeding or in either party to this proceeding.

3. In forming my opinions stated in this declaration, I reviewed and am familiar with the ’075 patent. I understand that Petitioner has requested Inter Partes Review (“IPR”) of the ’075 patent. I have also reviewed the materials Petitioner cited in support of its petition, including the Declaration of Kurtis P. Keller (Ex. 1002), the ’075 patent, its prosecution history, and the art cited in the Petition.

II. Background and Qualifications

4. Appendix A is a copy of my curriculum vitae with a list of cases where I have been retained in the past 5 years.

5. I am a retired engineer and researcher with over twenty years of experience in the consumer electronics industry developing electronic displays, touch sensors, human interfaces, and biometric devices. Approximately 70 U.S. patents have been issued for my inventions and hundreds more have been prosecuted with my input. From 2001 to 2017, I was employed by Synaptics, where I led development of touchscreens and launched the “ClearPad” transparent touchscreen product line in 2002. In 2006 we provided the touchscreen for the world’s first all-touchscreen smartphone, the LG Prada. A year later, Apple launched the iPhone, bringing touchscreen interfaces to the mass markets. While at Synaptics, we supplied billions of capacitive touchscreens and touch-displays to all of the major smartphone suppliers. Twenty-seven of the patents listed in Appendix A are for innovations in capacitive touch sensing. After retiring from the consumer electronics industry in 2017, I have consulted on intellectual property strategy, invention harvesting, and patent prosecution.

6. By virtue of at least the above education and experiences, I have gained a detailed understanding of the technology that is the subject of my Declaration. As such, I am qualified to provide opinions regarding the state of the art at the time of the priority date (which is July 16, 2014, the filing date of the first provisional application to which the '075 patent claims priority), as well as how one of ordinary skill in the art at that time would have interpreted and understood

the claimed inventions. However, the opinions I express herein would not change if the priority date were July 16, 2015, the filing date of the non-provisional application from which the '075 patent issued.

III. Relevant Legal Standards

7. I am not an attorney and I have no opinions on the law. Patent Owner's legal counsel has provided me with legal standards and asked me to apply those standards to the facts and to my opinions in the present IPR.

8. I understand that the validity analysis involves two steps. First, one must construe the terms of the patent claims to understand what meaning one of ordinary skill in the art would give the terms (which process may conclude that a term should be given its plain and ordinary meaning). Second, after the claim terms have been construed, one may then assess validity by comparing a patent claim to the "prior art." I understand that the teaching of the prior art is viewed through the eyes of a person of ordinary skill in the art ("POSA") at the time the invention was made.

A. Obviousness

9. I understand that Petitioner has asserted that the challenged claims are invalid as being obvious under 35 U.S.C. § 103 in light of the prior art. I understand that in an IPR, a claim may be invalid under § 103 if the Petitioner establishes by a preponderance of the evidence that the claimed invention as a

whole would have been obvious to a POSA at the time the invention was made. I understand that obviousness is a legal conclusion. I do not offer a legal conclusion, but rather provide testimony herein regarding the relevant facts underlying the legal conclusion. This includes the relevant art, the scope and content of the prior art, the motivation to combine the art, and the differences between the prior art and the claims.

10. I understand that even though an invention may not have been identically disclosed or described before it was made by an inventor, in order to be patentable, the invention must also not have been obvious to a POSA in the field of technology of the patent before the priority date of the patent.

11. I understand that in determining whether a claimed invention is obvious, one must consider the level of ordinary skill in the field of the invention that someone would have had as of the patent's priority date, the scope and content of the asserted prior art, any differences between the prior art and the claimed invention, whether a POSA would have been motivated to combine the prior-art references, and, if present, objective evidence or secondary considerations.

12. I understand that it is not permissible to use hindsight or *ex post* reasoning in assessing whether a claimed invention is invalid for obviousness. For example, an invention should not be considered in view of what a POSA would

know today, nor can it be reconstructed after the fact by reading into the prior art the teachings of the invention at issue.

13. I understand that obviousness cannot be proven merely by showing that an invention is a combination of elements that were previously known in the prior art. Rather, in an IPR, a patent challenger must further establish by a preponderance of the evidence that there were apparent reasons that would have prompted a POSA to have combined these known elements in the fashion claimed by the patent. Such reasons might include, for example, teachings, suggestions, or motivations to combine that would have been apparent to a POSA.

14. I also understand that one should keep in mind that the existence of each and every element of the claimed invention in the prior art does not necessarily prove obviousness. Most, if not all, inventions rely on building blocks of prior art. In considering whether a claimed invention is obvious, I understand that one should consider whether, at the time of the patent's priority date, there was a reason that would have prompted a POSA to combine the prior art in the manner proposed, taking into account such factors as (1) whether the claimed invention was merely the predictable result of using prior art elements according to their known function(s); (2) whether the claimed invention provides an obvious solution to a known problem in the relevant field; (3) whether the prior art teaches or suggests the desirability of combining elements claimed in the invention; (4)

whether the prior art teaches away from combining elements in the claimed invention; and (5) whether it would have been obvious to try the combinations of elements, such as when there is a design incentive or market pressure to solve a problem and there are a finite number of identified, predictable solutions. To find that the asserted combination of prior art rendered the claimed invention obvious, one must find that the asserted combination of the prior art provided a reasonable expectation of success.

15. I also understand that “obvious to try” is not sufficient in unpredictable technologies.

B. Independent and Dependent Claims

16. I understand that a dependent claim incorporates by reference all the limitations of the independent claim (and any intervening claims) from which it depends. Therefore, I understand that to prove that a dependent claim is obvious, a prior art reference, combination of references, and/or general knowledge in the art must disclose each and every claim limitation of the dependent claim, in addition to each and every limitation of the claims from which it depends.

IV. Definition of a Person of Ordinary Skill in the Art

17. Petitioner asserts that a POSA at the time of the invention of the '075 patent would have “a minimum of an undergraduate degree (or equivalent) in mechanical engineering or a related field, with knowledge of mechanical actuation

systems, basic optical design with lenses, head-mounted displays, a basic understanding of touchscreen technology, and at least two years of professional experience in mechanical and basic optical design or engineering.”

18. Petitioner’s proposed definition of a POSA gives too much weight to certain skills/experience that are of limited importance with respect to the ‘075 patent, and too little weight to other skills/experience that are pertinent to the claimed inventions of the ‘075 Patent. For example, Petitioner proposes a degree in “mechanical engineering or a related field.” Petitioner thus affords undue weight to the mechanical actuation mechanism of the claimed inventions, which mechanisms are simple machines readily understood by even those with limited specific educational background. Petitioner further proposes that the POSA should have knowledge of “basic optical design with lenses,” despite the fact that the ‘075 patent specification makes clear that the lenses in the claimed apparatuses are well known. Similarly, Petitioner proposed that the POSA should have knowledge of “head mounted displays,” again despite the fact that head mounted displays were well known. Petitioner’s undue weight on technologies that are well-known or not claimed elements of the inventions leads Petitioner to further contend incorrectly that a POSA should have at least two years of “professional experience in mechanical and basic optical design or engineering.” In fact, a POSA need not have such extensive experience in “mechanical and basic optical design or

engineering”; rather, a POSA should have sufficient experience in “touchscreen technology” and “capacitive/conductive technology and materials,” because they are pertinent to the inventive elements of the claimed inventions.

19. Only after contending that a POSA must have knowledge in each of the aforementioned areas, Petitioner suggests that a POSA should only have “a basic understanding of touchscreen technology.” Petitioner’s definition of a POSA is backwards. A strong understanding of touchscreen technology is fundamental to the inventions claimed in the ‘075 Patent.

20. Petitioner’s proposed definition falls short in that “a basic understanding of touchscreen technology” would be insufficient to understand the difference between the ’075 patent and the art that Petitioner relies on in its petition. Nor would a person having only a basic understanding of touchscreen technology understand the issues involved in determining whether a POSA would have been motivated to combine references in the manner Petitioner proposes.

21. The insufficiency of Petitioner’s definition of a POSA is further highlighted by apparent misunderstandings Petitioner has regarding touchscreen technology. For example, Petitioner’s expert states that capacitive touchscreens “use the electrical properties of the body to create a change of charge at a location on a polymer coated touchscreen.” Ex. 1002 at ¶ 31. While a capacitive touchscreen *may* rely on electrical properties of the human body, as the ’075 patent

discloses (discussed further below regarding claims 7 and 8), it is not *necessary* for a capacitive touchscreen to rely on the human body to induce touch events.

Further, the majority of touchscreens used in 2014-era smartphones are glass, not polymer or “polymer coated.”

22. In explaining capacitive touchscreens, Petitioner also uncritically quotes an inaccurate passage of Chu stating that a “human body is a good transferor and transferee of electric charge because of the electromagnetic field around the human body at all times.” Ex. 1001 ¶ 31 (quoting Ex. 1004, ¶0005). To the contrary, a human body conveys electrical signals easily because the body consists largely of salt water, which is electrically conductive, not because the human body is always surrounded by an electromagnetic field. Everything in the universe is surrounded by an electromagnetic field, so that is not a relevant distinction.

23. Similarly, Petitioner and its expert propose that the prior art references would be combined based on the desire to reach more users, including those with “resistive touchscreen” devices. A POSA would quickly recognize the inaccuracy of that position given the extensive differences in the two technologies and the limited use of resistive touchscreen devices in personal mobile electronic devices. Further, the poor optical properties of resistive touchscreens would render them a poor choice for use in a virtual reality headset.

24. Petitioner's definition also places too much emphasis on mechanical engineering experience. While some familiarity with basic principles of mechanical engineering would be required, it would not require a degree in mechanical engineering or the like. Rather, the necessary familiarity with simple machines (e.g., levers and buttons) such as those that can be utilized to move a component from a first position to a second position could be obtained through minimal education and experience with such simple mechanisms. Further, while the challenged claims include "lenses," the specification makes clear that the invention relies on existent lens technology.

25. Therefore, a POSA would have a minimum of two years of experience in implementing touchscreen and optics technology, along with relevant education (e.g., a bachelor's degree) in science or engineering. In addition to specific academic training, a POSA may draw upon appropriate industry experience.

V. Claim Construction

A. Claim Construction Standard

26. I have been informed and understand that claims are construed from the perspective of a POSA at the time of the claimed invention (i.e., the effective filing date of the patent). I also understand that claims are construed in an IPR proceeding using the same claim-construction standard used by federal courts.

27. Under this standard, “the Office will construe patent claims . . . by taking into account the claim language itself, the specification, the prosecution history of the patent, and extrinsic evidence, among other things, as briefed by the parties.” 83 Fed. Reg. 51340, 51343 (Oct. 11, 2018), available at <https://www.federalregister.gov/d/2018-22006/p-24>.

28. Under the *Phillips* standard, “The ‘words of a claim are generally given their ordinary and customary meaning,’ which is ‘the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention, *i.e.*, as of the effective filing date of the patent application.” 83 Fed. Reg. at 51343 (quoting *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-13 (Fed. Cir. 2005) (en banc)).

29. I understand that *Phillips* stated that the specification is “the single best guide to the meaning of a disputed term and . . . acts as a dictionary when it expressly defines terms used in the claims or when it defines terms by implication.” 83 Fed. Reg. at 51343 (quoting *Phillips* at 1321 (internal quotation marks omitted)).

30. I also understand that *Phillips* stated that the prosecution history “is another source of intrinsic evidence that can ‘inform the meaning of the claim language by demonstrating how the inventor understood the invention and whether the inventor limited the invention in the course of prosecution.’” However, “the

prosecution history ‘often lacks the clarity of the specification and thus is less useful for claim construction purposes.’” 83 Fed. Reg. at 51343 (quoting *Phillips* at 1317).

31. Finally, I understand that “Extrinsic evidence, such as expert testimony and dictionaries, may be useful in educating the court regarding the field of the invention or helping determine what a person of ordinary skill in the art would understand claim terms to mean.” 83 Fed. Reg. at 51343 (quoting *Phillips* at 1318-19). I also understand, however, that “extrinsic evidence in general is viewed as less reliable than intrinsic evidence.” 83 Fed. Reg. at 51343 (quoting *Phillips* at 1318).

32. I have provided an opinion below regarding the meaning of certain claim terms. As to the other terms that I do not address, I will simply apply the ordinary and customary meaning of those terms, which may be further addressed in my discussion of particular claims. In reaching my conclusions regarding the meaning of the claim terms, I considered the specification and its prosecution history. In the chart below, I provide a summary of the construction for certain terms that are relevant to the challenged claims. Following the chart, I provide my reasoning and the factual basis in support of my proposed interpretation for each term.

Claim	Claim Language	Proposed Construction
7	sized to have electrical properties that are sufficient to be detected by the touch-screen based on capacitance when the input mechanism is in the extended position and only the portion of the surface is contacting the touch-screen.	"sized to have electrical properties that are sufficient to be detected by the touch-screen based on capacitance when the input mechanism is in the extended position and only the portion of the surface is contacting the touch-screen, without relying on the electrical properties of other components or the human body"
8	sized to have sufficient capacitive properties such that contact between only the portion of the surface and the touch-screen can be detected by a capacitive touch-screen when the input mechanism is in the extended position and in the absence of human contact with the electric shield.	"sized to have sufficient capacitive properties such that contact between only the portion of the surface and the touch-screen can be detected by a capacitive touch-screen when the input mechanism is in the extended position, without relying on the electrical properties of other components or the human body"
12	lever	a stiff body pivoted on a fulcrum

B. The Electrical Shield of Claim 7

33. Claim 7 recites “[t]he virtual reality viewer of claim 6, wherein the surface of the electrical shield is sized to have electrical properties that are sufficient to be detected by the touch-screen based on capacitance when the input mechanism is in the extended position and only the portion of the surface is

contacting the touch-screen.” By the plain language of the claim, the electrical shield must be sized to have electrical properties that are sufficient to be detected by the touch-screen based on capacitance when the input mechanism is in the extended position and only the portion of the surface is contacting the touch-screen, without relying on the electrical properties of other components or the human body.

34. This is supported by the specification. The language of claim 7 closely tracks the specification’s description of an embodiment that does not rely on the electrical properties of the human body (or any other capacitive element) to induce a touch event:

In some implementations, the electric shield is configured (e.g., sized and/or positioned) so as to have capacitive properties sufficient to be detected by a capacitive touch-screen when the input mechanism is in the extended position *and in the absence of human contact* with the electric shield.

’075 patent at 7:52-56 (emphasis added). A POSA would understand what the ’075 patent means in stating that the electric shield is configured (e.g., sized) to have capacitive properties sufficient to induce a touch event on a capacitive touchscreen. For example, a POSA would understand that (1) a relatively large total area of electric-shield material is necessary in order to provide capacitive coupling to the rest of the world, since the value of a capacitor in general is proportional to the

area of its plates; and (2) a substantially smaller area of the electric-shield material is required to contact the touchscreen, similar to the area of a human fingertip.

35. A POSA would understand that the reference to “the absence of human contact” in this passage of the ‘075 patent means that the electric shield is configured (e.g., sized sufficiently) to provide enough capacitive coupling to induce a touch event on the touchscreen, without requiring any capacitive coupling from the human. This is made clear by the immediately following sentence, which describes an alternative embodiment which does rely on the capacitive coupling between the user’s body and the rest of the world to induce a touch event:

However, it can also be appreciated that, in some implementations, the electric shield can be electrically coupled to the portion of the input mechanism that is interacted with by the user such that electrical properties of the user's body can be utilized to induce the touch input.

’075 patent at 7:56-61.

36. A POSA would understand that the passage at column 7, lines 52-61 describes two distinct embodiments. A POSA would further understand that claim 7 is directed to the first embodiment (i.e., the embodiment in which the electric shield is configured to induce a touch event without relying on the electrical properties of the user’s body).

37. This conclusion is reinforced elsewhere in the specification. For example, an electric shield according to this first embodiment is again referenced

later in the specification, where the first embodiment describes an electric shield with sufficient electrical properties to induce a touch event:

The compressible pad and electrical shield material work to mimic the electrical and physical properties of a human finger so that any form of touch screen technology will register a touch event when the lever mechanism is actuated. As would be understood by those skilled in the art, the combination of physical, and electrical properties of this pad electrical shield material can be tuned to work on a variety of touch screen technologies such as capacitive or resistive touch screen technologies.

EX1001, 10:45-54.

38. As described in the specification above, the compressible pad and electrical shield “mimic” the properties of a human finger – the pad mimicking the physical properties of the finger and the electrical shield mimicking the electrical properties of the finger. Thus, because the human finger’s properties are “mimicked,” the human finger is superfluous to that embodiment.

39. As another example, the following passage of the ‘075 patent confirms that the first embodiment having a sufficiently sized electrical shield does not rely on the electrical properties of the human body to induce a touch event: “Moreover, the exemplary viewer and user input assembly can be configured to allow a user to interact with the touch sensitive screen without reliance on the electrical properties of the human body to induce the electrical event. For instance,

the metallized film 725 can be sized such that it is suitable for inducing a touch event without requiring user contact therewith.” EX1001, 10:61-67.

40. Accordingly, a POSA reading claim 7 in the context of the specification would understand that the electric shield of claim 7 must be sized to have electrical properties that are sufficient to be detected by the touch-screen based on capacitance when the input mechanism is in the extended position and only the portion of the surface is contacting the touch-screen, without relying on the electrical properties of other components or the human body.

C. The Electric Shield of Claim 8

41. Claim 8 recites, “The virtual reality viewer of claim 6, wherein the surface of the electric shield is sized to have sufficient capacitive properties such that contact between only the portion of the surface and the touch-screen can be detected by a capacitive touch-screen when the input mechanism is in the extended position and in the absence of human contact with the electric shield.”

42. Like claim 7, this claim is directed to the first embodiment disclosed in the specification in which the electric shield is sufficiently configured such that it does not rely on the electrical properties of the user’s body to induce a touch event. That conclusion is separately driven by each of the following recitations of claim 8: (1) “the surface of the electric shield is sized to have sufficient capacitive properties such that contact between only the portion of the surface and the touch-

screen can be detected by a capacitive touch-screen when the input mechanism is in the extended position”; and (2) “in the absence of human contact with the electric shield.”

43. The first of these limitations indicates that the electric shield must be sized such that its own capacitive properties are sufficient to induce a touch event. A POSA would understand that this means that the electric shield need not rely on the electric properties of the user’s body or another capacitive device to induce a touch event. As discussed regarding claim 7, the specification confirms that understanding. In two passages, the specification uses language similar to claim 8 to describe an embodiment in which the electric shield is sufficiently configured to induce a touch event without relying on user contact. The specification immediately and expressly contrasts that embodiment with another distinct embodiment in which the electric shield does rely on the electrical properties of the user’s body because it is not sufficiently configured to do so without the user’s body. ’075 patent at 7:56-61, 10:61-67.

44. The second limitation of claim 8 only reinforces that conclusion. A POSA would understand that the language “in the absence of human contact with the electric shield,” in this context, indicates that electrical coupling between the human user and the electric shield is not required. As discussed regarding claim 7, the specification confirms that understanding by contrasting the first embodiment,

in which the electric shield does not rely on the physical properties of the human to induce a touch event, and the second embodiment, in which it does rely on the physical properties of the human.

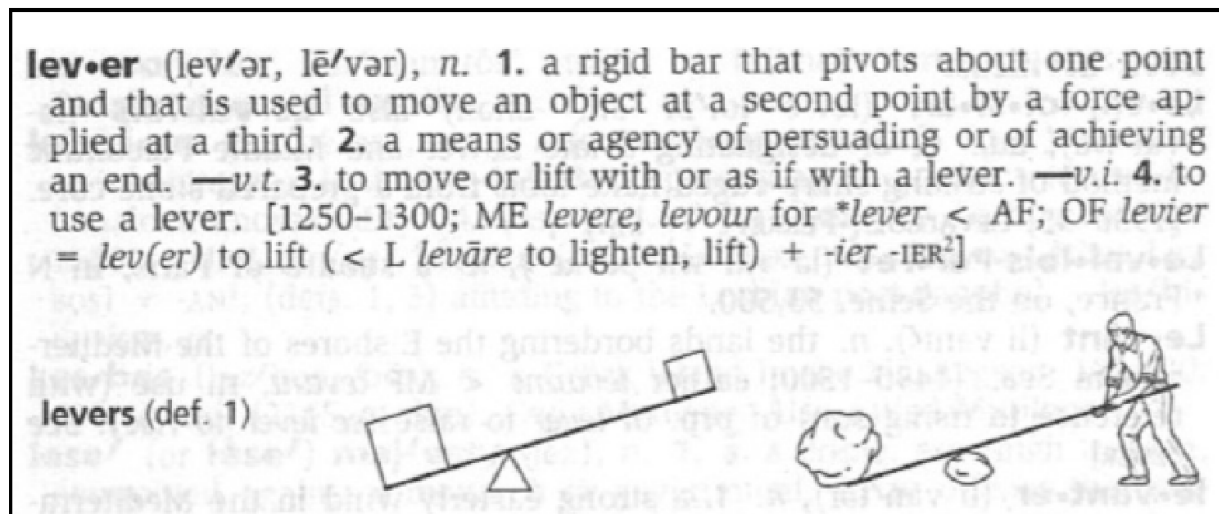
45. Petitioner's interpretation of this claim as merely requiring that a human not have *direct physical* contact with the electric shield is illogical. As discussed above, the point of the embodiment to which this claim is directed is that the electrical shield **need not rely on the electrical properties of the human body** to induce a touch event. An electrical shield that relies on the human body (whether through direct or indirect physical contact) would not be sufficiently configured to induce a touch event and therefore would not satisfy the requirements of claim 8.

46. Thus, a POSA would understand that the electric shield of claim 8 must be sized to have sufficient capacitive properties such that contact between only the portion of the surface and the touch-screen can be detected by a capacitive touch-screen when the input mechanism is in the extended position, without relying on the electrical properties of other components or the human body.

D. Lever

47. Petitioner's proposed construction of "lever" ignores the common meaning of "lever" (as well as the specification's teaching) and instead relies on an out-of-context secondary definition from a present-day online dictionary.

48. Petitioner only cites one dictionary definition that was published before the priority date of the '075 patent. That dictionary, excerpted below, does not support Petitioner's desired construction, so Petitioner claims that definition is irrelevant to the patent's usage.



Ex. 1006, pg. 3 (Random House Webster's College Dictionary, pg. 764 (2000)).

Petitioner states that this definition “encompass[es] a long plank or bar that lifts heavy objects, which a POSA would understand is irrelevant to the patent's usage.” Petition at 27. But while some levers may be used to lift heavy objects, nothing in this definition limits a lever to something used to move a heavy object.

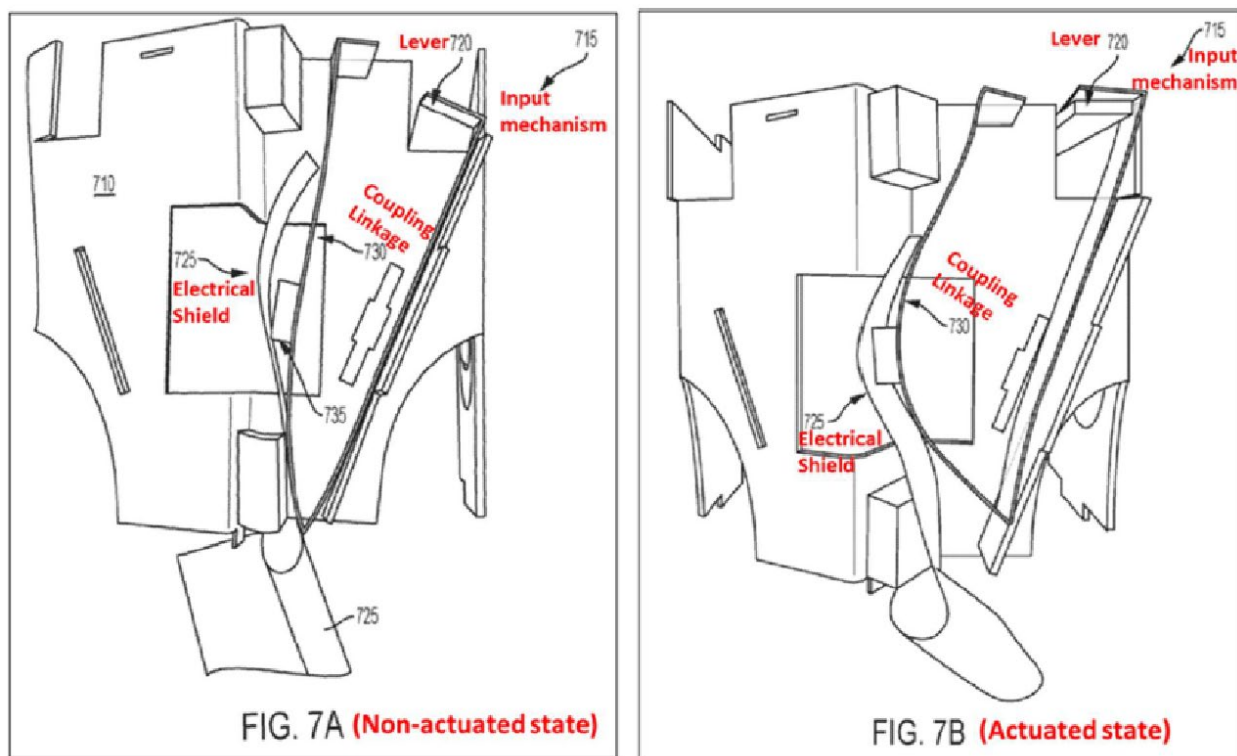
49. Moreover, the Webster's College Dictionary definition that Petitioner disregards is consistent with the definition from a technical dictionary published in 2013, shortly before the '075 patent's priority date. The Oxford Dictionary of Mechanical Engineering defines lever this way:

A stiff rod or beam pivoted about a fulcrum with a load at some point along the lever being moved by a force (effort) at a third point. There are three classes of lever defined according to the relative positions of the effort, fulcrum, and load. For class 1, the effort and the load are on opposite sides of the fulcrum (as in a pair of pliers); for class 2, effort and load are on the same side of the fulcrum with the effort further away (as in a wheelbarrow); class 3 is like class 2, but with the load further away (as with tweezers). Classes 1 and 2 provide a mechanical advantage, but class 3 does not.

Ex. 2051, Oxford Dictionary of Mechanical Engineering at 203 (2013).¹

50. The '075 patent provides an example of a lever that is consistent with these definitions, as illustrated in Figures 7A and 7B:

¹ Exhibit 2050 includes a true and correct copy of excerpts from the Oxford Dictionary of Mechanical Engineering (2013) in my possession, including the title page, copyright verso page, and an excerpt of page 203 showing the definition of “lever.”

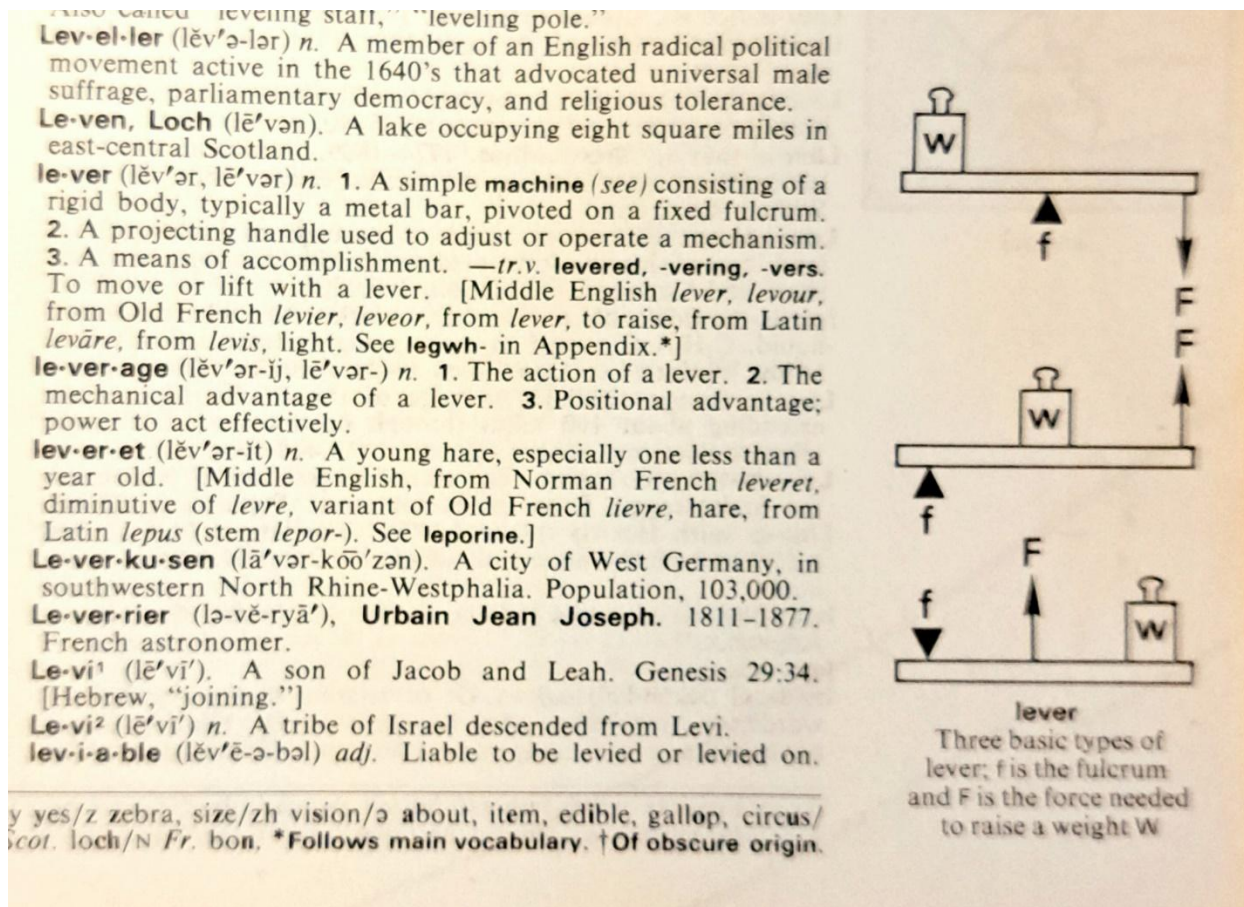


Ex. 1001, Figs. 7A & 7B (with Petitioner’s annotations in red). As shown here, when the user actuates the lever, the lever pivots, thereby causing the coupling 730 to deform and move the input mechanism towards the touchscreen. Ex. 1001, 7:62-8:10. This action of the lever is consistent with the definitions from both the Random House Webster’s College Dictionary submitted by Petitioner and the Oxford Dictionary of Mechanical Engineering submitted by Patent Owner. In the words of the Oxford dictionary, the lever 720 is “pivoted about a fulcrum with a load [the flexible linkage coupled to the compressible pad and electric shield] at some point along the lever being moved by a force (effort) at a third point [the point where the user actuates the lever].”

51. Petitioner rejects this common meaning of “lever” because it does not fit with Petitioner’s invalidity arguments. So instead, Petitioner looks to a secondary definition from an online dictionary and argues that it represents the ordinary meaning of “lever”: “(b) a projecting piece by which a mechanism (see MECHANISM sense 1) is operated or adjusted.” Petition at 18. Understood in the context of the full entry, this alternative phrasing is consistent with the definitions cited above. For example, the lever shown at right is consistent with all of the definitions.



52. However, taking this secondary definition out of context, as Petitioner does in rejecting the primary definitions of “lever,” strips such proposed definition of all meaning. Under Petitioner’s construction, any depressible button would apparently constitute a lever. This assertion is not consistent with the ordinary meaning of the term, nor is it consistent with the usage of “lever” in the ’075 patent. This is made even more clear by dictionaries published before the filing of the ’075 patent that contain a secondary definition for lever similar to Petitioner’s online dictionary. For example, the American Heritage Dictionary of the English Language provides the following definitions:



Ex. 2052, The American Heritage Dictionary of the English Language, New College Edition, at 751 (1976).²

53. Similar to the Webster's College Dictionary and the Oxford Dictionary of Mechanical Engineering, the primary definition involves a "rigid body . . . pivoted on a fixed fulcrum." The secondary definition, while similar to the secondary definition from Petitioner's online dictionary, provides more clarity in describing a "projecting *handle* used to adjust or operate a mechanism." This

² Exhibit 2051 includes a true and correct copy of excerpts from the American Heritage Dictionary of the English Language, New College Edition (1981) in my possession, including the title page, copyright verso page, and an excerpt of page 751 showing the definition of "lever."

would describe the pull lever pictured above without encompassing any depressible button.

54. For the foregoing reasons, the Board should construe the term “lever” in accordance with its ordinary meaning as a stiff body pivoted on a fulcrum, which is consistent with the technical and general dictionary definitions cited above.

VI. Overview of the Prior Art

A. Kondo

55. Kondo’s patent proposes a method of remote control for a “capacitive touch panel” (1506 in ¶0023) by “provid[ing] an attachment that achieves remote control input to a *touch panel mounted on* an electronic device.” (Kondo’s PROBLEM section; emphasis added). Kondo correctly identifies the type of touchscreen technology that is commonly used on smartphones as “projected-capacitive” (¶0024). However, the entire remainder of Kondo’s patent describes and is designed around a different form of touchscreen technology, that of surface-capacitive.

56. This contention is supported in multiple ways throughout the patent. In ¶0024, Kondo describes how a capacitive touchscreen works, as follows:
The user touching the panel causes the human body (contact object) to act as the impedance imparting body (capacitor or the like capacitance).
While in-phase and same-potential alternating currents are applied to

the four corners of the touch panel 1506, when a finger or the like touches the touch panel 1506, the current changes in accordance with the impedance of the human body. Furthermore, the contact coordinates in the coordinate system of the touch panel 1506 can be calculated from the ratio of the currents detected at the four corners.

EX1003, ¶0024.

57. This is an accurate description of how a surface-capacitive touchscreen works. An appropriate reference can be found in the 55-page "Touch Displays" chapter in the 1,800-page "Handbook of Digital Imaging," published by John Wiley & Sons, Ltd. in March 2015, written in 2013-2014.

(<https://onlinelibrary.wiley.com/doi/full/10.1002/9781118798706.hdi067>)

58. In addition, Kondo refers to this current-based method of touch-location detection in ¶0048, as follows: "Therefore, the touch panel 1506 can detect a current value corresponding to this impedance and recognize that a touch operation has been performed at the virtual button positions W31 to W34." This is different from the touch-location method used in a projected-capacitive touchscreen, which is based on detecting a change in the mutual capacitance between multiple drive and sense (X-Y) electrodes. (The same Wiley textbook referenced in the previous paragraph also includes a comprehensive description of projected-capacitive touchscreen technology.)

59. Kondo is describing a surface-capacitive touchscreen, not a projected-capacitive touchscreen. A POSA in the field of touchscreens at the time of the '075 patent would be aware of these two distinct types of capacitive touchscreens, and would recognize Kondo's description of the technology as a surface-capacitive touchscreen. The POSA would get further verification of the touchscreen technology used in Kondo's patent from Kondo's emphasis on the need for protection against static electricity, which is unique to surface-capacitive touchscreens (projected-capacitive touchscreens do not have this issue). This emphasis includes the following references:

- ¶0012: "...*static electricity* can be prevented from building up on the exterior, preventing malfunction of the remote touch circuit."
- ¶0033: Kondo expresses concern that a smartphone can be damaged by static electricity: "The device holding plate 44 is a plate material that secures the smartphone 1500, and is made of a material that is conductive or that dissipates *static electricity*."
- ¶0036: "The holding side ground circuit part 48 is a *static electricity* diffusion film attached to the inner surface of the recessed part 43, of which the tip end extends to the mating surface between the holding part 4 and the attachment main body 8. As long as the device holding plate 44 is secured to the cover part 42, the holding side ground circuit part 48 abuts on the outer

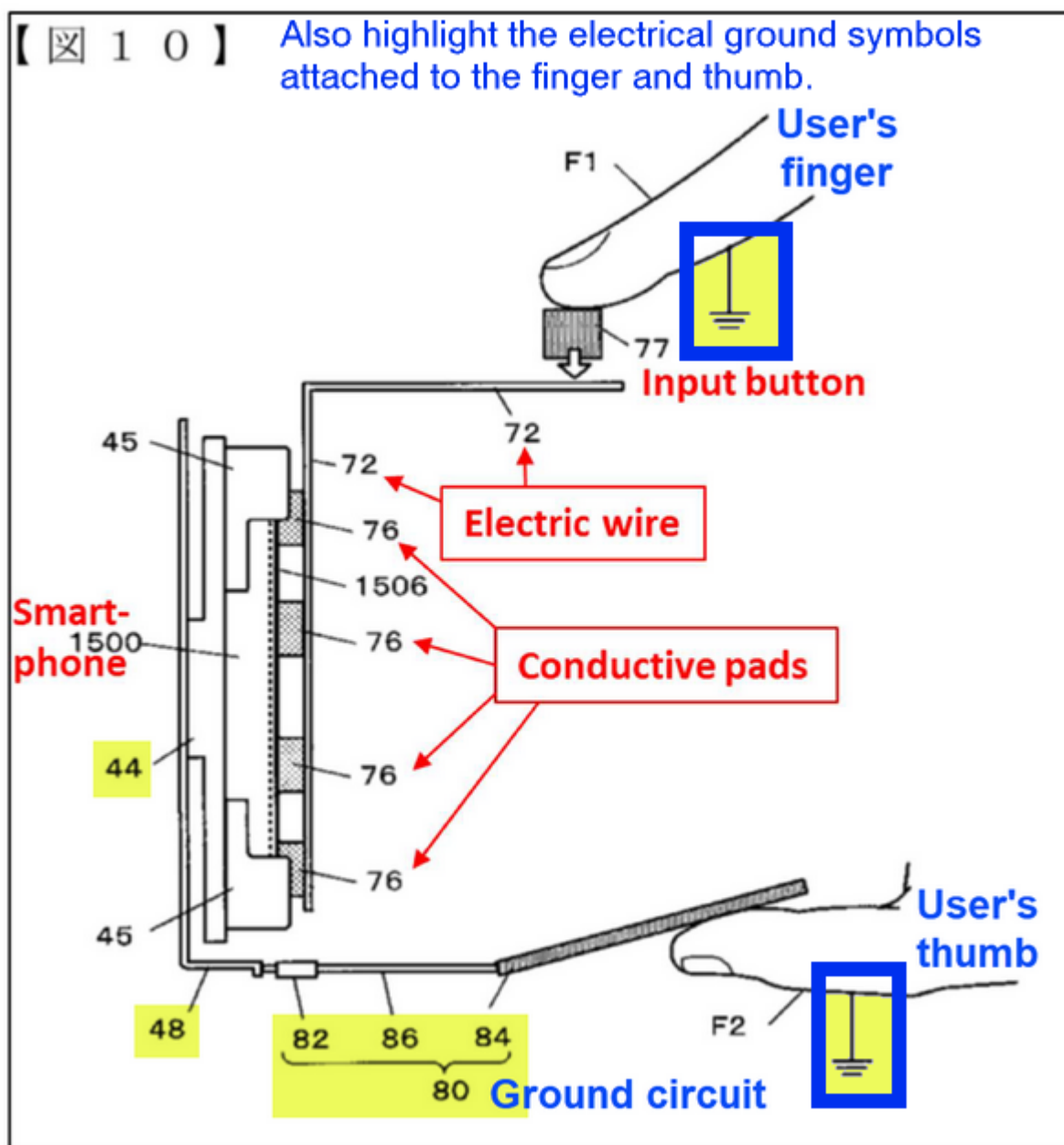
surface of the device holding plate 44 and removes *static electricity* from the main body of the smartphone 1500 via the device holding plate 44.”

- In ¶0039, when describing the “electrical wire 72” (actually a flex cable) that connects the conductive pad 76 to the button 77, Kondo is again concerned about static electricity: “The electrical wire part 72 is formed by sealing conductive lines 74 formed of a material that is conductive or that dissipates *static electricity* on a flexible sheet 73 formed of an antistatic material with excellent bending properties.”
- In ¶0042, the plastic part that surrounds the button 77 (“gripping part 9”) is also described as being made of antistatic material: “Moreover, the gripping part 9 is made of a non-conductive *antistatic* material.”

60. The use of “non-conductive antistatic material” is fundamentally flawed. A material is “antistatic” only because it is conductive. It must be at least weakly conductive to be considered an antistatic material.

61. Yet another indication that Kondo is designing his remote touch circuit around a surface-capacitive touchscreen can be found in his attempt to provide a reference ground for the user. Kondo describes a “ground circuit 80” (¶0038, illustrated in Figure 10, below) that in total is made up of the following parts (highlighted in yellow in Figure 10):

- 44 – Conductive device (smartphone) holding plate (¶0033), connected to 48;
- 48 – Holding side ground circuit static electricity diffusion film (¶0036), connected to 82;
- 82 – Spring connection terminal (¶0045), connected to 86;
- 86 – Ground wire (¶0044), connected to 84; and
- 84 – Conductive ground sheet (¶0046), on the bottom part of the attachment main body 8.
- In Fig. 10, the electrical ground symbol () attached to the finger F1
- In Fig. 10, the electrical ground symbol () attached to the thumb F2



EX1003, Fig 10 (red annotations by Petitioner, blue annotations and yellow highlights by Patent Owner).

62. The purpose of these parts is described in ¶0047, as follows: “When the holding part 4 is closed, *the main body of the smartphone 1500 is electrically conductively connected and grounded to the human body* that is the user through the device holding plate 44, holding side ground circuit 48, and attachment main body side ground circuit 80”. By providing an electrically conductive path between the hand (specifically, the thumb in ¶0046) of the human that’s holding the bottom part of the VR viewer and a conductive plate (44) holding the smartphone, Kondo is attempting to provide a reference ground for the surface-capacitive touchscreen.

63. One of the unique characteristics of a surface-capacitive touchscreen that differentiates it from projected-capacitive is its use of a low-impedance signal return path through the user’s finger back to the surface capacitive touchscreen’s signal reference. That signal reference is commonly called “reference ground” or “ground,” though it need not be a truly low-resistance connection to the earth. A stable reference ground is critically important in a surface-capacitive touchscreen because it establishes the baseline reference current for the “no-touch” condition. Also, the human body capacitance (or electrically grounded stylus) that induces a touch in a surface-capacitive touchscreen is referenced to the touchscreen electrical ground, not some generalized earth ground or “rest-of-the-world” ground. This is a very different situation than in a projected-capacitive touchscreen, where the

non-active electrodes provide a reference level for capacitive measurement of the active electrodes. No “reference ground” is needed in a projected-capacitive touchscreen.

64. As any smartphone user in 2014 would know, the touchscreen of a smartphone works whether the user is gripping the phone chassis with one hand and touching the touchscreen with one finger of the other hand, or touching only the screen with only one fingertip. A typical phone user would also know that the touchscreen operates whether the user is grounded, or if they are not grounded (*e.g.*, sitting in a plastic chair). A POSA would also know what the lay user knows in this case.

65. A POSA at the time of the ‘075 patent would know with certainty that it was not possible to integrate a surface-capacitive touchscreen into a mobile consumer-electronics device such as a smartphone. All smartphones capable of providing display capability sufficient for use in a VR viewer at that time used projected-capacitive touchscreens. A POSA at that time who was considering combining Kondo’s and Chu’s patents would therefore be faced with combining designs created for two different and incompatible touchscreen technologies. This would significantly increase the difficulty and decrease the likelihood of the combination being achieved.

VII. Obviousness Analysis of Challenged Claims

A. Claim 1

66. A POSA would not have been motivated to combine Kondo with Chu as Petitioner proposes.

67. As described above, a POSA would understand that Kondo's touch panel 1506 is a surface-capacitive touchscreen. A POSA would know that a surface-capacitive touchscreen such as Kondo's touch panel 1506 would not be used in personal mobile devices. Because of the electrical requirements of both the touchscreen and the control circuit, there would be no reason for a POSA to create a surface-capacitive touchscreen that would fit within and be powered by a personal mobile device.

68. Moreover, it would not be clear to a POSA that Kondo's design would work with a surface-capacitive touchscreen because the total impedance between the human-touchable button and the conductive pad that touches the touchscreen may be so high that insufficient capacitive coupling from the user is provided to register as a touch. Since surface-capacitive technology is typically used in ATMs, ticketing machines, kiosks, point-of-sale terminals, arcade games, and factory automation applications (all devices that are designed for a user to directly contact the screen with exactly one finger or stylus), there was no demand for *remote-touch* capability for surface-capacitive screens. A POSA would not have been

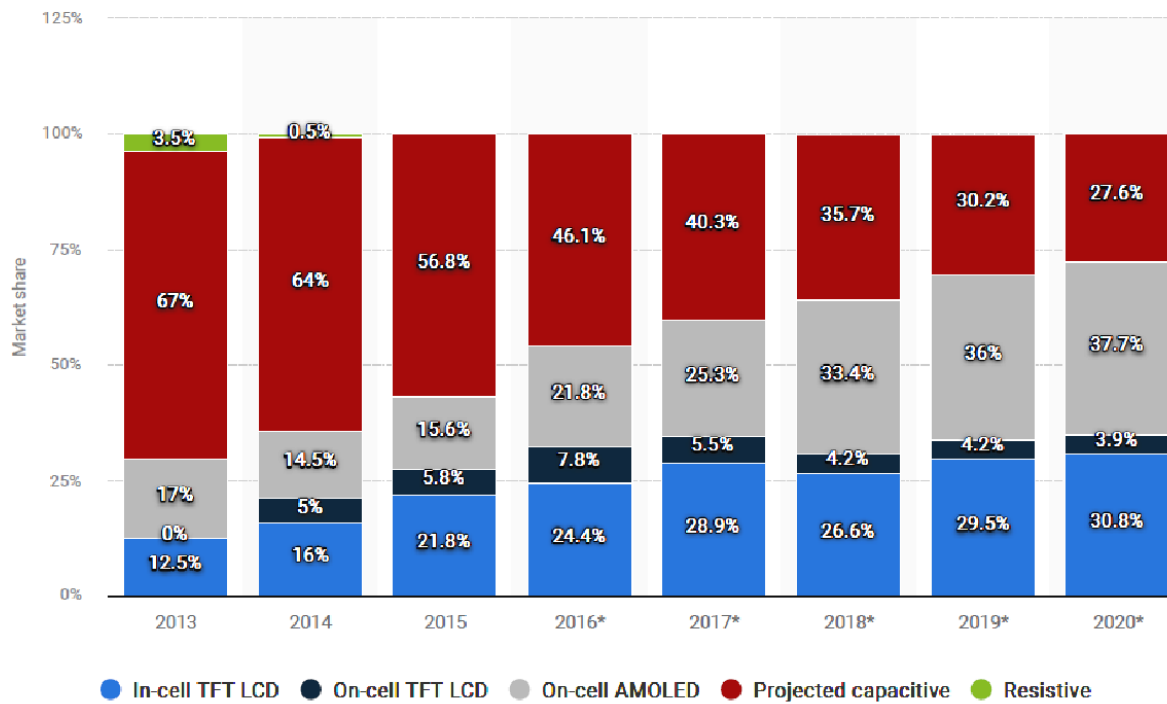
motivated to utilize Kondo's surface-capacitive touch panel 1506 as the mobile device recited in the challenged claims of the '075 patent. The inability of surface-capacitive touchscreens to identify and report two touch events makes them unsuitable for use in multi-touch user interfaces. Practically all smartphones in 2014 were based on multi-touch user interfaces (*e.g.*, those utilizing projected-capacitive touchscreens). A POSA would not have been motivated to utilize Kondo's surface-capacitive touch panel 1506 as the mobile device recited in the challenged claims of the '075 patent.

69. Petitioner's proposed combination also fails for additional reasons. Kondo only discloses embodiments in which the touch pads are in constant contact with the touchscreen after insertion of the touchscreen device into the headset. A POSA who understands that Kondo is using a surface-capacitive touchscreen would have no particular motivation to change Kondo's input mechanism to a non-contact system like Chu. In fact, a POSA would be motivated against modifying Kondo in that way because adding moving parts would make the remote touch system more complicated and expensive for no technical or user benefit. It would cost more and be less reliable. For this additional reason, a POSA would not have been motivated to modify Kondo in the manner Petitioner proposes.

70. Petitioner asserts that a POSA would have been motivated to modify Kondo to use Chu's input mechanism so that it would work with resistive

touchscreens. However, Kondo makes no mention of resistive touchscreens, and a POSA would also have known that, at the time of the invention of the '075 patent, resistive touchscreens comprised little, if any, market share. In 2013 only 3.5% of mobile phones used resistive touchscreens and by 2015 none did. Ex. 2046.³

Market share of mobile phone touch screens worldwide from 2013 to 2020, by technology



Ex. 2046. Market share of smartphones by touch sensor type.

³ The information found in Exhibit 2046 is available at the following URL: <https://www.statista.com/statistics/616468/mobile-phone-touch-technology-share-worldwide/>. I visited this web page and found that it includes the information included in Ex. 2046, including specifically the chart pasted below.

71. What few resistive touchscreens were available on the market were used on low-cost mobile devices that would not have had the graphic processing power or display resolution that was necessary for a mobile device to be used with a VR headset, further evincing the complete lack of motivation to combine. Indeed, Google's own Android specification from 2016-2017 sets forth specific hardware requirements for a smartphone to be VR ready, all of which were completely incompatible with resistive touchscreens at the time. Ex. 2048 at 74-75. Moreover, the Durovis Dive 5 was a VR viewer for use with a smartphone. Durovis's website lists compatible smartphones. EX2064. Of the compatible devices released in 2014 or earlier, publicly available information indicates that none of them used resistive touchscreens (e.g., they are specifically described as having capacitive touchscreens or they are described as having glass screens, which would be inconsistent with a resistive touchscreen). EX2065. (For a few of these phones, the information cited in EX2065 comes from Wikipedia rather than a site such as GSM Arena, a well-known website providing specifications on phones. However, in these cases, other contemporary phones by the same manufacturer (and often in the same series) were identified by GSM Arena as having glass screens, consistent with the Wikipedia entries for these few phones).

72. In EX2046, "in-cell" and "on-cell" refer to the location of the projected capacitance sensor electrodes within the display-touchscreen stack. The

red category is discrete projected capacitive sensors, in which the touch sensor is manufactured separately from the display. All of the categories except “Resistive” are types of projected-capacitive touchscreen constructions.

73. A further reason for avoiding the use of resistive touchscreens is their poor optical properties. A resistive touchscreen has an air gap between two conductive layers. A touch is indicated by bringing those two layers into contact with one another, making an electrical connection. Optically, this is two partial mirrors facing each other with a variable gap between them. Light bounces back and forth in this gap, creating offset images that interfere with the image from the display. In a virtual reality viewer, stereoimaging relies on slightly offset images to convey 3-dimensional depth information to the user. The images being further offset by the gap present in a resistive touchscreen would disrupt the ability to properly convey the 3D stereo image. A POSA with experience in the field of optics, as Petitioner proposes, would reject the resistive touchscreen, and therefore would not consider the resistive touchscreen relevant for Patent Owner’s claimed invention.

74. Resistive touchscreens, like surface-capacitive touchscreens, are designed to process a single input location. They are not able to process multi-touch gestures. Starting in 2007 (and continuing to present), multi-touch capability has been a requirement for use in smartphones, particularly those using the Apple

iOS and Google Android operating systems, which have dominated the consumer market. Without the ability to process multi-touch gestures, resistive and surface-capacitive touchscreens would be able to support only one user input at a time. A POSA seeking to enable more than one touch control in a VR viewer based on a smartphone would reject resistive and surface-capacitive touchscreens.

75. In other words, while capacitive and resistive touchscreens were generally known, the smartphone market was entirely dominated by projected capacitive touchscreens, almost to the complete exclusion of resistive touchscreens (with those limited resistive touchscreen devices incapable of operating for purposes of virtual reality viewing). Adding a resistive touchscreen to a smartphone was not simply a matter of switching out one comparable technology for another; it was directly contrary to the accepted approach of the entire market segment. Given this landscape, a POSA in 2014 would have had no reason to consider resistive touchscreens at all. Thus, a POSA seeking to use touchscreen-enabled mobile devices in 2014 would not be motivated to consider resistive or surface-capacitive touchscreens for use in a VR viewer based on a smartphone.

B. Claim 2

76. Claim 2 depends from claim 1 and includes each of its limitations. Therefore, Petitioner fails to establish that the proposed combination teaches or suggests all elements of claim 2 for the reasons discussed regarding claim 1.

C. Claim 3

77. Claim 3 depends from claim 1 and includes each of its limitations.

Therefore, Petitioner fails to establish that the proposed combination teaches or suggests all elements of claim 3 for the reasons discussed regarding claim 1.

D. Claim 4

78. Claim 4 depends indirectly from claim 1 (via intervening claim 3) and

includes each of the limitations from claims 1 and 3. Therefore, Petitioner fails to establish that the proposed combination teaches or suggests all elements of claim 4 for the reasons discussed regarding claim 1 and claim 3.

E. Claim 5

79. Claim 5 depends from claim 1 and includes each of its limitations.

Therefore, Petitioner fails to establish that the proposed combination teaches or suggests all elements of claim 5 for the reasons discussed regarding claim 1.

F. Claim 6

80. Claim 6 depends from claim 1 and includes each of its limitations.

Therefore, Petitioner fails to establish that the proposed combination teaches or suggests all elements of claim 6 for the reasons discussed regarding claim 1.

G. Claim 7

81. Claim 7 depends indirectly from claim 1 and includes each of its

limitations. Therefore, Petitioner fails to establish that the proposed combination

teaches or suggests all elements of claim 7 for the reasons discussed regarding claim 1.

82. Further, as discussed above in the Claim Construction section, a POSA reading claim 7 in the context of the specification would understand that the electric shield of claim 7 must be sized to have electrical properties that are sufficient to be detected by the touch-screen based on capacitance when the input mechanism is in the extended position and only the portion of the surface is contacting the touch-screen, without relying on the electrical properties of other components or the human body.

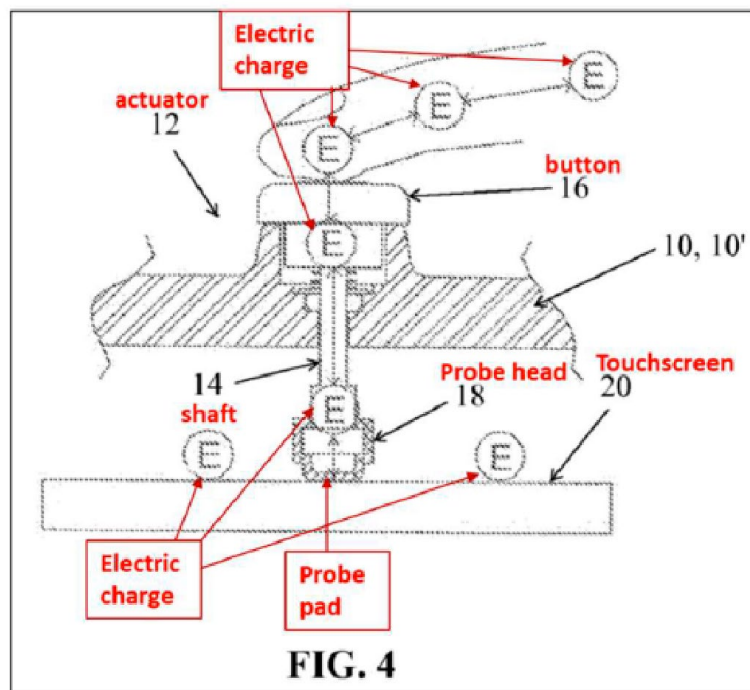
83. Petitioner provides no analysis of claim 7 specifically, instead stating only the following: “See the analysis of claims 1, 1(c), 1(d), 2, and 6 for a description of the Kondo/Chu combination’s input mechanism and how it operates to generate a touch event.” Petition at 83. Petitioner’s analysis of claim 1, in discussing the electrical shield, asserts that “the combinations of Kondo/Chu proposed above in §XI(C) would use Chu’s input mechanism to contact the central region of Kondo’s touchscreen.” Petition at 61. Petitioner goes on to state that “the electrical shield (Chu’s probe pad 30) in the Kondo/Chu combination would contact the central region of the smartphone’s touchscreen when the input mechanism is in an extended position.” Petition at 65. However, as Petitioner acknowledges, Chu’s probe pad is not itself sufficient to induce a touch event;

instead, it relies on the electrical properties of the human body to induce a touch event:

FIG. 4 shows the actuator mechanism 12 at an actuation position when the press button 16 is pushed downwards/inwards by a finger of a user, and the probe head 18 is touching the capacitive touch screen 20. *At this actuation position, electric charge E can be transferred between the finger of the user and the capacitive touch screen 20 through the press button 16, the actuator shaft 14 and the probe head 18*, as shown by the arrows.

Ex. 1004, ¶ 0041 (emphasis added).

84. This is further demonstrated in Petitioner's annotated version of Chu's Figure 4, in which Petitioner labels the "Electric charge" transferred from the user's finger through the probe pad 30 to induce a touch event:



Petition at 60 (reproducing Ex. 1004 Fig. 4 with Petitioner's annotations in red).

As Petitioner states, "[a]ll three embodiments of Chu operate in this same way."

Petition at 61. Therefore, Petitioner has failed to show that the requirements of claim 7 are found in Kondo or Chu. The requirements of claim 7 are completely missing from Kondo, Chu, and the asserted combination of Kondo and Chu.

85. In summary, a POSA would understand that claim 7 requires that the electric shield be sized to have electrical properties that are sufficient to induce a touch event by itself, without relying on other components or on the electrical properties of the human body. With regard to Chu's patent, a POSA would understand that all embodiments of Chu's input mechanism require the electrical properties of a human body in order to induce a touch event. The probe pad 30 of Chu's input mechanism is not sufficient by itself to induce a touch event. These facts are unchanged when Chu's input mechanism is inserted into Kondo's housing. Therefore, the combination of Kondo and Chu do not teach or suggest the additional recitations of claim 7.

H. Claim 8

86. Claim 8 depends indirectly from claim 1 and includes each of its limitations. Therefore, Petitioner fails to establish that the proposed combination teaches or suggests all elements of claim 8 for the reasons discussed regarding claim 1.

87. Further, as discussed in the Claim Construction section, a POSA would understand that the electric shield of claim 8 must be sized to have sufficient capacitive properties such that contact between only the portion of the surface of the electric shield and the touch-screen can be detected by a capacitive touch-screen when the input mechanism is in the extended position, without relying on the electrical properties of other components or the human body. Petitioner's argument on claim 8 relies on the same incorrect analysis as its argument for claim 7. In other words, Petitioner argues that claim 8 is satisfied by Chu's probe pad 30 even though the probe pad does not have sufficient capacitive properties to induce a touch event, and therefore instead relies on the electrical properties of the human body to do so. That interpretation is incorrect for the reasons discussed above, and therefore Petitioner's argument fails for the same reasons discussed regarding claim 7.

88. Petitioner's alternative argument relying on the embodiment of Kondo disclosing the use of a capacitive element also falls short. In that embodiment of Kondo, the button "can be configured to connect to a capacitive element instead of the human body." Specifically, Kondo says, "Connect a first terminal of the capacitive element 11 to the attachment main body side ground circuit 80, and connect the second terminal to the button part 77. Furthermore, the button part 77

can be configured to connect the second terminal of the capacitive element 11 to the conductive line 74 when the button part is pressed.” Petition at 84.

89. Petitioner does not explain how it proposes to modify its combination of Kondo’s housing and Chu’s input mechanism to incorporate this capacitive element. For example, Chu’s input mechanism does not have any equivalent of Kondo’s “main body ground circuit 80,” so there’s nothing to connect the capacitive element to. (See the overview of Kondo above for more discussion of “ground” in capacitive touchscreens.)

90. In any case, the use of Kondo’s capacitive element would not satisfy the recitations of claim 8. Claim 8 requires that “the surface of the electric shield is sized to have sufficient capacitive properties such that contact between only the portion of the surface and the touch-screen can be detected by a capacitive touch-screen when the input mechanism is in the extended position.” The reason for Kondo’s alternative embodiment using the capacitive element is that Kondo does not disclose an electrical shield having sufficient capacitive properties to induce a touch event in the absence of a human. Kondo’s primary embodiment relies on the electrical properties of the human body. Its alternative embodiment relies on the capacitive element in place of the human body. In neither case does Kondo disclose that its touch pad 76, which Petitioner calls an electrical shield (Petition at 85), is sufficient to induce a touch event. If it were, then the capacitive element

would not be necessary. Thus, the introduction of Kondo's capacitive element into Petitioner's proposed combination would not satisfy the additional recitations of claim 8. This claim element is completely missing from Kondo and Chu.

I. Claim 9

91. Claim 9 depends from claim 8 and includes each of its limitations. Therefore, Petitioner fails to establish that the proposed combination teaches or suggests all elements of claim 8 for the reasons discussed regarding 8. Therefore, Petitioner fails to show that the proposed combination teaches or suggests all elements of claim 9 for at least the same reasons discussed above regarding claim 8.

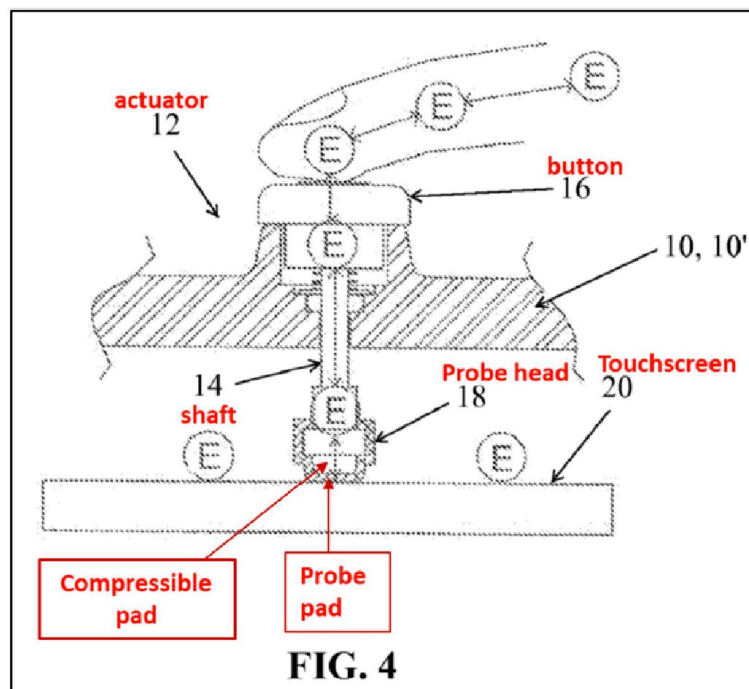
J. Claim 10

92. Claim 10 depends indirectly from claim 1 and includes its recitations. Petitioner therefore fails to show that the proposed combination teaches or suggests all elements of claim 10 for at least the same reasons discussed regarding claim 1. Petitioner also fails to show that its proposed combination teaches or suggests all elements of the additional recitations of claim 10.

93. Claim 10 recites, "The virtual reality viewer of claim 6, further comprising a compressible pad disposed between the second portion of the input mechanism and the portion of the surface of the electric shield, wherein the pad is configured to create a sufficiently sized area of contact between the portion of the

surface and the touch-screen when the input mechanism is in the extended position.”

94. As discussed above, Petitioner argues that Chu’s probe pad 30 is the recited electrical shield. Petitioner argues that Chu also includes additional “padding” in the white space behind probe pad 30 that is shown in Chu’s Figures 4 and 5. Petitioner states that Chu “indicates to a POSA that there is a substantial thickness to the probe pad and it is not empty,” providing the following annotated version of Chu’s Fig. 4 labeling the white space behind probe pad 30 as a compressible pad:



Petition at 90 (Ex. 1004, Fig. 4 with Petitioner’s annotations in red).

95. In some places, Petitioner appears to argue that the white space that is labeled “compressible pad” is part of probe pad 30. In others, Petitioner appears to

argue that the white space is a separate component. In either case, Petitioner is reading disclosure into Chu that is not there.

96. First, a POSA would understand that the white space behind probe pad 30 is not part of probe pad 30. Chu's Fig. 5 is a cross-sectional view that uses cross-hatching to illustrate the area of probe pad 30. That cross-hatching distinguishes probe pad 30 from the white space. (Chu's Figs. 3, 4, and 9a are similar.) Thus, a POSA would understand that the white space is not part of probe pad 30.⁴

97. Second, nothing in Chu would indicate that there is separate padding in the empty space behind probe pad 30. Chu's figures do not label this area. Nor does Chu's specification indicate that there is padding or anything else in this white space. Thus, a POSA would understand that this space is empty. A POSA would find this consistent with the state of the art at the relevant time. Chu's probe pad 30 is very similar to the rubber tips found on passive styluses, such as the one pictured below made by CoAsia in Taiwan in around 2012. Such styluses did not have padding underneath the rubber tip, and a POSA would not expect Chu's similar probe pad to include padding either.

⁴ Even if probe pad 30 were thicker than indicated in Chu's figures, saying that the probe pad 30 could constitute both the electric shield and the compressible pad would effectively render the "compressible pad" limitation meaningless.



98. Petitioner argues that the arrows in Chu's Fig. 4 showing a flow of electric charge between the touch screen and the user's finger indicate to a POSA that the white space is not empty and instead includes a compressible pad.

Petitioner puts far more weight on the arrows showing the flow of electric charge than would a POSA, especially since Chu does not label this space or otherwise state that it includes any component, let alone a "compressible pad."

99. First, a POSA would understand that Chu's use of the "electric charge E" labels is not accurate. There is no "charge transferred" as Chu states in ¶0041 describing the "electric charge E" labels in Fig. 4. In projected-capacitive touchscreens like that disclosed in Chu, there is "polarization" current but no electrical charge transfer between the touchscreen and the finger. "Polarization" is a convention to treat electric fields as if they were actual currents, but in reality the charge carriers (electrons) only move ~0.1 nm or less. That's less than one millionth of the distance from the finger to the touchscreen electrodes. Thus, a POSA would not accept Petitioner's conclusion that Chu's Fig. 4 means electric charge is being transferred between the touchscreen and the user's finger and

would certainly not assume there must be padding in the white space behind probe pad 30.

100. Rather, a POSA would understand that what Chu intended to convey is that the probe pad 30 is electrically coupled to the button 16, such that when a user touches button 16, the electrical properties of the user's body may induce a touch event. And a POSA would understand that no conductive padding behind probe pad 30 is required for such electrical coupling between probe pad 30 and button 16. Chu describes Fig. 4 in this way:

FIG. 4 shows the actuator mechanism **12** at an actuation position when the press button **16** is pushed downwards/inwards by a finger of a user, and the probe head **18** is touching the capacitive touch screen **20**. At this actuation position, electric charge E can be transferred between the finger of the user and the capacitive touch screen **20** through the press button **16**, the actuator shaft **14** and the probe head **18**, as shown by the arrows.

EX1004, ¶0041. This passage indicates that the arrows are intended to show electrical coupling between the touchscreen 20 through the probe head 18 to the actuator shaft 14 to the button 16 to the user's finger.

101. Chu's Fig. 5 shows that the probe head 18 is made up of probe pad 30 and sleeve 28. EX1004, Fig. 5, ¶0048 ("the probe head 18 may include an adaptor in the form of a sleeve 28 and a probe pad 30 for direct contact with the touch screen 20."). Chu states that "[t]he sleeve 28 may be mounted on the inner end of

the actuator shaft 14 and the probe pad 30 can be mounted on an enlarged free end of the sleeve 28.” EX1004, ¶0048. It further describes that the sleeve “may be formed with internal threads for threadedly engaging complementary external threads formed on the inner end of the actuator shaft 14.” Chu discloses that the press button, the shaft, and the probe head (including the sleeve) may be made of metal. EX1004, ¶0014. It also teaches that probe pad 30 may be made of “soft material such as rubber,” and that “[a]dditive may be added to the rubber in order to enhance its electric charge transfer performance.” EX1004, ¶0049. A POSA would understand that this would permit electrical coupling between the touchscreen and the user’s finger without the need for additional padding in the white space. Thus, based on Chu’s description of Fig. 4 in ¶0041, a POSA would understand that electric field is coupled from the touchscreen to probe pad 30, to sleeve 28 (part of probe head 18, as shown in Fig. 5), to shaft 14, to button 16, and to the user. Thus, contrary to Petitioner’s suggestion (*see* EX1002, ¶138), a POSA would not understand that the white space behind probe pad 30 would need to include conductive padding for probe pad 30 to be electrically coupled to button 16.

102. There is no merit to Petitioner’s alternative argument that “even if there weren’t such padding, a POSA would be motivated to add it for more of a cushioning effect against the touchscreen and increased conductivity because it

would be made of conductive rubber.” Petition at 91-92. As explained above, Chu’s probe pad 30 is similar to the rubber tip used by passive styluses. A POSA would therefore not be motivated to do anything different than was done by passive styluses at the time (which did not include a compressible pad behind the rubber tip). Adding additional conductive padding would actually make it harder to deform the probe pad, leading to an undesirable user experience. Thus, it is unsurprising that Chu makes no mention of a need for more cushioning effect. Chu’s deformable probe pad would provide sufficient cushioning.

103. Moreover, contrary to Petitioner’s assertion, adding additional conductive rubber under the probe pad would not provide “increased conductivity” from the point of view of the touchscreen. The amount of capacitive coupling seen by the touchscreen is determined by the area of touch contact, not the amount of conductive rubber above the contact area. Adding more conductive rubber above the probe pad would actually have two negative effects. First, it would likely decrease the amount of deformation undergone by the probe pad. This would decrease the conductive area seen by the touchscreen, which would in turn decrease the reliability of the touch event. Second, it would increase the total electrical resistance between the probe pad and the human’s finger, potentially decreasing the “electric charge transfer performance” (Ex. 1004, ¶0049). This would also decrease the reliability of the touch event. Due to these potentially

negative effects, a POSA would not have a reasonable expectation of success, but instead would be concerned that adding more conductive rubber might not be successful.

K. Claim 11

104. Claim 11 depends from claim 10. Therefore, Petitioner fails to show that the proposed combination teaches or suggests all elements of claim 11 for the reasons discussed regarding claim 10. Moreover, Petitioner fails to show that the proposed combination teaches or suggests the additional recitations of claim 11.

105. Claim 11 recites, “The virtual reality viewer of claim 10, wherein the pad is configured to vary the size of the area of contact between the portion of the surface of the electric shield and the touch-screen as a function of a force applied to the input mechanism from the exterior of the housing.” Chu teaches that the deformation of probe pad 30 (which Petitioner treats as the recited electric shield) is caused by the probe pad 30 pressing against the touch screen. Ex. 1004, ¶0055. It does not attribute deformation of the probe pad 30 to some compressible pad (indeed, Chu does not disclose the use of a compressible pad).

L. Claim 12

106. Claim 12 depends from claim 1. Therefore, Petitioner fails to show that the proposed combination teaches or suggests all elements of claim 12 for the reasons discussed regarding claim 1. Petitioner also fails to show that the proposed

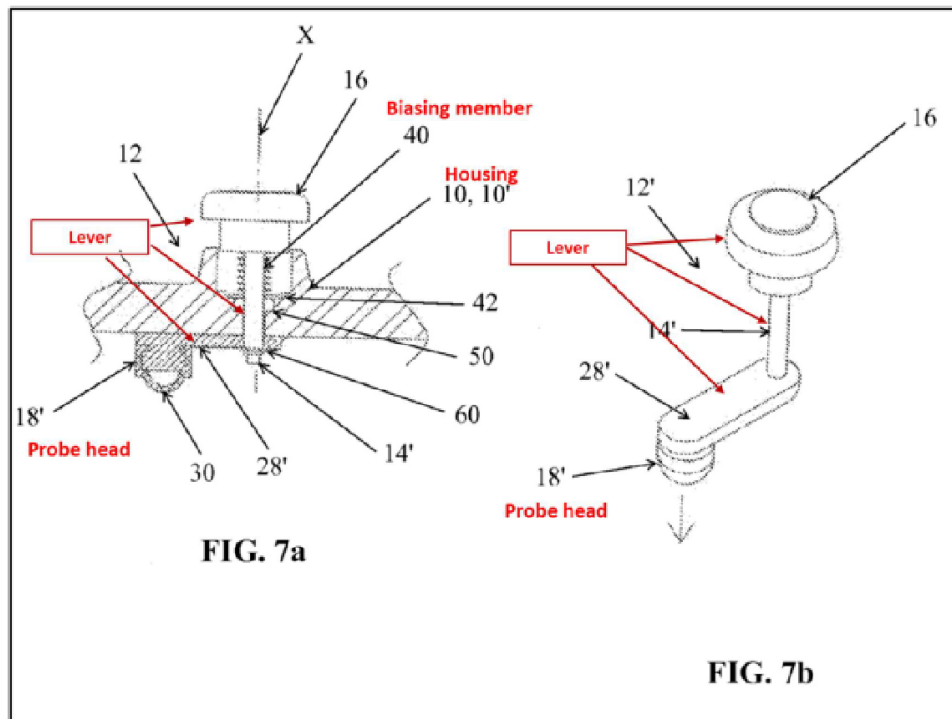
combination teaches or suggests all elements of the additional recitations of claim 12.

107. Claim 12 recites, “The virtual reality viewer of claim 1, wherein the input mechanism includes a lever and a flexible linkage coupled to the housing, wherein the flexible linkage is configured to deform when the lever is actuated and thereby guide at least the portion of the surface between the first position and the extended position.”

108. First, the proposed combination does not include “a flexible linkage coupled to the housing, wherein the flexible linkage is configured to deform when the lever is actuated and thereby guide at least the portion of the surface between the first position and the extended position.” Petitioner’s argument that Chu’s biasing member 40, which Petitioner characterizes as a spring/coil structure, fails to satisfy all the requirements relating to the flexible linkage recited in claim 12.

109. As Petitioner notes, when button 16 is pressed, “[t]he biasing member 40 is compressed.” Petition at 98 (quoting Ex. 1004, ¶0055). However, contrary to Petitioner’s assertion, nothing in Chu’s Figures 7A or 7B shows that the biasing member 40 is coupled to the housing. There is no reason why it could not simply be resting within the housing, as a spring is often placed inside a retractable ballpoint pen without being coupled to the housing of the pen.

110. Moreover, the biasing member 40 does not “guide at least the portion of the surface [of the electric shield] between the first position and the extended position.” Biasing member 40 does not guide Chu’s probe pad 30 (which Petitioner treats as the electric shield) between a first position and an extended position. It actually does the opposite, resisting movement of the probe pad 30 to the extended position. Petitioner’s assertion to the contrary is unsupported and conflicts with Chu’s figures and description, as evident from Petitioner’s annotated version of Chu’s Figures 7A and 7B:



Petition at 97 (Ex. 1004, Figs. 7A & 7B with Petitioner’s annotations in red).

111. Second, the proposed combination does not teach or suggest the lever recited in claim 12. Petitioner’s argument that Chu discloses a lever is based on its

flawed construction of lever as merely “a projecting piece by which a mechanism is operated or adjusted.” As discussed above, the proper construction of “lever” is a stiff body pivoted on a fulcrum.

112. When the motion of an object is a pure translation, with no rotation, there is no fulcrum and no lever. There is no “leverage” in the common sense of the word, as the force to actuate a button is the same throughout the button mechanism. Chu’s specification describes how to ensure that the button mechanism allows only linear translation with no rotation.

113. Petitioner argues that Chu’s button 16, shaft 14 and extension arm 28’ together constitute the claimed lever “because it projects from housing 10 and operates the VR viewer.” Petition at 96. This is incorrect because the whole point of this mechanism is to *avoid* any pivoting about a point. While the extension arm 28’ allows the probe head to be offset from the actuator shaft (Ex. 1004, ¶0057), Chu makes clear that there is to be no rotation in this mechanism. Indeed, to ensure that there is no rotation, Chu teaches that “[i]n order to prevent the extension arm 28’ from swinging or rotating about the actuator shaft 14 which may result in the probe head 18 probing at the wrong location on the touch screen 20, one or more posts or guides (not shown) may be provided along the sides of the extension arm 28’. This allows the probe head 18’ to moves [*sic*] only vertically up or down.” Ex. 1004, ¶0059. Thus, Chu’s button 16, shaft 14 and extension arm 28’ do not

constitute the claimed lever. Petitioner's alternative position that the shaft 14 and extension arm 28' alone would constitute the lever fails for the same reason.

114. Petitioner's alternative argument that a POSA would have been motivated to replace Chu's button with a handle also fails. Even if simply replacing a button with a handle transformed it into a lever (which Petitioner does not explain), Petitioner does not establish that a POSA would have been motivated to replace Chu's button with a handle. Chu explains that the button 16 "may be in the shape of a mushroom or flat head such that it is comfortable for a user to press with a finger or hand." Ex. 1004, ¶0043. Thus, Chu provides a specific reason for the shape of its button. Contrary to Petitioner's suggestion, Chu teaches that its disclosed shape is well-suited to Chu's purpose. Moreover, if the button was replaced with a handle, it would make it more likely that depressing it would result in "swinging or rotating about the actuator shaft," which Chu teaches should be avoided. Ex. 1004, ¶0059. Thus, a POSA would not have been motivated to replace Chu's button with a handle.

M.Claim 14

115. Claim 14 depends from claim 12 and includes all its recitations. Therefore, Petitioner fails to show that the proposed combination teaches or suggests all elements of claim 14 for the reasons discussed regarding claim 12.

N. Claim 18

1. Petitioner Incorrectly Argues that Claim 18 Cannot be Understood

116. Petitioner asserts that claim 18 cannot be understood. However, claim 18 includes no inconsistencies or ambiguities rendering it unable to be understood. As it relates to Petitioner's assertion, claim 18 recites an "input device" including "a first portion that is accessible from an exterior of the housing, and an elongate second portion disposed within the interior of the housing between the left and right regions wherein the second portion is generally oriented in a vertical direction that is perpendicular to the horizontal direction." Claim 18 also recites "an electric shield" wherein "a first surface of the electric shield is disposed on the first portion and is electrically coupled to a second surface of the electric shield" and "wherein the second surface is disposed on the second portion within the interior and is generally centered in the horizontal direction between the left and right regions, and wherein only the second surface of the electric shield is configured to contact a central portion of the touch-screen."

117. In short, claim 18 recites an input device with a first portion and a second portion. The first portion is accessible to the user from the exterior of the housing. In other words, the first portion of the input device is what the user touches to initiate a touch event. The claim also recites an electric shield with a first surface and a second surface. The electric shield's second surface is disposed

on the second portion of the input device so as to contact the touchscreen when the input device is actuated. The electric shield's first surface is disposed on the input device's first portion (the portion of the input device that the user actuates).

118. The '075 patent describes an embodiment consistent with this claim language, in which the electric shield not only contacts the touchscreen but also includes an exposed portion disposed on the user input that the user touches when actuating the input: "In addition or alternatively, the portion of the metallized film⁵ that is configured to touch the screen can be accessible to receiving a user touch. For instance, a portion of the metallized film can be exposed on the lever **722** or otherwise accessible to the user on an external surface." EX1001, 10:67-11:4.

119. In my opinion, a POSA could read claim 18 and understand how to provide each feature in the arrangement described in the claim. The specification passages discussed above would provide further guidance in that endeavor. A POSA would not be confused by the fact that claim 18 is directed to a somewhat different embodiment than illustrated in Fig. 7A.

120. Petitioner's argument that claim 18 is confusing or internally inconsistent appears to depend on its expert's understanding that claim 18 requires

⁵ The preceding sentence refers to the metallized film as element 725, making clear that this metallized film serves as the electric shield in this embodiment, as the specification elsewhere refers to the electric shield as element 725. EX1001, 7:18.

the second surface of the electric shield to *face* the second portion of the input device: “Because the second surface is facing and disposed on the second portion, it does not seem apparent how it could also touch the touchscreen as the claim requires.” EX1002, ¶158; *see also id.* (“both surfaces of the electric shield are disposed on different parts of the input device, which, from a mechanical perspective, would not seem to allow the electric shield to contact the touchscreen because both of its surfaces are facing and disposed on something else.”). Claim 18 includes no requirement that the second surface of the electric shield *face* the second portion of the input device, nor does it require that the first surface of the electric shield *face* the first portion of the input device.

121. Petitioner’s expert asserts that a POSA could not understand claim 18 without reference to the specification. While I understand that claims are interpreted in light of the specification, I disagree that claim 18 cannot be understood without reference to the specification. Moreover, Petitioner’s expert goes astray in attempting to map claim 18 to the embodiment illustrated in Fig. 7A of the ’075 patent. Fig. 7A shows a *different* embodiment than the one to which claim 18 is directed. As noted above, the embodiment corresponding to claim 18 is introduced with the phrase “[i]n addition or alternatively.” EX1001, 10:67. This plainly indicates that this passage describes an additional/alternative embodiment; it is not the only embodiment disclosed in the ’075 patent. Moreover, nothing in

the '075 patent indicates that Fig. 7A is intended to illustrate the embodiment described at col. 10, line 67 through col. 11, line 4. Therefore, the fact that Petitioner's expert struggled to map the language of claim 18 onto Fig. 7A does not show that claim 18 is somehow internally inconsistent.

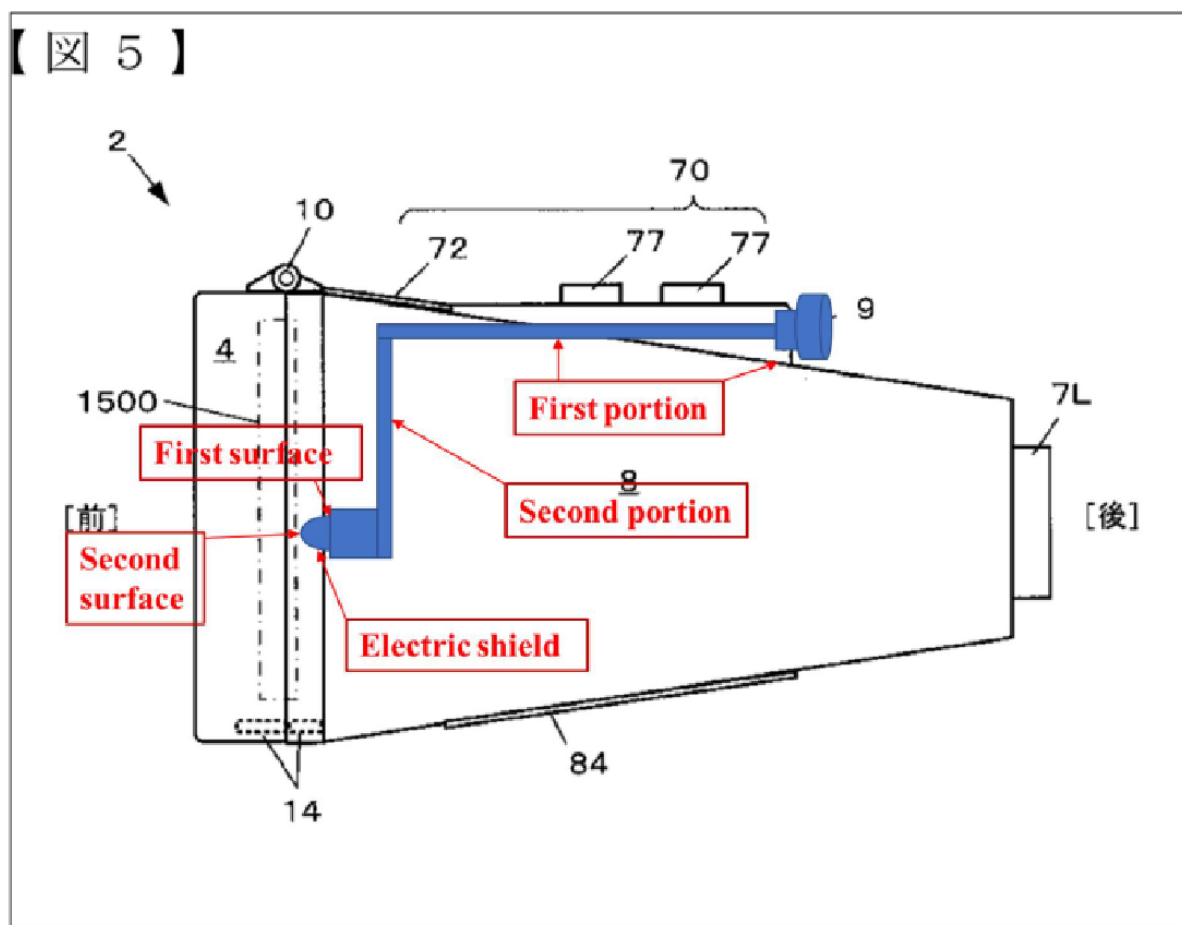
122. Petitioner relies on its expert's flawed analysis to argue that the phrase "disposed on" should be rewritten "to include an indirect connection." EX1002, ¶160. Petitioner does not argue that this is the ordinary meaning of the phrase "disposed on." Its only justification for this interpretation is that it is "[t]he only way it could possibly make sense." *Id.* For the reasons discussed above, claim 18 is not internally inconsistent, so Petitioner's interpretation is unnecessary and should be rejected.

2. Petitioner Fails to Show a Motivation to Combine

123. Petitioner proposes the same combination of Kondo and Chu for independent claim 18 that it proposes for independent claim 1. Petitioner therefore fails to show that a POSA would have been motivated to combine Kondo and Chu in the manner proposed for claim 18 for the same reasons discussed regarding claim 1.

3. Claim 18(g): wherein a first surface of the electric shield is disposed on the first portion and is electrically coupled to a second surface of the electric shield

124. Claim 18 recites “an input device including, a first portion that is accessible from an exterior of the housing.” Claim 18 further recites “an electric shield, wherein a first surface of the electric shield is disposed on the first portion and is electrically coupled to a second surface of the electric shield.” Petitioner asserts that this latter recitation is satisfied with the following combination of Kondo and Chu:



Petition at 111 (showing EX1003, Fig. 5 with annotations in blue and red).

125. Petitioner’s mapping fails to account for the claim language, which requires that “a first surface of the electric shield” be “disposed on the first

portion” of the input device, with that first portion being “accessible from an exterior of the housing.” For the “first surface of the electric shield,” Petitioner points to the upper collar of Chu’s probe pad 30, which is mounted on sleeve 28 of Chu’s probe head 18. *See, e.g.*, EX1004, Fig. 5, ¶0048. For the “first portion” of the input device, Petitioner points to the outer end of Chu’s actuator shaft 14 that extends through an opening in the housing and button 16 mounted on the shaft. *See, e.g.*, EX1004, Fig. 4, 6, ¶0042, ¶0043. Petitioner repeats this argument with its annotations to Chu’s Figs. 9b and 8. *See* Petition at 112-13.

126. As Petitioner’s own annotated illustrations make plain, what it calls the “first surface” of Chu’s probe pad 30 is not disposed on what it calls the “first surface” of Chu’s input device. Therefore, Petitioner has failed to show that its proposed combination includes “an electric shield, wherein a first surface of the electric shield is disposed on the first portion,” with the first portion being “accessible from an exterior of the housing.”

O. Claim 19

127. Claim 19 depends from claim 18 and includes its recitations. Petitioner fails to establish that the combination of Kondo and Chu teaches or suggests all elements of claim 19 for the reasons discussed regarding claim 18.

128. Petitioner also fails to show that the combination of Kondo and Chu teaches or suggests claim 19’s additional recitations of “a compressible pad

disposed between the second portion and the second surface to provide an area of contact between the second surface and the touch-screen that is sufficient to transfer the capacitive touch input.” Petitioner relies on its analysis of claims 10 and 11 in support of its assertions that the proposed combination discloses the claimed compressible pad. These arguments fail for the same reasons discussed regarding claims 10 and 11.

P. Claim 20

1. Petitioner Fails to Show a Motivation to Combine

129. Petitioner proposes the same combination of Kondo and Chu for independent claim 20 that it proposes for independent claim 1. Petitioner therefore fails to show that a POSA would have been motivated to combine Kondo and Chu in the manner proposed for claim 20 for the same reasons discussed regarding claim 1.

2. Claim 20(d): a lever that is accessible through the cut-out;

130. Claim 20 recites, *inter alia*, “a lever that is accessible through the cut-out.” Petitioner relies on its analysis of claim 12 for the lever. Therefore, Petitioner’s assertion regarding claim 20 fails for the same reasons discussed regarding the “lever” element of claim 12.

3. Claim 20(f): a flexible linkage coupled to the lever and the housing, wherein the linkage is configured to deform in response to actuation of the lever and thereby guide the portion of the surface between the first position and the extended position

131. Claim 20 recites, *inter alia*, “a flexible linkage coupled to the lever and the housing, wherein the linkage is configured to deform in response to actuation of the lever and thereby guide the portion of the surface between the first position and the extended position.”

132. Petitioner relies on its analysis regarding claims 12 and 14 for this recitation of claim 20. While the language of claim 20(f) is similar to the “flexible linkage” recitation in claim 12, it is different in that claim 12 requires that the flexible linkage be coupled to the housing, whereas claim 20 requires that the flexible linkage be coupled to the lever. Petitioner does not attempt to argue that Chu’s biasing spring (which Petitioner improperly equates to the flexible linkage) is coupled to the components that Petitioner argues constitute the claimed lever. Nor does Chu indicate this is the case. Petitioner therefore fails to establish that the proposed combination teaches this aspect of claim 20(f).

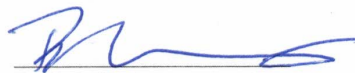
133. Moreover, claim 20’s recitation that the flexible linkage is “configured to deform in response to actuation of the lever and *thereby guide the portion of the surface between the first position and the extended position*” is identical to claim 12’s. Therefore, Petitioner fails to show that the proposed combination teaches or suggests this recitation for the same reasons discussed regarding claim 12.

VIII. Oath

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

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

Executed on 1/30, 2024


Bob Mackey

APPENDIX A

Bob L. Mackey

consult@bmackey.com

707.622.5392

San Jose, California

Summary of Experience and Qualifications

- Launched several different product lines that resulted in hundreds of millions of units each and \$100M to over \$1B in revenues.
- Twenty-plus years of extensive research, development, and management experience developing advanced materials and processes for electronics.
- Substantial advances were made in polymer materials, electronic materials, design methods, manufacturing processes, and measurement techniques.
- Quick, incisive approach to problem-solving and decision-making
- Several new technologies developed from conception through profitable mass production Communicates clearly and confidently with expert colleagues as well as laypersons
- Innovations with track record of invention and patenting of novel ideas with proven value
- Management experience in research, development, and manufacturing
- Skilled in a broad range of chemical research techniques: organic, inorganic, polymer, physical
- Extensive experience in CVD, PVD, plasma, evaporation, lithography, etching, and wet processing
- Analytical techniques – spectroscopies, microscopies, walking the line and listening to operators
- Excellent mechanical engineering, construction, and testing skills
- Troubleshooting and Root Cause analysis – I can figure out why something doesn't work
- Ability to apply knowledge and methods from diverse fields in innovative ways
- Extensive experience developing suppliers in Asia: Japan, Korea, Taiwan, China, and Thailand
- Design and construction of high-performance composite aircraft and control systems
- Managing teams of up to 20 direct reports or many hundreds in contract manufacturing
- Highly energetic, productive nature yields quick results

Work Experience

Intellectual Property Strategy Consulting, 2020 - Present

- Identify and implement IP development strategies in technology startups
- Meet with development teams and inventors to capture inventions

- Foster a culture of innovation and documenting of inventions
- Patent key inventions to develop and protect company value
- Draft patent applications
- Advise on technology acquisition decisions
- Evaluate patent portfolios in corporate acquisitions

Aircraft Development Lead, ZeroAvia, 2020 - 2022

- Managed development of hydrogen fuel cell powered electric aircraft
- Facilities management for construction of aircraft development and research center
- Technical Lead on \$100M+ development proposals

Distinguished Engineer, IDEX Biometrics, 2019

- Consulting on launch of worldwide biometrics development
- Developed materials and manufacturing processes for embedded-fingerprint credit cards

Director of Architecture / Principal Scientist, Synaptics, 2002 - 2018

- Responsible for development of new technologies in a leading human-machine interface company
- Developed touchscreen product line leading to >\$1 Billion in sales, including the first touchscreen cell phone in 2006. This required new materials, manufacturing processes, and suppliers
- Integrated touchscreen functionality into LCD and OLED display drivers, again resulting in a new product line with > \$1 Billion in sales
- From 2014, Chief Architect for Biometric Products Division
- Launched fingerprint sensor product with over \$100M revenue in first year
- Invented and applied for 40+ patents in sensor design
- Represented Synaptics at international conferences with dozens of invited presentations
- Recognized worldwide as a leading developer of transparent conductive materials, optical materials, and adhesives for consumer electronics
- Intellectual Property Committee - identified and developed inventions into patent applications and trade secrets
- Evaluated IP portfolios in support of acquisitions
- Supporting IP litigation in key cases, including:
Synaptics v. Goodix, 2015, 3:15-cv-01742
Synaptics v. Elantech, 2007, 3:07-cv-06434
Synaptics v. Alps, 2005, resulting in cross license agreement and payment to Synaptics
We also supported customers in certain high-profile cases, e.g. Apple v. Samsung.

Co-Founder and President, Pure Flight, 1998-Present

- Design, build, and test personal aircraft, components, and systems
- Design and construction of extremely high performance soaring aircraft

- Invented and developed control systems for ultra-lightweight aircraft
- Driving high performance composite materials development for maximum strength and stiffness with minimum weight.
- Formation airshow performances
- Composite aircraft design, development, and fabrication services

Senior Materials Scientist, Petalogic Corporation, 2001

- Managed project to develop an ultrafast, micron-scale, direct-modulation semiconductor laser
- Developed waveguide manufacturing process for on-chip optical communications
- Led efforts to transfer research innovations to controlled manufacturing processes

Systems Architect, Geocast Network Systems, 1999 – 2000

- Developed a personal data network operating over digital television channels
- Built cutting-edge mobile test equipment for measurement of ATSC digital television signals
- Managed all engineering and procurement of disk drives for personal data server
- Drove improvement of disk drive acoustic performance with vendors

Process and Integration Engineer, Candescent Technologies, 1996 – 2000

- Responsible for field emission display (FED) faceplate design and development
- Developed and applied optical models of field emission displays to improve contrast and brightness
- Increased process yield from <50% to over 90% in one year
- Scaled up production facilities from 100 mm to 150 mm to 320x340mm in the same year
- Invented several new processes and device structures which resulted in patents and improved displays

Principal Investigator / Staff Scientist, Physical Dynamics, 1989 – 1990

- Proposed and secured funding for a Small Business Innovative Research (SBIR) program to develop improved circuit board designs for thermal management
- Developed a heat pipe design to remove 100 Watts of heat from each small circuit board in a standard military electronics module. This technology became common 10 years later in PCs

Visiting Scientist, Los Alamos National Laboratory, 1986 – 1987

- Specified requirements for massively parallel computers for special classes of problems such as protein folding and computational fluid dynamics
- Examined a class of computationally difficult problems with a multidisciplinary group of scientists

Staff Chemist, Maxwell Laboratories, Inc. 1986 – 1990

- Developed and tested liquid and polymer dielectric materials for high energy density capacitors
- Collaborated with 3M, Pennwalt, Sandia, and JPL to develop superior new dielectric materials
- Increased capacitor energy density 100-fold in four years
- Introduced electrical double-layer capacitor technology. Now called Supercaps or Ultracaps, this technology became a major new business unit for Maxwell and led to their acquisition by Tesla
- Designed and built automated equipment for polymer dielectric materials testing
- Guided a group of technicians in the capacitor and dielectric materials test group

Research Technician, Jet Propulsion Laboratory 1985 – 1986

- Researched advanced high efficiency silicon solar cells for use on NASA spacecraft
- Developed high quality anti-reflective and passivating coatings for charge coupled devices (CCDs), including the CCD that was flown on the Hubble Space Telescope's Wide Field/Planetary Camera
- Designed neural network integrated circuits and software for challenging computational problems

Education

Ph.D. Program in Materials Science

University of California, San Diego, 1990-1996

Thesis: "The Chemical and Electronic Properties of the Diamond Surface"

Thesis advisors: Professor John E. Crowell, and Dr. James E. Butler (Naval Research Laboratory)

- Advanced research under Professor Crowell and Dr. Butler explored the surface chemistry of group IV semiconductors, including diamond, silicon, and germanium.
- Invented and developed innovative infrared optical techniques to measure surface and bulk electronic properties in situ.
- Discovered conductive states of pure diamond surfaces.

Fannie and John Hertz Foundation Fellowship

University of California Regent's Fellowship

B.S. in Chemistry

California Institute of Technology (Caltech) 1981-1985

- Synthetic organic chemistry research under Professor David A. Evans (now at Harvard). Developed a stereospecific Diels-Alder reaction for the synthesis of anti-nausea pharmaceuticals.
- Theoretical studies under Professor William A. Goddard III. Studied quantitative structure-activity relationships by modeling of the dihydrofolate reductase–methotrexate system.
- Achievement Rewards for College Scientist (ARCS) Foundation Scholarship

University Work Experience

Visiting Scientist, Naval Research Laboratory, Washington DC

- Discovered that the [110] face of diamond is electrically conductive.
- Invented a new spectroscopic techniques for measuring surface electrical conduction
- Designed, constructed, and maintained electronic and spectroscopic test equipment, ultrahigh vacuum systems, automated data collection, and laboratory computer networks
- Established the electronic properties of diamond surfaces

Research Assistant, University of California, San Diego

- Designed and constructed original research tools for the study of germanium, silicon and diamond surface chemistry
- Developed pioneering optical methods for sensitive electronic materials characterization
· Improved pre-production spectrometers and software for a major scientific instrument manufacturer

Consulting and other Experience

Board of Directors, Osocalis Distillery

Co-owner and Director of a small distillery making world-class brandies. My responsibilities include fundraising, business planning, marketing, communications, welding, and driving the forklift or truck. Osocalis brandies are now sold in 35 states.

Various Technology Startup and Venture Capital Firms

Evaluated business plans and technical capabilities of startup firms on behalf of funding venture capitalists. Advised startup firms in the areas of materials, optics, chemistry, and intellectual property. As an advisor to Boards of Directors, I have guided technology development and manufacturing launch for a variety of new product lines.

Sample consulting customers: IDEX Biometrics, Covalent Metrology, ZeroAvia, SigmaSense, RDI Computers, Freer Logic, Curated Innovation

DaSH-PA “Dead Simple Human Powered Airplane”

Participated in the design, construction, and flight testing of a simple human-powered aircraft

Fire Arts

Designed, built, and constructed several large-scale pyrotechnic displays. Consulted on many more. In addition to controlling combustion chemistry, public safety and legal compliance are factors in getting approval for thousand-foot hundred-foot fire tornadoes or thousand-foot diameter fireballs.

Fannie and John Hertz Foundation, Livermore, California

Designed and implemented an Internet mailing list and website, enabling communication between past and present Fellows and the Directors of the Foundation.

House of Representatives, Washington, D.C.

Advised House Telecommunications Committee Chairman, Edward Markey, on technical aspects of satellite communications legislation.

Scientific Presentations and Publications

“Oxygen adsorption on the (110)-Oriented Diamond Surface”, B. L. Mackey, J. E. Crowell, J. N. Russell, Jr., P. E. Pehrsson, and J. E. Butler, *The Journal of Physical Chemistry B*; 105(18); 3803-3812, 2001.

“Effect of Surface Termination on the Electrical Conductivity and Broadband Infrared Reflectance of a Diamond (110) Surface”, B. L. Mackey, J. N. Russell, Jr., J. E. Crowell, and J. E. Butler, *Physical Review B, Rapid Communications*, 52, p. R17009, 1995.

“Observation of a Conductive Diamond (110) Surface by Multiple Internal Reflection Infrared Spectroscopy”, B. L. Mackey, J. N. Russell, Jr., J. E. Crowell, and J. E. Butler, *American Vacuum Society*, oral presentation, 1995.

“The Effect of Hydrogen on the Electrical Conductivity of the Diamond (110) Surface”, B. L. Mackey, J. N. Russell, Jr., P. E. Pehrsson, J. E. Crowell, and J. E. Butler, *Diamond Materials/1995*, edited by J. P. Dismukes and K. V. Ravi, p. 455, *The Electrochemical Society*, Pennington, NJ, 1995.

“Infrared Evidence for an Electrically Conductive Diamond (110) Surface”, B. L. Mackey, J. N. Russell, Jr., J. E. Crowell, and J. E. Butler, *American Vacuum Society*, poster presentation, 1994.

“The Effect of Doping on the Infrared Reflection Spectra (IRRAS) of Thin Silicon Oxides”, B. L. Mackey, J. E. Crowell, M. Liehr, and K. J. Uram, *American Vacuum Society*, poster presentation, 1993.

“High Thermal Conductivity Electronic Substrate”, Final Report on a planar heat pipe design for thermal management in an Air Force electronics module. Air Force Small Business Innovative Research (SBIR) Project AF89-209, 1990.

“Winning at Chelan”, in “Sky Adventures: Fantasies of Free Flight”, J. Palmieri, M. Palmieri, eds., Sky Dog Publications, Roanoke, Virginia, 1996.

Invited talks and classes at SID, IDTechEx, FineTech, SVC, and other scientific and industry conferences.

Patented Inventions

60+ issued US Patents, with many foreign counterparts. Several patent applications pending.

11,575,138	Liquid hydrogen storage system as thermal battery
11,308,309	Fingerprint sensor having an increased sensing area
10,955,603	Method and system for optical imaging using point source illumination
10,657,350	Finger detection with auto-baseline tracking
10,572,707	Transparent fingerprint sensor pattern
10,496,863	Systems and methods for image alignment
10,366,268	Method and system for optical imaging using patterned illumination
10,311,276	Under display optical fingerprint sensor arrangement for mitigating moire effects
10,289,891	Optical biometric sensor having diffractive optical elements
10,268,884	Optical fingerprint sensor under a display
10,229,304	Finger detection with auto-baseline tracking
10,185,866	Optical fingerprint sensor package
10,146,258	Optical image sensor for display integration
10,115,000	Method and System for optical imaging using patterned illumination
10,108,841	Biometric sensor with diverging optical element
9,946,917	Efficient determination of biometric attribute for fast rejection of enrolled templates ...
9,798,429	Guard electrodes in a sensing stack
9,785,818	Systems and methods for image alignment
9,760,758	Determining which hand is being used to operate a device using a fingerprint sensor

9,235,309	Mesh sensor design for reduced visibility in touch screen devices
9,075,095	Device and method for localized force sensing
9,052,766	Mesh sensor design for reduced visibility in touch screen devices
8,854,333	Polar sensor patterns
8,643,624	Capacitive sensing using a segmented common voltage electrode of a display
8,493,348	Capacitive sensing apparatus
8,243,044	Methods and systems for changing the appearance of a position sensor with a light effect
8,189,339	Flexible circuit assembly for a capacitive-sensing device
8,120,371	Object position sensing apparatus
7,965,281	Unambiguous capacitance sensing using shared inputs
7,737,953	Capacitive sensing apparatus having varying depth sensing elements
7,735,383	Balanced resistance capacitive sensing apparatus
7,692,431	Capacitive sensing apparatus designs
7,688,080	Variably dimensioned capacitance sensor elements
7,548,073	Capacitive sensing apparatus designs
7,545,289	Capacitive sensing using a repeated pattern of sensing elements
7,490,407	Method of patterning wall and phosphor well matrix utilizing glass
7,463,246	Capacitive sensing device
7,433,167	Strike ring based electrostatic discharge protection
7,382,360	Methods and systems for changing the appearance of a position sensor with a light effect
7,382,139	One layer capacitive sensing apparatus having varying width sensing elements
7,218,124	Capacitive sensing apparatus designs
7,202,859	Capacitive sensing pattern
7,129,935	Sensor patterns for a capacitive sensing apparatus
7,090,554	Fabrication of flat-panel display having spacer ... inhibiting secondary electron escape
7,002,287	Protected substrate structure for a field emission display device
6,853,129	Protected substrate structure for a field emission display device
6,834,431	Method of patterning wall and phosphor well matrix utilizing glass
6,742,257	Method of forming powder metal phosphor matrix and gripper structures in wall support
6,741,027	Protected substrate structure for a field emission display device

6,734,608	Constitution and fabrication of flat-panel display and porous- ... spacer of flat-panel display
6,691,404	Fabricating of a flat-panel displace using porous spacer
6,617,772	Flat-panel display having spacer with rough face for inhibiting secondary electron escape
6,562,551	Gripping multi-level black matrix
6,528,930	Conductive Focus Waffle
6,432,593	Gripping multi-level structure
6,403,209	Constitution and fabrication of flat-panel display and porous... spacer of flat-panel display
6,380,670	Encapsulated flat panel display components
6,322,937	Method for Creating a Color Filter Layer on a Field Emission Display Screen Structure
6,215,241	Flat Panel Display with Encapsulated Matrix Structure
6,176,754	Method for forming a Conductive Focus Waffle
6,113,708	Cleaning of Flat-Panel Display
6,135,841	Use of Printer Head Techniques to Form Pixel Assemblies in Field-Emission Displays
5,858,619	Multi-level Conductive Matrix Formation Method