

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SONY CORPORATION,
Petitioner,

v.

OPTIMUM IMAGING TECHNOLOGIES, LLC,
Patent Owner.

Case No. IPR2024-00924
Patent No. 7,612,805

DECLARATION OF LEONARD LAUB
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW

Sony Exhibit 1003 Sony v. Optimum

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I, Leonard Laub, declare:

I. INTRODUCTION

1. I have been retained by Wolf, Greenfield & Sacks, P.C., on behalf of Sony Corporation (“Sony” or the “Petitioner”) as an independent technical expert in the above-captioned IPR proceeding (“the IPR”). This document provides certain of my opinions concerning the patentability of claims in U.S. Patent No. 7,612,805 (EX1001, “the ’805 patent”), specifically claims 1-3, 9, 18-20, and 24 (the “Challenged Claims”). I make this Declaration in support of Sony’s petition in the IPR.

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

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

II. PERSONAL AND PROFESSIONAL BACKGROUND

4. I am qualified to render expert opinion in this matter by virtue of my professional experience and education, which are summarized below. A copy of my CV detailing my educational background and professional experience is provided with this Declaration as EX1004.

5. I have more than fifty-five years of experience working on optical systems design and analysis with industry as an employee and later as a consultant through my firm Keryston Associates, Inc. I have worked extensively in digital camera system design and image processing since 1965. Throughout this time, I have designed, implemented, and tested various optical imaging systems and products.

6. Some prior work experience most relevant to the issues discussed in this Declaration are summarized below.

7. At Zenith Radio Corp. (1965-1976), I performed work including (1) detailed mathematical and experimental study of lens aberrations and designs to minimize same while developing novel commercial imaging and projection systems for cameras and displays, (2) invention and development of novel electronic image processing systems, and (3) invention and development of real-time Fourier-transform techniques for image analysis and processing.

8. While consulting to Infodetics (1984-1988), I performed work including development of advanced image sensors with embedded real time digital processing.

9. While consulting to Sony and others (2006-2012), I performed work including intensive analysis of techniques and of hardware and software implementations of advanced digital image processing systems incorporating Fourier transform techniques and complex filtration.

10. While consulting to DxO Labs (2007-2018), I performed work including (1) in-depth analysis of digital image processing systems for correcting lens aberrations based on look-up tables of measured aberrations; and (2) support of development of digital image processing systems to produce high-quality images from smartphone cameras using simple lenses.

11. I am a named inventor in 20 patents (U.S. and foreign) concerning electronic video image processing and various complex optical and electro-optical systems.

12. I have been a member of the Optical Society of America (now Optica) for 50 years.

13. I am a Life Member of the Institute of Electrical and Electronic Engineers (IEEE) and an Observer Member of the Advanced Television Systems Committee (ATSC), which maintains standards for digital television in the USA.

14. I received a Bachelor of Science degree in Physics from Illinois Institute of Technology in 1970.

15. I undertook additional graduate level studies including (i) the study of Mathematics at Northeastern Illinois University, 1971-1972 (toward M.Sc.), (ii) the study of Optics at University of Rochester, 1974, and (iii) the study of Physics at Northwestern University, 1974-1975 (toward Ph.D.).

16. My curriculum vitae is provided as EX1004.

III. MATERIALS REVIEWED AND CONSIDERED

17. I have reviewed the '805 patent, its prosecution history, and the prior art and other documents and materials cited herein. For ease of reference, the full list of documents that I have considered is included in Appendix B. I have also considered the documents cited and referenced herein, even if not included in Appendix B. Each of these materials is a type of document that experts in my field would have reasonably relied upon when forming their opinions and would have had access to either through the applicable patent office and/or well-known libraries, conferences, publications, organizations, and websites in the field as further discussed herein.

18. My opinions in this Declaration are based on my review of these documents, as well as upon my education, training, research, knowledge, and experience. When developing the opinions set forth in this declaration, I assumed

the perspective of a person having ordinary skill in the art (a “POSITA”), as set forth below.

19. The opinions and comments formulated during this assessment are based on observations and information available at the time of this investigation.

IV. MY UNDERSTANDING OF PATENT LAW

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

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

22. I understand that, in this proceeding, Petitioner has the burden of proving that the challenged claims of the ’805 patent are unpatentable by a preponderance of the evidence. I understand that a “preponderance of the evidence” means that the evidence establishes that a fact or conclusion is more likely true than not true.

23. I understand that patent claims can be independent or dependent. I understand that a dependent claim must reference a claim previously set forth, and then must specify a further limitation of the claimed subject matter. I also

understand that a dependent claim is treated as incorporating by reference all limitations of the previously recited claim that it references. I understand that an independent claim does not reference or incorporate limitations from a previously disclosed claim.

24. I understand that, in IPR proceedings, claim terms in a patent are given their ordinary and customary meaning as understood by a person of ordinary skill in the art (“POSITA”) in the context of the entire patent and the prosecution history pertaining to the patent. If the specification provides a special definition for a claim term that differs from the meaning the term would otherwise possess, the specification’s special definition takes precedence. I have applied these standards in preparing the opinions in this declaration.

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

A. Anticipation

26. I understand that, for a patent claim to be “anticipated” by the prior art (and therefore not novel), each and every claim limitation must be disclosed, expressly or inherently, in the subject matter provided by a single prior-art reference. I understand that anticipation requires that all of the elements of a claim

have to be arranged in the same manner as in the claims or can be immediately envisaged. I understand that a claim limitation is disclosed for the purpose of anticipation if a POSITA would have understood the reference to disclose the limitation based on inferences that a POSITA would reasonably be expected to draw from the explicit teachings in the reference when read in the context provided by the POSITA's knowledge and experience.

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

B. Obviousness

28. I understand that a patent claim may be unpatentable if the claimed invention would have been obvious to a POSITA in view of a single prior-art reference or a combination of prior-art references. I have been informed that obviousness is determined from the perspective of a hypothetical person of ordinary skill in the art and that the asserted claims of the patent should be read from the point of view of such a person at the time the alleged invention was made. I have been informed that a hypothetical person of ordinary skill in the art is assumed to know and to have all relevant prior art in the field of endeavor covered by the '805 patent and would thus have been familiar with each of the references

cited herein, as well as the background knowledge discussed in the art and the full range of teachings they contain.

29. I have been informed that there are two criteria for determining whether prior art is analogous and thus can be considered prior art: (1) whether the art is from the same field of endeavor, regardless of the problem addressed, and (2) if the reference is not within the field of the patentee's endeavor, whether the reference still is reasonably pertinent to the particular problem with which the patentee is involved. I have also been informed that the field of endeavor of a patent is not limited to the specific point of novelty, the narrowest possible conception of the field, or the particular focus within a given field. I have also been informed that a reference is reasonably pertinent if, even though it may be in a different field from that of the patentee's endeavor, it is one which, because of the matter with which it deals, logically would have commended itself to a patentee's attention in considering his problem.

30. I understand that a patent claim is obvious if the differences between the subject matter of the claim and the prior art are such that the claimed subject matter, as a whole, would have been obvious to a POSITA at the time the invention was made. I have been informed as well that a prior art reference should be viewed as a whole. Specifically, I understand that the obviousness question involves a consideration of the scope and content of the prior art; the differences between the

prior art and the claims at issue; the knowledge of a POSITA; and any “secondary considerations” of non-obviousness.

31. I have been informed that certain factors called “secondary considerations” can include (1) the invention’s commercial success, (2) long felt but unresolved needs, (3) the failure of others, (4) skepticism by experts, (5) praise by others, (6) teaching away by others, (7) recognition of a problem, (8) copying of the invention by competitors, and (9) other relevant factors. I have been informed, however, that for such objective evidence to be relevant to the obviousness of a claim, there must be a causal relationship (called a “nexus”) between the claim and the evidence and that this nexus must be based on what is claimed and novel in the claim rather than something in the prior art. I also have been informed that even when they are present, secondary considerations may be unable to overcome primary evidence of obviousness (e.g., motivation to combine with predictable results) that is sufficiently strong.

32. I am not aware of any such “secondary considerations” applicable to the Challenged Claims. To my knowledge, the Patent Owner has not asserted any such secondary considerations with respect to the ’805 patent. However, should any be presented, I may address those unknown factors if asked by the Petitioner to do so.

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

34. I have also been informed that in considering whether an invention for a claimed combination would have been obvious, I may assess whether the POSITA would have had reasons to combine known elements in the prior art in the manner claimed in view of interrelated teachings of multiple prior art references, the effects of demands known to the design community or present in the marketplace, and/or the background knowledge possessed by a person having ordinary skill in the art. I have been informed that other principles may be relied on in evaluating whether an alleged invention would have been obvious, and that these principles include the following:

35. A combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.

36. When a device or technology is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or in a different one, so that if a person of ordinary skill in the art can implement a predictable variation, the variation is likely obvious.

37. If a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.

38. An explicit or implicit teaching, suggestion, or motivation to combine two prior art references to form the claimed combination may demonstrate obviousness, but proof of obviousness does not depend on, or require, showing a teaching, suggestion, or motivation to combine.

39. Market demand, rather than scientific literature, can drive design trends and may show obviousness.

40. In determining whether the subject matter of a patent claim would have been obvious, neither the particular motivation nor the avowed purpose of the named inventor controls.

41. One of the ways in which a patent's subject can be proved obvious is by noting that there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims.

42. Any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.

43. “Common sense” teaches that familiar items may have obvious uses beyond their primary purposes, and in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle.

44. A person of ordinary skill in the art is also a person of ordinary creativity and is not an automaton.

45. A patent claim can be proved obvious by showing that the claimed combination of elements was “obvious to try,” particularly when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions such that a person of ordinary skill in the art would have had good reason to pursue the known options within his or her technical grasp.

46. And one should be cautious of using hindsight in evaluating whether an alleged invention would have been obvious.

47. I understand that a POSITA must have a reasonable expectation of success in combining the teachings in the references that underly a combination. I understand that a reasonable expectation of success refers to the likelihood of success in combining the teachings in references to meet the limitations of the claimed invention, e.g., to achieve the claimed invention. I understand that in evaluating a combination, a predictable result means not only that the prior art

elements are capable of being physically combined, but also that the combination would have worked for its intended purpose.

48. I have been asked to consider the patentability of the Challenged Claims. I have been informed that for *inter partes* reviews (“IPR”), unpatentability must be shown under a preponderance of the evidence standard. I have been informed that to establish something by a preponderance of the evidence one needs to prove it is more likely true than not true. I have concluded that the Challenged Claims are unpatentable at least as obvious based on the references described below and as explained herein.

V. PERSON OF ORDINARY SKILL IN THE ART (“POSITA”)

49. I have been informed and understand that for purposes of assessing whether prior-art references disclose every element of a patent claim (thus “anticipating” the claim) and/or would have rendered the claim obvious, the patent and the prior-art references must be assessed from the perspective of a person having ordinary skill in the art (“POSITA”) to which the patent is related on the patent claim’s date of invention. I have been informed and understand that a POSITA is presumed to be aware of all pertinent prior art and the conventional wisdom in the art, and is a person of ordinary creativity. I have applied this standard throughout my declaration.

50. I understand that the '805 patent issued from an application filed on July 6, 2007. I also understand that the '805 patent purports to claim priority to a provisional application filed on July 11, 2006. However, I have been asked to assume that the Patent Owner has a burden to prove on a claim-by-claim basis that any particular claim is entitled to a priority date or date of invention of July 11, 2006. I understand that at the time of this declaration the Patent Owner has not made any such showing. If the Patent Owner attempts to make such a showing, I understand that I may be asked to respond in a subsequent declaration. Accordingly, I have been asked to assume that the time of invention for each claim in the '805 patent is July 6, 2007, and I have applied that understanding in forming my opinions throughout this Declaration.

51. In my opinion the '805 patent concerns the fields of digital imaging systems and image processing, particularly digital signal processing. The relevant fields include understanding the imaging properties of physical optics, specifically the optical distortions or aberrations introduced by imaging systems, as well as other artifacts introduced to digital images by imaging system components.

52. I have been asked to provide my opinions as to the state of the art in these fields on July 6, 2007. Whenever I offer an opinion in this declaration about the knowledge of a POSITA, the manner in which a POSITA would have understood the claims of the '805 patent or its description, the manner in which a

POSITA would have understood the prior art, or what a POSITA would have been led to do based on the prior art, I am referencing the July 6, 2007 timeframe, even if I do not say so specifically in each case.

53. I was asked to identify the POSITA and their ordinary level of skill in the relevant art on the effective filing date of July 6, 2007. I understand that the POSITA's level of skill in the art can be determined by several non-exhaustive factors including (1) the inventor's educational level; (2) the type of problems encountered in the art; (3) prior art solutions to the type of problems encountered in the art; (4) the rapidity with which innovations are made in the art; (5) the sophistication of the technology; and (6) the educational level of active workers in the field. I understand that the prior art discussed in this Declaration is itself evidence for determining the POSITA's ordinary level of skill. I have considered these factors in forming an opinion on the POSITA's level of skill on July 6, 2007.

54. I believe a POSITA in the field of the '805 patent on or around July 6, 2007, would have been a person with a Bachelor of Science degree in electrical engineering or a related field (which includes physics in the case of digital cameras) with at least two years of industry experience or research, both concerning digital camera system design and image processing.

55. This POSITA definition is consistent with:

- the practice and experience at the relevant time of integrating effective and affordable hardware and software for improving image quality into digital cameras;
- the considerable literature available at the relevant time teaching logical, mathematical, and electronic ways to do the same;
- the rapid progress at the relevant time in digital camera image resolution (sometimes understood as the number of pixels defining an image capture, often denoted in units of 1 million pixels or “megapixels”) and video frame rates, and in the computing power, signal processor capabilities, and the practicality of integrating these functions onto a single chip; and
- my experience with, at the relevant time, more than 35 years working on digital imaging systems and digital signal processing in the industry.

56. My opinion on the POSITA’s background and ordinary skill does not change if I were to consider the definition of a POSITA on or around July 11, 2006, although the earlier date would change the scope of the POSITA’s background knowledge by limiting it to subject matter that would have been known to practitioners on July 11, 2006, rather than July 6, 2007.

57. By July 2006, I had a B.Sc. degree in Physics, with graduate work in Physics toward a Ph.D. degree and had worked in the consumer electronics and optics industries for more than 40 years. As such, I was qualified as at least a POSITA, and I have had a sufficient level of knowledge, experience, and education to provide expert opinions in the field of the '805 patent, particularly on how a POSITA would have viewed the prior art. I have worked on projects in the relevant field with a number of professionals who would have qualified as a POSITA on July 6, 2007.

58. My opinions below are based on the perspective of a POSITA on July 6, 2007. My opinions would not change if I used the perspective of a POSITA on July 11, 2006.

VI. CLAIM INTERPRETATION

59. For the purpose of this declaration, I interpret certain claim terms as discussed below:

A. “wherein the system software is organized to identify specific optical aberrations and to access the database to identify specific corrections to the aberrations”

60. All challenged claims recite a version of “identify specific optical aberrations and to access the database to identify specific corrections to the aberrations,” (with some claims reciting “system software is organized to” perform the identifying), for example:

“wherein the system software is organized to identify specific optical aberrations and to access the database to identify specific corrections to the aberrations,” ([1.e], [9.d]);

“identifying specific optical aberrations and accessing a database to identify specific corrections to the aberrations,” ([18.e], [24.e]).

61. The '805 patent's specification states:

“In the process, the camera **identifies a specific lens and refers to a database that matches the lens type with the specific aberrations.** The aberrations are consistent throughout all images for each formula of a specific prime lens type and are thus corrected by adjusting for each specific aberration category.” (EX1001, 10:49-54; emphasis supplied);

"the present system allows each lens type to be digitally corrected for these types of aberrations. The in-camera digital process works by **identifying a specific lens and comparing the lens pattern to an internal database.**" (EX1001, 10:62-65; emphasis supplied);

“Once detection of the lens type, the sensor type, the exposure settings, the user and the subject is made, **optical and digital distortions are identified** and specific combinations of corrections are applied both before and after the digital sensor in order to optimize the image.” (EX1001, 24:54-58; emphasis supplied);

“The digital corrective process is described in FIG. 5. After **a specific lens type is identified (500) and a database is referenced (510), the lens type is matched with the specific optical aberrations (520).**

The digital filter then applies a correction to specific optical aberrations (530).” (EX1001, 30:44-48; emphasis supplied).

62. I read this as disclosing identifying aberrations by looking up the predetermined aberration characteristics of the lens and lens settings used to capture an image. This approach to identifying aberrations does not include examination of any actual image; rather, it acknowledges that a known lens and lens settings will cause certain aberrations that will be the same in any image captured with that lens and those settings, so those aberrations can then be corrected just using the predetermined aberration characteristics of the lens at those settings.

B. “using”

63. Various claims recite performing steps “using” components, such as the ASIC, DSP, or microprocessor.

64. I am informed by Petitioner’s counsel that in prior litigation the Patent Owner’s proposed construction of “using the application specific integrated circuit and the digital signal processor” is its plain meaning (EX1027, 37-39), and that in adopting Patent Owner’s construction, the district court found that “the claims include only the requirement that each [of the application specific integrated circuit and digital signal processor] play a role, and the details of how responsibilities are assigned are not part of the claim limitation” (EX1027, 38).

65. The term “using” should be interpreted to mean that each subject component plays a role in performing the recited step.

C. “succession”

66. Various claims recite “lens focal length alternates from specific fixed focal length lens settings in a *succession* of steps” and “optical aberrations are corrected with digital filtration to modify multiple images from different focal lengths in a *succession* of data files,” among other similar limitations. Emphasis supplied.

67. I am informed by Petitioner’s counsel that in prior litigation, the Patent Owner adopts a meaning of “succession of steps” as meaning that a zoom lens “successively move[s] through each zoom setting/position.” EX1032, 21-22 (citing Plaintiff’s Patent Local Rule 3-1 and 3-2 Disclosures, No. 2:19-cv-00246-JRG (E.D. Tex. Oct. 1, 2019), 118-19, 239).

68. I am further informed by Petitioner’s counsel that Patent Owner adopts the construction that “succession of data files” refers to “multiple files that are created when the system captures multiple images from multiple focal lengths consistently with the claim element above in which ‘succession of steps’ appears.” Ex. 1027, 49 (citing to Dkt. No. 69 at 19.)

69. All other terms should be given their ordinary meaning to a POSITA.

VII. SUMMARY OF OPINIONS

70. I was asked to provide my opinion on (1) the level of ordinary skill in the art pertinent to the '805 patent; (2) the scope and content of the prior art identified below; and (3) the differences between the identified prior art and the Challenged Claims (claims 1-3, 9, 18-20, and 24) in the '805 patent.

71. I was also asked to provide my opinion on reasons a POSITA would have combined prior art teachings as explained in various circumstances below, and whether POSITAs would have had a reasonable expectation of success in the combinations.

72. In forming my opinions I relied on the materials cited, the teachings in the prior art, my training and experience, and the perspective of the POSITA on July 6, 2007. My opinions do not change if I instead assume the level of ordinary skill of the POSITA on July 11, 2006.

73. Based on the materials that I have reviewed, the analysis I have performed, and the positions I have summarized within this report, I have formed at least the following opinions listed below.

- Claims 9 and 24 are obvious over U.S. Patent Pub. No. 2005/0280877 (EX1005, "Watanabe").

- Claims 1-3 and 18-20 are obvious over Watanabe in view of John C. Russ, THE IMAGE PROCESSING HANDBOOK (CRC Press, 4th ed. 2002) (EX 1054, “Russ”). .
- Claims 9 and 24 are obvious over U.S. Patent Pub. No. 2003/0223007 (EX1009, “Takane”) in view of Watanabe.
- Claims 1-3 and 18-20 are obvious over Takane in view of Watanabe in view of Russ.

VIII. THE '805 PATENT

A. Background

74. The '805 patent relates to digital image processing. It describes correcting aberrations that appear in images, which are due, at least, to the lens system of the digital camera used in capture.

1. Aberration Correction

75. Photography is based on using a lens to project an image of a scene onto a surface that can respond to the light in that image. Historically, that surface has been a plate or a flexible film covered with a light-sensitive emulsion containing silver halide crystals (“film”).

76. More recently, cameras have come to use semiconductor photosensor arrays (“sensors”) in place of film. Such a sensor produces electrical signals

representing the pattern of light projected onto the sensor by the lens (the original image).

77. Typically, those electrical signals are converted in the camera to digital data representing the image, hence the term “digital photography.”

78. Ideally, the image of the scene projected by the lens would be perfectly sharp, undistorted, and otherwise free of anything or any effect not present in the scene.

79. However, all real lenses produce images with various combinations of distortions and artifacts. These generally are called “aberrations.” Designers of lenses do what they can to minimize aberrations, but must balance that desire to minimize aberrations against issues of size, complexity, and cost of the designed lens.

80. Digital photography brought about new solutions for these problems, as compared to film photography. Digital sensors, microprocessors, and circuits aid in automated and user-assisted correction of image data. This allows for a simpler, smaller, and less expensive lens with greater design flaws to be used where the aberrations caused by such a lens can be corrected in digital processing.

81. While such digital processing was first done in computers working on digitally-represented images collected by cameras, continuing progress in the amount of processing power that can be put in small integrated circuits has come to

permit embedding powerful image correction and processing in the software and electronic hardware of a digital camera, even at the level of the cameras built into smartphones.

82. The challenged claims address topics related to digital aberration correction and/or modification of captured image data.

83. In particular, the corrections may relate to known lens issues. These include, in part, the five Seidel aberrations, known to lens designers since their mathematical description was published in 1857 by Ludwig von Seidel. The Seidel aberrations are (1) spherical, (2) comatic, (3) astigmatism, (4) curvature of field, and (5) distortion. These and other image defects arising due to the construction of the lens are well known to developers and inventors of digital image correction systems. *See* EX1043 at 2:10-14, EX1044 at [0003], EX1045 at 1:32-38, EX1046 at [0012].

84. A digital processing algorithm which carries out image correction is sometimes called a digital filter. *See* EX1046 at [0036]-[0037], [0058], [0066], EX1043 at 4:51-5:13.

85. It has been known since at least 1995 that image correction may be performed in a digital camera using on-board digital processing. *See e.g.* EX1045, 1:9-14, 3:13-16; EX1065, 4:9-26; *infra* paragraph 141.

86. Digital image correction or filtration can be sufficiently powerful to enable high quality images to be delivered even when the camera uses a smaller, lighter, lower quality lens. *See e.g.* EX1044 at [0003]-[0004].

87. An illustrative example can be seen in a study conducted by Ricoh. EX1047. In that study, image processing was used to correct distortion and shading. EX1047 at p. 103. The test shows the efficacy of these programs, which, as discussed below, were described throughout the prior art. Ricoh tested conditions known to cause certain aberrations such as distortion and peripheral shading. EX1047 at p. 104-105. Ricoh showed that corrections can accurately be made using stored information including characteristics of the lens and the conditions under which the image was taken. E.g., EX1047, 104 (“distortion aberration depends on the zoom position (the focal length used)”), 105 (“distortion aberration is calculated for each of the conditions of lens zoom position and photographing distance”).

88. Aberrations originate from the design and construction of the lens and are affected by the settings of the lens.

89. Most camera lenses incorporate an aperture (often realized as an iris diaphragm) which can be opened or closed to carrying degrees to control the overall amount of light taken in by the lens. Some cameras permit the user to

adjust the aperture, but most current cameras, especially simpler ones, adjust the aperture automatically.

90. The aperture setting of a lens is typically described by an “f-number” or “f-stop” which is the ratio of the lens’ focal length (see below) to the diameter of the aperture. Larger f-numbers describe smaller aperture settings, which allow less light through the lens to form the image.

91. Changing the f-number by 1.4 (the square root of 2) changes the area of the aperture, and thus the total amount of light sent to the image, by a factor of two. In photographic parlance, this is called a change of “one stop.”

92. The aberrations in the image projected by the lens typically change as the aperture changes. The nature and amount of such changes, and thus the proper corrections for those aberrations, are specific to each lens design.

93. Separately, the aberrations in the image projected by a lens typically change with what can be called the “focusing point,” the distance from the lens at which a subject is rendered in sharp focus in the image. The nature and amount of such changes, and thus the proper corrections for those aberrations, are also specific to each lens design.

94. The scale of the image projected by the lens is determined by the “focal length” of the lens. A larger focal length lens produces a bigger image of a

subject at a given distance, and so subjects in the scene are rendered bigger in the image.

95. Some camera lenses permit the focal length to be changed to vary the scale of the image. This changing, typically directed by the user, is often called “zooming” and a lens whose focal length is variable is often called a “zoom lens.”

96. The aberrations in the image projected by a zoom lens typically also change as the focal length changes. The nature and amount of such changes, and thus the proper corrections for those aberrations, are specific to each lens design, as explained in EX1048 (“Goosey”), 1:37-42 (“the requirement to produce a compact zoom lens with a minimum number of independently movable zooming lens units and a minimum number of lens elements often conflicts with the requirement to produce high quality images over a large focal length range.”), 1:51-57 (“If the optical power of the lens units increases (without additional lens elements) in order to provide a larger zoom ratio, lens surfaces become stronger, compromising the performance of the zoom lens. In addition, the shorter the focal length of the zoom lens in the wide angle mode, the more difficult it is to control field aberrations such as coma, astigmatism and field curvature.”); EX1045, 7:27-32; Kita, claim 10; EX1051, [0007] (“the lens information is aperture data related to the position and diameter of multiple pupils optically formed in the imaging lens, and the correcting unit calculates the light intensity distribution reaching the imaging plane through

the multiple pupils based on the aperture data, and corrects the luminance distribution of the image data in a direction to eliminate the light intensity distribution”); EX1044 at [0014]-[0015].

97. Some other camera lenses do not permit the focal length to vary. Such a lens can be called a “fixed focal length lens.” This can permit either a design with lower aberrations than a zoom lens (in the case of what are called “prime” lenses) or a simpler, lighter, and less expensive lens. Cameras capable of using interchangeable lenses of different characteristics, including both fixed focal length and zoom lenses, were known. For example:

“The present invention relates to a photographing camera capable of being used with a plurality of types of interchangeable lens systems (lens-interchangeable camera)” EX1077 (“Kawasaki”), 1:8-11;

“Reference numeral 73 designates a lens ROM. The lens ROM 73 stores lens characteristic data to make AE and AF operations possible. As described before, the lens characteristic data includes, for example, an open lens-stop value, a minimum lens-stop value, a coefficient for converting the amount of divergence of a movable lens from the focal point with respect to the subject into a quantity of length along which the movable lens is to be moved (as will be described later in more detail). If the photographing lens is a zoom lens, the lens characteristic

data include open lens-stop values varying with zooming, quantities for shifting the, focal distance, and the like.” EX1077 (“Kawasaki”), 7:18-30.

98. Digital image correction or filtration must thus either take note of or adapt to the aberrations produced by the lens in use (more sophisticated cameras permit interchange of lenses for various purposes) at the aperture and, if it’s a zoom lens, focal length used to take a particular picture.

99. It was known before the filing date that lens-caused aberrations could be digitally corrected in the camera by storing correction information for each lens and some likely combinations of aperture and (if a zoom lens) focal length settings. *See, e.g.* Watanabe, [0047] (storing aberration correction data corresponding to the type of lens and the focal length settings), *see also* EX1051 at [0032]; Kita at [0060] (selecting a filter by referencing a table that is determined in advance using the zoom value (“zooming amount”), the defocusing amount, and the iris value (“diaphragming amount”) as keys); EX1046 at [0164] (obtaining optical characteristics of an optical system as the image from storage); EX1050 at 4:50-5:4; EX1063 at [0084], [0130] [0168]; *see also id.* [0108], [0123] (describing that correction tables are stored for parameters such as focal length).

100. It was known that this type of correction information can be stored in the camera lens itself, the camera body, or in devices connected to the camera. *See, e.g.* EX1052, [0005]; EX1063, [0083]-[0085], Watanabe, [0046]-[0047].

101. Regardless of where the correction/aberration information was stored in the camera body, the lens, or elsewhere, the available references would make clear to a POSITA what information was to be used in processing, where that information could be stored, and how it could be used to correct for aberrations.

2. Fast Fourier Transforms

102. The Fourier transform is a mathematical tool which, when applied to an image, presents a map of regions of specific fineness of structure (“spatial frequency”) in that image. This is a useful tool for certain kinds of image analysis and adjustment.

103. The Fourier transform has been known for nearly two centuries, growing out of Jean-Baptiste Joseph Fourier’s 1822 publication. Fourier transforms can be performed digitally on computers, and their mathematical complexity was greatly reduced, permitting simple computers to perform complex Fourier transforms quickly, with the invention by Cooley and Tukey in 1965 of the Fast Fourier Transform (“FFT”). EX1054 (“Russ”), at pp. 277, 315-316; EX1053 (“Gonzalez”) at pp. 208-213.

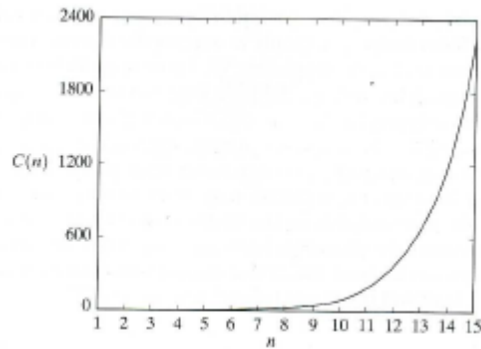


FIGURE 4.42
Computational advantage of the FFT over a direct implementation of the 1-D DFT. Note that the advantage increases rapidly as a function of n .

Gonzalez at p.213.

104. Image processing with Fourier transforms has an extensive literature prior to the filing date. *See, e.g.,* Russ, at pp. 277-332; Gonzalez, at p. 158 (“Filtering in the frequency domain is straightforward.”), 213 (“Virtually all comprehensive signal and image processing software packages have generalized implementations of the FFT.”).

105. As illustrated below, the basic approach to image processing with Fourier transforms uses the practical digital implementations of the Fourier transform, called the fast Fourier transform (“FFT”) or the inverse fast Fourier transform (“IFFT”), in this fashion:

- Perform a Fourier transform (typically by FFT) on the image;
- Apply a filter function which selectively affects different spatial frequencies; and
- Perform an inverse Fourier transform (typically by IFFT) to recover the image, now modified by the filter function.

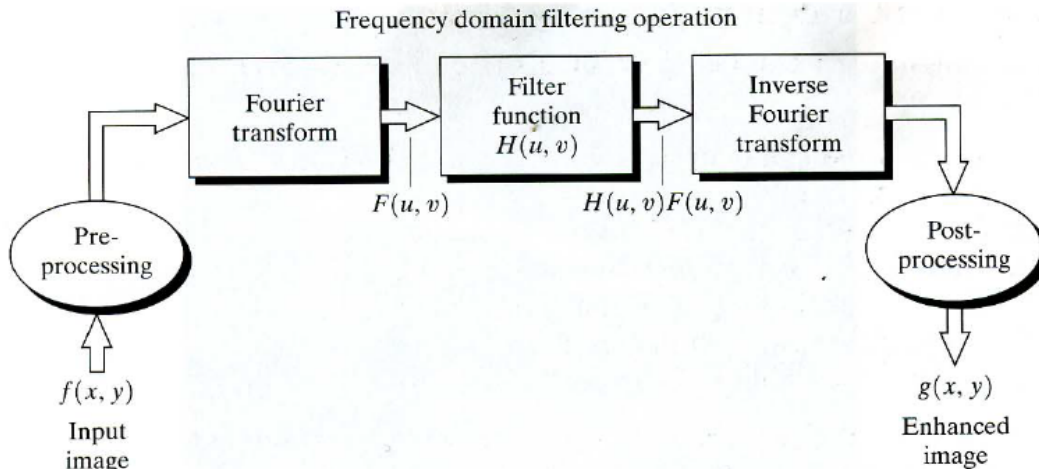
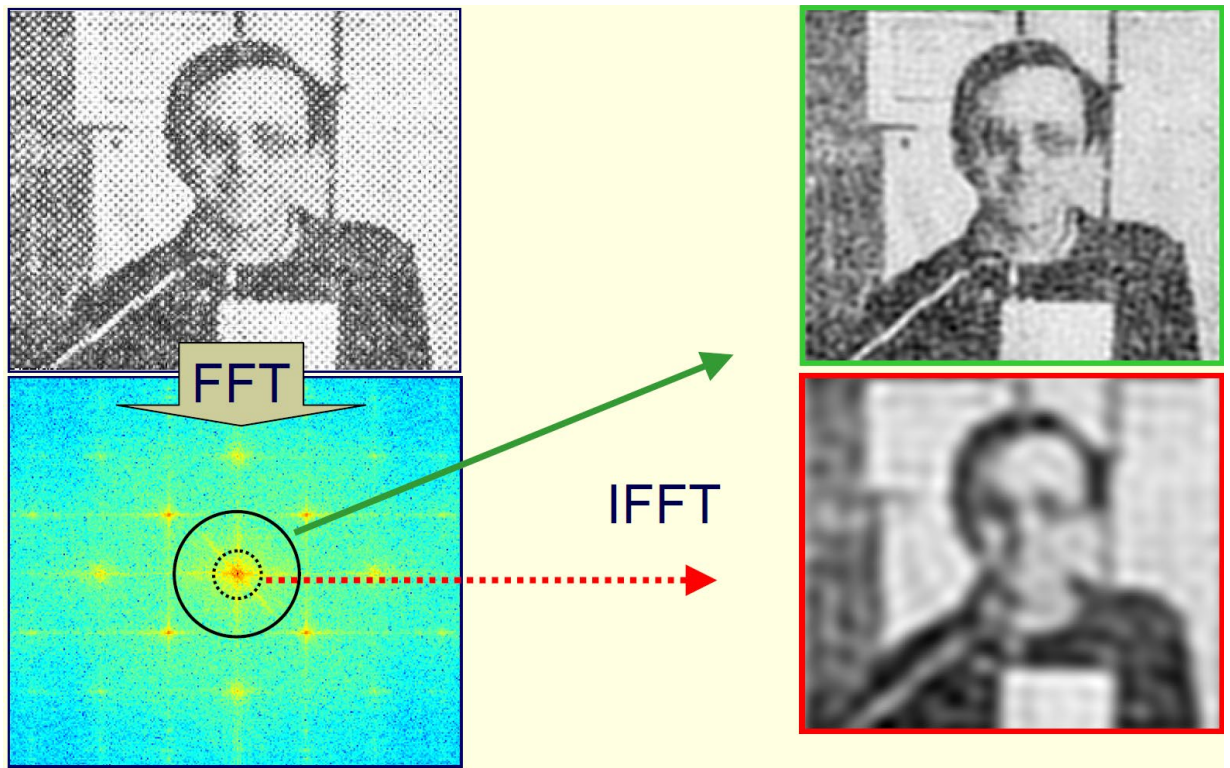


FIGURE 4.5 Basic steps for filtering in the frequency domain.

Gonzalez at p. 159.

106. The illustration below shows two types of FFT, including a filter function and Inverse FFT processing of an image. First, there is noise reduction by excluding in the FFT of the image just the spatial frequencies (cluster of bright dots) carrying the halftone pattern in the original image (the filter function is shown as the larger circle). Second, there is a softening by also excluding some of the spatial frequencies carrying fine detail in the original image (the smaller circle):



EX1076, 42.

107. Fourier transforms, typically FFTs, are known to be useful for sharpening images. *See, e.g.,* Russ at pp. 318-319; EX1064, 5:37-42.

108. Fourier transforms are also used in color adjustment of images. Typically, FFTs are used to convert and suitably filter each individual color component from a captured image into the frequency domain. *See, Russ, pp. 308-309.* This allows the user to be able to adjust the color hue and saturation, either alone or in conjunction with other processing or effects.

109. The same progress in increased density and power of integrated circuits has permitted FFT-based image processing to be carried out in-camera. *See e.g., Gonzalez at pp. 476-477; EX1066 at Abstract, [0009].*

3. Camera Components

110. The asserted claims recite many well-known, programmable components. The claims recite a microprocessor, digital signal processor (“DSP”), application specific integrated circuit (“ASIC”), and software. Each of these components was well-known, alone and in combination, and easily programmed to carry out specified tasks. EX1055 at 1:67-2:4 (“Conventional digital image processing, however, utilizes conventional processing technology, such as digital signal processors (‘DSPs’), microprocessors, or application-specific integrated circuits (ASICs).”); *see also* EX1044 at [0005]; EX1056 at [0045]; EX1049 at 4:8-14 (disclosing a microprocessor, DSP, and ASIC); EX1057 at 23:59-64, 24:2 (disclosing a microprocessor, ASIC, and DSP).

111. A POSITA would readily appreciate that digital image processing technology for cameras could be implemented in any one of a number of manners. Specifically, a POSITA would understand that microprocessors, ASICs, and DSPs can be interchanged and combined as needed to carry out specific functions or processes. Often this is a question of cost and manufacturing efficiencies.

112. The ’805 patent appears to admit this understanding: “This process can be performed with a single microprocessor, multiple microprocessors, multiple ASICs or a combination of microprocessors and ASICs.” (EX1001, 17:37-39).

113. For example, the Challenged Claims recite a microprocessor, a DSP, an ASIC, and software to perform the claimed processing tasks. The '805 patent is vague in its use of the term "DSP." It identifies the DSP as element 195 despite also referring to an ASIC as 195. EX1001, 29:64-67, FIG. 1. The DSP is referred to as element 220 of Fig. 2, despite that portion of Fig. 2 referring to functional steps. EX1001, 30:26, FIG. 2 ("Digital Signal Processing").

114. Software applications for executing image processing were also known before the filing date. EX1049 at 4:8-14; EX1067 at [0047] ("ordinarily be implemented as a software program"). The successful implementation of software-defined processing into cameras was vital to the rise in popularity of digital cameras. Software allows a POSITA to program the various internal workings of the camera to carry out the tasks desired by the user.

B. The Claims of the '805 Patent

115. The '805 patent has 32 claims. In this declaration, the challenged claims are parsed as shown in Appendix A.

116. Those parsings are referred to and shown below as limitations are addressed.

IX. GROUND 1: WATANABE RENDERS OBVIOUS CLAIMS 9 AND 24

A. Watanabe

117. U.S. Patent Pub. No. 2005/0280877 (EX1005, “Watanabe”) published December 22, 2005 is prior art to all claims of the ’805 patent. Watanabe incorporates JP2004-233872 (EX1006, “JP-872”). Watanabe, [0015].

118. Watanabe discloses in-camera correction for a degradation of light intensity of a peripheral portion (also called “vignetting”) and for distortion of a digitally-captured image: “the present invention relates to an image recording apparatus and an image processing system capable of automatically and simply executing an image process such as distortion aberration correction or peripheral light intensity correction.” Watanabe, [0002].

119. Watanabe does so by selecting from among stored correction tables in order find a table that has the necessary information to correct for the distortion aberration and peripheral light intensity caused by the lens at the specific settings of focal length (“zoom position”) and focus distance to subject. Watanabe, [0037]-[0039] (“the digital signal processing circuit 56... executes... correction... The ROM 58 stores programs, data necessary for executing programs, etc.”).

120. Watanabe explains that “tables 70 including distortion aberration correction values and peripheral light intensity correction values in accordance with focusing points and zoom positions are prepared in advance on a lens to lens

basis, then the CPU determines a table according to a lens type and determines correction values according to a focusing point and a zoom position, and image data 72 is obtained in compliance with the correction values.” Watanabe, [0047].

121. Watanabe describes an image processing system for a digital camera that uses a CCD sensor to capture images:

“the digital camera as an image recording device is composed of the following... CCD 53,” JP-872, [0006];

“a digital camera 100 as the image recording apparatus is provided with... a CCD (Charge Coupled Device) 53,” Watanabe, [0035].

122. As shown in Watanabe FIG. 1A, the lens 51 held by its mechanical structure projects an image as a light pattern onto CCD 53. This produces an analog signal representative of each captured image.

123. This signal is then initially processed (CDS 54) and digitized by analog-to-digital (“A/D”) converter 55:

“The CCD 53 is a circuit for converting an image inputted through the lens unit to electrical signals (analogue image data), and the CDS circuit is a circuit for reducing noise for the CCD-type image photographing device. Further, the A/D converter converts analogue image data inputted from the CCD 53 through the CDS circuit 54, to digital image data.” Watanabe, [0037].

FIG. 1A

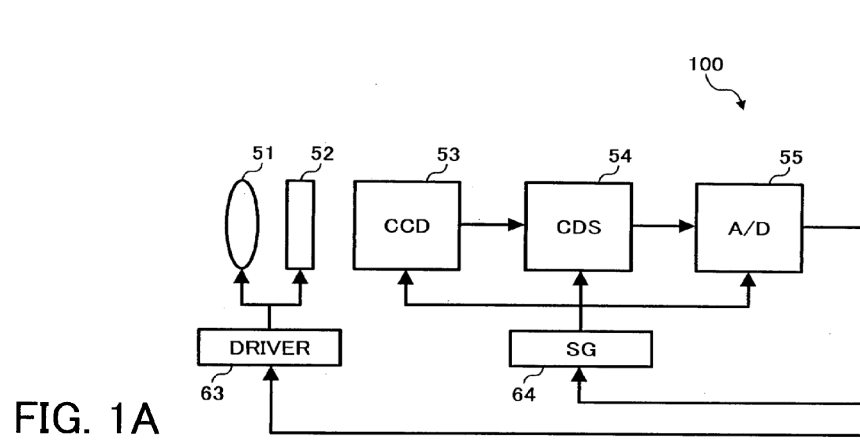


FIG. 1A

124. A “digital signal processing circuit 6... performs various processing” and “correction” to images that have been digitized by A/D converter 5. JP-872, [0006]; *see also* Watanabe, [0038] (“digital signal processing circuit 56... executes various processes” and “correction” to digitized images). Watanabe identifies distortion aberration and peripheral light intensity corrections (JP-872, [0007]; Watanabe, [0047]) and processes the digitized images to apply the corrections (JP-872, [0006]-[0008]; Watanabe, [0032], [0048]-[0064]).

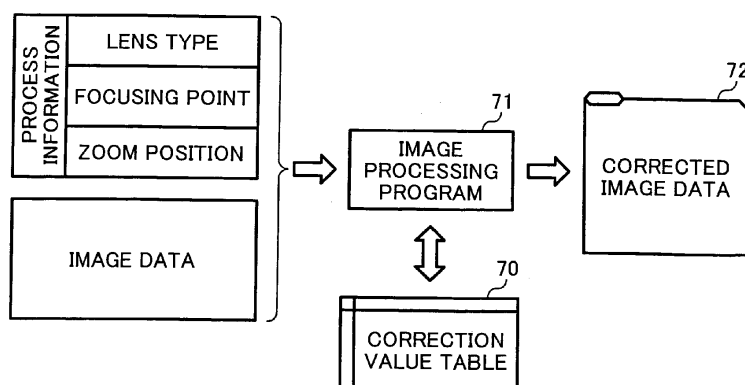
125. As shown below in Watanabe FIG. 3, to each captured image Watanabe adds “information related to lens characteristics” including “lens type... focal length at the time of shooting... and the zoom position” to the image data (JP-872, [0007]). For example:

- “various data (data 1-data N) are added to image data as process information. As these process information, for example, information relative to lens characteristic (i.e. information relative

to distortion aberration in terms of distortion aberration correction), information of peripheral light intensity as information relative to peripheral light intensity correction, and so forth are stored” Watanabe, [0046].

126. This “process information” is produced by the lens and camera. For each captured image, the lens producing that image reports its type and its aperture and focal length settings when the image is captured. The camera receives that information and attaches it to the image data.

FIG. 3



127. The image processing program 71 uses that information to identify and access from the stored table 70 “distortion aberration correction” and “peripheral light amount corrections” based on “focal length and zoom position for each lens.” JP-872, [0007]; *see also* Watanabe, [0046]-[0047].

128. The image processing program 71 then uses the retrieved stored corrections to produce the corrected image data 72. JP-872, [0007]; Watanabe, [0048].

129. The information in table 70 is collected in advance by the lens or camera manufacturer from design information or measurements of aberrations taken from images a distortion aberration correction process is executed of test targets at various combinations of lens settings:

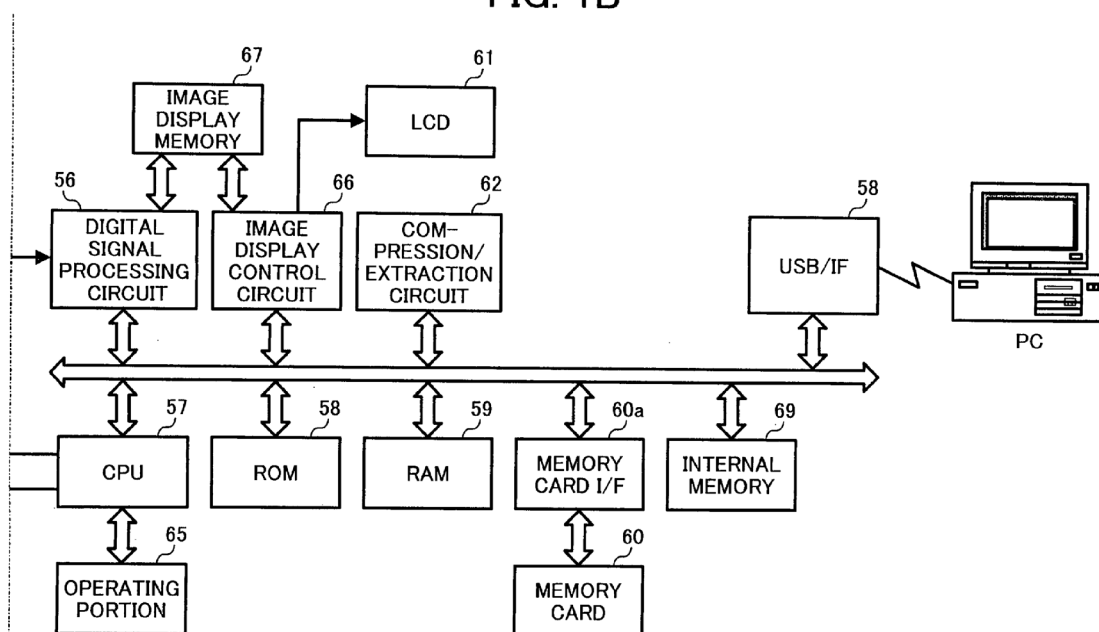
JP-872, [0007] (“a table 20 of correction values for distortion and peripheral light amount consisting of focal length and zoom position for each lens is prepared in advance”);

Watanabe, [0047] (“tables 70 including distortion aberration correction values and peripheral light intensity correction values in accordance with focusing points and zoom positions are prepared in advance on a lens to lens basis”).

130. As shown below in a digital camera hardware implementation in Watanabe FIG. 1B, the package of image data and process information (Watanabe, [0046]) enters the digital signal processing circuit 56 (“the digital signal processing circuit 56 sorts out the image data inputted from the A/D converter 55” Watanabe, [0038]). This is connected to a bus, to which the CPU 57, which executes the image processing program 71 (Watanabe, [0042]), and the ROM 58, which contains the control program (Watanabe, [0042]) and the correction value table 70 (Watanabe, [0039]), are also connected. Watanabe, [0035].

131. Watanabe does not limit such a hardware implementation to discrete versus integrated components.

FIG. 1B



B. Claim 9

132. Claim 9 can be parsed into limitations as follows:

#	Limitation
9.PRE	A digital imaging system for image filtration comprising:
9.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, an application specific integrated circuit, system software, a database management system and a memory storage sub-system;
9.b	wherein the aberrations from the optical lens mechanism are corrected by applying digital filtration by using the application specific integrated circuit and the digital signal processor;
9.c	wherein the microprocessor is used to provide digital and optical data to the digital signal processor;
9.d	wherein the system software is organized to identify specific optical aberrations and to access the database to identify specific corrections to the aberrations;
9.e	wherein the system software forwards the data from the digital sensor to the digital processor;
9.f	wherein the digital signal processor selects a specific procedure to optimize the image and corrects the aberrations;
9.g	wherein the lens type is a zoom lens;

#	Limitation
9.h	wherein the lens focal length alternates from specific fixed focal length lens settings in a succession of steps;
9.i	wherein optical aberrations are corrected with digital filtration to modify multiple images from different focal lengths in a succession of data files; and
9.j	wherein the modified data file consisting of the digital data optimized from the aberrations that are corrected from the original optical image is stored in memory.

133. Watanabe shows the features of claim 9. Many of the claimed elements, e.g., a zoom lens, digital image sensor, microprocessor, application specific integrated circuit, digital signal processor, and memory are well-known and easily implemented hardware components. While Watanabe schematically shows hardware and software meeting the claim, a POSITA would have appreciated that any specific hardware or software arrangement or functionality would be a simple design choice. Watanabe's schematic arrangements in this regard could be adapted or modified without issue. As merely one example, fixed focal length lenses were well-known as interchangeable with zoom lenses as dictated by imaging conditions, and a POSITA would recognize that cameras often substitute one lens assembly for another zoom to fixed, or vice versa, as conditions demand. *Infra* §X.C.2.

1. Limitation [9.PRE]

9.PRE	A digital imaging system for image filtration comprising:
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134. If [9.PRE] is limiting, Watanabe meets it because Watanabe describes a digital imaging system:

“an image recording apparatus and an image processing system capable of... distortion aberration correction” (Watanabe, [0002]);

“digital camera 100 as the image recording apparatus is provided with... a digital signal processing circuit” (Watanabe, [0035]).

135. Watanabe performs image filtration in digital images as explained above in §IX.A and below regarding limitations [9.a]-[9.j].

2. Limitation [9.a]

9.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, an application specific integrated circuit, system software, a database management system and a memory storage sub-system;
-----	---

136. Watanabe meets limitation [9.a] as follows:

a. “a digital camera mechanism”

137. Watanabe’s “digital camera” (“the digital camera as an image recording device” JP-872, [0006], Fig. 1; “digital camera 100 as the image recording apparatus” Watanabe, [0035], Figs. 1A-1B) is a “digital camera” because it captures images with a CCD and digitizes its output:

“The CCD 3 is a circuit that converts the video input through the lens unit into an electrical signal (analog image data), and the CDS circuit 4 is a circuit for reducing noise for the CCD type image sensor.

Further, the A/D converter 5 converts analog image data input from

the CCD 3 via the CDS circuit 4 into digital image data.” JP-872, [0006].

b. “optical lens mechanism”

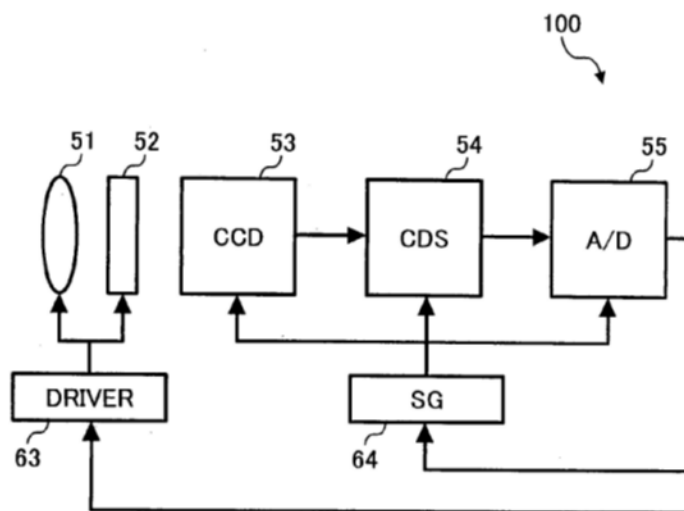
138. The term “optical lens mechanism” does not appear in the ’805 patent’s specification, nor does the term “lens mechanism.” The ’805 patent states, “zoom lenses have become extremely complex optical mechanisms consisting of multiple groups of lens elements” (EX1001, 25:35-37) and claim limitation [1.g] imposes the requirement “wherein the lens type is a zoom lens,” so the “optical lens mechanism” of limitation [1.a] is some form of lens.

139. As shown in FIG. 1A and described in detail in §IX.A above, Watanabe discloses lens 51 (Watanabe, [0035]) and states: “A lens unit includes the lens 51, the mechanical structure 52 including the auto focus (AF) mechanism, a diagram [*sic*; should be “diaphragm”] and a filter portion, and so forth.” Watanabe, [0036]. A POSITA would have understood that Watanabe’s reference to a “diagram” in [0036] was a typographical error that should read “diaphragm,” meaning the iris that sets the stops or aperture for the imaging system as used in Watanabe, [0007].

c. “a digital sensor”

140. The ’805 specification identifies “CCD” as a “digital sensor[]” in which “photons are recorded by electrically charged pixels.” EX1001, 13:63-14:4. As described in detail in §IX.A above, Watanabe’s CCD captures images, which

are digitized. JP-872, [0006] (CCD 3, A/D converter 5), Fig. 1; Watanabe, [0035] (CCD 53, A/D converter 55), [0037] (“A/D converter converts analogue image data... to digital image data”), Fig. 1A.



d. “a microprocessor, a digital signal processor, an application specific integrated circuit”

141. I am informed by Petitioner’s Counsel that, in prosecution of the child Application No. 12/586,221 (now Patent No. 8,451,339), the Patent Owner concedes that the hardware components of the claims are known to be used in cameras for image processing, stating that “it is acknowledged that microprocessors and ASICs are used in digital cameras,” where “[t]he microprocessor is a CPU that controls the computing functions of the camera,” and that “it is recognized that a digital signal processor (DSP)” or “an application specific integrated circuit (ASIC), is used to process a digital image file.” EX1026, 154-155. The Patent Owner states that:

“It is acknowledged that microprocessors and ASICs are used in digital cameras, however. These mechanisms have evolved to be applied to embedded computing devices including digital cameras. The microprocessor **is a CPU that controls the computing functions of the camera.** The CPU may use memory circuits (DRAM, EPROM, EEPROM, Flash memory) in order to store and access data to perform a set of control functions. For example, the camera microprocessor is used to identify the correct exposure of an image by using the exposure meter in the camera. In addition, the microprocessor is used in conjunction with a lens CPU in order to autofocus the image. Further, the microprocessor is used in conjunction with a flash CPU in order to automatically illuminate an image based on user preferences. **Moreover, it is recognized that a digital signal processor (DSP), typically an application specific integrated circuit (ASIC), is used to process a digital image file.** In general, the general exposure data of the image file is processed using the DSP.” EX1026, 154-155; emphasis supplied.

142. The '805 patent does not provide, either in the specification or the claims, any description of the claimed “digital signal processor” other than as a name for a body of functional capability assigned to carry out certain processes on digital data. As I understand the '805 patent, anything which performs the process assigned to the claimed “digital signal processor” can meet this limitation.

143. Semiconductor devices called “digital signal processors” or “DSPs” are general-purpose devices which are directed to carry out a certain process by programming specific to that process.

144. Watanabe’s digital camera includes a central processing unit (“CPU”) and digital signal processing circuit:

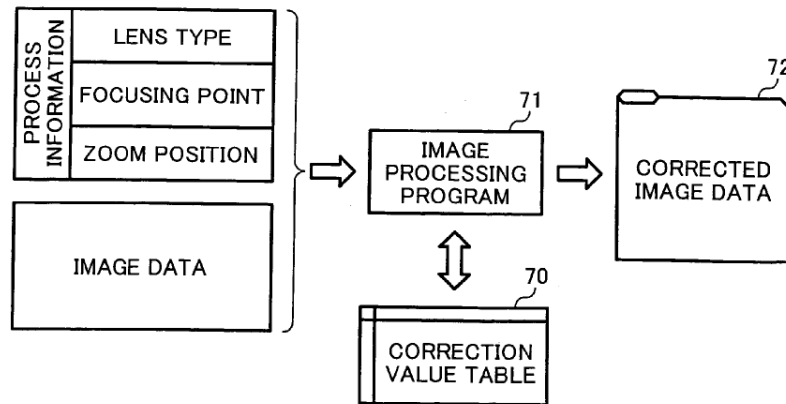
“the digital camera as an image recording device is composed of the following:... digital signal processing circuit 6, CPU 7” JP-872, [0006], Fig. 1;

“The CPU 7, in accordance with the control program stored in the ROM 8... processes image data using the image processing program within the control program.” JP-872, [0007];

“a digital camera 100 as the image recording apparatus is provided with... a digital signal processing circuit 56, a CPU 57,” Watanabe, [0035] Fig. 1B;

“Based on a control program stored in the ROM 58 the CPU 57... processes image data by way of an image processing program in the control program.” Watanabe, [0042].

145. Watanabe meets this “digital signal processor” limitation with the digital signal processing circuit 56 controlled by the CPU 57, which runs the image processing program within operating portion 65 and provides digital signal processing circuit with correction information from the correction value table 70. Watanabe, [0038], [0042], [0047], Figs. 1B, 3.



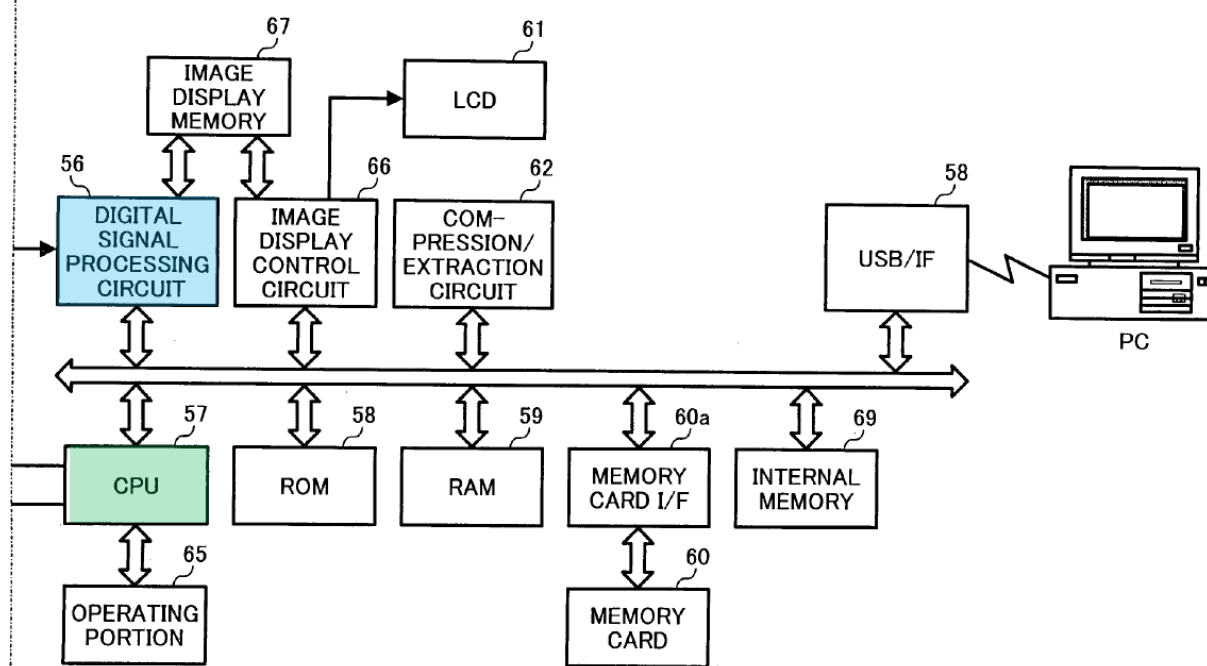
Watanabe, Figure 3.

146. Watanabe's digital signal processing circuit processes digital signals, and so is a digital signal processor ("DSP").

147. Watanabe's CPU meets the claimed "microprocessor." The Patent Owner concedes that "a microprocessor is a CPU that controls the computing functions of the camera." EX1026, 154-155. Watanabe describes a CPU that controls computing functions of its camera. See Watanabe, [0042] ("CPU 57 controls operation of each part of the digital still camera"). Therefore, Watanabe describes a microprocessor. Furthermore, a microprocessor is an obvious implementation of a CPU.

148. Watanabe only presents its functional components downstream from the digital sensor, including the digital signal processor and the CPU (highlighted blue and green respectively below) in a schematic way (Watanabe, FIG. 1B):

FIG. 1B



149. Watanabe does not specify how the hardware components of digital camera 100 are implemented, but it was well known, and would have been an obvious and attractive design choice for a POSITA, to provide a combination of a microprocessor and one or more DSPs, such as on a single integrated circuit or “chip:”

“The TMS320C8x digital signal processor (DSP) is a single-chip, multiprocessor device for use in image processing...” EX1019, SL: 1-1;

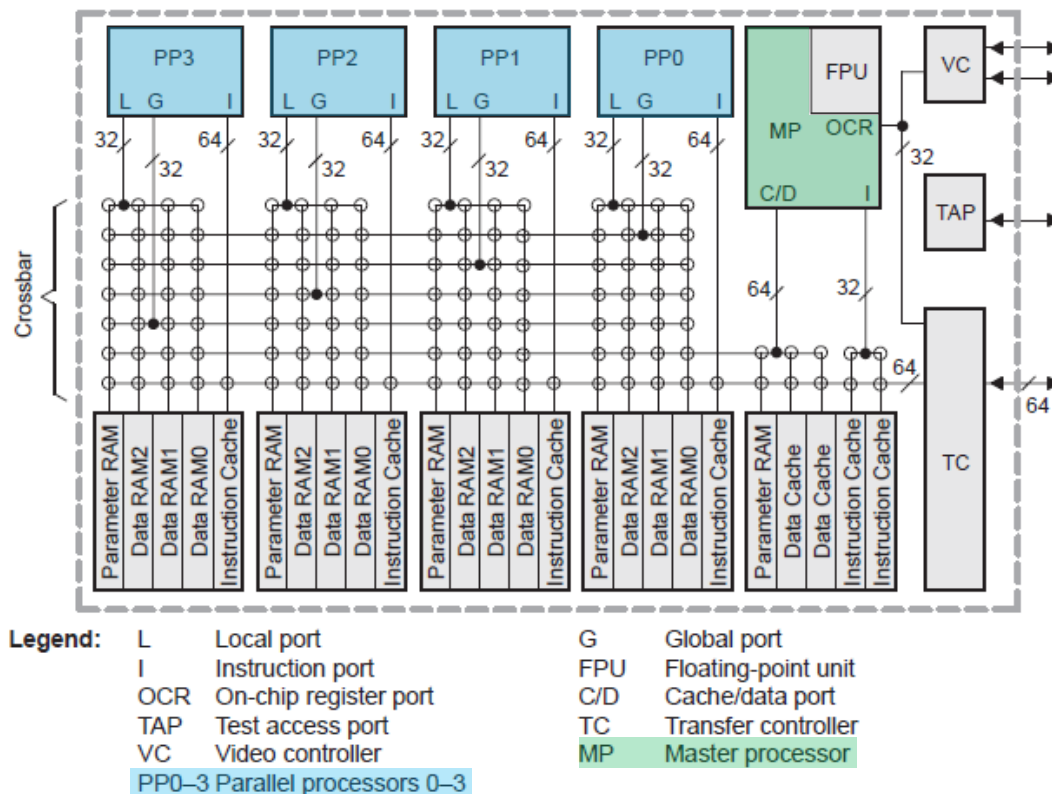
“The TMS320C8x architecture combines RISC processing and the processing power of multiple advanced DSPs (parallel processors).” EX1019, SL: 2-1;

“The following information describes each functional unit of the TMS320C8x:

- Master processor (MP). The MP [highlighted green in annotated Figure 2-1 below] is a 32-bit RISC processor with an IEEE-754 floating-point unit (FPU)
- Parallel processors (PPs). The PPs [highlighted blue in annotated Figure 2-1 below] are advanced DSP, 32-bit integer units.”

EX1019, SL: 2-3.

Figure 2–1. TMS320C80 Block Diagram



EX1019, Figure 2-1 (annotated).

150. This master processor (MP) is a specific kind of CPU.

151. Computers, both general and special purpose, contain processors (often called “central processing units” or “CPUs”) which can carry out mathematical and logical operations defined in their structures as “instructions” which can be called for by programs provided to and executed by the CPUs.

152. Many dedicated CPUs, as found in digital cameras, need only a modest set of instructions to carry out the kinds of programs they’ll be asked to run. Such processors can be called “RISC” (for “Reduced Instruction Set Computer”) processors because their instruction sets are “reduced” compared to the larger instruction sets of a general-purpose processor as found in a Windows or Macintosh computer.

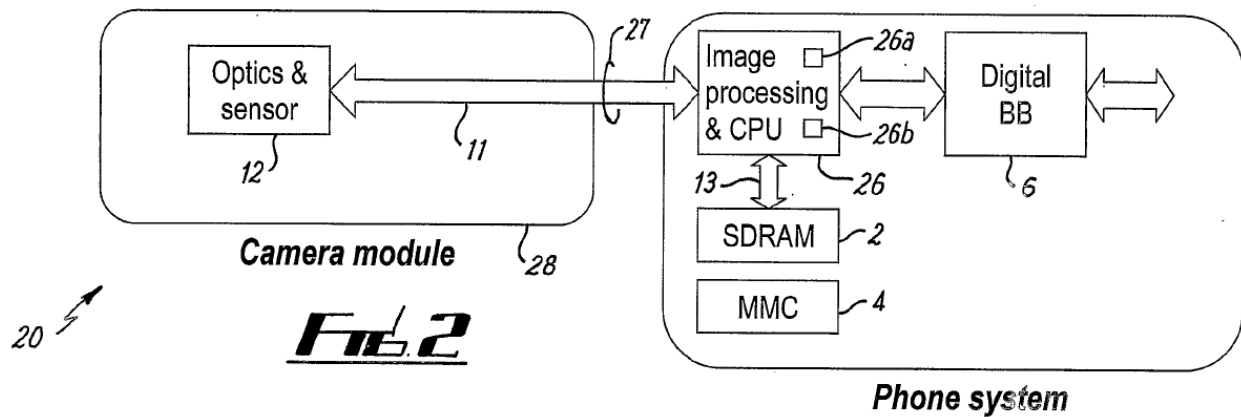
153. A POSITA would understand combining a CPU and DSPs suited to the specific application on a chip (making what is sometimes called a “system on chip” or “SoC”) has many practical benefits:

- An SoC is physically smaller and likely less expensive than the equivalent array of discrete components, enabling a more compact and attractively priced product (such as a digital camera for casual users);
- An SoC can permit tasks required by a specific application to be distributed more efficiently or with higher performance than when that application is implemented with discrete components;

- An SoC carries most of the data pathways, so reduces or eliminates the need for traces on a circuit board, further reducing product size, minimizing signal interference and delays, and permitting closer coupling of memory to processes using it;
- An SoC consumes less power than the equivalent array of discrete components, reducing heat and permitting a portable product to have either a smaller battery or longer operating per charge.

154. SoCs were known and available for processing of digital camera images; e.g.:

“Fig. 2 and 3 are schematic illustrations of a mobile camera telephone 20 according to a first embodiment of the invention. The telephone 20 includes, as distinct components, an optics and image sensor 12 and an application processor 26. The application processor 26 is a single chip. It has a CPU block 26a that operates as the CPU of the telephone 20, a camera image processing block 26b that operates as a camera image processor and interfaces 26c to storage devices SDRAM 2 and memory card 4. The application processor 26 may be a system on a chip (SOC).” EX1018, 4:2-9.



155. The considerable and detailed documentation for commercial SoCs and the precedent of SoCs processing images in digital cameras cited above show implementing Watanabe's image processing with an SoC to achieve some or all of the above-listed benefits to have been within the ordinary skill of a POSITA.

156. A POSITA would be well familiar with processing platform design options, which were known to include application specific integrated circuits and their well-known implementation benefits for repetitive and labor-intensive digital filtration operations. EX1055, 1:65-2:4.

157. While the general processing function of the CPU/microprocessor enables overall control of a system, a DSP provides known advantages where a programmable upgrade in processing function (such as image optimization) may be desirable. While the application specific integrated circuit is known to offload labor-intensive operations of a system whereby its higher speed hardware switching operation may be leveraged for repetitive tasks such as aberration correction. For example, as shown in EX1079, 6:58-62, 21:54-57, 25:7-13, DSPs,

processors, and application specific integrated circuits were known for implementing FFT operations such as those of the '805 patent. DSPs provide upgrade benefits as compared to application specific integrated circuits based on software programming while the dedicated hardware of application specific integrated circuits is better suited to repetitive labor-intensive tasks to consume less power. EX1081, 7:48-8:23.

158. For these reasons, application specific integrated circuits were known image processing components of correction schemes. EX1080,9:28:47, 17:45-67, 24:48-25:3, 25:51-57. . A POSITA understood that application specific integrated circuits relieved other processing elements of an image processing system of labor-intensive image processing tasks and were faster and consumed less power for repetitive tasks—important to handheld devices such a digital camera. Likewise, a POSITA would recognize that while lens aberrations were known, optimization schemes may require the flexible programming of a DSP.

159. I am informed by Petitioner's counsel that Patent Owner has indicated that each of application specific integrated circuits, microprocessors, and DSPs are known to be used in cameras for image processing and other tasks (EX1026, 154-155), stating that:

“It is acknowledged that microprocessors and ASICs are used in digital cameras, however. These mechanisms have evolved to be applied to embedded computing devices including digital cameras.

The microprocessor **is a CPU that controls the computing functions of the camera.** The CPU may use memory circuits (DRAM, EPROM, EEPROM, Flash memory) in order to store and access data to perform a set of control functions. For example, the camera microprocessor is used to identify the correct exposure of an image by using the exposure meter in the camera. In addition, the microprocessor is used in conjunction with a lens CPU in order to autofocus the image. Further, the microprocessor is used in conjunction with a flash CPU in order to automatically illuminate an image based on user preferences. **Moreover, it is recognized that a digital signal processor (DSP), typically an application specific integrated circuit (ASIC), is used to process a digital image file.** In general, the general exposure data of the image file is processed using the DSP.” *Id.*, emphasis supplied.

160. Accordingly, by the Patent Owner’s own admissions it would have been obvious to implement an application specific integrated circuit and DSP in combination with a CPU/microprocessor.

161. POSITAs would have had a reasonable expectation of success of implementing this combination because microprocessors, DSPs, and application specific integrated circuits were available in commercial off-the-shelf components routinely used for image processing in cameras as admitted by Patent Owner. Implementing Watanabe’s system with any combination of microprocessors, DSPs, or application specific integrated circuits was well-within the POSITA’s ordinary skill.

162. All these factors would enable a POSITA to understand that integrating Watanabe's CPU and digital signal processor on a single chip provides the claimed "microprocessor, a digital signal processor, and application specific integrated circuit."

163. Watanabe thus meets these limitations of [9.a].

e. "system software"

164. Watanabe's "control program" can include firmware (code controlling the underlying operations of, directly executed by, and typically stored in the CPU and certain other hardware) as well as higher-level code implementing specific functions such as image processing.

165. The term "system software" does not appear in the '805 specification, but a POSITA would understand that term to include Watanabe's control program as that is part of Watanabe's system.

166. Any variation on this would be understood by a POSITA to be an example of the claimed "software" in the same way recited by the '805 patent's discussion of embedding "complex system functions including those described herein" into "digital still camera" and "video cameras" as well as "networks of sensors, networks of cameras or integrated networks of both sensors and cameras." (EX1001, 30:9-22).

167. The '805 patent goes on to describe a range of structures and systems in which software would participate in producing corrected images wide enough that a POSITA would understand the '805 patent's view of "software" to touch on all seven levels (Physical, Data Link, Network, Transport, Session, Presentation, and Application) of the Open Systems Interconnection ("OSI") stack:

"The digital imaging system applies to consumer and professional still and video camera technologies, to cellular telephones and to personal digital assistants (PDAs)... The present invention also applies to networks of remote camera sensors for surveillance. The system also applies to native digital cinematography and telecine conversion from analogue to digital media. The system may be applied to image scanning and image copying technologies. Finally, the present system may be applied to any optical digital capture, processing and storage sub-system technologies, including groups of sensors or satellites."

EX1001, 6:62-7:9;

"in-camera software can be... remotely downloaded" EX1001, 7:60-64;

"the present system reveals approaches to improve network coordination and wireless external storage and publication capabilities for digital imaging systems." EX1001, 8:24-26;

"The present invention is divided into several main subsystems: (1) digital filters to correct optical and digital aberrations;... (3) digital system improvements that link multiple digital corrections;... and (5) digital image network improvements." EX1001, 8:30-36;

“In order for the camera to learn about the preferences of a specific user, the camera must adjust to each particular user, much as each individual identity must log onto a computer network privately.”

EX1001, 24:47-50.

168. Watanabe’s image recording apparatus discloses “system software” because, as discussed in detail in §IX.A above, it “stores programs” in read-only memory (“ROM”). JP-872, [0006], Fig. 1 (ROM8); Watanabe, [0039] (“ROM 58 stores programs”), [0042] (“control program stored in the ROM 58”), Fig. 1B (ROM 58), Fig. 3 (image processing program 71).

f. database management system (“DBMS”)

169. As described in detail in §IX.A above, Watanabe describes “tables 70 including distortion aberration correction values and peripheral light intensity correction values in accordance with focusing points and zoom positions” that “are prepared in advance on a lens to lens basis[.]” Watanabe, [0047], Fig. 3 (“correction value table 70”). Watanabe’s value “table 20” is also “prepared” to correct distortion aberration and peripheral lighting based on the “focal length and zoom position for each lens[.]” JP-872, [0007].

170. Watanabe’s tables comprise a database as that term would be understood by a POSITA:

“a database may be viewed as one or more tables of information”

EX1022 (“Bestgen”), 2:8-12;

“Data records in a computer database are maintained in tables, which are a collection of rows all having the same columns.” EX1023 (“Cesare”), 1:36-39.

171. The term “database management system” does not appear in the specification of the ’805 patent, and only appears in limitation [1.a] as a name.

172. Per EX1029, p. 238, the plain meaning of “database management system (DBMS)” is “software used to create, store, retrieve, change, manipulate, sort, format and print... the information in a database.”

173. A POSITA would understand that term to describe something capable of at least finding some specific information in that database in response to a specific query. EX1060 (“Iida”), [0005] (“[A] digital still camera is provided, comprising search means having a certain compiled database, extracting and bringing up information related to the subject image from the database[.]”).

174. Watanabe discloses “a control program stored in the ROM 58” that CPU 57 uses to “control[] each part” of the camera including “a correction process on image data.” Watanabe, [0042], [0048] (“distortion aberration correction process is executed according to distortion aberration information”), [0059] (“CPU 57... control[s] each part of the apparatus according to the image processing program”), Fig. 4 (step S104 image processing).

175. Watanabe’s “control program” comprises a DBMS because, as described in detail in §IX.A above, it is software that retrieves image correction

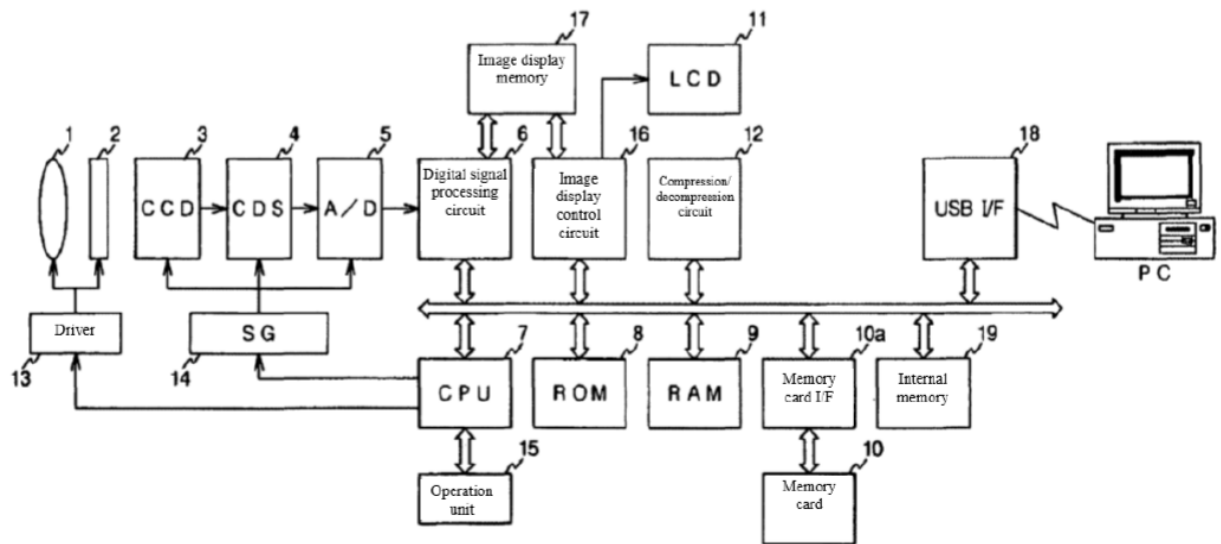
data associated with lens-specific focusing points and zoom positions from the database (Watanabe's tables 70, JP-872's table 20). Watanabe, [0042], [0047], [0049] ("a distortion aberration correction process is executed according to a lens type, a focusing point, and a zoom position"), Fig. 3; JP-872, [0007] ("using the image correction processing program 21, the CPU 7 determines a correction value table based on the lens type, determines a correction value based on the zoom position").

176. Apart from those specifics, POSITAs would have known to use a DBMS to access the correction data in Watanabe's tables because, as cited above in this section, DBMSs were well known in 2006.

g. "memory storage sub-system"

177. Watanabe discloses a "memory storage sub-system."

178. As shown below in JP-872 FIG. 1, read only memory ("ROM") 8 "stores programs and data," random access memory ("RAM") 9 "temporarily stores data," and "memory card 10 and built-in memory 19" store image data in "an image data file." JP-872, [0006]; see also Watanabe, [0035] (ROM 58, RAM 59, memory card 60, memory card interface 60a), [0042] ("control program stored in the ROM 58," "an image data file recorded in the memory card 60").



3. Limitation [9.b]

9.b	wherein the aberrations from the optical lens mechanism are corrected by applying digital filtration by using the application specific integrated circuit and the digital signal processor;
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a. Claim terms

i. “digital filtration”

179. Digital filtering means digital signal processing: EX1028, 193

(“digital filter” is “the computational process or algorithm by which a sampled signal or sequence of numbers (acting as an input) is transformed into a second sequence of numbers termed the output signal.”).

180. The '805 specification describes digital filtering as “digital filtration”:

“the present system demonstrates that in-camera digital filtration out-performs better than external filters.” EX1001, 7:24-27;

“FIG. 2 describes digital image signal processing. After an analog signal (200) is captured, it is converted to a digital signal by an

analog-to-digital converter (210). The signal is then forwarded to the digital signal processor (220) and filtered (230).” EX1001 30:23-27.

Item 230 in FIG. 2 is labeled “Digital Filtration”:

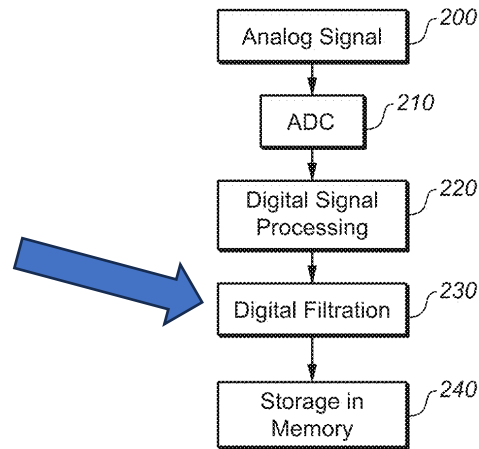


FIG. 2

181. Further, EX1001, 30:65-31:24 (discussing FFT), 31:11-12 (“One example of a digital filtration process is a fast Fourier transform (FFT).”).

182. Watanabe’s digital signal processor’s corrections are “digital filtration” because, per §IX.B.3.a.i above, the digital signal processor digitally (numerically) processes the image data to correct it using the corrections from the table:

“digital signal processing circuit 6 divides the image data input from the A/D converter 5 into color difference data and luminance data, and performs various processing, correction, and data processing” JP-872, [0006];

“using the image correction processing program 21, the CPU 7 determines a correction value table based on the lens type, determines

a correction value based on the zoom position and focal length, and obtains corrected image data 22 according to the correction value” JP-872, [0008];

See also Watanabe, [0048]-[0049], [0062]-[0063].

b. Watanabe meets [9.b].

183. As described in §IX.B.2.d above, Watanabe discloses the claimed “digital signal processor.” Watanabe meets [1.f] because, as described in detail in §IX.A above, Watanabe’s digital signal processor corrects optical image aberrations in images by applying corrections from the database:

“the digital signal processing circuit 6... performs... correction,” JP-872, [0006];

“the CPU 7 determines a correction value table based on the lens type, determines a correction value based on the zoom position and focal length, and obtains corrected image data 22 according to the correction value.” JP-872, [0007];

“The image processing program receives the processing information and image data sent to the image processing program (Step 103), performs image processing on the image data based on the processing information (Step 104),” JP-872, [0008], FIG. 4;

“the digital signal processing circuit 56 sorts out the image data inputted from the A/D converter 55... and executes... correction” Watanabe, [0038];

“the CPU determines a table according to a lens type and determines correction values according to a focusing point and a Zoom position, and image data 72 is obtained in compliance with the correction values,” Watanabe, [0047];

“distortion aberration correction process is executed,” Watanabe, [0049];

“In the image processing program, the process information and the image data transferred to the image processing program side are received (Step 103), an image process is executed on the image data in accordance with the process information (Step 104).” Watanabe, [0062].

184. As the block diagram in Watanabe Figs. 1A-1B suggests, Watanabe’s digital signal processor processes the captured images and corrects distortion aberrations and peripheral light intensity, under CPU control (Watanabe, [0042], [0059]-[0060]), using the correction data from the database table 70 as shown in Fig. 3 (Watanabe, [0047]).

185. The ’805 specification refers to “mathematical algorithms for automatic correction of optical aberrations” (EX1001, 12:40-41) and states:

“the present system demonstrates that in-camera digital filtration outperforms better than external filters” (EX1001, 7:24-27);

“FIG. 2 describes digital image signal processing. After an analog signal (200) is captured, it is converted to a digital signal by an

analog-to-digital converter (210). The signal is then forwarded to the digital signal processor (220) and filtered (230).” EX1001 31:30:23-27;

As discussed above, item 230 in EX1001, FIG. 2 is labeled “Digital Filtration.”

Watanabe executes an “image process... on the image data in accordance with the process information” (Watanabe, [0062] (step 104)) for correcting distortion aberration and peripheral light intensity, and:

“data results from produced image data on which a distortion aberration correction process is executed according to a lens type, a focusing point and a zoom position, data results from produced image data on which a peripheral light intensity correction process is executed according to a lens type, a focusing point and a zoom position, and so forth can be recorded” Watanabe, [0049].

186. As described in §IX.B.3.a.i above, POSITAs would understand “digital filtration” to be carried out with a “computational process or algorithm.” (EX1028, 193).

187. Watanabe’s “aberration correction process” can thus be aligned with ’805’s “mathematical algorithms for automatic correction of optical aberrations” and thus meets the “applying digital filtration” requirement of [9.b].

188. As discussed above in §VI.B, the term “using” should be interpreted to mean that each subject component plays a role in performing the recited step. Therefore, Watanabe meets “using” the application specific integrated circuit to “correct[] by applying digital filtration” so long as the application specific integrated circuit plays some role in performing the correction by applying the digital filtration.

189. To the extent an application specific integrated circuit is not taught by Watanabe’s digital filtration disclosure, a POSITA would recognize the benefit of modifying Watanabe for the digital signal processor to employ an application specific integrated circuit for labor intensive, repetitive image processing tasks such as digital filtration as admitted by the Patent Owner.

4. Limitation [9.c]

9.c	wherein the microprocessor is used to provide digital and optical data to the digital signal processor;
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190. I am informed by Petitioner’s counsel that in prior litigation, the district court held that “wherein the microprocessor is used to provide digital and optical data to the digital signal processor” as in [9.c] (and other limitations reciting providing or forwarding data to the digital signal processor) should be construed as reciting a “data pathway[] between the digital sensor and the digital signal processor.” EX1027, 41.

191. Watanabe meets [9.c] because it describes a data pathway between the digital sensor and the digital signal processor by which digital and optical data is provided. The data pathway shown in Watanabe forwarding data from the digital sensor to the digital processor described above in the discussion of limitation [9.c] is, like all other parts of the camera 100, operated by the control program stored in the ROM 58 running on the CPU 57. Watanabe, [0037]-[0038], [0085]; *see also* FIG. 1b, [0071].

192. As discussed above regarding limitation [9.a], Watanabe shows the claimed system software as the “control program stored in the ROM 58” on the basis of which CPU 57 “controls operation of each part of the digital still camera.” Watanabe, [0042].

193. Watanabe provides “optical data” because Watanabe’s in-camera software adds “information relative to distortion aberration” and “peripheral light intensity” (e.g., “optical aberrations”) to image data based on the lens used to capture the image. JP-872, [0007]; Watanabe, [0046]. The data corresponds to actual optical data represented in the image data that requires aberration correction.

5. Limitation [9.d]

9.d	wherein the system software is organized to identify specific optical aberrations and to access the database to identify specific corrections to the aberrations;
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194. Watanabe meets [9.d] because Watanabe's system software adds "information relative to distortion aberration" and "peripheral light intensity" (e.g., "at least one optical image aberration") to image data based on the lens used to capture the image. Watanabe, [0046]; *see also* JP-872, [0007]. Watanabe also includes a CPU running a control program that identifies an optical image aberration correction, and therefore also identifies the optical image aberration, by database lookup based on the lens type, focusing point, and zoom position:

"Based on a control program stored in the ROM 58 the CPU 57... processes image data by way of an image processing program in the control program" (Watanabe, [0042]);

"the CPU determines a table according to a lens type and determines correction values according to a focusing point and a zoom position" (Watanabe, [0047]);

"using the image correction processing program 21, the CPU 7 determines a correction value table based on the lens type, determines a correction value based on the zoom position" (JP-872, [0007]).

195. Watanabe further meets [9.d] because the image processing program identifies a corresponding algorithm for correcting the aberration:

"The CPU 7... obtains corrected image data 22 according to the correction value," JP-872, [0007];

"data results from produced image data on which a distortion aberration correction process is executed according to distortion

aberration information, data results from produced image data on which a peripheral light intensity correction process is executed according to peripheral light intensity information, and so forth can be recorded.” Watanabe, [0048].

196. A POSITA would have understood that a “specific correction” as claimed in [9.d] is corrected with a “specific procedure” (discussed in [9.f] below). The POSITA would have further understood that the “specific procedure” corresponds to an “algorithm” that includes a “specific sequence of operations” applied by the DSP; e.g.:

“In the operation of the data processing system 10, the general purpose processor 18 selects from a basic set of DSP operations to define a specific sequence of operations as the DSP algorithm to be executed by the DSP module 16.” EX1069 (“Intratater”), 6:37-40;

“The general purpose processor then retrieves operands required for execution of the selected DSP algorithm and/or instructions and data critical to the general purpose processor for controlling the DSP module 16 and loads them into the internal RAM array 22.” Intratater, 6:41-47;

“The general purpose processor then invokes the first DSP operation in the selected sequence by issuing the corresponding command to the control register of the DSP module 16. The DSP module then places the general purpose processor 18 in a continuous wait state while it performs the first DSP operation utilizing operands retrieved by the

address generator 28 from the RAM array 22 and system memory.”

Intratater, 6:47-54;

“Upon completion of the DSP operation, the DSP module cancels the continuous wait state and the general purpose processor 18 then either reads the status of the DSP module 16 or the result of the DSP

operation or carries on with the execution of its normal program flow, which may be either invoking the next DSP operation in the selected sequence by issuing the appropriate command to the DSP module

control register or performance of a general purpose task.” Intratater, 6:54-62;

“an image processing apparatus that is able to compress image data by various methods” (EX1070 (“Kashida”), 1:48-50);

“Data compressor 18a in turn comprises a programmable DSP (digital signal processor).” Kashida, 2:14-16;

“The DSPs can change their compression characteristics by changing the compression software programs loaded in them. These compression software programs, having suitable characteristics for the various apparatus, are stored in the respective ROMs. For instance, a high speed compression algorithm is stored in ROM 32b.” Kashida, 2:50-56;

“The digital signal processor 153 executes a main routine that can call various routines to perform the different aspects of image processing. The routines are stored in the Read-only Memory 177 or in some other form of non-volatile memory.” EX1072 (“Buchin”), 10:28-32;

“The DSP 162, however, does not contain power down data storage capability. All internal data required by the DSP 162, including OCR algorithms and image processing programs, must therefore be downloaded to the DSP 162 each time it is powered up to perform a processing function. The DSP 162 is configured such that the internal registers of the DSP 162 are accessed by the CPU 160 as input/output devices over the bus 164.” EX1071 (“Reddig”), 13:8-17.

197. Watanabe does not explain where the algorithms that its DSP applies are stored.

198. A POSITA would have understood that while a DSP dedicated to a single algorithm could have that algorithm baked into it, DSPs used for the kinds of adaptive image processing considered in this matter require access to sets of algorithms, one of which will suit at the given moment based on, e.g., the current lens type and setting.

199. As cited extensively above in this section, it was known to select and load algorithms from memory to provide particular signal processing (“filtration”) at the DSP to suit various needs.

200. A POSITA would have stored or, at a minimum identified, in Watanabe’s database the particular DSP filtration algorithm needed for a particular aberration correction. Thus, Watanabe’s microprocessor would “obtain” the correction algorithm by accessing the database using information identifying the

algorithm, then “forward[ing]” that algorithm to the DSP so that it could apply the filter and correct the aberration.

6. Limitation [9.e]

9.e	wherein the system software forwards the data from the digital sensor to the digital processor;
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201. As described in detail in §IX.B.2.c above, Watanabe discloses the claimed digital sensor.

202. Watanabe meets [9.e] because Watanabe’s “digital sensor” captures images and forwards them to the DSP. JP-872, Fig. 1, [0006] (“the output signal of the CCD 3 is converted into a digital signal by the A/D converter 5... the digital signal processing circuit 6 divides the image data input from the A/D converter 5”); Watanabe, Figs. 1A-1B, [0037]-[0038] (“the A/D converter converts analogue image data inputted from the CCD 53 through the CDS circuit 54, to digital image data... the digital signal processing circuit 56 sorts out the image data inputted from the A/D converter 55”), [0061]-[0062] (“the image data are transferred to the image processing program side (Step 203). In the image processing program, the process information and the image data transferred to the image processing program side are received (Step 103)”).

7. Limitation [9.f]

9.f	wherein the digital signal processor selects a specific procedure to optimize the image and corrects the aberrations;
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203. As described in §IX.B.2.d above, Watanabe discloses the claimed “digital signal processor.” Watanabe meets [9.f] because, as described in detail in §IX.A above with respect to [9.d], Watanabe identifies an optical image aberration correction for an optical image aberration, by database lookup based on the lens type, focusing point, and zoom position.

204. The POSITA would have understood that the “specific procedure” of the claim corresponds to an “algorithm” that includes a “specific sequence of operations,” which could be applied by Watanabe’s DSP.

205. As discussed above with respect to [9.d], the POSITA would have stored or, at a minimum identified, in Watanabe’s database the particular DSP filtration algorithm (the “specific procedure”) needed for a particular aberration correction. Thus, Watanabe DSP would “select” the correction algorithm by accessing the database using information identifying the algorithm, then obtain that algorithm so that it could apply the filter and correct the aberration.

8. Limitation [9.g]

9.g	wherein the lens type is a zoom lens;
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206. Watanabe describes “zoom position” and correcting distortion “based on... zoom position for each lens.” JP-872, [0007] and refers to a lens having multiple “zoom positions.” Watanabe, [0047], Fig. 3.

207. As described in detail §VIII.A.1 above, the term “zooming” refers to changing the focal length of a lens, and a lens whose focal length is variable is often called a “zoom lens.” Since each lens contemplated by Watanabe has multiple “zoom positions,” Watanabe meets [9.g] because it discloses a zoom lens.

9. Limitation [9.h]

9.h	wherein the lens focal length alternates from specific fixed focal length lens settings in a succession of steps;
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208. As discussed above at §VI.C, the Patent Owner adopts a construction of “succession of steps” as meaning that a zoom lens “successively move[s] through each zoom setting/position.” EX1032, 21-22.

209. The ’805 specification mentions “the zoom lens changes focal-length positions” (EX1001, 16:23) but also:

“the zoom is moved to a new focal position” EX1001, 26:31;

“In the case of zooms, however, where the focal-length is not fixed, the adjustments must correlate to the changes in the focal length.” EX1001, 25:57-59;

“The general problem with zoom lenses is the trade-off that must be made: To minimize the distortions of the widest possible focal length,

distortions become maximized at the longest possible focal length, and vice-versa.” EX1001, 25:37-41.

210. Variations on the claim term “focal-length positions” were well known:

“ f_t is the focal length of the zoom lens in the telephoto position, and f_w is the focal length of the zoom lens in the wide-angle position.”
EX1048 (“Goosey”), Abstract.

211. From all this, a POSITA would understand “the zoom lens changes focal-length positions” to describe changing the focal length of a zoom lens.

212. As described above in §IX.B.2.f above, Watanabe uses the term “zoom position” to describe the current focal-length setting of a zoom lens. This usage was well known:

“efforts are being made to create more compact zoom lenses... producing high quality images over a large focal length range. More specifically, a zoom lens must maintain high image quality in each zoom position” EX1048 (“Goosey”), 1:24-30.

213. Watanabe reflects this by referring to a lens having “zoom positions” in the plural:

“correction values in accordance with focusing points and zoom positions are prepared in advance on a lens to lens basis” Watanabe, [0047].

214. Watanabe describes a zoom lens that “successively move[s] through each zoom setting/position” and meets [9.h]. Watanabe [0049] (describing “zoom positions” (plural)).

10. Limitation [9.i]

9.i	wherein optical aberrations are corrected with digital filtration to modify multiple images from different focal lengths in a succession of data files; and
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215. Watanabe meets that the “optical aberrations are corrected with digital filtration to modify” images for the same reasons Watanabe meets [9.b]. The correction is for “multiple images from different focal lengths in a succession of data files” because Watanabe executes aberration correction according to zoom position. Watanabe, [0049] (“peripheral light intensity correction process is executed according to a lens type, a focusing point and a zoom position,” emphasis added).

216. As discussed above at §VI.C, the Patent Owner adopts construction that “succession of data files” means the “multiple files that are created when the system captures multiple images from multiple focal lengths consistently with the claim element above in which ‘succession of steps’ appears.” As discussed above with respect to [9.h], Watanabe describes a zoom lens that “successively move[s] through each zoom setting/position.” Watanabe [0049] (describing “zoom positions” (plural)). Because Watanabe meets “succession of steps” and performs

aberration correction at each zoom position, Watanabe therefore also meets the “succession of data files.”

11. Limitation [9.j]

9.j	wherein the modified data file consisting of the digital data optimized from the aberrations that are corrected from the original optical image is stored in memory.
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217. Watanabe meets [9.j] because it discloses memory card 10 and memory card interface 10a storing processed image data, e.g., corrected “optimized” images:

“CPU 7 controls the recording operation of image data on the memory card 10,” JP-872, [0006];

“record data that has been subjected to distortion aberration correction,” JP-872, [0007];

“the processed image data is recorded in a file, that is, the memory card 10 (Step 206),” JP-872, [0008];

Watanabe, Fig. 1B (memory card 60);

Watanabe, Fig. 3 (corrected image data 72);

“data results from produced image data on which a distortion aberration correction process is executed according to distortion aberration information, data results from produced image data on which a peripheral light intensity correction process is executed according to peripheral light intensity information, and so forth can be recorded,” Watanabe, [0048];

“the image data on which the correction process is executed is transferred to the photographing program and is recorded on the memory card 60,” Watanabe, [0058];

“an image process is executed on the image data in accordance with the process information (Step 104), and the processed image data are transferred to the photographing program side (Step 105)... the processed data transferred to the photographing program side is received (Step 205), and the processed data are recorded on a file, i.e. the memory card 60 (Step 206),” Watanabe, [0062]-[0063].

C. Claim 24

218. Claim 24 can be parsed as follows:

24.PRE	A method of image filtration comprising:
24.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, an application specific integrated circuit, system software, a database management system and a memory storage sub-system;
24.b	wherein the aberrations from the optical lens mechanism are corrected by applying digital filtration by using the application specific integrated circuit and digital signal processor, the method consisting of;
24.c	alternating the lens focal length of a zoom lens from specific fixed focal length lens settings in a succession of steps;
24.d	creating data files corresponding to each focal length lens setting;
24.e	forwarding the data from a digital sensor to the digital signal processor;
24.f	providing digital and optical data to a digital signal processor;
24.g	identifying specific optical aberrations and accessing a database to identify specific corrections to the aberrations;
24.h	selecting a specific procedure from the database using the microprocessor to optimize the image and correct the aberrations;
24.i	applying digital filtration by using the application specific integrated circuit and digital signal processor to correct digital or optical aberrations;

24.j	correcting optical aberrations with digital filtration to modify multiple images from different focal lengths in a succession of data files; and
24.k	storing the modified data files in memory.

1. Limitations [24.PRE], [24.a], [24.b], [24.c], [24.e], [24.f], [24.g], [24.i], [24.j], and [24.k]

24.PRE	A method of image filtration comprising:
24.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, an application specific integrated circuit, system software, a database management system and a memory storage sub-system;
24.b	wherein the aberrations from the optical lens mechanism are corrected by applying digital filtration by using the application specific integrated circuit and digital signal processor, the method consisting of;
24.c	alternating the lens focal length of a zoom lens from specific fixed focal length lens settings in a succession of steps;
24.e	forwarding the data from a digital sensor to the digital signal processor;
24.f	providing digital and optical data to a digital signal processor;
24.g	identifying specific optical aberrations and accessing a database to identify specific corrections to the aberrations;
24.i	applying digital filtration by using the application specific integrated circuit and digital signal processor to correct digital or optical aberrations;
24.j	correcting optical aberrations with digital filtration to modify multiple images from different focal lengths in a succession of data files; and
24.k	storing the modified data files in memory.

219. Watanabe meets these claim 14 limitations for the same reasons

Watanabe meets the corresponding limitations in claim 9:

Limitation	Corresponding Limitation	Discussion
[24.PRE]	[9.PRE]	§IX.B.1
[24.a]	[9.a]	§IX.B.2
[24.b], [24.i]	[9.b]	§IX.B.3
[24.c]	[9.g], [9.h]	§IX.B.8, §IX.B.9
[24.e]	[9.e]	§IX.B.6
[24.f]	[9.c]	§IX.B.4
[24.g]	[9.d]	§IX.B.5
[24.j]	[9.i]	§IX.B.10
[24.k]	[9.j]	§IX.B.11

2. Limitation [24.d]

24.d	creating data files corresponding to each focal length lens setting;
------	--

220. Watanabe meets [24.d] because records of a database are created in advance of processing for each focal length and employed to “modify multiple images from different focal lengths” because Watanabe describes selecting corrections based on lens, focal length, and zoom position from the database, the files exist prior to that operation. JP-872, [0007]; Watanabe, [0049].

3. Limitation [24.h]

24.d	selecting a specific procedure from the database using the microprocessor to optimize the image and correct the aberrations;
------	--

221. As described in above with respect to [9.d] and [9.f], Watanabe’s DSP and CPU (the “microprocessor”) identify an optical image aberration correction for an optical image aberration, by database lookup based on the lens type, focusing

point, and zoom position, and the POSITA would have understood that the “specific procedure” of the claim corresponds to an “algorithm” that includes a “specific sequence of operations,” which could be applied by Watanabe’s DSP.

222. Therefore, the POSITA would have stored or, at a minimum identified, in Watanabe’s database the particular DSP filtration algorithm (the “specific procedure”) needed for a particular aberration correction. Thus, Watanabe’s DSP and CPU would “select[]” the correction algorithm by accessing the database using information identifying the algorithm, then obtain that algorithm so that it could apply the filter and correct the aberration.

X. GROUND 2: WATANABE IN VIEW OF RUSS RENDERS OBVIOUS CLAIMS 1-3 AND 18-20

A. Russ

223. Russ discusses the various ways in which one may use digital image processing to optimize or otherwise modify images to the viewer’s liking, as well as to correct for lens aberrations. Russ, “Introduction.” Russ also details the ways in which the Fourier transform is a useful tool for a POSITA to manipulate image data for either category of image modification—aberration or enhancement. Russ, p. 297-309.

224. Russ is a textbook that addresses many of the major topics of digital image processing, including image correction (useful for aberration correction) and image enhancement (useful for special effects) with digital filtration.

225. Russ “presents an extensive collection of image processing tools, so that the user of computer-based systems can both understand those methods provided in packaged software, and program those additions that may be needed for particular applications.” Russ, “Introduction”.

226. Many references call for, e.g., execution of a softening effect on an image or a correction of peripheral shading, but Russ provides rich and practical detail on how to actually carry out those processes. Russ, 8-13, 36-39, 131-205, 207-276, 277-332.

227. In particular, Russ describes and demonstrates in detail the use of fast Fourier transforms to efficiently modify image data. Russ, 277-332.

228. Russ first presents the Fourier transform in its original continuous form, applicable to analog signals or presentations (Russ, pp. 279):

$$F(u) = \int_{-\infty}^{+\infty} f(x)e^{-2\pi iux} dx$$

Russ then presents the Fourier transform its discrete form, applicable to segmented signals or presentations, such as the pixel-by-pixel representation of an image by the sensor in a digital camera:

$$F(u) = \frac{1}{N} \sum_{x=0}^{N-1} f(x) \cdot e^{-i2\pi ux/N}$$

229. Russ then presents a section of software code for computing a fast Fourier transform (“FFT”) (Russ, 280-81):

```

SUBROUTINE FFT(F, LN)
COMPLEX F(1024), U, W, T, CMPLX
PI=3.14159265
N=2**LN
NV2=N/2
NM1=N-1
J=1
DO 3 I=1, NM1
    IF (I.GE.J) GOTO 1
    T=F(J)
    F(J)=F(I)
    F(I)=T
1    K=NV2
2    IF (K.GE.J) GOTO 3
    J=J-K
    K=K/2
    GOTO 2
3    J=J+K
    DO 5 L=1, LN
        LE=2**L
        LE1=LE/2
        U=(1.0, 0.0)
        W=CMPLX(COS(PI/LE1), -SIN(PI/LE1))
        DO 5 J=1, LE1
            DO 4 I=J, N, LE
                IP=I+LE1
                T=F(IP)*U
                F(IP)=F(I)-T
4            F(I)=F(I)+T
5        U=U*W
    DO 6 I=1, MN
        F(I)=F(I)/FLOAT(N)
6    RETURN
END

```

230. Russ then meticulously explains and demonstrates how aspects of ideal and real images manifest in the Fourier transforms of images. Russ, pp. 280-297.

231. Russ then describes and demonstrates many specific and useful image processing techniques for correction and special effects using Fourier transforms and digital filtration. Russ, pp. 297-332.

232. Russ thus provides workers seeking to implement the correction and enhancement processes mentioned in references regarding image processing in digital cameras with useful background and detail on how to carry out those implementations.

B. Watanabe in view of Russ

233. Watanabe does not describe a detailed methodology for correcting optical aberrations aside from vignetting.

234. A POSITA would have had reason to combine the image modification processes from Russ with Watanabe because Russ lends itself to combination with Watanabe by describing and demonstrates the detailed implementation of many digital image processing options for correction and enhancement, which can be used in, e.g., digital cameras. That matches the purpose of Watanabe.

235. In particular, Watanabe has two functional areas for which Russ would provide useful information for implementation: aberration correction and image enhancement. Russ describes specific manners of executing such processes in digital cameras.

236. Further, Watanabe broadly states that it is capable of performing various image processing. Watanabe, [0038]. This would suggest to a POSITA that Watanabe's hardware and processes are easily programmable to perform a multitude of different tasks. The descriptions of the various components would further support this. For example, the CPU 57 constitutes both an image producing device, controlling each part of photographing according to a program, as well as an image processing device, controlling each part of the apparatus according to an image processing program. Watanabe, [0059]. Thus, a POSITA would believe Watanabe to be easily customizable and combinable with other references.

237. Specifically, a POSITA would look to combine Russ and Watanabe because Russ provides the detailed mechanisms by which Watanabe corrects aberrations. Russ is an image processing handbook which seeks to assist a POSITA in applying digital image processing. Russ, "Introduction" (providing image processing tools "so that the user of computer-based systems can ... understand those methods provided in packaged software.").

238. For example, Watanabe teaches that its processes can be controlled by a user. Watanabe, [0041] (explaining that the camera has series of buttons for selecting a function, configuring settings, displaying guidance on a screen, carrying out a function by operation, and "other functions according to each operation mode"), [0083] (teaching that the photographer can select desired entry contents

from the display). It would be expected that such user control would include image enhancement options, as the same were common in digital cameras at the time.

239. Russ describes the manner of implementing image processing, whether for aberration correction or general image enhancement, as already discussed at VIII.2 and X.A above.

240. Because of the detail disclosed in Russ, and the fact that Russ is a book on digital processing techniques, a POSITA would reasonably expect to combine these two sources successfully. Further supporting this expectation of success is the fact that Russ specifically explains how its tools are useful in cameras. Russ, pp. 319-30 (explaining how to cure image blur in a digital camera).

C. Claim 1

241. Claim 1 can be parsed as follows:

1.PRE	A digital imaging system for image filtration comprising:
1.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, an application specific integrated circuit, system software, a database management system and a memory storage sub-system;
1.b	wherein the optical lens mechanism is a fixed focal length;
1.c	wherein the aberrations from the optical lens mechanism are corrected by applying digital filtration by using the application specific integrated circuit and the digital signal processor;
1.d	wherein the microprocessor is used to provide digital and optical data to the digital signal processor;
1.e	wherein the system software is organized to identify specific optical aberrations and to access the database to identify specific corrections to the aberrations;
1.f	wherein the system software forwards the data from the digital sensor to the digital processor;

1.g	wherein the digital signal processor selects a specific procedure to optimize the image and corrects the aberrations;
1.h	wherein the data are forwarded from the digital sensor to the digital signal processor by an application specific integrated circuit;
1.i	wherein the digital signal processor applies a fast Fourier transform to a data file in order to satisfy a user specified special effects function;
1.j	wherein the digital signal processor modifies the data file by applying the special effects function;
1.k	wherein the modified data file consisting of the digital data optimized from the aberrations that are corrected from the original optical image is stored in memory.

1. Limitations [1.PRE], [1.a], [1.c], [1.d], [1.e], [1.f], [1.g], and [1.k]

1.PRE	A digital imaging system for image filtration comprising:
1.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, an application specific integrated circuit, system software, a database management system and a memory storage sub-system;
1.c	wherein the aberrations from the optical lens mechanism are corrected by applying digital filtration by using the application specific integrated circuit and the digital signal processor;
1.d	wherein the microprocessor is used to provide digital and optical data to the digital signal processor;
1.e	wherein the system software is organized to identify specific optical aberrations and to access the database to identify specific corrections to the aberrations;
1.f	wherein the system software forwards the data from the digital sensor to the digital processor;
1.g	wherein the digital signal processor selects a specific procedure to optimize the image and corrects the aberrations;
1.k	wherein the modified data file consisting of the digital data optimized from the aberrations that are corrected from the original optical image is stored in memory.

242. Watanabe meets these claim 1 limitations for the same reasons

Watanabe meets the corresponding limitations in claim 9:

Limitation	Corresponding Limitation	Discussion
[1.PRE]	[9.PRE]	§IX.B.1
[1.a]	[9.a]	§IX.B.2
[1.c]	[9.b]	§IX.B.3
[1.d]	[9.c]	§IX.B.4
[1.e]	[9.d]	§IX.B.5
[1.f]	[9.e]	§IX.B.6
[1.g]	[9.f]	§IX.B.7

Watanabe meets the remaining limitations in claim 1 as follows.

2. Limitation [1.b]

1.b	wherein the optical lens mechanism is a fixed focal length;
-----	---

243. Watanabe discloses or suggests meets [1.b] because fixed focal length lenses were well-known as interchangeable with zoom lenses as dictated by imaging conditions. A POSITA would recognize that cameras often substitute one lens assembly for another zoom to fixed, or vice versa, as conditions demand, as discussed above at §VIII.A.1. *See, e.g.* EX1077 (“Kawasaki”), 1:8-11, 7:18-30.

3. Limitation [1.h]

1.h	wherein the data are forwarded from the digital sensor to the digital signal processor by an application specific integrated circuit;
-----	---

244. Watanabe meets [1.h] because Watanabe’s “digital sensor” captures images and forwards them to the DSP. JP-872, Fig. 1, [0006] (“the output signal of the CCD 3 is converted into a digital signal by the A/D converter 5... the digital signal processing circuit 6 divides the image data input from the A/D converter

5”); Watanabe, Figs. 1A-1B, [0037]-[0038] (“the A/D converter converts analogue image data imputed from the CCD 53 through the CDS circuit 54, to digital image data... the digital signal processing circuit 56 sorts out the image data inputted from the A/D converter 55”), [0061]-[0062] (“the image data are transferred to the image processing program side (Step 203). In the image processing program, the process information and the image data transferred to the image processing program side are received (Step 103)”).

245. To the extent an application specific integrated circuit is not taught by Watanabe’s digital sensor data forwarding disclosure, a POSITA would recognize the benefit of modifying Watanabe for the digital signal processor to employ an application specific integrated circuit for labor intensive, repetitive image processing tasks such as data forwarding as admitted by the Patent Owner, as discussed above at §IX.B.2.d.

4. Limitation [1.i]

1.i	wherein the digital signal processor applies a fast Fourier transform to a data file in order to satisfy a user specified special effects function;
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246. Limitation [1.i] is the first introduction of the term the “data file,” as the “data file.” Furthermore, the term “data” referred to elsewhere in the claim (e.g., “the **data** are forwarded from the digital sensor to the digital signal processor by an application specific integrated circuit,” emphasis added) has no antecedent basis.

247. The POSITA would understand that claim 1 does not require that the “image” in which an aberration is corrected also be processed for special effects, and that the claim instead covers two independent process: (1) an aberration of an image is corrected (e.g., EX1001, Fig. 5), and (2) a special effects function is applied to a data file that may or may not be the same image (e.g., EX1001, Fig. 14, which is a process independent of the process in Fig. 5). Even if claim 1 was construed to require that the special effects function was applied to the same as the image in which an aberration is corrected, Watanabe in view of Russ would meet this construction.

248. Watanabe in view of Russ renders obvious the application of a fast Fourier transform to satisfy a user specified special effect. Watanabe already has the interface necessary for a user to select different settings, functions, and operation modes. Watanabe, [0041], [0083]. Further, Watanabe sorts image data into color-difference data and brightness data which would be useful to a POSITA looking to apply a special effect. Russ contains the details on how to apply such a special effect using a Fourier transform.

249. Russ teaches special effects being implemented through a fast Fourier transform. Specifically, Russ explains how to create a filter to apply a smoothing or softening effect and a color effect. Russ, pp. 277, 305, 312, 334. A POSITA would have understood a fast Fourier transform to be a common and preferable

manner of applying special effects such as image softening. The POSITA would find it obvious to use Russ’s frequency space image enhancement techniques, like color filter special effects functions and smoothing special effects functions, in order to improve image quality as discussed *infra* §§X.D, X.E. Russ, 277 (“[W]orking in frequency space to perform certain image... processing operation... Image quality... certainly includes the alteration of grey levels and color values,... removal of fine-scale texture in the image.”), 304 (“It is important to use a smoothing function to modify the edges of the regions.”), 308 (“A common recommendation... for dealing with... moiré patterns... is to use smoothing to eliminate the pattern”), 332 (“Processing images in the frequency domain is useful for removing certain types of noise”). As such, since it was known to be “important to use” a smoothing function and other special effects, a POSITA would have been motivated to apply Russ’s smoothing teachings to Watanabe’s system in order to provide a feature recognized in the art as highly desirable.

5. Limitation [1.j]

1.j	wherein the digital signal processor modifies the data file by applying the special effects function;
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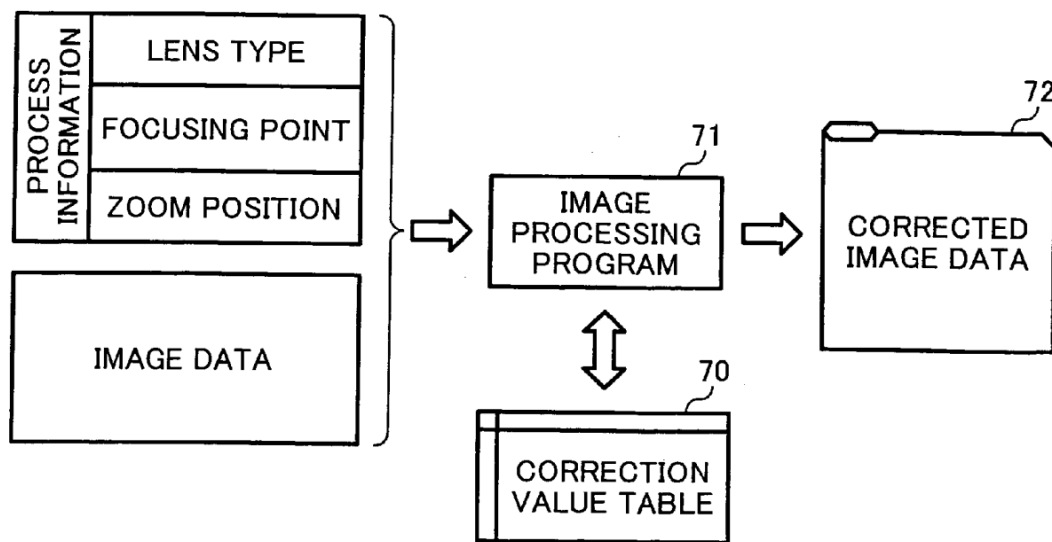
250. Watanabe describes a DSP through digital signal processing circuit 56, as controlled by CPU 57. Each of these components performs a part of Watanabe’s digital image processing. For example, the CPU 57 performs image

processing according to an image processing program. Watanabe, [0059], [0071].

Watanabe suggests that the image data for each captured image is provided in a different file. Fig. 3 shows a file icon with the title corrected image data, indicating that each image is corrected and stored in a file. Watanabe, FIG. 3. Therefore it would have been obvious for a POSITA to also program the CPU 57 and DSP circuit 56 to modify the data files by applying the special effects function.

Watanabe, at [0038], [0059], [0071].

FIG. 3



D. Claim 2

251. Claim 2 can be parsed as follows:

2.PRE	The system of claim 1:
2.a	wherein the special effects function is a color enhancing function.

252. I understand that in prior litigation, the district court construed the term “color enhancing function” to mean “color changes to an image.” EX1032, p. 8.

253. As explained, Russ applies Fourier transforms to enhance images. One of those enhancements is a color enhancement which applies “color changes to an image.” Russ, pp. 277, 305, 308-09, 334. Russ explains applying a “top hat” filter to the Fourier transform which resulted in color changes to the image. Russ, pp. 308-09. A POSITA reading Watanabe in view of Russ would see that the color enhancement procedures detailed in Russ can be applied to the digital imaging system in Watanabe and that Watanabe’s color difference data would be useful in performing color enhancement. Watanabe, [0038]. Russ provides great detail on how to carry-out such procedures so it would be a simple task to do.

254. The POSITA would find it obvious to apply “a color enhancing function” in order to make provide higher quality images by making image colors appear more realistic, which is standard in cameras and desirable to viewers. Russ, 277 (“Image quality... certainly includes the alteration of grey levels and color values”), EX1053, 343 (“desirable to distribute the intensities of a color image equally between the highlights and the shadows” using “a variety of color transformations for the correction of tonal and color imbalances”). Another example of a desirable color enhancing function is white balance adjustment.

When a DSP adjusts an image's white balance, it applies color filters (the "color enhancing function"). EX1035 ("Dorrell"), [0155]-[0159], Figs. 4-6, 12; EX1036 ("Masuno"), [0081]-[0082] [0147]-[0156]. "White balance" is used to adjust a digital photograph to make its colors appear more realistic or enhanced. EX1035 ("Dorrell"), [0003], [0025], [0145]-[0146]. As it was known that adjusting color values (e.g., by applying color filters) improved image quality, and Watanabe is directed to image improvements, it would have been obvious for a POSITA to modify Watanabe to provide this known and desirable processing feature.

E. Claim 3

255. Claim 3 can be parsed as follows:

3.PRE	The system of claim 1:
3.a	wherein the special effects function is a diffusion function of soft effect.

256. As discussed throughout this Declaration, softening effects were often provided in digital cameras for a user to select. And as discussed, Watanabe suggests user control of processing operations. It would have been obvious for Watanabe's digital camera to provide for a softening effect, at least because Russ suggests that same as a known image processing option.

257. In particular, Russ teaches how to create a filter in a digital camera which will use FFT to produce a soft effect. Russ, p. 286, 301-303. The FFT efficiently converts image data into its frequency domain. Russ teaches that a

Butterworth low-pass filter can be applied to an image and it will smooth the high-frequency components of the image data to smooth and produce some blurring. With the formulae and examples disclosed in Russ, it would be obvious for a POSITA to apply a soft effect.

258. The POSITA would find it obvious to use Russ's image enhancement techniques, including smoothing effects, in Watanabe's camera, in order to provide further image enhancements on top of Watanabe's explicitly described corrections. Russ describes that smoothing is a known function for enhancing image quality by removing unwanted noise. Russ, 277 ("Image quality... certainly includes... removal of fine-scale texture in the image."), 304 ("It is important to use a smoothing function to modify the edges of the regions."), 308 ("A common recommendation... for dealing with... moiré patterns... is to use smoothing to eliminate the pattern"), 332 ("Processing images in the frequency domain is useful for removing certain types of noise"). Because it was known to be "important to use" a smoothing function, a POSITA would have been motivated to apply Russ's smoothing teachings to Watanabe's system in order to provide a feature recognized in the art as highly desirable. Therefore it would have been obvious for a POSITA to also program the CPU 57 and DSP circuit 56 to modify the data files by applying a soft effect function. This was a common feature in digital cameras. See, e.g., EXs. 1040, 1041, 1042, 1043

F. Claim 18

259. Claim 18 can be parsed as follows:

18.PRE	A method of image filtration which comprises:
18.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, an application specific integrated circuit, system software, a database management system and a memory storage sub-system;
18.b	wherein the aberrations from the optical lens mechanism are corrected by applying digital filtration by using the application specific integrated circuit and the digital signal processor, the method consisting of;
18.c	forwarding the data from a digital sensor to a digital signal processor by an application specific integrated circuit;
18.d	providing digital and optical data to the digital signal processor;
18.e	identifying specific optical aberrations and accessing a database to identify specific corrections to the aberrations:
18.f	selecting a specific procedure from the database using the microprocessor to optimize the image and correct the aberrations:
18.g	applying digital filtration by using the application specific integrated circuit and digital signal processor to correct digital or optical aberrations:
18.h	applying a fast Fourier transform to a data file in order to satisfy a user specified special effects function;
18.i	modifying the data file by applying the special effects function using the digital signal processor; and
18.j	storing the data file in memory.

1. Limitations [18.PRE], [18.a], [18.b], [18.d], [18.e], [18.g], and [18.j]

18.PRE	A method of image filtration which comprises:
18.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, an application specific integrated circuit, system software, a database management system and a memory storage sub-system;
18.b	wherein the aberrations from the optical lens mechanism are corrected by applying digital filtration by using the application specific integrated circuit and the digital signal processor, the method consisting of;
18.d	providing digital and optical data to the digital signal processor;

18.e	identifying specific optical aberrations and accessing a database to identify specific corrections to the aberrations:
18.g	applying digital filtration by using the application specific integrated circuit and digital signal processor to correct digital or optical aberrations:
18.j	storing the data file in memory.

260. Watanabe meets these claim 18 limitations for the same reasons

Watanabe meets the corresponding limitations in claim 9:

Limitation	Corresponding Limitation	Discussion
[18.PRE]	[9.PRE]	§IX.B.1
[18.a]	[9.a]	§IX.B.2
[18.b], [18.g]	[9.b]	§IX.B.3
[18.d]	[9.c]	§IX.B.4
[18.e]	[9.d]	§IX.B.5
[18.j]	[9.j]	§IX.B.11

261. While [18.g] recites “correct digital or optical aberrations,” the digital and optical aberrations are joined by the disjunctive “or,” and thus Watanabe meets [18.g] by correcting optical aberrations as described above with respect to [9.b].

Watanabe meets the remaining limitations in claim 18 as follows.

2. Limitation [18.c]

18.c	forwarding the data from a digital sensor to a digital signal processor by an application specific integrated circuit;
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262. Watanabe meets [18.c] for the same reason it meets limitation [1.h].

263. The Patent Owner also concedes that DSPs and application specific integrated circuits are well known components used in cameras for image processing and other tasks. EX1026, 154-155.

1. Limitation [18.f]

18.f	selecting a specific procedure from the database using the microprocessor to optimize the image and correct the aberrations: [sic]
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264. Watanabe meets [18.f] for the same reason it meets limitation [24.h].

265. As discussed above at §§IX.B.5, VI.B.7, a POSITA would have understood that a “specific procedure to optimize the image and corrects the aberrations” may be an algorithm that includes a “specific sequence of operations” applied by the DSP. E.g., EX1069 (“Intratater”), 6:37-40.

266. The POSITA would have understood that Watanabe’s microprocessor would “select” the such a correction algorithm by accessing the database for information identifying the algorithm (or the algorithm itself) then forward the algorithm to the DSP so that it could apply the filter and correct the aberration, as discussed above at §§IX.B.5, VI.B.7.

2. Limitation [18.h]

18.h	applying a fast Fourier transform to a data file in order to satisfy a user specified special effects function;
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267. Similar to claim 1, claim 18 recites a “data file,” to which a Fourier transform is applied to satisfy an effects function, and elsewhere in the claim

separately recites “data” (e.g., “forwarding the data from a digital sensor to a [DSP] by an [ASIC],” emphasis added) and an “image” (selecting a specific procedure from the database using the microprocessor to optimize the image and correct the aberrations,” emphasis added).

268. Similar to claim 1 (as discussed above at §X.C.4), claim 18 therefore does not require that the “image” to be optimized from aberration also be processed for special effects. Rather, the claim covers two independent process: (1) an aberration of an image is to be corrected (e.g., EX1001, Fig. 5), and (2) a special effects function is applied to a data file that may or may not be the same image (e.g., EX1001, Fig. 14, which is a process independent of the process in Fig. 5).

269. Therefore, Watanabe in view of Russ meets [18.h] for the same reason it meets limitation [1.i].

3. Limitation [18.i]

18.i	modifying the data file by applying the special effects function using the digital signal processor; and
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270. Watanabe in view of Russ meets [18.i] for the same reason it meets limitation [1.j].

G. Claim 19

271. Claim 19 can be parsed as follows:

19.PRE	The method of claim 18 further comprising the step of:
19.a	applying the special effects function as a color enhancing function.

272. As discussed above with respect to claim 2, the POSITA would find it obvious to apply white balance or other “a color enhancing function” in order to make image colors appear more realistic, which is standard in cameras and desirable to viewers, as above at X.D. Russ, 277 (“Image quality... certainly includes the alteration of grey levels and color values”), EX1053, 343 (“desirable to distribute the intensities of a color image equally between the highlights and the shadows” using “a variety of color transformations for the correction of tonal and color imbalances”), *see also* EX1035 (“Dorrell”), [0003], [0025], [0145]-[0146], [0155]-[0159], Figs. 4-6, 12, EX1036 (“Masuno”), [0081]-[0082] [0147]-[0156]. As it was known that adjusting color values (e.g., by applying color filters) improved image quality, and Watanabe is directed to image improvements, it would have been obvious for a POSITA to modify Watanabe to provide this known and desirable processing feature.

273. Watanabe in view of Russ meets claim 19 for the same reason it meets claim 2.

H. Claim 20

274. Claim 20 can be parsed as follows:

20.PRE	The method of claim 18 further comprising the step of:
20.a	applying the special effects function as a diffusion function of soft effect.

275. As discussed above with respect to claim 3, the POSITA would find it obvious to use Russ’s image enhancement techniques, including smoothing effects (“a diffusion function of soft effect”), in Watanabe’s camera, in order to provide further image enhancements on top of Watanabe’s explicitly described corrections. As discussed above at §X.E, Russ describes that smoothing is a known function for enhancing image quality by removing unwanted noise. Russ, 277, 304, 308, 332. Because it was known to be “important to use” a smoothing function, a POSITA would have been motivated to apply Russ’s smoothing teachings to Watanabe’s system in order to provide a feature recognized in the art as highly desirable.

276. Watanabe in view of Russ meets claim 20 for the same reason it meets claim 3.

XI. GROUND 3: TAKANE IN VIEW OF WATANABE RENDERS OBVIOUS CLAIMS 9 AND 24

A. Takane

277. Takane describes image processing for still images and “dynamic images,” which Takane receives from a digital camera:

“photographing device (such as a digital still camera or a digital video camera or the like) in which an image is acquired by digital data and recorded on a recording medium (such a device is called a ‘digital photographing device’ hereinafter)” Takane, [0006].

278. The camera provides corrections to “pin-cushion distortion” and “barrel distortion” lens aberrations:

“[D]istortion arises at the periphery of the acquired image due to refraction of the lens. Such distortion is generally called optical distortion, and is classified into the following two types: ‘pin-cushion distortion’ in which the corner portions of the image extend outwardly, and ‘barrel distortion’ in which, conversely, the corner portions contract.” Takane, [0005];

“[T]he digital image data which is obtained by photographing is subjected to optical distortion correction by the selected correcting section” Takane, [0016];

“[A] first distortion correction circuit 56 and a second distortion correction circuit which serve as correcting sections and are for correcting optical distortion[.]” Takane, [0043].

279. Takane’s camera also performs other corrections:

“the digital image data is subjected to, for example, various types of correction processings such as white balance adjustment, gamma correction, sharpness correction, and the like” Takane, [0044].

280. Takane describes: “a digital camera 10 relating to the present embodiment is structured to include... an external ROM 22 in which various programs, parameters, conversion tables and the like are stored in advance” (Takane [0033], Figs. 1, 2)

281. Takane states:

“Parameters expressing a polynomial which approximates the amount of displacement of the optical distortion (i.e., the coefficients of a polynomial) are stored in advance in each of the first distortion correction circuit 56 and the second distortion correction circuit 58. By using these parameters, the first distortion correction circuit 56 and the second distortion correction circuit 58 correct the optical distortion included in the inputted digital image data.” Takane, [0054];

“in order to handle different focal lengths such as the telephoto end and the wide-angle end and the like, JP-A No. 11-275391 discloses storing parameters for each focal length, and carrying out correction by selecting the parameters in accordance with the focal length at the time of photographing.” Takane, [0008];

“the digital camera 10 of the present embodiment has an optical zoom function. Thus, parameters which are peculiar to the predetermined image size obtained at the time of photographing standby or at the time of dynamic image photographing (the VGA size in the present embodiment) can be stored for each of a plurality of predetermined focal distances. The group of optimal parameters can be selected in accordance with the focal length at the time of obtaining the digital image data which is the object of correction, and processing for correcting the optical distortion can be carried out.” Takane, [0060].

282. Takane does not explain how it stores correction parameters in ROM 22 or distortion circuits 56 and 58, how the system loads correction parameters into

circuits 56 and 58, or how the system changes the correction parameters in the distortion correction circuits to match the aberration(s) for different optical system components (lenses) and their settings or parameters (focal length or zoom position).

B. Takane in view of Watanabe

283. Takane shows as well known:

“in order to handle different focal lengths such as the telephoto end and the wide-angle end and the like, JP-A No. 11-275391 discloses storing parameters for each focal length, and carrying out correction by selecting the parameters in accordance with the focal length at the time of photographing.” Takane, [0008].

284. However, Takane leaves the camera’s data storage and retrieval techniques to the implementer.

285. Watanabe discloses storing optical distortion correction parameters by a lens, focal length, and zoom position in tables as explained in detail in §§IX.B,2 ([9.a]), IX.B.5 ([9.d]) above. Watanabe’s tables comprise a database as explained in detail in §IX.B.2.f above regarding [9.a].

286. As explained in detail in §IX.B.2.f above, Watanabe’s control program retrieves image correction data associated with lens-specific focusing points and zoom positions from the database (tables 70, table 20), thus comprising

a DBMS, and Watanabe's software provides the distortion correction parameters to the DSP to correct image distortions.

287. As described in detail in § IX.B.2.f above, Watanabe's database and DBMS teachings were well known. POSITAs would have had several reasons to use those teachings in order to implement Takane's system by organizing distortion correction parameters by image size, lens, focal length, and zoom position in tables comprising a database, then identifying and retrieving parameters, and providing them to Takane's distortion correction circuits to correct distortion, because Watanabe demonstrates these techniques were conventional.

288. POSITAs would have known that Watanabe's database techniques would provide for storing in tables in a database Takane's description of correction parameters for each focal length (Takane, [0008]) and for accessing tables from the database to select correction parameters based on focal length at the time of image capture (Takane, [0060]).

289. Takane expresses concern that if the correction amounts are stored as numerical values per pixel, the resulting tables storing those correction amounts would be large ([0007]) and suggests instead "expressing the correction amounts by an approximate expression" in which case "correction can be set in correspondence by computation" (Takane [0008]).

290. A POSITA would choose one or the other approach to storing correction amounts based on practical consideration of the cost of memory versus the cost of additional computing power.

291. Using Watanabe's database and DBMS teaching was within the POSITA's ordinary skill and would have improved Takane in the same way it improved Watanabe (as explained in detail in § IX.B.2.f above).

292. POSITAs would have had a reasonable expectation of success because, as described in detail in §IX.B.2.f above, Watanabe demonstrates that storing correction parameters in a database and DBMS software retrieving parameters from the database were conventional.

293. Thus in Takane in view of Watanabe, Takane's system uses Watanabe's tables (database) to organize and store parameters for optical distortion correction for each image size, lens, focal length, and zoom position in Takane's ROM 22.

294. Takane describes its software:

“a control routine (a main routine) executed at a CPU of the digital camera” Takane, [0028];

“dynamic image photographing processing (a sub-routine) executed at the CPU of the digital camera” Takane, [0030].

295. Takane's software then uses Watanabe's teaching to retrieve parameters from the database and loads them into the distortion correction circuits based on the image size, lens, focal length, and zoom position at the time of image capture:

"Parameters expressing a polynomial which approximates the amount of displacement of the optical distortion (i.e., the coefficients of a polynomial) are stored in advance in each of the first distortion correction circuit 56 and the second distortion correction circuit 58. By using these parameters, the first distortion correction circuit 56 and the second distortion correction circuit 58 correct the optical distortion included in the inputted digital image data." Takane, [0054];

"The group of optimal parameters can be selected in accordance with the focal length at the time of obtaining the digital image data which is the object of correction, and processing for correcting the optical distortion can be carried out." Takane, [0060].

C. Claim 9

296. Claim 9 can be parsed as follows:

9.PRE	A digital imaging system for image filtration comprising:
9.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, an application specific integrated circuit, system software, a database management system and a memory storage sub-system;
9.b	wherein the aberrations from the optical lens mechanism are corrected by applying digital filtration by using the application specific integrated circuit and the digital signal processor;
9.c	wherein the microprocessor is used to provide digital and optical data to the digital signal processor;

9.d	wherein the system software is organized to identify specific optical aberrations and to access the database to identify specific corrections to the aberrations;
9.e	wherein the system software forwards the data from the digital sensor to the digital processor;
9.f	wherein the digital signal processor selects a specific procedure to optimize the image and corrects the aberrations;
9.g	wherein the lens type is a zoom lens;
9.h	wherein the lens focal length alternates from specific fixed focal length lens settings in a succession of steps;
9.i	wherein optical aberrations are corrected with digital filtration to modify multiple images from different focal lengths in a succession of data files; and
9.j	wherein the modified data file consisting of the digital data optimized from the aberrations that are corrected from the original optical image is stored in memory.

1. Limitation [9.PRE]

9.PRE	A digital imaging system for image filtration comprising:
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297. As described in §XI.A above, Takane describes a digital photographing device that corrects optical distortion by digital signal processing on images captured by a CCD. Takane, [0041], [0006], [0011], [0014], [0017].

298. Takane performs filtration in digital images as explained above in §XI.A and below regarding limitations [9.a]-[9.j].

299. Takane in view of Watanabe thus meets [9.PRE].

2. Limitation [9.a]

9.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, an application specific integrated circuit, system software, a database management system and a memory storage sub-system;
-----	---

300. Takane in view of Watanabe meets [9.a] as shown below.

a. “digital camera mechanism”

301. As described in detail in §XI.A above, Takane describes a “digital photographing device” that includes a digital camera. Takane, [0006], [0015], [0041]-[0042].

b. “optical lens mechanism”

302. As described in detail in §IX.B.2.b above, the “optical lens mechanism” of limitation [9.a] is some form of lens.

303. Takane describes an “optical unit 12” that “is structured as a zoom lens whose focal length can be changed[.]” Takane, [0038].

304. Takane in view of Watanabe thus has the required “optical lens mechanism.”

c. “a digital sensor”

305. The '805 specification identifies “CCD” as a “digital sensor[.]” in which “photons are recorded by electrically charged pixels.” EX1001, 13:63-14:4. Takane captures images using a CCD, which it digitizes to provide digital image data. Takane, [0033], [0035], [0039], [0041]-[0042], [0044], Fig. 1 (CCD 14, A/D 30).

306. Takane in view of Watanabe thus has the required “digital sensor.”

d. “a microprocessor, a digital signal processor, an application specific integrated circuit”

307. The '805 Patent does not provide, either in the specification or the claims, any description of the claimed “digital signal processor” other than as a name for a body of functional capability assigned to carry out certain processes on digital data. As I understand the '805 Patent, anything which performs the process assigned to the claimed “digital signal processor” can meet this limitation.

308. Takane states:

“[T]he main controlling section 24 [includes] a computing section 44 which carries out control computation of the entire main controlling section 24. The computing section 44 is structured to include an image processing circuit 46 which carries out predetermined processings on an inputted digital signal and generates digital image data, and a CPU 48 serving as a control section which governs control of the main controlling section 24.” Takane [0035];

“the image processing circuit 46 is structured to include a signal processing circuit 50... a dynamic image signal processing circuit 52... a still image signal processing circuit 54... and a first distortion correction circuit 56 and a second distortion correction circuit [58]” Takane, [0043].

309. All Takane’s “processing circuit[s]” and “correction circuit[s]” listed above process a “digital signal” representing an image and treated as “digital image data”:

“[T]he image signal, which expresses the subject obtained by the CCD 14 at the time of photographing, is converted from an analog signal into a digital signal, the digital signal is inputted to the image processing circuit 46 and is treated as digital image data.” Takane, [0042].

310. All Takane’s “processing circuit[s]” and “correction circuit[s]” thus process digital signals, and so could be regarded as “digital signal processors.”

311. Takane’s CPU meets the claimed “microprocessor.” The Patent Owner concedes that “a microprocessor is a CPU that controls the computing functions of the camera.” EX1026, 154-155. Takane describes a CPU that controls functions of its digital camera. *See, e.g.* Takane [0028] (“a CPU of the digital camera”), [0035] (“CPU 48 serving as a control section”), [0072] (“CPU 48 governs the operations”). Therefore, Takane describes a microprocessor. Furthermore, a microprocessor is an obvious implementation of Takane’s “main controlling section 24”.

312. Takane does not describe how distortion correction circuits 56 or 58 are implemented, leaving that to the POSITA, but does place at least the aforementioned processors and the aforementioned CPU on a single integrated circuit:

“the main controlling section 24 is structured as a one-chip LSI (large scale integrated circuit)” Takane, [0036].

313. Semiconductor devices called “digital signal processors” or “DSPs” which include a CPU on the same chip are general-purpose devices which are directed to carry out a certain process on a digital signal by programming specific to that process.

314. POSITAs would have had reasons to use such an integrated DSP-plus-CPU on a chip to implement circuits 50, 52, 54, 56, and 58, with a reasonable expectation of success, because such DSPs were designed and routinely used for digital signal processing, including image processing:

“The TMS320C8x digital signal processor (DSP) is a single-chip, multiprocessor device for use in image processing...” EX1019, SL: 1-1;

“The TMS320C8x architecture combines RISC processing and the processing power of multiple advanced DSPs (parallel processors).” EX1019, SL: 2-1;

“The following information describes each functional unit of the TMS320C8x:

- Master processor (MP). The MP [highlighted green in figure 2-1 below] is a 32-bit RISC processor with an IEEE-754 floating-point unit (FPU)
- Parallel processors (PPs). The PPs [all four highlighted blue in figure 2-1 below] are advanced DSP, 32-bit integer units.” EX1019, SL: 2-3;

Figure 2–1. TMS320C80 Block Diagram

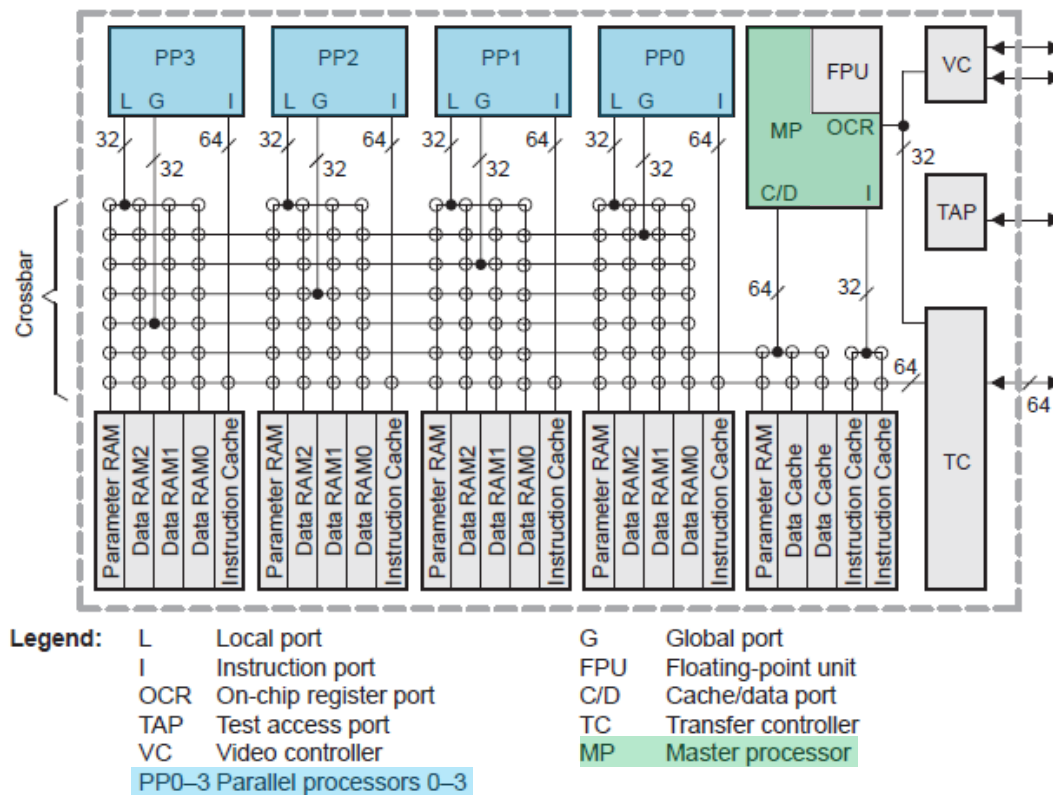


Figure 2–1, with color annotations added. EX1019, SL: 2-2.

315. This master processor (MP) is a specific kind of CPU.

316. Computers, both general and special purpose, contain processors (often called “central processing units” or “CPUs”) which can carry out mathematical and logical operations defined in their structures as “instructions” which can be called for by programs provided to and executed by the CPUs.

317. Many dedicated CPUs, as found in digital cameras, need only a modest set of instructions to carry out the kinds of programs they’ll be asked to run. Such processors can be called “RISC” (for “Reduced Instruction Set Computer”) processors because their instruction sets are “reduced” compared to

the larger instruction sets of a general purpose processor as found in a Windows or Macintosh computer.

318. POSITAs would understand that the programmability of DSPs and their support processors would simplify implementation of additional corrections and other functions, whether part of the continuous image processing stream or asynchronous:

“A single 'C8x contains up to five powerful, fully programmable processors: a master processor (MP) and up to four parallel processors (PPs). The MP is a 32-bit RISC (reduced instruction set computer) processor with an integral, high-performance IEEE-754 floating-point unit. Each PP is a 32-bit advanced DSP that combines capabilities similar to those of conventional DSPs with advanced features to accelerate operation on a variety of data types.” EX1019, iii;

“Software tools allow you to write programs in C and assembly language for the MP and PPs.” EX1019, SL: 1-2;

“The 'C8x... readily adapts to the computational requirements of proprietary algorithms by combining exceptional processing speed with full programmability” EX1019, SL: 1-6;

“The 'C8x generation offers multiprocessing capabilities.” EX1019, SL: 1-3.

319. Furthermore, it would have been obvious to implement an application specific integrated circuit and DSP in combination with a CPU/microprocessor in

Takane for the same reasons discussed above in §IX.B.2.d, and POSITAs would have had a reasonable expectation of success of implementing this combination because microprocessors, DSPs, and application specific integrated circuits were available in commercial off-the-shelf components routinely used for image processing in cameras. Implementing Watanabe's system with any combination of microprocessors, DSPs, or application specific integrated circuits was well-within the POSITA's ordinary skill, as discussed above at §IX.B.2.d.

320. Thus, Takane's "one-chip LSI (large scale integrated circuit)" carrying control section 24 including one or more DSPs implementing at least the first distortion correction circuit 56 and the second distortion correction circuit 58 provides Takane in view of Watanabe "a microprocessor, a digital signal processor, an application specific integrated circuit," as required by limitation [9.a].

e. "system software"

321. Takane's device executes a "control routine" that includes image processing. Takane, [0028], [0030], [0073], [0100]-[0111], Fig. 3 (step 106), Fig. 5.

322. The stored programs and the routines that Takane's camera executes are "system software" because they execute in the camera system:

"FIG. 3 is a flowchart showing a control routine (a main routine) executed at a CPU of the digital camera" Takane, [0028];

“FIG. 5 is a flowchart showing dynamic image photographing processing (a sub-routine) executed at the CPU of the digital camera” Takane, [0030];

“[A] digital camera 10 relating to the present embodiment is structured to include a main controlling section 24 governing the overall operation of the digital camera 10.” Takane, [0033];

“[T]he main controlling section 24 is structured [to include] a computing section 44 which carries out control computation of the entire main controlling section 24. The computing section 44 is structured to include an image processing circuit 46 which carries out predetermined processings on an inputted digital signal and generates digital image data, and a CPU 48 serving as a control section which governs control of the main controlling section 24.” Takane, [0035].

323. Takane in view of Watanabe thus meets [1.a].

324.

f. database management system (“DBMS”)

325. As described in detail in §XI.C.2.d above, Takane satisfies a microprocessor, a digital signal processor, and an application specific integrated circuit.

326. As described in detail in §XI.C.2.e above, in Takane in view of Watanabe, Takane’s microprocessor uses software that accesses a database

comprising tables with correction parameters that it provides to the DSP comprising distortion correction circuit 56.

327. As described in detail in §IX.B.2.f above, the software accessing the database is a database management system.

328. As discussed in detail in §XI.B above, Takane in view of Watanabe's database contains parameters for correcting optical distortion aberration for many different lenses and lens settings.

329. Thus, Takane in view of Watanabe provides "a database management system."

g. "memory storage sub-system"

330. Takane describes:

"an image data temporarily storing section 20 such as an SRAM or an SDRAM or the like, for temporarily storing the digital image data obtained by photographing by the CCD" Takane, [0033];

"The digital image data, which has been subjected to optical distortion correcting processing in the first distortion correction circuit 56 or the second distortion correction circuit 58, is transmitted to the memory control circuit 36 via the bus 60, and, under the control of the memory control circuit 36, is temporarily stored in the image data temporarily storing section 20." Takane, [0065];

"the corrected digital image data which has been stored in the image data temporarily storing section 20 in this way, is read by the memory

control circuit 36, is transmitted to the compression/decompression circuit 38 via the bus 60, and is compressed in a predetermined compression format (e.g., JPEG) by the compression/decompression circuit 38. Thereafter, the data can be transmitted to the media control circuit 42 via the bus 60, and can be stored in the external recording medium 72 by the media control circuit 42.” Takane, [0066].

331. A POSITA would recognize the ensemble of these components as the required “a memory storage sub-system.”

3. Limitation [9.b]

9.b	wherein the aberrations from the optical lens mechanism are corrected by applying digital filtration by using the application specific integrated circuit and the digital signal processor;
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332. Takane in view of Watanabe meets [9.b] because Takane’s first distortion correction circuit 56 comprising a DSP (per §XI.C.2.d above) corrects optical distortion in the image data using the polynomial parameters relating to distortion based on the lens and focal length. Takane, [0054]-[0062], [0100]-[0102]; §XI.A above.

333. Takane describes determining the image before correction using nearest-neighbor or bi-linear interpolation and a multidimensional function parameterized by the coefficients associated with the lens focal length (Takane, [0055]-[0057]), then correcting optical distortion by “making the pixel data... into pixel data of the coordinates (x, y) in the image after correction.” Takane, [0058].

334. Takane in view of Watanabe applies “digital filtration” for correction as explained in detail in §IX.B.3.a.i above and because Takane’s first distortion circuit 56 is a DSP that uses the identified parameters identified and an interpolation algorithm to correct optical distortion in digital images:

“Parameters expressing a polynomial which approximates the amount of displacement of the optical distortion (i.e., the coefficients of a polynomial) are stored in advance in each of the first distortion correction circuit 56 and the second distortion correction circuit 58. By using these parameters, the first distortion correction circuit 56 and the second distortion correction circuit 58 correct the optical distortion included in the inputted digital image data.” Takane, [0054];

“in order to decrease the memory capacity required for correction by the correction sections, it is preferable that the correction sections approximate the optical distortion by a polynomial, and correct the optical distortion by interpolating each pixel after correction from digital image data before correction.” Takane, [0025];

“optical distortion can be corrected by making the pixel data, which is determined by interpolation in accordance with an interpolation method such as nearest neighbor interpolation, bi-linear interpolation, or the like, into pixel data of the coordinates (x,y) in the image after correction.” Takane, [0058].

335. Takane’s distortion correction and interpolation scheme (Takane, [0055]-[0058]) is a form of the claimed “digital filtration” for the same reasons, described in detail in §IX.B.3.a.i above, that Watanabe’s correction process is.

336. To the extent an application specific integrated circuit is not taught by Takane’s digital filtration disclosure, a POSITA would recognize the benefit of modifying Takane for the digital signal processor to employ an application specific integrated circuit for labor intensive, repetitive image processing tasks such as digital filtration as admitted by the Patent Owner.

337. This meets [9.b].

4. Limitation [9.c]

9.c	wherein the microprocessor is used to provide digital and optical data to the digital signal processor;
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338. As discussed above, [9.c] should be construed as reciting a “data pathway[] between the digital sensor and the digital signal processor.” EX1027, 41. Takane in view of Watanabe meets [9.c] because it describes a data pathway between the digital sensor and the digital signal processor by which digital and optical data is provided.

339. Takane in view of Watanabe meets [9.c] because Takane’s CCD captures images (Takane, [0041]) and Takane’s A/D converter digitizes the images and sends them to the CPU (“microprocessor”), which then passes them to signal processing circuit 50, dynamic image signal processing circuit 52, and first

distortion correction circuit 56, which comprise a DSP (Takane, [0042]-[0045], [0053]).

340. Takane provides “optical data” because Takane’s digital signal processor includes “correction sections correcting optical distortion included in the digital image data” (Takane, 0015) for which “conversion tables and the like are stored in advance” (Takane, 0033]). The data corresponds to actual optical data represented in the image data that requires aberration correction.

5. Limitation [9.d]

9.d	wherein the system software is organized to identify specific optical aberrations and to access the database to identify specific corrections to the aberrations;
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341. Takane’s digital signal processor includes “correction sections correcting optical distortion included in the digital image data” (Takane, 0015) for which “conversion tables and the like are stored in advance” (Takane, 0033]).

342. As explained in detail in §XI.B above, these tables contain “parameters which are peculiar to the predetermined image size... at the time of dynamic image photographing” that have been “stored for each of a plurality of predetermined focal distances.” Takane, [0060].

343. As explained in detail in §XI.C.2.d, that microprocessor contains the system software which “carries out predetermined processings performing video image processing.” Takane, [0035].

344. A POSITA would understand that “carr[ying] out predetermined processings” for “correcting optical distortion” aberration is done in Takane by having the system software identify in the database the proper “conversion table[]” for the specific aberration, which could be the “pin-cushion” or “barrel” distortion that Takane describes as known to be correctable with its method for the lens and focal length at image capture:

“Such distortion is generally called optical distortion, and is classified into the following two types: ‘pin-cushion distortion’ in which the corner portions of the image extend outwardly, and ‘barrel distortion’ in which, conversely, the corner portions contract.” Takane, [0005];

“a digital photographing device in which the processing time for correcting optical distortion can be shortened.” Takane, [0014];

“various programs, parameters, conversion tables and the like are stored in advance” Takane, [0033];

“parameters which are peculiar to the predetermined image size obtained at the time of photographing standby or at the time of dynamic image photographing (the VGA size in the present embodiment) can be stored for each of a plurality of predetermined focal distances. The group of optimal parameters can be selected in accordance with the focal length at the time of obtaining the digital image data which is the object of correction, and processing for correcting the optical distortion can be carried out.” Takane, [0060].

345. Takane in view of Watanabe thus meets [1.c] because Takane's microprocessor uses the system software to identify at least one optical image aberration.

346. Takane's image processing circuit 46, and first distortion correction circuit 56, "carries out predetermined digital signal processing" and corrects optical distortion on digital images:

"a signal processing circuit 50 which, regardless of whether the image is a still image or dynamic images, carries out predetermined digital signal processings on the inputted digital image data" Takane, [0043]

"if the photographing mode selected by the photographer operating the mode switching switch 18B is the dynamic image photographing mode, the routine proceeds from step 100 in FIG. 3 to step 102 and step 106, and the sequence processings (dynamic image photographing processing), which are for photographing dynamic images and are shown in FIG. 5, are carried out... correction processing is carried out by the first distortion correction circuit 56 such that the optical distortion in the horizontal direction is corrected." Takane, [0100]-[0102]

347. Takane in view of Watanabe uses Watanabe's teaching of using multiple lenses with an imaging system. Takane stores correction parameters "in advance" in first distortion correction circuit 56 based on the lens and focal length, then corrects optical distortion in digital images using the correction parameters.

Takane, [0054]. These correction parameters are “stored” for either the “pin-cushion” or “barrel” distortion aberrations that Takane describes as known to be correctable with its method (Takane, [0005], [0054]-[0059]) and for each of a plurality of predetermined focal distances and the lens and focal length at video capture.” Takane, [0060].

348. Takane’s DSP uses multi-dimensional function(s) $F(d)$ with parameters “stored in advance” to determine “displacement of the optical distortion:

“Parameters expressing a polynomial which approximates the amount of displacement of the optical distortion (i.e., the coefficients of a polynomial) are stored in advance in each of the first distortion correction circuit 56 and the second distortion correction circuit 58. By using these parameters, the first distortion correction circuit 56 and the second distortion correction circuit 58 correct the optical distortion included in the inputted digital image data.” Takane, [0054];

“Specifically, the amount of displacement of the optical distortion can be approximately expressed by a multidimensional function $F(d)$ of a distance d from the center of the image (the optical center).” Takane, [0055].

349. Takane does not explain where it stores $F(d)$, leaving this detail to a POSITA. A POSITA would have understood that there were two known alternatives: (1) storing the algorithm(s) implementing the function $F(d)$ for a

particular lens as executable code in the DSP if the DSP is capable of and has capacity for that non-volatile storage, or (2) storing them in some other memory or computer-readable medium and loading them into the DSP as needed. The first of these could work for a basic camera, while the second permits a camera to correct images in a wider range of settings and circumstances.

350. As discussed in detail above at §§IX.B.2.d and XI.C.2.d concerning the Texas Instruments SoCs containing CPUs and DSPs, it was known to select and load algorithms from memory to provide particular signal processing (“filtration”) at the DSP.

351. In Takane in view of Watanabe, a POSITA would have understood to store, or at least identify, the DSP filtration algorithm for a particular aberration correction in Watanabe’s database to retrieve and apply the stored parameters (e.g., as memory offsets or look-up addresses in the algorithm database).

352. Thus, Takane’s SoC would “identify” the correction algorithm by accessing the database for information identifying the algorithm (or the algorithm itself), then obtain the algorithm for the DSP so it could apply the filter and correct the aberration.

353. As discussed above (regarding option (2)), the retrieval option frees the DSP from having to store every aberration correction algorithm used by the system in advance by loading them on an as-needed basis.

354. Takane in view of Watanabe meets [9.d] because in the combination Takane's main controlling section 24, the integrated circuit (per §XI.C.2.d above), uses in-camera software (per §XI.C.2.e above) to access a database to obtain correction parameters associated with the lens and focal length at the time of image capture, which the integrated circuit provides to the distortion correction circuit. §§XI.B, XI.C.2.f above; Takane, [0054]-[0062], [0100]-[0102].

355. The correction parameters "express[] a polynomial which approximates the amount of displacement of the optical distortion." Takane, [0054]. Constructing this polynomial for each image size and focal length is an algorithm, as is digital filtration that uses that polynomial to interpolate pixel positions and correct distortion. Takane, [0054]-[0060].

356. Providing the parameters thus provides and enables a filtration algorithm.

357. This meets [9.d].

6. Limitation [9.e]

1.e	wherein when the image file is captured by the digital sensor the digital file is forwarded to the digital signal processor;
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358. Takane in view of Watanabe meets [9.e] because Takane's CCD captures images (Takane, [0041]) and Takane's A/D converter digitizes the images at the CCD output and sends it to signal processing circuit 50, dynamic image

signal processing circuit 52, and first distortion correction circuit 56, all of which are, as described in detail in §XI.C.2.d above, are digital signal processors:

“At the image processing circuit 46, the digital image data from the A/D converter 30 is first inputted to the signal processing circuit 50.” Takane, [0044];

“The output end of the signal processing circuit 50 is connected to the dynamic image signal processing circuit 52 and the still image signal processing circuit 54.” Takane, [0045];

“The digital image data, which has been processed by the dynamic image signal processing circuit 52 or the still image signal processing circuit 54, is inputted via the bus 60 to the first distortion correction circuit 56 or the second distortion correction circuit 56.” Takane, [0053].

359. This meets [9.e].

7. Limitation [9.f]

9.f	wherein the digital signal processor selects a specific procedure to optimize the image and corrects the aberrations;
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360. As described in §XI.B.2.d above, Takane discloses the claimed “digital signal processor.”

361. As discussed above with respect to [9.d], Takane would “select” a correction algorithm (the “specific procedure”) by accessing the database for

information identifying the algorithm (or the algorithm itself), then obtain the algorithm for the DSP so it could apply it and correct the aberration.

362. Therefore, Takane in view of Watanabe meets [9.f].

8. Limitation [9.g]

9.g	wherein the lens type is a zoom lens;
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363. Takane in view of Watanabe meets [9.g] because Takane's "optical unit 12 is structured as a zoom lens[.]" Takane, [0038].

9. Limitation [9.h]

9.g	wherein the lens focal length alternates from specific fixed focal length lens settings in a succession of steps;
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364. As discussed above at §VI.C, the Patent Owner adopts a construction of "succession of steps" as meaning that a zoom lens "successively move[s] through each zoom setting/position." EX1032, 21-22.

365. Takane in view of Watanabe meets [9.h] because Takane's "optical unit 12 is structured as a zoom lens whose focal length can be changed," which would occur by the zoom lens successively moving through each zoom setting/position. Takane, [0038].

10. Limitation [9.i]

9.i	wherein optical aberrations are corrected with digital filtration to modify multiple images from different focal lengths in a succession of data files; and
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366. Takane in view of Watanabe meets that the “optical aberrations are corrected with digital filtration to modify” images for the same reasons Takane in view of Watanabe meets [9.b].

367. The correction is for “multiple images from different focal lengths in a succession of data files” because Takane in view of Watanabe retrieves correction parameters from the database based on, among other things, the lens and focal length of the zoom lens used at the time of image capture.

368. As discussed above at §VI.C, the Patent Owner adopts construction that “succession of data files” means the “multiple files that are created when the system captures multiple images from multiple focal lengths consistently with the claim element above in which ‘succession of steps’ appears.” As discussed above with respect to [9.h], Takane describes a zoom lens that “successively move[s] through each zoom setting/position.” Takane, [0038].

369. Because Takane in view of Watanabe meets “succession of steps” and performs aberration correction at each zoom position, Takane in view of Watanabe therefore also meets the “succession of data files.”

11. Limitation [9.j]

9.j	wherein the modified data file consisting of the digital data optimized from the aberrations that are corrected from the original optical image is stored in memory.
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370. Takane in view of Watanabe meets [9.j] because, as described in detail in §XI.C.2.g above, Takane discloses storing corrected image data in the claimed memory storage sub-system.

D. Claim 24

371. Claim 24 can be parsed as follows:

24.PRE	A method of image filtration comprising:
24.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, an application specific integrated circuit, system software, a database management system and a memory storage sub-system;
24.b	wherein the aberrations from the optical lens mechanism are corrected by applying digital filtration by using the application specific integrated circuit and digital signal processor, the method consisting of;
24.c	alternating the lens focal length of a zoom lens from specific fixed focal length lens settings in a succession of steps;
24.d	creating data files corresponding to each focal length lens setting;
24.e	forwarding the data from a digital sensor to the digital signal processor;
24.f	providing digital and optical data to a digital signal processor;
24.g	identifying specific optical aberrations and accessing a database to identify specific corrections to the aberrations;
24.h	selecting a specific procedure from the database using the microprocessor to optimize the image and correct the aberrations;
24.i	applying digital filtration by using the application specific integrated circuit and digital signal processor to correct digital or optical aberrations;
24.j	correcting optical aberrations with digital filtration to modify multiple images from different focal lengths in a succession of data files; and
24.k	storing the modified data files in memory.

1. Limitations [24.PRE], [24.a], [24.b], [24.c], [24.e], [24.f], [24.g], [24.i], [24.j], and [24.k]

24.PRE	A method of image filtration comprising:
24.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, an application

	specific integrated circuit, system software, a database management system and a memory storage sub-system;
24.b	wherein the aberrations from the optical lens mechanism are corrected by applying digital filtration by using the application specific integrated circuit and digital signal processor, the method consisting of;
24.c	alternating the lens focal length of a zoom lens from specific fixed focal length lens settings in a succession of steps;
24.e	forwarding the data from a digital sensor to the digital signal processor;
24.f	providing digital and optical data to a digital signal processor;
24.g	identifying specific optical aberrations and accessing a database to identify specific corrections to the aberrations;
24.i	applying digital filtration by using the application specific integrated circuit and digital signal processor to correct digital or optical aberrations;
24.j	correcting optical aberrations with digital filtration to modify multiple images from different focal lengths in a succession of data files; and
24.k	storing the modified data files in memory.

372. Takane in view of Watanabe meets the following claim 14 limitations for the same reasons it meets the corresponding limitations in claim 1:

Limitation	Corresponding Limitation	Discussion
[24.PRE]	[9.PRE]	§XI.C.1
[24.a]	[9.a]	§XI.C.2
[24.b], [24.i]	[9.b]	§XI.C.3
[24.c]	[9.g], [9.h]	§XI.C.8, §XI.C.9
[24.e]	[9.e]	§XI.C.6
[24.f]	[9.c]	§XI.C.4
[24.g]	[9.d]	§XI.C.5
[24.j]	[9.i]	§XI.C.10
[24.k]	[9.j]	§XI.C.11

2. Limitation [24.d]

24.d	creating data files corresponding to each focal length lens setting;
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373. Takane in view of Watanabe meets [24.d] because the combination uses Takane's microprocessor to execute Watanabe's modified software to retrieve correction parameters from the database based on, among other things, the lens and focal length of the zoom lens used at the time of image capture. §§XI.E.3, XI.B above.

374. As discussed above, Watanabe's database uses records created in advance for each focal length, because Watanabe describes selecting corrections based on lens, focal length, and zoom position from the database, so the files exist prior to that operation. JP-872, [0007]; Watanabe, [0049].

3. Limitation [24.h]

24.d	selecting a specific procedure from the database using the microprocessor to optimize the image and correct the aberrations;
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375. As described in above with respect to [9.d] and [9.f], Takane in view of Watanabe would "select" a correction algorithm (the "specific procedure") by accessing the database for information identifying the algorithm (or the algorithm itself), then obtain the algorithm for the DSP so it could apply it and correct the aberration.

376. This meets [24.d].

XII. GROUND 4: TAKANE IN VIEW OF WATANABE IN FURTHER VIEW OF RUSS RENDERS OBVIOUS CLAIMS 1-3 AND 18-20

A. Takane in View of Watanabe in View of Russ

377. Neither Takane nor Watanabe describes a detailed methodology for correcting their discussed optical aberrations other than vignetting. As discussed above in §X.A, Russ provides details on how to actually carry out those image processes (Russ, 8-13, 36-39, 131-205, 207-276, 277-332) such as details for using fast Fourier transforms to efficiently modify image data (Russ, 277-332.)

378. A POSITA would have had reasons to combine the image modification processes from Russ with Takane in view of Watanabe that were similar to the reasons for combining Russ with Watanabe, discussed above at §X.B.

379. For example, Russ lends itself to combination with Takane in view of Watanabe by describing and demonstrating detailed implementation of many digital image processing options for correction and enhancement used in digital cameras, matching the purposes of Takane and Watanabe.

380. Further, POSITAs would have had reasons to use Russ's filtering and image processing teachings in the system of Takane in view of Watanabe to achieve Takane's aberration (distortion) corrections, or Takane's other "various types of correction[s]" (*see, e.g.*, Takane, [0044], describing "white balance adjustment, gamma correction, sharpness correction").

381. This combination would combine familiar techniques and components (Russ's filtering and image processing with the imaging and image processing system of Takane in view of Watanabe and various types of corrections) yielding predictable results. *KSR*, 550 U.S. at 416. POSITAs would have had a reasonable expectation of success because Russ's techniques used software that could be implemented in the system of Takane in view of Watanabe and doing so was within the POSITA's ordinary skill.

382. POSITAs would have known that Russ's technique applied to Takane's digital image data because Russ's technique applied to images, as discussed above at §X.B.

B. Claim 1

383. Claim 1 can be parsed as follows:

1.PRE	A digital imaging system for image filtration comprising:
1.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, an application specific integrated circuit, system software, a database management system and a memory storage sub-system;
1.b	wherein the optical lens mechanism is a fixed focal length;
1.c	wherein the aberrations from the optical lens mechanism are corrected by applying digital filtration by using the application specific integrated circuit and the digital signal processor;
1.d	wherein the microprocessor is used to provide digital and optical data to the digital signal processor;
1.e	wherein the system software is organized to identify specific optical aberrations and to access the database to identify specific corrections to the aberrations;
1.f	wherein the system software forwards the data from the digital sensor to the digital processor;

1.g	wherein the digital signal processor selects a specific procedure to optimize the image and corrects the aberrations;
1.h	wherein the data are forwarded from the digital sensor to the digital signal processor by an application specific integrated circuit;
1.i	wherein the digital signal processor applies a fast Fourier transform to a data file in order to satisfy a user specified special effects function;
1.j	wherein the digital signal processor modifies the data file by applying the special effects function;
1.k	wherein the modified data file consisting of the digital data optimized from the aberrations that are corrected from the original optical image is stored in memory.

1. Limitations [1.PRE], [1.a], [1.c], [1.d], [1.e], [1.f], [1.g], and [1.k]

1.PRE	A digital imaging system for image filtration comprising:
1.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, an application specific integrated circuit, system software, a database management system and a memory storage sub-system;
1.c	wherein the aberrations from the optical lens mechanism are corrected by applying digital filtration by using the application specific integrated circuit and the digital signal processor;
1.d	wherein the microprocessor is used to provide digital and optical data to the digital signal processor;
1.e	wherein the system software is organized to identify specific optical aberrations and to access the database to identify specific corrections to the aberrations;
1.f	wherein the system software forwards the data from the digital sensor to the digital processor;
1.g	wherein the digital signal processor selects a specific procedure to optimize the image and corrects the aberrations;
1.k	wherein the modified data file consisting of the digital data optimized from the aberrations that are corrected from the original optical image is stored in memory.

384. Takane in view of Watanabe meets these claim 1 limitations for the same reasons Takane in view of Watanabe meets the corresponding limitations in claim 9:

Limitation	Corresponding Limitation	Discussion
[1.PRE]	[9.PRE]	§XI.C.1
[1.a]	[9.a]	§XI.C.2
[1.c]	[9.b]	§XI.C.3
[1.d]	[9.c]	§XI.C.4
[1.e]	[9.d]	§XI.C.5
[1.f]	[9.e]	§XI.C.6
[1.g]	[9.f]	§XI.C.7

Takane in view of Watanabe in view of Russ meets the remaining limitations in claim 1 as follows.

2. Limitation [1.b]

1.b	wherein the optical lens mechanism is a fixed focal length;
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385. Takane meets [1.b] because fixed focal length lenses were known as interchangeable with zoom lenses as dictated by imaging conditions, as discussed above at §VIII.A.1. *See, e.g.* EX1077 (“Kawasaki”), 1:8-11, 7:18-30.

3. Limitation [1.h]

1.h	wherein the data are forwarded from the digital sensor to the digital signal processor by an application specific integrated circuit;
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386. Takane in view of Watanabe meets [1.h] because Takane forwards the data from its digital sensor a first distortion correction circuit that comprises a DSP as explained as explained in §§XI.C.6, XI.E.2 above.

387. To the extent an application specific integrated circuit is not taught by Watanabe's digital sensor data forwarding disclosure, a POSITA would recognize the benefit of modifying Watanabe for the digital signal processor to employ an application specific integrated circuit for labor intensive, repetitive image processing tasks such as data forwarding as admitted by the Patent Owner.

4. Limitation [1.i]

1.i	wherein the digital signal processor applies a fast Fourier transform to a data file in order to satisfy a user specified special effects function;
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388. Takane in view Watanabe in view of Russ renders obvious the application of a fast Fourier transform to satisfy a user specified special effect.

389. As described above Takane disclosing a DSP in describing a first distortion correction circuit 56.

390. Further, Watanabe's processing teachings include sorting image data into color-difference data and brightness data which would be useful to a POSITA looking to apply a special effect.

391. Russ contains the details on how to apply such a special effect using a Fourier transform. Russ teaches special effects being implemented through a fast Fourier transform. Specifically, Russ explains how to create a filter to apply a

smoothing or softening effect and a color effect. Russ, pp. 277, 305, 312, 334. A POSITA would have understood a fast Fourier transform to be a common and preferable manner of applying special effects such as image softening. As discussed above at §X.C.4, the POSITA would find it obvious to use Russ’s frequency space image enhancement techniques, like color filter special effects functions and smoothing special effects functions, in order to improve image quality. *Supra* §§X.D, X.E, Russ, 277 (“[W]orking in frequency space to perform certain image... processing operation... Image quality... certainly includes the alteration of grey levels and color values... removal of fine-scale texture in the image.”), 304 (“It is important to use a smoothing function to modify the edges of the regions.”), 308 (“A common recommendation... for dealing with... moiré patterns... is to use smoothing to eliminate the pattern”), 332 (“Processing images in the frequency domain is useful for removing certain types of noise”). Because it was known to be “important to use” a smoothing function and other special effects, a POSITA would have been motivated to apply Russ’s smoothing teachings to Takane in view of Watanabe in order to provide a feature recognized in the art as highly desirable.

5. Limitation [1.j]

1.j	wherein the digital signal processor modifies the data file by applying the special effects function;
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392. Takane discloses a DSP in describing a first distortion correction circuit 56. In Watanabe, “the digital signal processing circuit 56 sorts out image data inputted from the A/D converter 55 into color-difference data and brightness data and executes various processing.” Watanabe at [0038]. Takane in view of Watanabe would sort out image data into color-difference data and brightness data that would be used for “various processing.”

393. Watanabe suggests that the image data for each captured image is provided in a different file. Fig. 3 shows a file icon with the title corrected image data, indicating that each image is corrected and stored in a file. Watanabe, FIG. 3.

394. It would have been obvious for a POSITA to modify Takane’s CPU and DSP as in Watanabe so that it sorts image data files into color-difference data and brightness data that would be used for “various processing,” including modifying the data files by applying Russ’s special effects function, as discussed above at §X.C.5. Watanabe, at [0038], [0059], [0071].

C. Claim 2

395. Claim 2 can be parsed as follows:

2.PRE	The system of claim 1:
2.a	wherein the special effects function is a color enhancing function.

396. As discussed above, in prior litigation, the district court construed the term “color enhancing function” to mean “color changes to an image.” EX1032, p. 8.

397. In Watanabe, “the digital signal processing circuit 56 sorts out image data inputted from the A/D converter 55 into color-difference data and brightness data and executes various processes.” Watanabe, [0038]. The POSITA would implement Watanabe’s “various processes” executed using “color-difference data and brightness data” in Takane’s system for the purpose of enhancing images.

398. As discussed above at §X.A, Russ applies Fourier transforms to enhance images, and one such enhancement is a color enhancement which applies “color changes to an image.” Russ, pp. 277, 305, 308-09, 334. For example, Russ describes a top hat filter to the Fourier transform resulting in color changes to the image. Russ, pp. 308-09.

399. The POSITA would find it obvious to apply white balance (in which there is applied “color changes to an image”) or another “a color enhancing function” in Takane in view of Watanabe in order to make image colors appear more realistic, which is standard in cameras and desirable to viewers, as discussed above at X.D. Russ, 277 (“Image quality... certainly includes the alteration of grey levels and color values”), EX1053, 343 (“desirable to distribute the intensities of a color image equally between the highlights and the shadows” using “a variety of color transformations for the correction of tonal and color imbalances”), *see also* EX1035 (“Dorrell”), [0003], [0025], [0145]-[0146], [0155]-[0159], Figs. 4-6, 12, EX1036 (“Masuno”), [0081]-[0082] [0147]-[0156]. As it was known that adjusting

color values (e.g., by applying color filters) improved image quality, and Takane and Watanabe are directed to image improvements, it would have been obvious for a POSITA to modify Takane in view of Watanabe to provide this known and desirable processing feature.

D. Claim 3

400. Claim 3 can be parsed as follows:

3.PRE	The system of claim 1:
3.a	wherein the special effects function is a diffusion function of soft effect.

401. As discussed above at §XII.C, Watanabe performs “various processing” on images (Watanabe, [0038]) that the POSITA would incorporate into Takane’s system to enhance images.

402. As discussed above, Russ describes softening effects, such as a filter in a digital camera which will use FFT to produce a soft effect. Russ, p. 286, 301-303. The FFT efficiently converts image data into its frequency domain. Russ teaches that a Butterworth low-pass filter can be applied to an image and it will smooth the high-frequency components of the image data to smooth and produce some blurring. With the formulae and examples disclosed in Russ, it would be obvious for a POSITA to apply a soft effect.

403. The POSITA would find it obvious to use Russ’s image enhancement techniques, including smoothing effects, into Takane in view of Watanabe, in order

to provide further image enhancements on top of Takane and Watanabe's explicitly described corrections. As discussed above at §X.E, Russ describes that smoothing is a known function for enhancing image quality by removing unwanted noise. Russ, 277, 304, 308, 332. Because it was known to be "important to use" a smoothing function, a POSITA would have been motivated to apply Russ's smoothing teachings to Takane in view of Watanabe in order to provide a feature recognized in the art as highly desirable.

E. Claim 18

404. Claim 18 can be parsed as follows:

18.PRE	A method of image filtration which comprises:
18.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, an application specific integrated circuit, system software, a database management system and a memory storage sub-system;
18.b	wherein the aberrations from the optical lens mechanism are corrected by applying digital filtration by using the application specific integrated circuit and the digital signal processor, the method consisting of;
18.c	forwarding the data from a digital sensor to a digital signal processor by an application specific integrated circuit;
18.d	providing digital and optical data to the digital signal processor;
18.e	identifying specific optical aberrations and accessing a database to identify specific corrections to the aberrations:
18.f	selecting a specific procedure from the database using the microprocessor to optimize the image and correct the aberrations:
18.g	applying digital filtration by using the application specific integrated circuit and digital signal processor to correct digital or optical aberrations:
18.h	applying a fast Fourier transform to a data file in order to satisfy a user specified special effects function;
18.i	modifying the data file by applying the special effects function using the digital signal processor; and

18.j	storing the data file in memory.
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1. Limitations [18.PRE], [18.a], [18.b], [18.d], [18.e], [18.g], and [18.j]

18.PRE	A method of image filtration which comprises:
18.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, an application specific integrated circuit, system software, a database management system and a memory storage sub-system;
18.b	wherein the aberrations from the optical lens mechanism are corrected by applying digital filtration by using the application specific integrated circuit and the digital signal processor, the method consisting of;
18.d	providing digital and optical data to the digital signal processor;
18.e	identifying specific optical aberrations and accessing a database to identify specific corrections to the aberrations:
18.g	applying digital filtration by using the application specific integrated circuit and digital signal processor to correct digital or optical aberrations:
18.j	storing the data file in memory.

405. Takane in view of Watanabe meets these claim 18 limitations for the same reasons Takane in view of Watanabe meets the corresponding limitations in claim 9:

Limitation	Corresponding Limitation	Discussion
[18.PRE]	[9.PRE]	§XI.C.1
[18.a]	[9.a]	§XI.C.2
[18.b], [18.g]	[9.b]	§XI.C.3
[18.d]	[9.c]	§XI.C.4
[18.e]	[9.d]	§XI.C.5
[18.j]	[9.j]	§XI.C.11

406. While [18.g] recites “correct digital or optical aberrations,” the digital and optical aberrations are joined by the disjunctive “or,” and thus Takane in view of Watanabe meets [18.g] by correcting optical aberrations as described above with respect to [9.b]. Takane in view of Watanabe in view of Russ meets the remaining limitations in claim 18 as follows.

2. Limitation [18.c]

18.c	forwarding the data from a digital sensor to a digital signal processor by an application specific integrated circuit;
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407. Takane in view of Watanabe meets [18.c] for the same reason it meets limitation [1.h].

408. The Patent Owner also concedes that DSPs and application specific integrated circuits are well known components used in cameras for image processing and other tasks. EX1026, 154-155.

3. Limitation [18.f]

18.f	selecting a specific procedure from the database using the microprocessor to optimize the image and correct the aberrations: [sic]
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409. Takane in view of Watanabe meets [18.f] for the same reason it meets limitation [24.h].

410. As described in above with respect to [9.d] and [9.f], Takane in view of Watanabe would “select” a correction algorithm (the “specific procedure”) by accessing the database for information identifying the algorithm (or the algorithm itself), then obtain the algorithm for the DSP so it could apply it and correct the aberration.

4. Limitation [18.h]

18.h	applying a fast Fourier transform to a data file in order to satisfy a user specified special effects function;
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411. Takane in view of Watanabe in view of Russ meets [18.h] for the same reason it meets limitation [1.i].

5. Limitation [18.i]

18.i	modifying the data file by applying the special effects function using the digital signal processor; and
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412. Takane in view of Watanabe in view of Russ meets [18.i] for the same reason it meets limitation [1.j].

F. Claim 19

413. Claim 19 can be parsed as follows:

19.PRE	The method of claim 18 further comprising the step of:
19.a	applying the special effects function as a color enhancing function.

414. As discussed above with respect to claim 2, the POSITA would find it obvious to apply white balance or other “a color enhancing function” in order to make image colors appear more realistic, which is standard in cameras and desirable to viewers, as above at X.D. Russ, 277 (“Image quality... certainly includes the alteration of grey levels and color values”), EX1053, 343 (“desirable to distribute the intensities of a color image equally between the highlights and the shadows” using “a variety of color transformations for the correction of tonal and color imbalances”), see also EX1035 (“Dorrell”), [0003], [0025], [0145]-[0146], [0155]-[0159], Figs. 4-6, 12, EX1036 (“Masuno”), [0081]-[0082] [0147]-[0156]. As it was known that adjusting color values (e.g., by applying color filters) improved image quality, and Takane and Watanabe are directed to image improvements, it would have been obvious for a POSITA to modify Takane in view of Watanabe to provide this known and desirable processing feature.

415. Takane in view of Watanabe in view of Russ meets claim 19 for the same reason it meets claim 2.

G. Claim 20

416. Claim 20 can be parsed as follows:

20.PRE	The method of claim 18 further comprising the step of:
20.a	applying the special effects function as a diffusion function of soft effect.

417. As discussed above with respect to claim 3, the POSITA would find it obvious to use Russ's image enhancement techniques, including smoothing effects ("a diffusion function of soft effect"), in Watanabe's camera, in order to provide further image enhancements on top of Watanabe's explicitly described corrections. As discussed above at §X.E, Russ describes that smoothing is a known function for enhancing image quality by removing unwanted noise. Russ, 277, 304, 308, 332. Because it was known to be "important to use" a smoothing function, a POSITA would have been motivated to apply Russ's smoothing teachings to Takane in view of Watanabe in order to provide a feature recognized in the art as highly desirable.

418. Takane in view of Watanabe in view of Russ meets claim 20 for the same reason it meets claim 3.

XIII. CONCLUSION

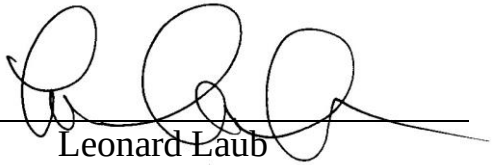
419. It is my opinion that based on the POSITA's ordinary level of skill, the scope and content of the prior art, and the differences between the Challenged Claims and the prior art teachings, a POSITA would have found the subject matter of claims 1-19 and 22-30 to be well-known and obvious for the reasons explained in the Grounds discussed in this Declaration.

420. I have reached the opinions expressed in this Declaration based on my knowledge, education, experience, and expertise, which enable me to speak to what a POSITA would have understood at the relevant time of invention.

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

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

Dated: 17 May 2024


Leonard Laub

APPENDIX A: U.S. PATENT NO. 7,612,805 CLAIM LIST

Ref	Limitation
1.PRE	A digital imaging system for image filtration comprising:
1.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, an application specific integrated circuit, system software, a database management system and a memory storage sub-system;
1.b	wherein the optical lens mechanism is a fixed focal length;
1.c	wherein the aberrations from the optical lens mechanism are corrected by applying digital filtration by using the application specific integrated circuit and the digital signal processor;
1.d	wherein the microprocessor is used to provide digital and optical data to the digital signal processor;
1.e	wherein the system software is organized to identify specific optical aberrations and to access the database to identify specific corrections to the aberrations;
1.f	wherein the system software forwards the data from the digital sensor to the digital processor;
1.g	wherein the digital signal processor selects a specific procedure to optimize the image and corrects the aberrations;
1.h	wherein the data are forwarded from the digital sensor to the digital signal processor by an application specific integrated circuit;
1.i	wherein the digital signal processor applies a fast Fourier transform to a data file in order to satisfy a user specified special effects function;
1.j	wherein the digital signal processor modifies the data file by applying the special effects function; and
1.k	wherein the modified data file consisting of the digital data optimized from the aberrations that are corrected from the original optical image is stored in memory.
2.PRE	The system of claim 1:
2.a	wherein the special effects function is a color enhancing function.
3.PRE	The system of claim 1:
3.a	wherein the special effects function is a diffusion function of soft effect.
9.PRE	A digital imaging system for image filtration comprising:
9.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, an application specific integrated circuit, system software, a database management system and a memory storage sub-system;

Ref	Limitation
9.b	wherein the aberrations from the optical lens mechanism are corrected by applying digital filtration by using the application specific integrated circuit and the digital signal processor;
9.c	wherein the microprocessor is used to provide digital and optical data to the digital signal processor;
9.d	wherein the system software is organized to identify specific optical aberrations and to access the database to identify specific corrections to the aberrations;
9.e	wherein the system software forwards the data from the digital sensor to the digital processor;
9.f	wherein the digital signal processor selects a specific procedure to optimize the image and corrects the aberrations;
9.g	wherein the lens type is a zoom lens;
9.h	wherein the lens focal length alternates from specific fixed focal length lens settings in a succession of steps;
9.i	wherein optical aberrations are corrected with digital filtration to modify multiple images from different focal lengths in a succession of data files; and
9.j	wherein the modified data file consisting of the digital data optimized from the aberrations that are corrected from the original optical image is stored in memory.
18.PRE	A method of image filtration which comprises
18.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, an application specific integrated circuit, system software, a database management system and a memory storage sub-system;
18.b	wherein the aberrations from the optical lens mechanism are corrected by applying digital filtration by using the application specific integrated circuit and the digital signal processor, the method consisting of;
18.c	forwarding the data from a digital sensor to a digital signal processor by an application specific integrated circuit;
18.d	providing digital and optical data to the digital signal processor;
18.e	identifying specific optical aberrations and accessing a database to identify specific corrections to the aberrations: [sic]
18.f	selecting a specific procedure from the database using the microprocessor to optimize the image and correct the aberrations: [sic]

Ref	Limitation
18.g	applying digital filtration by using the application specific integrated circuit and digital signal processor to correct digital or optical aberrations: [sic]
18.h	applying a fast Fourier transform to a data file in order to satisfy a user specified special effects function;
18.i	modifying the data file by applying the special effects function using the digital signal processor; and
18.j	storing the data file in memory.
19.PRE	The method of claim 18 further comprising the step of:
19.a	applying the special effects function as a color enhancing function.
20.PRE	The method of claim 18 further comprising the step of:
20.a	applying the special effects function as a diffusion function of soft effect.
24.PRE	A method of image filtration comprising:
24.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, an application specific integrated circuit, system software, a database management system and a memory storage sub-system;
24.b	wherein the aberrations from the optical lens mechanism are corrected by applying digital filtration by using the application specific integrated circuit and digital signal processor, the method consisting of;
24.c	alternating the lens focal length of a zoom lens from specific fixed focal length lens settings in a succession of steps;
24.d	creating data files corresponding to each focal length lens setting;
24.e	forwarding the data from a digital sensor to the digital signal processor;
24.f	providing digital and optical data to a digital signal processor;
24.g	identifying specific optical aberrations and accessing a database to identify specific corrections to the aberrations;
24.h	selecting a specific procedure from the database using the microprocessor to optimize the image and correct the aberrations;
24.i	applying digital filtration by using the application specific integrated circuit and digital signal processor to correct digital or optical aberrations;
24.j	correcting optical aberrations with digital filtration to modify multiple images from different focal lengths in a succession of data files; and
24.k	storing the modified data files in memory.

APPENDIX B: MATERIALS CONSIDERED

Exhibit	Description
1001	U.S. Patent No. 7,612,805
1002	Prosecution History of U.S. Patent No. 7,612,805
1003	RESERVED
1004	Curriculum Vitae of Leonard Laub
1005	U.S. Patent Publication No. 2005/0280877 (“Watanabe”)
1006	Certified Translation of Japanese Patent Application No. JP2004-233872 (“JP-872”)
1007	Certified Translation of Japanese Patent No. JPA 2004-343358 (“Kishida”)
1008	Certified Translation of Japanese Patent Application Publication JP 2004-328506A (“Kita”)
1009	U.S. Patent Publication No. 2003/0223007 A1 (“Takane”)
1010	RESERVED
1011	RESERVED
1012	RESERVED
1013	RESERVED
1014	RESERVED
1015	RESERVED
1016	RESERVED
1017	RESERVED
1018	PCT Publication No. WO 2004/093438 A1 (“Dutta”)
1019	Texas Instruments, TMS320C8x System-Level Synopsis (Sep. 1995)
1020	RESERVED
1021	RESERVED
1022	U.S. Patent No. 9,063,982 (“Bestgen”)
1023	U.S. Patent No. 6,920,443 (“Cesare”)
1024	U.S. Patent Publication No. 2006/0268357 A1 (“Vook”)
1025	U.S. Patent No. 5,739,691 (“Hoenninger”)
1026	Prosecution History of U.S. Patent No. 8,451,339
1027	Dkt. No. 88, Claim Construction Memorandum Opinion and Order, <i>Optimum Imaging Technologies LLC v. Canon Inc.</i> , No. 2:19-cv-00246 (E.D. Tex. June 11, 2020)
1028	<i>digital filter</i> , Comprehensive Dictionary of Electrical Engineering (2d ed. CRC Press 2005)

Exhibit	Description
1029	<i>database management system</i> , Newton’s Telecom Dictionary (CMP Books, 2005)
1030	<i>Canon Inc. v. Optimum Imaging Technologies LLC</i> , IPR2020-1322, Paper 1 (Jul. 20, 2020) (“-01322 Petition”)
1031	<i>Canon Inc. v. Optimum Imaging Technologies LLC</i> IPR2020-1322, Paper 9 (Mar. 1, 2021) (“-01322 D.I.”)
1032	<i>Canon Inc. v. Optimum Imaging Technologies LLC</i> , IPR2020-1321, Paper 1 (Jul. 20, 2020) (“-01321 Petition”)
1033	<i>Canon Inc. v. Optimum Imaging Technologies LLC</i> , IPR2020-1321, Paper 10 (Mar. 1, 2021) (“-01321 D.I.”)
1034	RESERVED
1035	U.S. Patent Publication No. 2006/0050335 A1 (“Dorrell”)
1036	U.S. Patent Publication No. 2006/0098253 A1 (“Masuno”)
1037	Dkt. No. 1, Complaint, <i>Optimum Imaging Technologies LLC v. Sony Corp.</i> , No. 4:23-cv-00928 (E.D. Tex. Oct. 18, 2023)
1038	RESERVED
1039	RESERVED
1040	U.S. Patent No. 7,206,136 (“Labaziewicz”)
1041	U.S. Patent No. 5,444,482 (“Misawa”)
1042	U.S. Patent No. 5,742,806 (“Reiner”)
1043	U.S. Patent No. 7,245,319 (“Enomoto”)
1044	Certified Translation of Japanese Patent No. JPH (1999)-313250 (“Yamagata”)
1045	U.S. Patent No. 5,905,530 (“Yokota”)
1046	U.S. Patent Publication No. 2004/0150732 (“Yamanaka II”)
1047	GUAN et al., <i>Digital Image Correcting Method for Digital Camera</i> (December 2005) (“Ricoh”)
1048	U.S. Patent No. 5,999,330 (“Goosey”)
1049	U.S. Patent No. 7,738,015 (“Steinberg I”)
1050	U.S. Patent No. 7,590,305 (“Steinberg II”)
1051	Certified Translation of Japanese Patent No. JPA 2002-190979 (“Kuniba”)
1052	Certified Translation of Japanese Patent No. JPA 2000-184247 (“Imai”)
1053	GONZALEZ & WOODS, <i>DIGITAL IMAGE PROCESSING</i> , (Prentice Hall, 2d ed. 2002) (“Gonzalez”)

Exhibit	Description
1054	JOHN C. RUSS, THE IMAGE PROCESSING HANDBOOK (CRC Press, 4th ed. 2002) (“Russ”).
1055	U.S. Patent No. 7,609,297 (“Master”)
1056	U.S. Patent Publication No. 2007/0080280 (“Havens”)
1057	U.S. Patent No. 7,936,392 (“Ng”)
1058	Certified Translation of PCT Publication No. WO 2002/069214 (“Takae”)
1059	U.S. Patent No. 6,279,004 (“Lee”)
1060	Certified Translation of Japanese Patent Application Publication No. JP 2001-251546A (“Iida”)
1061	U.S. Patent No. 5,818,524 (“Juen”)
1062	The image processing handbook, Library of Congress Catalog, available at https://lccn.loc.gov/2002073595
1063	U.S. Patent Publication No. 2002/0135688 (“Niikawa”)
1064	U.S. Patent No. 4,903,204 (“Dobbins”)
1065	U.S. Patent No. 5,414,782 (“Carasso”)
1066	Certified Translation of Japanese Patent No. JPA 2006-72660 (“Yamazaki”)
1067	U.S. Patent Publication No. 2003/0095197 (“Wheeler”)
1068	RESERVED
1069	U.S. Patent No. 5,630,153 (“Intrater”)
1070	U.S. Patent No. 5,864,409 (“Kashida-409”)
1071	PCT Publication No. WO 1993-020536 A1 (“Reddig”)
1072	U.S. Patent No. 5,475,420 (“Buchin”)
1073	RESERVED
1074	RESERVED
1075	RESERVED
1076	P. Strumiłło and M. Strzelecki, Fourier Transform of Images, available at http://mstrzel.eletel.p.lodz.pl/mstrzel/pattern_rec/fft_ang.pdf (visited May 10, 2024).
1077	U.S. Patent No. 4,841,322 (“Kawasaki”)
1078	U.S. Patent Publication No. US2007014347 A1 (“PrechtI”)
1079	U.S. Patent No. 7,767,949 (“Perlman”)
1080	U.S. Patent No. 8,009,195 (“Fuji”)
1081	U.S. Patent No. 8,849,964 (“Ralston”)