

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. IPR2024-01046
Patent No. 10,877,266

**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. 10,877,266 (EX1001, “the ’266 patent”), specifically claims 1-27, 29-30 (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 '266 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 “POSA”), 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 ’266 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 (“POSA”) 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 POSA would have understood the reference to disclose the limitation based on inferences that a POSA would reasonably be expected to draw from the explicit teachings in the reference when read in the context provided by the POSA's knowledge and experience.

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 POSA 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 POSA 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 '266 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 POSA 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 POSA; 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 ’266 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 POSA must have had a reason for combining teachings from multiple prior-art references (or for altering a single prior-art reference, in the case of obviousness in view of a single reference) in the fashion proposed.

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 POSA 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 POSA 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 (“POSA”)

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 (“POSA”) to which the patent is related on the patent claim’s date of invention. I have been informed and understand that a POSA 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 '266 patent issued from an application filed on July 6, 2007. I also understand that the '266 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 '266 patent is July 6, 2007, and I have applied that understanding in forming my opinions throughout this Declaration.

51. In my opinion the '266 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 POSA, the manner in which a POSA would have understood the claims of the '266 patent or its description, the manner in which a POSA would

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

53. I was asked to identify the POSA and their ordinary level of skill in the relevant art on the effective filing date of July 6, 2007. I understand that the POSA'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 POSA's ordinary level of skill. I have considered these factors in forming an opinion on the POSA's level of skill on July 6, 2007.

54. I believe a POSA in the field of the '266 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 POSA 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 POSA’s background and ordinary skill does not change if I were to consider the definition of a POSA on or around July 11, 2006, although the earlier date would change the scope of the POSA’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 POSA, and I have had a sufficient level of knowledge, experience, and education to provide expert opinions in the field of the '266 patent, particularly on how a POSA 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 POSA on July 6, 2007.

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

VI. CLAIM INTERPRETATION

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

60. All other terms should be given their ordinary meaning to a POSA.

VII. SUMMARY OF OPINIONS

61. I was asked to provide my opinion on (1) the level of ordinary skill in the art pertinent to the '266 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 1-2, 4-5, 8-9, 11-27, and 29-30) in the '266 patent.

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

63. 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 POSA on July 6, 2007. My opinions do not change if I instead assume the level of ordinary skill of the POSA on July 11, 2006.

64. 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 1-2, 4-5, 8, 11, 13-20, 22-23, 25, 27, and 30 are obvious over U.S. Patent Application Publication 2002/013568A1 (EX1006, “Niikawa”) in view of Japanese Patent No. 2004-192178 (Cert. Translation) (EX1005, “Watanabe-JP”);
- Claims 1-3, 5-11, 16, 19, and 22-24 are obvious over Niikawa in view of Watanabe-JP in view of U.S. Patent No. 6,301,440 (EX1007, “Bolle”);

- Claims 1, 11-12, 21-22, and 25-26 are obvious over Niikawa in view of Watanabe-JP in view of International Application Publication WO 2006/039486A2 (EX1008, “Ng”);
- Claims 1, 22, 29, and 30 are obvious over Niikawa in view of Watanabe-JP in view of U.S. Patent Application Publication No. 2006/0050158A1 (EX1011, “Irie”);
- Claims 1, 17 and 22 are obvious over Niikawa in view of Watanabe-JP in view of U.S. Patent Application Publication No. 2005/0280877 A1 (EX1013, “Watanabe-US”).

VIII. THE '266 PATENT

A. Overview

65. The '266 patent describes performing image corrections in-camera that were, according to the patent, conventionally performed by optical filters or by external software. 6:42-54, 7:27-40, 8:14-19, 13:19-23. The specification discloses various image corrections, e.g., lens aberration corrections (30:58-31:32), color enhancing (15:20-33), tonal range correction (14:15-67, 33:12-19) and depth of field optimization correction (13:31-14:14, 33:6-11) that were well-known and conventionally performed in-camera (16:43-17:15, 26:54-27:3, 32:50-34:4).

B. Background

66. The '266 patent relates to digital image processing. It describes digital techniques carried out within a digital camera for correcting imperfections in images.

67. The image corrections addressed in this declaration fall into three groups:

- Those due to characteristics of the image sensor in the camera; and
- Those due to the characteristics of the scene or subject being photographed; and
- Those due to characteristics of the lens used to capture an image.

1. Digital Photography

68. 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.

69. Historically, that surface has been a plate or a flexible film covered with a light-sensitive emulsion containing silver halide crystals (“film”).

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).

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

2. Digital Image Correction In Camera

71. It has been known since at least 1992 and 1994 (the original filing dates of Yokota and Fisher cited below) that image correction may be performed in a digital camera using on-board digital processing:

“An image pickup apparatus is disclosed which is provided with a distortional-aberration memorizing element for memorizing distortional-aberration information about an objective lens, a state-of-objective-lens detecting circuit for detecting a State of the objective lens, an image correcting circuit for reading out distortional-aberration information about distortional aberration occurring during photography from the distortional-aberration memorizing element on the basis of information supplied from the state-of-objective lens detecting circuit, and electrically correcting a distortion of an image due to the objective lens with a predetermined image height in a photographed image selected as a datum.” US 5,905,530 (EX1066, “Yokota”), Abstract

“An integrated image capture system: a portable digital image capture device; and image manipulation software. The manipulation software provides a user with the ability to adjust the captured imagery to suit his or her personal preferences, directly from the camera itself.” US 2004/0080621 A1 (EX1019, “Fisher”), [0023]

“The invention is distinguished over the known prior art in a multiplicity of ways. For one thing, the invention allows the user the opportunity to initiate correction work immediately after capture. Equally as important, however, is the ability in another embodiment to

have an "auto correct" button (e.g., well known in the art-i.e., Photoshop) to provide the user with the ability to automatically correct and adjust their imagery.” Fisher, [0028]

72. 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 (EX1063 (“Yamagata”), [0003]-[0004] cited in full below)

73. An illustrative example can be seen in a study conducted by Ricoh published in 2005. In that study, image processing was used to correct distortion and shading. 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. 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., “distortion aberration depends on the zoom position (the focal length used)”, “distortion aberration is calculated for each of the conditions of lens zoom position and photographing distance”):

“At Ricoh, digital camera development has been performed with the keyword of ‘expanding the area of photographing,’ and one of the means to achieve this purpose is the adoption of wide-angle zoom lenses. However, distortion aberration, chromatic aberration, and decrease in the peripheral light amount tend to occur with wide-angle

zoom lenses, and minimizing these aberrations and securing abundant peripheral light amount by optical design alone are obstacles to lens miniaturization. Thus, we have developed a technique to correct image distortion and decrease in the peripheral light amount using image processing. According to this method, it is possible to improve the image quality of an image taken with a digital camera by software processing. By implementing various speed-enhancing innovations, the software in the camera alone corrects these degradations without using any special hardware. We conducted image correction experiments using actual images photographed with a digital camera, evaluated the image quality of the corrected images and the processing time inside the camera, and checked and confirmed the effectiveness of this method.” Digital Image Correcting Method for Digital Camera (EX1046, “Ricoh”), p. 103

74. Also known was use of various correction approaches to handle still versus moving images to fit correction into the time between image captures:

“A digital photographing device in which processing time for correcting optical distortion is shortened. A first distortion correction circuit, which can carry out processing at a low correction accuracy but in a short time, and a second distortion correction circuit, which carries out processing at a high correction accuracy but requires time for processing, are provided at an image processing circuit for processing digital image data. Control is carried out such that the second distortion correction circuit is selected and carries out optical distortion correction at a high accuracy only at a time of actually photographing a still image (i.e., when the still image photographing mode is selected and a release button is depressed fully).

In other cases, control is carried out such that the first distortion correction circuit is selected.” 2003/0223007A1 (“Takane”), Abstract

a. Storage of Correction Information

75. 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:

“For example, JPA H2(1990)-123879 discloses a technology that has a means to store distortion and shading information in an interchangeable lens, sends the aforesaid information to the body, corrects the image information obtained from the imaging element in the body, and stores the corrected high quality image information in memory.” JPA2000-184247 (EX1064, “Imai”), [0005]

76. 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 POSA what information was to be used in processing, where that information could be stored, and how it could be used to correct images.

b. Digital Filters

77. A digital processing algorithm which carries out image correction is sometimes called a “filter.”

“The image signal obtained is converted to, for example, a 12-bit digital signal by a not-shown A/D converter, and the digital signal is outputted to the image processing unit 22.” Yamanaka, [0050]

“the control unit 25 can identify the state of the image capturing optical system at the time of photographing (hereinafter, referred to as the image capturing condition). The control unit 25 determines an image filter (hereinafter, simply referred to as a filter) applied when the color interpolating process and chromatic aberration correcting process are performed in the image processing unit 22 and supplies the filter to the image processing unit 22. In order to determine the filter, the memory 27 is provided in the body 2.” Yamanaka, [0057]-[0058].

c. Digital Image Processing in Software

78. A POSA would readily appreciate that digital image processing technology for cameras could be implemented in any one of a number of manners.

79. Software applications for executing image processing were known before the filing date:

“It can be appreciated that many of the processes implemented in the digital camera may be implemented in or controlled by software operating in a microprocessor (μ Proc), central processing unit (CPU), controller, digital signal processor (DSP) and/or an application specific integrated circuit (ASIC), collectively depicted as block 120 and termed as “processor.” US 7,738,015 B2 (EX1043, “Steinberg-2”), 4:8-14

“In the following description, a preferred embodiment of the present invention would ordinarily be implemented as a software program, although those skilled in the art will readily recognize that the

equivalent of such software may also be constructed in hardware.” US 2003/0095.197 A1 (EX1070, “Wheeler”), [0047]

80. The successful implementation of software-defined processing into cameras was vital to the rise in popularity of digital cameras. Software allows a POSA to program the various internal workings of the camera to carry out the tasks desired by the user.

3. Corrections Due to the Image Sensor

81. Historically, that surface has been a plate or a flexible film covered with a light-sensitive emulsion containing silver halide crystals (“film”).

82. 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). Typically, those electrical signals are converted in the camera to digital data representing the image.

83. Digital cameras often correct captured images for gamma (γ), tonal range, and defective pixels.

a. Gamma Correction

84. The term “gamma” (represented by the Greek letter γ) refers to the relationship between light intensity falling on a sensor and the electrical signal produced by that sensor, or between electrical signal sent to an image display and the brightness of light delivered by that display. This can be expressed as an

exponential relation between input and output, with the exponent designated γ . A linear relationship occurs when $\gamma=1$, but other values of γ may be desired in specific situations.

85. Either way, it is desirable to correct that relationship to achieve a specific result, and this is often done by digital processing of the image signal in the digital camera:

“A gamma correction circuit, that can be used for a video camera having an image pick-up element for generating a video signal corresponding to an object image, and an analog-to-digital converter for converting the video signal generated from the image pick-up element to a corresponding digital video signal, comprises a memory (12) for storing slope data and intercept data of each portion of a polygonal line approximating a desired gamma correction characteristic” (EX1057, “Murayama”), Abstract

“Figure 3 shows the configuration of a gamma correction circuit according to an embodiment of the invention. In Figure 3, a digital video signal X provided by converting a video signal from a charge coupled device (CCD) image sensor (hereinafter referred to as a CCD) of, for example, a video camera to a digital signal is supplied to an encoder 11 and to a multiplier circuit 13 from an input terminal 10. The encoder 11 converts the input digital video signal X to a readout address for a memory circuit 12. The memory circuit 12 comprises, for example, a random access memory (RAM). In the memory circuit 12, slopes (hereinafter referred to as slope data a_n) and intercepts

(hereinafter referred to as intercept data b_n) of respective line serpents forming a polygonal line approximating to a gamma correction characteristic, that is a curve represented by $Y=X^{(1/\gamma)}$, are stored. The slope data a_n and the intercept data b_n stored in the memory circuit 12 are read out on the basis of a readout address from the encoder 11. The slope data a_n thus read out are supplied to the multiplier circuit 13, and the intercept data b_n thus read out are supplied to an adder circuit 14. The multiplier circuit 13 multiplies the input digital video signal X supplied via the input terminal 10 by slope data a_n from the memory circuit 12 and supplies the multiplied result (product) to the adder circuit 14. The adder circuit 14 adds the output from the multiplier circuit 13 and intercept data b_n from the memory circuit 12 to output the added result (sum), at an output terminal 15, as a gamma corrected digital video signal Y .” Murayama, 3:20-51

“Referring to FIG. 1, a digital still camera 10 of this embodiment includes a CCD imager 12. The CCD imager 12 receives optical images of an object through a mosaic type primary-color filter 12a as shown in FIG. 2 to create a camera signal corresponding to the optical image. The camera signal is subjected to correlate double sampling and automatic gain control by a CDS/AGC circuit 14. The camera signal thus processed is converted into a digital signal by an A/D converter 16. While a shutter release button 38 is not depressed, a control circuit 42 connects the switch SW1 to a terminal 40b, turned on a switch SW2, and turned off a switch SW3. A third gamma table 30 is previously stored with a gamma characteristic for bit map display, as shown in FIG. 4. A first gamma correction circuit 18

references third gamma table to gamma-correct the digital signal from the A/D converter 16 in a manner appropriate for bit map display.”

EX1058 (“Haruki”), 3:12-25

b. Tonal Range Correction

86. As acknowledged by the ‘266 patent (EX1001, 14”15-15:19), digital image sensors have limited linear range of electrical representation of image brightness. This causes dark areas of the scene or subject to go to apparent black, or light area to be “blown out” to apparent white.

87. Digital correction of tonal range, to produce images with well-resolved dark and light areas, was known, e.g., by capturing both an underexposed and an overexposed image of the subject, then synthesizing a single image from those two:

“there have been proposed image processing techniques wherein using two images of different image qualities that have been captured for the same subject, an image having improved image quality and graphic effect compared to the original images is synthesized.” EX1006 (“Niikawa”), [0005]

“this image processing apparatus comprises... an image generator for generating a synthesized image of the first image and the second image” Niikawa, [0014]

“As for this first image F1, since the exposure time of the CCD 303 is set shorter than the proper value, the image is in general dark because of less

amount of light exposure compared to images captured in the normal exposure mode.” Niikawa, [0109]

“AS for this second image F2, since the exposure time of the CCD303 is set longer than the proper value, the image is in general light because of the amount of light exposure is larger in comparison with images captured in the normal exposure mode.” Niikawa, [0110]

“In the image synthesis process, by adding the image data of the first image F1 and the image data of the second image F2 for every pixel at an appropriate adding ration, image data having desired gradation characteristic within the range interposed between the gradation characteristic LU and the gradation characteristic LO in FIG. 12A is generated.” Niikawa, [0119]

c. Defective Pixel Correction

88. Digital image sensors have millions to tens of millions of pixels, each of which is intended to convert incident light to an electrical signal. Practical manufacturing issues can leave a few such pixels “stuck” on white or black. Dust getting into the camera can adhere to and obscure some pixels. Both effects will be evident in the captured image unless corrected.

89. Digital correction for defective pixels using information from neighboring pixels was known:

" An image capture device provided with a first memory unit, which memorizes position information of non-continuous defective pixels of a solid-state image capture component, and a second memory unit with a

higher access rate than the first memory unit, which memorizes position information of continuous defective pixels. When a continuous photography mode or a video photography mode is set, defective pixel correction processing is carried out on image data corresponding to each of defective pixels according to the defective pixel position information stored at the second memory unit. Alternatively, when a still photography mode is set, image data corresponding to all defective pixels is corrected, based on both the defective pixel position information stored at the first memory unit and the defective pixel position information stored at the second memory unit. As a result, it is possible to correct defective pixels with high efficiency in accordance with conditions of photography.” US 2006/0050158A1 (EX1011, “Irie”), Abstract.

4. Corrections Due to the Scene or Subject Being Photographed

90. Digital cameras often correct white balance and depth of field.

a. White Balance

91. The term “white balance” refers to errors in overall color in the image due to the color characteristics of the lighting on the subject. White balance is often corrected digitally in the digital camera:

“Currently, the automatic white-balance correction method is in wide spread use in the digital camera, digital video camera or a PC camera. However, the variation of natural light due to different time or weather condition and the effect of artificial illumination may cause errors in color tones as taking pictures by a camera or video camera. For example, the picture will show yellow color when the color

temperature of light source is low, and blue color when the color temperature of light source is high. Therefore, the high color temperature (8500K) of light source from the fluorescent lamps commonly used in our everyday life will make the color of picture to be of blue color. Moreover, the specific wavelength of the fluorescent lamps may also make the color of picture to be of green color. As such, there is a need to perform an adjustment such that the color of the captured object is not affected by the circumstance. Such an adjustment is performed by white-balance correction, which allows the captured picture to be white-balanced in color. That is, the color of a white object is always shown to be white under any light sources.” EX1025 (“Hsieh”), 1:14-35;

“For digital cameras, if white balancing is not performed well then captured images may appear to have a color bias or some colors in a captured image may not appear natural compared to other colors in the captured image.” EX1031 (“Dorrell”), [0003];

“adjusting the white balance of the first image using the determined color transform” Dorrell, [0025].

b. Color Enhancement

92. Similar manipulation of the color components of the image data can be done to adjust the strength (saturation) of some or all colors in an image. This can be done for esthetic reasons or to produce a special effect.

c. Depth of Field

93. As acknowledged by the '266 patent (EX1001, 13:34-14:15), the combination of what's in the scene and the photographer's inclination as what items in the scene to render in sharp focus makes the range of subject distances in which focus is maintained, known as "depth of field" of interest in creating the most satisfactory image.

94. It was known to adjust depth of field by changing the setting of the aperture in the lens (its f-number), and to make that adjustment in some optimal way either manually or automatically:

"Sometimes the scene arbitration unit, 226, will report several potential scene classifications instead of just one. In such cases the intent of the photographer is often not clear; for example, there might be two people at different depths. Here the photographic expert, 104, must choose a consistent set of imaging parameters in some way. The camera may do this by having some default or 'optimal' set of parameters for every situation, with certain hypotheses predetermined to override alternative hypotheses. For instance, it may choose the focus based on the nearest subject or always choose the depth-of-field to keep all subjects in focus when possible. This would be preferable for a camera in the "point-and-shoot" category or for a "Zero intervention mode" of a more sophisticated camera. However, for the more experienced user, the choices may be offered to the user through some user interface, 105." EX1007 ("Bolle"), 5:52-67

5. Corrections Due to the Lens

95. 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.

96. 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.

97. 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.

98. 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.

99. 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.

100. 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 was well known to developers and inventors of digital image correction systems:

“It is preferable that the image quality deterioration corrected by the lens characteristic correction unit is at least one of a chromatic aberration of magnification, a distortion aberration, defocusing and a decrease in marginal lumination.” US 7,245,319 B1 (EX1068, “Enomoto”), 2:10-14

“Among the image quality-related factors that are obtained as the output of a camera through a lens as described above, the lens has a factor known as Seidel 5 aberrations. To reduce these aberrations, low-dispersion glass is used for the lens material and a large number of lenses are combined in order to improve resolution; in order to eliminate distortion, high-end electronic field production (EFP) lenses are forced to become larger and larger. This has forced electronic news gathering (ENG) cameras, for which lightweight performance is required, to suffer from various aberrations, including distortion

performance.

This invention was made to solve the above problem. The problem to be solved by this invention is to improve the distortion aberration among the Seidel 5 aberrations, which is not only related to the weight of the lens but also reveals whether the image quality is good or bad at first glance. This invention attempts to solve this problem on the camera side, independent of the lens. In addition, this invention also provides a means to compensate for each focal length, since the distortion aberration changes in relation to the focal length as the focal length changes during zooming. Furthermore, the distortion aberration, which shows unique characteristics when a lens is replaced, will be immediately corrected for each lens when the lens is attached or detached.” JPH (1999)-313250 (EX1063, “Yamagata”), [0003]-[0004]

“According to this method, pixel signals are read out from the solid-state image pickup device in accordance with the geometrical deformation of an image which occurs in a photographic lens, and the read-out pixel signals are subjected to interpolation so that the distortional aberration of the image is corrected. However, in a case where a zoom lens is used as the objective lens, if correction of the distortional aberration of the zoom lens is to be performed at each photographing position thereof by using signal processing, an enormous amount of computing processing and an extremely long computing time as well as a large-scale signal processing circuit are needed for the signal processing.” US 5,905,530 (EX1066, “Yokota”), 1:45-57

“an image capturing apparatus comprises: an image capturing optical system; a color image sensor for converting a light image obtained by said image capturing optical system to an image signal having a color component which varies according to a pixel; and an image processor for concurrently performing a chromatic aberration correcting process of correcting a chromatic aberration of said image capturing optical system and a color interpolating process of interpolating a dropout color component pixel by pixel on an image signal generated by said color image sensor.” US 2004/0150732 A1 (EX1069, “Yamanaka”), [0012]

101. As mentioned above, aberrations originate from the design and construction of the lens and are affected by the settings of the lens.

102. Most camera lenses incorporate an aperture (often realized as an iris diaphragm) which can be opened or closed to varying 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.

103. 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.

104. 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” (also sometimes called “one step”).

105. 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.

106. 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.

107. 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.”

108. 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:

“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.” US 5,999,330 (EX1045, “Goosey”), 1:37-42

“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.” Goosey, 1:51-57

“The data indicative of the amount of distortion may be memorized in the form of raw data relative to each zoom position and each focus position, or may also be memorized in the form of the coefficient of a function which approximates the amount of distortional aberration.” Yokota, 7:27-32

“An image restoring method as described in Claim 9, wherein in such an image restoring method, the aforesaid image restoring step is a correcting process with a filter having inverse function characteristics of the amplitude transfer function of the aforesaid optical system, and it restores the image to the frequency characteristics prior to passing through the aforesaid optical system using a filter with inverse function characteristics of the amplitude transfer function provided corresponding to the aforesaid amount of optical adjustment of the zooming amount, the defocusing amount, and/or the diaphragming amount.” JPA2004-328506 (EX1062, “Kita”), Claim 10

“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” JPA2002-190979 (EX1044, “Kuniba”), [0007]

“Reference Table 7 outputs the correction value data of the difference from normal distortion aberration to DSP 9, which configures closed-loop circuits and applies feedback. Furthermore, since the correction value output by the Reference Table 7 varies depending on the focal length of the zoom lens 2, etc., for example, the zoom position information is detected by the zoom position detecting means 6 through the servo means 5 that servos the zoom lens 2 of the camera 1, converted into a digital signal, and supplied to Reference Table 7, where the correction values corresponding to each focal length can be read out.” Yamagata, [0014]-[0015]

109. 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.

110. 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.

111. 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:

“Step S9: The image correcting unit 18 obtains a data table D(h) for distortion aberration from the lens information obtained in step S3.”

Kuniba, [0032]

“The MTF correction filter in the MTF inverse function table 87 is selected and determined by referring to a predetermined table using the zooming amount, defocusing amount, and diaphragming amount as keys.” Kita, [0060]

“The CPU 61 checks image capturing conditions from the tag information included in the image file (step S13) and specifies a parameter for correcting a chromatic aberration on the basis of the image capturing conditions (step S14). It is assumed that information indicative of optical characteristics of an image capturing optical system as the image capturing apparatus 1a connected to the computer 50 is preliminarily registered in the storing unit 62.” Yamanaka, [0164]

“The preferred embodiment then extracts the shooting parameters (120). Such parameters include, but not limited to data about: the generic device parameters such as Camera parameters (122) such as Camera name, Model, and conversion data specific for the camera, Lens parameters (124) such as Lens brand, lens type, lens focal length, and lens calibration tables; as well as parameters specific to

the image (126) such as focal length at acquisition, aperture range, aperture at acquisition.” US 7,590,305 B2 (EX1042, “Steinberg 1”), 4:50-5:4

112. 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:

“For example, JPA H2(1990)-123879 discloses a technology that has a means to store distortion and shading information in an interchangeable lens, sends the aforesaid information to the body, corrects the image information obtained from the imaging element in the body, and stores the corrected high quality image information in memory.” JPA2000-184247 (EX1064, “Imai”), [0005]

113. 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 POSA what information was to be used in processing, where that information could be stored, and how it could be used to correct for aberrations.

6. Digital Video Cameras

Digital photographic technique, as described above, captures images and renders them digitally for processing, storage, and delivery. A camera which captures a single image when requested by its user can be called a “still camera.” If this capture is done digitally, the device can be called a “digital still camera.”

114. Motion picture photography is based on collecting a rapid sequence of images. These images are referred to as “frames.” When these images are captured electronically, the result can be called “video.”

115. Digital video cameras work by capturing frames in rapid sequence, with each frame captured as in still digital photography. This is recognized in the ’266 patent: “video be viewed as merely a very rapid (30 to 60 frames per second) application of still photography” (EX1001, 27:35-36).

116. When images are captured and subsequently presented at rates of 24 frames per second (most movies), 30 frames per second (older television and computer monitors), or higher (e.g., 60 frames per second for 1080p 60 high-definition television, 120+ frames per second for gaming monitors), a human viewer perceives an illusion of continuous motion.

117. Video recording was a well-known digital camera functionality in 2006:

“[M]ost digital cameras use a zoom lens and a single color image sensor to capture still and motion images.”); EX1067 (“Labaziewicz”), 1:14-15

“digital electronic camera” captures “still and movie images” in “still picture” and “movie picture” modes. EX1065 (“Misawa”), 1:54-2:14

“a continuous photography mode or a video photography mode is set: EX1011 (Irie”), Abstract

“a mode setting unit, at which mode information representing a photography mode is set, and a correction unit which corrects the image data, wherein, when the mode information set at the mode setting unit represents one of a continuous photography mode for providing image data of a series of photographic images and a video photography mode for providing image data of a moving image... the mode information set at the mode setting unit represents a still photography mode for providing image data of a still image” Irie, [0009]

“As photography modes of the present embodiment, a case in which it is possible to set a still photography mode, which obtains image data of a still image when the release switch 32 is put into the full-pressed state, a continuous photography mode, which performs consecutive image capture of a designated number of images when the release switch 32 is put into the full-pressed State, and a video photography mode, which obtains image data of a moving image when the release Switch 32 is put into the full-pressed state, will be described.” Irie, [0035]

118. Some digital video cameras (e.g., television cameras) are dedicated to video, while others (e.g., many consumer and professional cameras) can take still photos as well as videos. In either case, a digital camera taking video can be called a “digital video camera.”

C. Summary of the '266 Patent

119. The '266 patent is directed to a digital camera system having “in-camera digital filters” that the patent alleges will “largely replace optical filters” and provide an “improvement over post-production digital filter systems which require substantial time, cost and skill to implement:”

“This digital imaging system eliminates, or minimizes, post-production processes. In addition, the system presents substantial cost savings as well as time savings relative to existing digital imaging systems because of the automation of integrated in-camera optical and digital corrections of aberrations. With the present system, in-camera digital filters will largely replace optical filters. With less distortion, cost and weight/size than current optical filters and with far more control and quality results, the present system demonstrates that in-camera digital filtration out-performs better than external filters. The in-camera filter system is also an improvement over post-production digital filter systems which require substantial time, cost and skill to implement.” EX1001, 7:27-40

120. More particularly, the '266 patent proposes integrating image correction algorithms into a digital camera that were, according to the patent, conventionally by optical filters (i.e., pre-sensor filters) or applied post-production using, for example, software applications such as Adobe Photoshop or proprietary programs sold by the camera manufacturer:

“In order to transcend the optical and digital limits of present camera systems, software systems have been developed that deal with the problems in post-production. While the most notable of these post-production digital editing software programs is Adobe Photoshop, each camera manufacturer has its own proprietary program. In the main, these post-production software programs are limited to color correction and sharpening/softening of images. Additionally, some of these software programs are able to emulate specific artificial filter techniques to produce creative modifications of an original image.”

EX1001, 6:42-54

“The in-camera filter system is also an improvement over post-production digital filter systems which require substantial time, cost and skill to implement.” EX1001, 7:38-40

“The present system provides in-camera digital corrections to both optical and digital aberrations. In the case of optical aberrations, distinct lens-specific imperfections are caused by wide-angle, telephoto and zoom lens types. In the case of digital aberrations, specific digital artifacts, such as aliasing and dust, must be corrected.”

EX1001, 8:14-19

“In the past, these optical filtration processes were added after the production process via editing software such as Photoshop. However, in the present system, these combinations of processes are performed in-camera by user-adjusted settings.” EX1001, 13:19-23

121. The '266 patent identified common optical aberrations (e.g., vignetting, pin cushion and barrel distortion, etc.) that were purportedly conventionally corrected for optically that the '266 patent corrects for using “digital filters” (i.e., operations performed on digital image data):

“Since each lens has specific aberrations, depending on manufacturer and even differences in the specimens themselves, the camera software system will have preprogrammed general corrections for each specific lens type... An effective software solution is one which brings the optical image quality to a level consistent with a benchmark as measured by low MTF curves for each lens in its class in terms of both resolution and contrast throughout the image... In a general sense, this process of correction is similar to correcting an ocular astigmatism with reading glasses. However, rather than using an optical solution to an ocular problem, the present system reveals a digital solution to an optical problem. 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... other types of distortion occur primarily in large aperture telephoto lenses, most notably chromatic aberrations... each lens with a unique optical formula will have specific aberrations, the corrections for which will be accessible in a database.” EX1001, 10:41-11:30

122. The '266 patent discloses storing corrections for different optical aberrations by lens type in a database system, an example “configuration” of which

is illustrated in FIG. 6 (below right). Corrections for specific optical aberrations can be obtained for a camera's specific lens and applied to correct for that aberration—e.g., via the “digital correction process” shown in FIG. 5 (below left) in which, “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)” and the “digital filter then applies a correction to the specific optical aberrations (530)”, which is “the vignetting effect” in this example as shown in red outline:

“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). As an example, the vignetting effect is corrected by gradually darkening the center of the image in concentric rings (540). FIG. 6 shows the database configuration of several different types of 24 mm f72.8 lenses (600 to 630) with different optical configurations. Each lens type has a different set of manifestations of optical aberrations including vignetting (640), spherical aberration (650), pin cushion distortion (660), barrel distortion (670) and comatic aberration (680). For each lens, there will be a unique combination of optical aberrations compared to each lens type from different optical configurations. The database is accessed to provide the multi-objective optimization solution for correcting several different optical aberrations for each specific lens formula.” EX1001, 31:14-27

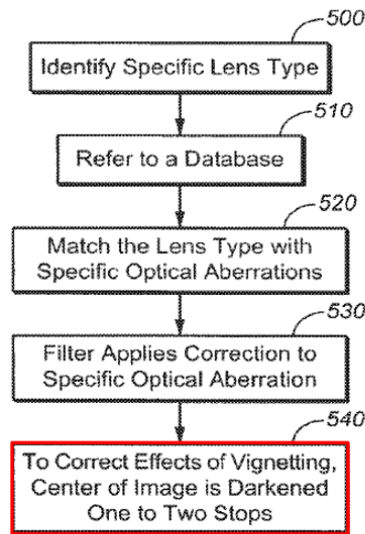


FIG. 5

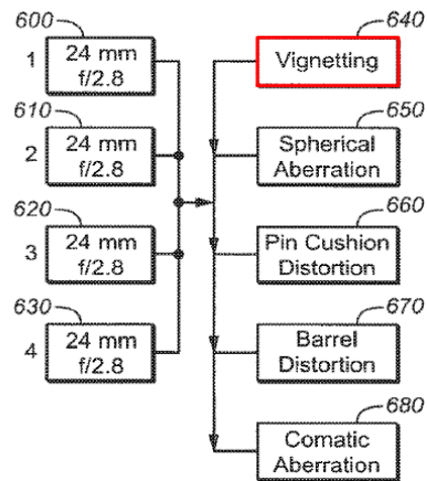


FIG. 6

123. FIG. 1 below shows a digital camera with a “database (190)” that is “connected to at least one sensor (A or B).” The ’266 patent’s database is “accessed” by the “camera’s microprocessor” to obtain data stored thereon, which is then used to carry out various image corrections:

“A digital signal processor (DSP) (195) is connected to at least one sensor (A or B). A database (190) is connected to at least one sensor (A or B) as well. The digital sensors are connected to an ASIC (195) and/or a microprocessor (193) in order to process the image and control the camera.” EX1001, 30:31-36

“Image exposure adjustment using in-camera filtration is described in FIG. 1.3. Once the camera assesses a two stop difference in parts of the image (1300), the camera's microprocessor accesses the database of similar scenes (1310) and then selects the optimal metering for the image and the user activates the digital sensor (1320), capturing an image.” EX1001, 33:41-46

“ 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). As an example, the vignetting effect is corrected by gradually darkening the center of the image in concentric rings (540). FIG. 6 shows the database configuration of several different types of 24 mm f72.8 lenses (600 to 630) with different optical configurations. Each lens type has a different set of manifestations of optical aberrations including vignetting (640), spherical aberration (650), pin cushion distortion (660), barrel distortion (670) and comatic aberration (680). For each lens, there will be a unique combination of optical aberrations compared to each lens type from different optical configurations. The database is accessed to provide the multi-objective optimization solution for correcting several different optical aberrations for each specific lens formula.” EX1001, 31:14-32.

FIG. 1

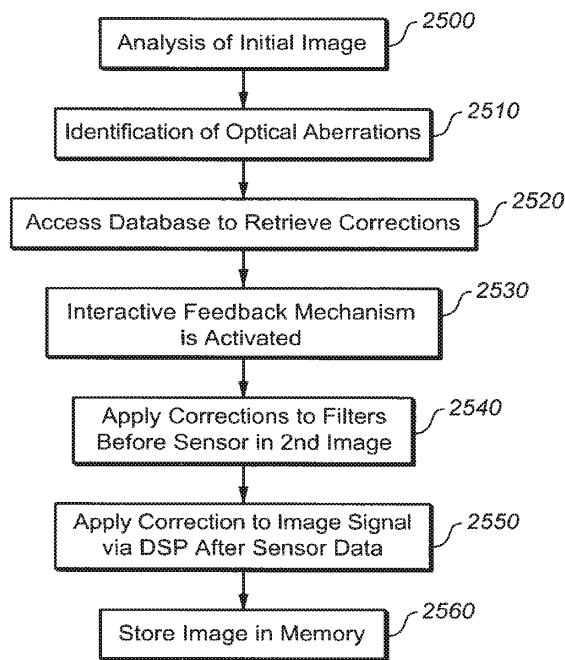


FIG. 25

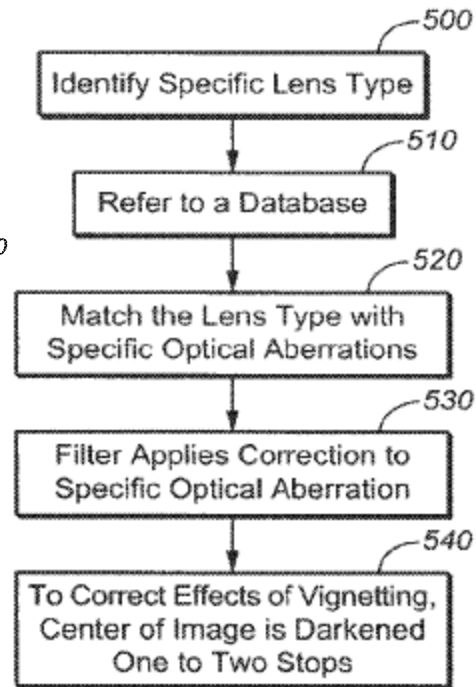


FIG. 5

124. The '266 patent discloses that the digital camera may include “wireless communication features” (not illustrated or described) that allow the camera to send “digital image data files wirelessly” to a computer and/or locations accessible via the Internet and software updates can also be “downloaded from the Internet to the camera, both automatically and through manual intervention,” as illustrated in FIG. 34 below:

“In FIG. 34, wireless communication features of the digital imaging system are described. The camera (3400) sends digital image data files wirelessly to a computer (3410). Files are also uploaded from the camera to the Internet in accessible locations (3450), while software files are downloaded from the Internet to the camera, both automatically and through manual intervention. Files are

automatically downloaded if the user sets the camera to receive automated software updates. One advantage of loading files automatically to the Internet is that the images are then automatically published (3460) at a remote location, or locations, for viewing.”

EX1001, 36:61-37:5

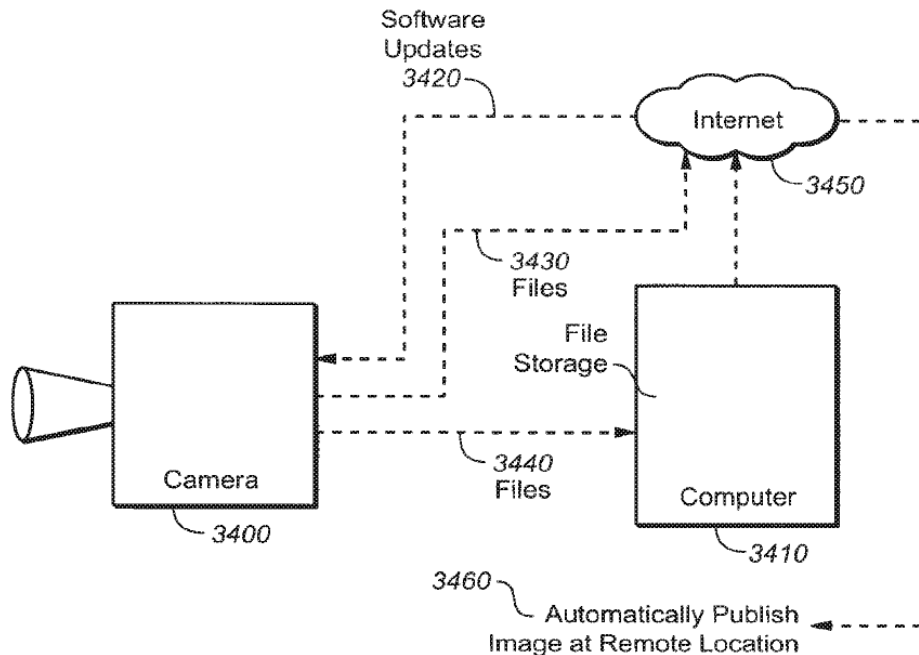


FIG. 34

D. The Claims of the '266 Patent

125. The '266 patent has 30 claims. In this declaration, those claims are parsed as shown in Appendix A.

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

1. Independent Claims

127. The challenged independent claims 1 and 22 are substantially the same. Both recite three known features of a digital camera, shown in claim 1 by way of example: (1) performing in-camera image correction processes, processing stored correction data, and storing corrected images ([1A], [1A1]-[1A2], [1B]); (2) upgrading the digital camera with updated software and correction data ([1A3]-[1A4], [1D]); and (3) wirelessly transmitting corrected images ([1C]).

128. All of these features were well-known, routine and conventional, as discussed in detail below regarding the respective limitations.

[PRE] a method of processing one or more images with a digital camera comprising:

[1A] digitally processing at least one captured image, the processing using in-camera hardware and software that is configured to:

[1A1] perform a plurality of image correction algorithms,

[1A2] process image correction data stored in a database system,

[1A3] receive updated software and image correction data, and

[1A4] upgrade the digital camera with the updated software and image correction data;

[1B] storing in memory one or more corrected images resulting from digitally processing the at least one captured image; and

[1C] wirelessly transmitting at least one of the one or more corrected images,

[1D] wherein the in-camera software and database system are upgradable to provide improved algorithms and correction data for correction of images.

2. Image Processing and Storage Limitations [1A1]-[1A2], [1B]

129. Conventional digital cameras performed a wide range of in-camera “image processing algorithms” ([1A1]). Many conventional imaging processing algorithms used correction data stored in the camera’s memory. ([1A2]).

“A plurality of correction tables for different parameters which are the optical conditions such as focal length and f-number at the time of imaging are prepared and stored in a shading ROM 153 provided in the general controller 150. The general controller 150 performs selection of correction table from the shading ROM 153 in accordance with the optical condition such as focal length and f-number at the time of imaging.” EX1006 (“Niikawa”), [0084]

“The WB circuit 124 adjusts a white balance of captured image by converting the level of image data of each color component R,G,B with the use of a level conversion table inputted from the general controller 150. The γ correction circuit 125 corrects a γ characteristic of image data. The γ correction circuit 125 corrects the level of each image data using the γ correction table which is preliminarily set.” Niikawa, [0086]

“A process such as distortion aberration correction or peripheral light intensity correction may be executed on image data as need arises. As a distortion aberration correction process, generally known is a table look-up method where a lens distortion aberration rate is predetermined at each focusing point and zoom position” EX1013 (“Watanabe-US”), [0006]

“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” Watanabe-US, [0047]

“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-US, [0049]

“a lens data memory for storing lens data that indicates the shading characteristics of the photographing lens, a lens data reader that reads the lens data based on the identification data, and an image corrector that corrects an error in the image of the subject caused by shading, based on the lens data read by the lens data reader and imaging device data that indicates the shading characteristics of the imaging device.” EX1014 (“Arimoto”), Abstract

“An image pickup device may include an optical system having a distortion that captures a distortion-containing optical image, a

conversion unit that converts the distortion-containing optical image into distortion-containing image data, a storage unit that stores the distortion-containing image data and additional data related to a distortion of the distortion-containing image data, and a distortion correction unit that corrects the distortion of the distortion-containing image data with reference to the additional data.” EX1015 (“Azuma”).
Abstract

130. Uniformly, the resulting “corrected images” are then “stored in memory” ([1B]) often on the camera’s memory card:

“The image memory 126 is a memory for temporarily storing image data for which image processing has been completed.” Niikawa, [0087].

“the recording controller 156 generates an image file in which tag information is attached to compressed captured image and thumbnail image, and records the image file onto the memory card 8.” Niikawa, [0100]

“the RAM 59 temporarily stores data to be processed by the CPU 57. Compressed image data are stored in the memory card 60 and the internal memory 69, as image data files.” Watanabe-US, [0039]

“The digitalized image signals are temporally stored in an image memory 42 after processing by a digital signal processing circuit 38.”
Arimoto, 4:49-51

“At the following step S20, the image signals, after undergoing various processes such as white balance adjustment and gamma

correction, are stored in the memory card 46, that is, the corrected photographed image is stored.” Arimoto, 5:51-55

“The frame memory 511 stores the corrected image signal that has been corrected by the image correction unit 501.” Azuma, [0137]

131. Limitations [1A1]-[1A2] and [1B] merely recite common operations routinely performed by conventional digital cameras.

3. Software Update Limitations [1A3]-[1A4], [1D]

132. Upgrading a camera’s software when improvements or additional features become available was also well-known. EX1007 (“Sarbadhikari”) disclosed updating a digital camera’s software correction tables more than a decade before the ’266 patent:

“It is well known that computer programs are updated more regularly than computer hardware, since the software can be refined to provide higher performance (i.e. better image quality) or more features while using the same hardware. An electronic camera can use a programmable digital processor controlled by software. Such a camera offers an opportunity for software updates, if the system is designed to facilitate such updates. What is needed is a method for software updates of the camera algorithms for higher performance, and for adding new features to a camera. Such a method should be quick and convenient for the user, preferably without requiring the use of additional storage modules. Existing memory devices are capable of limited two-way communication with an electronic camera, such as to report to the camera on memory space availability. An opportunity

exists for enhancing such "upstream" communication to provide altogether new applications for an electronic camera.” Sarbadhikari, 2:28-46

“A camera according to this invention, however, uses the removable media to transfer software previously recorded on the memory card (such as improved camera firmware to process the image, or a special access code) to the camera. The advantageous effect is that the operation of the camera or playback device can be improved some years after the camera is purchased, by using an "enhanced" memory card containing improved software for operating the camera or playback device. Moreover, such two-way communication opens use of the storage device to other enhancement possibilities, e.g., to modify image data in selected ways, to modify camera performance for special situations, or to communicate non-captured images (special overlays) to the camera.” Sarabadhikari, 3:8-21

“The invention is based on the recognition that the storage device, i.e., the memory card 3 in FIG. 1, need not be primarily oriented to storage of data for downstream (i.e., computer) processing. The storage device may additionally contain files (data, code, etc.) which are capable of upstream modification of image data and camera performance. This provides an opportunity for affecting image data during the capture and manipulation stages prior to storage. Furthermore, these files may be accessed automatically by the camera, or selected by the user by means of appropriate intervention through the camera. Therefore, the removable image storage device is capable of two-way communication with the camera. That is, the card slot

interface is not limited to "dumping" image data downstream to the removable storage device, but also allows communication from the removable storage device upstream to the camera as well. Inasmuch as the files are software which enhance the operation of the camera, the digital storage device may be viewed as a software-enhanced device, and the files are hereinafter referred to as enhancement data files. A number of advantages arise from such two-way communication. Enhancement files can be included in the digital storage device which are not in themselves images. Image processing software, look-up tables, matrices, compression tables, dynamic range optimization tables, and other files capable of affecting the captured image data can be included in the digital storage device. Typical algorithms which can be modified, or updated, thus include color filter array interpolation algorithms, noise reduction algorithms, edge sharpening algorithms, color reproduction algorithms, compression algorithms, or dynamic range optimization algorithms” Sarabadhikari, 4:37-5:1

“While the invention has been described with particular reference to several embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements of the embodiments without departing from invention. For example, instead of using a removable memory card 24, the image data files 24a and enhancement files 24b could be stored in non-removable electrically programmable non-volatile memory located inside the camera. As shown in FIG. 11, image data would be downloaded from the non-volatile image memory 35 in the camera 1

to the computer 4 over a standard electrical computer interface cable 38, such as a RS-232 or SCSI interface connection. The enhancement file would be supplied on a floppy disk, downloaded to the computer 4, and then uploaded by the computer 4 to an electrically erasable firmware memory 36 in the camera 1 via the same interface cable 38. This additional embodiment of the invention is further shown in FIG. 10 in relation to an interface section 34 through which images are transferred to the computer 4 and operating software is uploaded from the computer to the electrically erasable firmware memory 36 in the camera. FIG. 11 generally shows the connection of the camera of FIG. 10 to a computer 4 by means of a standard electrical computer interface cable 38. In addition, many modifications may be made to adapt a particular situation without departing from the essential teachings of the present invention. It is accordingly intended that the claims shall cover all such modifications and applications as do not depart from the true spirit and scope of the invention.” Sarabadhikari, 11:14-42

133. EX1005 (“Watanabe-JP”) and EX1008 (“Kokubu”) both discuss the benefits of this known technique and disclose different beneficial approaches to performing software upgrades, wirelessly and camera-to-camera, respectively:

“information equipment operates based on programs stored in its internal memory, but there are cases in which the version of a program may be upgraded by eliminating defects or adding new functions that were not considered when the program was designed. For this reason, a system has been proposed in which the memory in

which the program is stored in the information equipment is rewritable, the information equipment is connected to a storage device that stores the version upgraded program, and the version upgraded program is sent to the information equipment to upgrade the version of the program of the information equipment (see Patent Documents 3 and 4). According to this system, information equipment and storage devices are connected by connectors, etc., and updated program data is sent from the storage device to the information equipment to update the program of the information equipment.” Watanabe-JP, [0004]

However, in the systems described in Patent Documents 3 and 4 above, if the connector is inadvertently disconnected during transmission of program data, transmission of program data will stop. If the transmission of program data is stopped in this way, not only will the program not be updated, but also the program may be updated in an incomplete form, which may cause problems in the operation of the information equipment. In addition, it is necessary to provide a connector to properly connect the information equipment and the storage device.” Watanabe-JP, [0009]

“The data management system according to this invention has information equipment equipped with a first transmission means for generating power by electromagnetic induction with electromagnetic waves and transmitting and receiving information superimposed on the said electromagnetic waves, a second transmission means for data communication by wireless method, and a data storage means for storing the predetermined data, and a host device provided with a third transmission means that outputs the aforesaid electromagnetic waves

to the first transmission means and transmits and receives information superimposed on the said electromagnetic waves, a fourth transmission means for performing wireless data communication, and a data management means that when the aforesaid third transmission means is brought into proximity with the aforesaid first transmission means the aforesaid electromagnetic waves are output from the third aforesaid transmission means, and at the same time, the storage information about the aforesaid predetermined data stored in the aforesaid data storage means, which is superimposed on the electromagnetic waves output by the aforesaid first transmission means, is obtained via the aforesaid third transmission means, and then data communication between the aforesaid fourth transmission means and the aforesaid second transmission means is performed based on the stored information to perform data management of the aforesaid predetermined data.” Watanabe-JP, [0012]

“in the data management system according to this invention, the aforesaid prescribed data is the program data that operates the aforesaid information equipment, the aforesaid storage information is information that identifies the version of the program data stored in the aforesaid data storage means, and the aforesaid data management means has a program storage means for storing the updated program data, and is a means that, based on the aforesaid storage information, if the program data stored in the aforesaid data storage means is older than the version of the program data stored in the aforesaid program storage means, data communication is performed between the aforesaid fourth transmission means and the aforesaid second

transmission means, and then data management is performed to send the aforesaid updated program data from the aforesaid host device to the aforesaid information equipment to update the program data stored in the aforesaid data storage means.” Watanabe-JP, [0022]

“Digital cameras that record captured images as digital data are becoming popular. A digital camera captures an object with an imaging means such as a CCD, converts the captured image into digital data, and stores it on a memory card or other storage medium. The digital camera is controlled and operated by a control program, and the control program and the control data used in the control program are stored on a storage unit inside the digital camera. However, there are cases where a version upgrade of the control program or control data is required because a bug exists in the control program or control data, or because a better control program or control data has been developed. For these reasons, there is a need for devices that allow the control program and control data to be changed even after the product has been purchased.” Kokubu, [0002]-[0003]

“the digital camera of this invention is a digital camera equipped with a storage unit that stores the control program used to control the digital camera and the control data used in the control program, and an information communication means to send and receive various data by connecting to an external device, wherein it is provided with a data transmission mode that transmits part or all of its control program and control data to another digital camera by means of the aforesaid information communication means, and a data receiving mode, which receives part or all of the control program and control data sent by

another digital camera and rewrites the control program and control data stored on its own storage unit. The aforesaid information communication means may send and receive various types of data through a wired connection or through a wireless connection.” Kokubu, [0009]

“Fig. 5 shows the procedures for rewriting the older version data stored in the digital camera 10 with the version upgrade data stored in the digital camera 100 (version upgrade of the digital camera 10). When the user wants to upgrade the version of the digital camera 10, the user can connect the digital camera 10 and the digital camera 100 using a USB cable 51 as shown in Fig. 5(a). Then it is fine to follow the flow chart shown in Fig. 5(b).” Kokubu, [0032]

“Upgrading your software and firmware
Download the latest versions of the software included on the Kodak EasyShare software CD and the camera firmware (the software that runs on the camera).” EX1017 (“Kodak EasyShare-One zoom digital camera”), p. 102

134. Limitations [1A3]-[1A4] and [1D] recite nothing more than the conventional and well-known practice of updating a digital camera’s software.

4. Wireless Transfer of Images Limitation ([1C])

135. Wirelessly transmitting images was yet another conventional feature of digital cameras with well-known benefits:

“The wireless LAN communication unit 33 communicates data with the personal computer 2 using standards such as IEEE802.11b and

11a, and the data transfer rate is 11 Mbps to several tens of Mbps. In addition, the data communication range is several tens of meters.”

Watanabe-JP, [0044]

The wireless LAN communication device 25 performs data communication with the wireless LAN communication unit 33 of the digital camera 1 according to the same standard as the wireless LAN communication unit 33, such as IEEE802.11b and 11a.” Watanabe-JP, [0049]

“The wireless LAN communication device 25 connected to the personal computer 2 receives the image data S2 and inputs it to the personal computer 2, and then the personal computer 2 saves the image data S2 input from the wireless LAN communication device 25 in the prescribed folder (step S10).” Watanabe-JP, [0059]

“An imaging device 10 may transfer one or more images to a second device (e.g., computing device 120)” EX1021 (“Walker”), [0173]

“The imaging device 110 may have a wireless Internet connection (e.g., using the 802.11 wireless protocol) and use this connection to transmit images to a personal computer that is connected to the Internet.” Walker, [0176]

“communications between the imaging apparatus and the home server apparatus are performed by wireless communications, the imaging apparatus transmits predetermined imaging apparatus information to the home server apparatus, and the home server apparatus receives image data from the imaging apparatus only when the imaging

apparatus information received from the imaging apparatus matches imaging apparatus information stored in advance.” EX1053 (Watanabe-634), [0019]

“an electronic camera 100 that includes a memory card saves electronic image data or digital image data (hereafter referred to as image data) obtained through a photographing operation into the memory card. In addition, the electronic camera 100 has a short-distance wireless communication function (e.g., Bluetooth (registered trademark; RTM) enabling communication within a range of approximately a 10M) and engages in communication with a portable telephone 160 that also has a short-distance wireless communication function.” EX1016 (Kusaka), [0157]

“image data obtained through a photographing operation at the electronic camera 100 are transferred to the portable telephone 160 from the electronic camera 100, and then the image data are transferred to a personal computer 140 for personal use or an image server 150, first via a wireless base station 120 through a wireless portable telephone line 120 and then via a wired or wireless public telephone line or the Internet 130” Kusaka, [0158]

“The image transmitter 2604 is configured to perform a communication to the image receiver 2607 of the receiving storing system 2613. The communication may be a wired-communication or a wireless communication.” EX015 (Azuma), [0292]

“The compressed image signals that have been generated by the processor-compressor 2603 are then supplied to the image transmitter

2604. The image signals are converted by the image transmitter 2604 in accordance with the communication protocol. The image signals are also added with the error correction codes by the image transmitter 2604. The image transmitter 2604 performs a wireless or wired communication with the receiving storing system 2613 to transmit the image data to the receiving storing system 2613.” Azuma, [0306]

“The inventive device is integrated with a standard printer (or computer pr storage device), via an industry standard interface (e.g., USB port, Firewire port, and wireless means, such as Bluetooth, or Ultra-Wideband).” EX1019 (Fisher), [0026]

“FIG. 1 also shows the data flow from the camera 108 to external device 102, via communications 104. Besides USB or Firewire, such communications 104 may also consist of any industry standard communications means (e.g., direct physical connection, PCMIA, Local Area Network (LAN), a Wide Area Network (WAN), the Internet, a telecommunication network and wireless options such as cellular communication, infrared, Laser, radio frequency means (RF), Bluetooth, DSSS, Ultra Wideband, wireless LAN or WAN) or other connection means.” Fisher, [0034]

136. Commercially available digital cameras (e.g., Kodak EasyShare-One digital camera) were Wi-Fi enabled for wireless image transfer before the '266 patent was filed:

“Wireless transfer of your pictures and videos
You can transfer the pictures and videos on your camera to EasyShare

software on your computer over a Wi-Fi wireless network using a Kodak Wi-Fi® card” EX1017, p. 61

“Transferring pictures and videos to a computer

You can transfer pictures and videos from your camera to any computer that has EasyShare software installed. Use the USB cable to transfer automatically, or select pictures on your camera then select Transfer from the Share menu to transfer over your Wi-Fi wireless network.” EX1017, p. 70

137. Limitation [1C] also recites a conventional feature of digital cameras.

138. The independent claims recite nothing more than well-known, conventional features of a digital camera used in the usual way.

5. Dependent Claims

139. The dependent claims likewise disclose well-known features of digital cameras.

E. Summary of Grounds

140. As discussed in §VIII.C above, the ’266 patent is directed to a digital camera system having “in-camera” software that digitally performs corrections that allegedly were conventionally performed by optical filters or external software.

141. The ’266 patent’s independent claims do not require any particular image correction to be performed, only that “in-camera hardware and software” be configured to: (1) “perform a plurality of image correction algorithms,” and (2) “process image correction data stored in a database system” (claims 1 and 22).

142. Niikawa, like hosts of other digital cameras, performed these operations in-camera. (see §IX.A below).

143. To this standard in-camera capability, the independent claims recite two additional common features: (1) updating the camera's software, and (2) wirelessly transmitting corrected images stored on the camera, both of which were well-known and widely used by conventional cameras. As discussed in detail both in §VIII.C above and in the sections on the respective limitations below.

144. For example, as discussed in detail in §IX.B.2 below, Watanabe-JP discloses an image data and software version management system that wirelessly transfers a camera's newly captured images to an external device and wirelessly updates the digital camera's program data when new versions are available.

145. The obvious and beneficial application of Watanabe-JPs image and version management techniques to Niikawa's digital camera forms the basis of Ground 1 (§IX), which demonstrates the unpatentability of the independent claims and numerous dependent claims. Conventional techniques disclosed in Bolle (EX1007), Ng (EX1008), Irie (EX1011) and Watanabe-US (EX1013) applied to Niikawa's camera form the basis of Grounds 2-5 (§§X-XIII), respectively, and demonstrate the unpatentability of each of claims 1-27 and 29-30 ("challenged claims").

IX. GROUND 1: NIIKAWA IN VIEW OF WATANABE-JP RENDERS OBVIOUS CLAIMS 1-2, 4-5, 8, 11, 13-20, 22-23, 25, 27, AND 30

A. Niikawa

146. US 2002/0135688A1 (EX1006, “Niikawa”) discloses a “gradation control process” for correcting the “narrow dynamic range” of a digital camera’s imaging sensor by combining image data from two images captured with different exposure settings to obtain a synthesized image “whose dynamic range is substantially widened:”

“when a subject is photographed by a digital camera or the like, a phenomenon sometimes occurs that light portions in the Subject image are too white, while dark portions in the subject image are too black. This phenomenon results from a narrow dynamic range of a general image pickup device and causes deterioration in image quality. For eliminating such a phenomenon, it has been supposed that an image whose dynamic range is substantially widened is generated by capturing two images of different exposures for the same subject in different timings and synthesizing them to conduct a gradation control process.” Niikawa, [0061]

147. Niikawa teaches that the two captured images may differ not only in exposure but also in position, as either the camera or subject may have moved in the time between capture of the two images, so the images must be corrected for position before combining them:

“In the case of capturing two images in different timings for obtaining a synthesized image, a small difference in position occurs between these two images thus captured because of the difference in timing. For this reason, in synthesizing two images, it is necessary to effect positioning for these two images prior to synthesizing the images while taking such a positional difference between these images into consideration.” Niikawa, [0062]

148. Niikawa further teaches that each of these images must first be corrected for “shading” (i.e., the variation in brightness from center to edge of the image often called “vignetting”):

“When a subject is photographed by using an image pickup device such as CCD in an image processing apparatus such as digital camera equipped with an imaging lens, a phenomenon that the level of image data decreases with the distance from the center of the image to the periphery, so-called ‘shading’ occurs.” Niikawa, [0056]

“it is impossible to effect accurate positioning without taking such an influence of shading as described above into consideration. In preferred embodiments as will be described below, the above-mentioned influence of shading is taken into consideration when effecting the positioning on such two images.” Niikawa, [0062]

149. Niikawa describes a digital camera which can be operated either in the “gradation control processing” mode described above in which two images are

captured with different exposures, or in a “normal exposure mode” in which a single image is captured:

“A user can open the menu screen for selection of exposure mode and select an exposure mode by operating the four-gang switch 15, the switch group 16 and the like. The exposure mode includes a normal exposure mode in which an exposure is made one by one in the usual manner and a gradation control processing mode. The gradation control processing mode refers to a mode intended for obtaining a synthesized image with substantially widened dynamic range by capturing two images having different exposures for the same subject in different timings, and synthesizing these images in an appropriate adding ratio. A single operation of the shutter button 9 triggers two exposures while changing the exposure condition so as to obtain two images.” Niikawa, [0074]

150. Niikawa describes how the camera in gradation control processing mode first establishes proper focus and exposure and when the user presses the shutter button halfway down, then when the shutter button is pressed all the way down takes a picture underexposed by two steps (a factor of four) and another overexposed by two steps:

“In step S11, when the shutter button 9 is pressed half way down, a focal point of the lens group 30 of the imaging lens 3 is adjusted for a main subject, an exposure control value is calculated by using a live view image and a white balance adjustment value is set. The exposure control value which is calculated at this time is a value to provide

correct exposure, and concretely, a shutter speed and an f-number which are correct values are obtained (step S12).” Niikawa, [0106]

“Next, when the shutter button 9 is pressed all the way down in step S13, the shutter speed is set at a shutter speed which is at two steps under the shutter speed which is a correct value (step S14). Then, the CCD303 is exposed to the light for an exposure time corresponding to this shutter speed, and thereby a first image F1 of the subject is captured (step S15).” Niikawa, [0107]

“Next, from the shutter speed which is a proper value, a shutter speed over two steps is set (step S18), and the CCD 303 is exposed to the light for an exposure time corresponding to this shutter speed, and a second image F2 of the subject is captured (step S19).” Niikawa, [0110]

151. Niikawa teaches that each of these images is affected by shading, but since both images were taken by the same lens at the same focal length and f-number, the pattern of shading is the same for both, so both can be and are corrected for shading by applying a correction table describing that how that lens causes shading when set at that particular focal length and f-number (though Niikawa does not limit the correction tables to just those two parameters):

“A plurality of correction tables for different parameters which are the optical conditions such as focal length and f-number at the time of imaging are prepared and stored” Niikawa, [0084]

“Next, in the shading correction circuit 123, correction of shading is executed (step S16). At this time, a correction table which corresponds to the optical conditions of focal length and f-number at the time of exposure is selected and inputted to the shading correction circuit 123 by the general controller 150. The shading correction circuit 123 performs shading correction by executing multiplication process of image data outputted from the A/D conversion circuit 122 and the inputted correction table (see FIG. 6).” Niikawa, [0108]

“As for this first image F1... since the shading correction is performed in the shading correction circuit 123, an influence of shading is eliminated.” Niikawa, [0109]

“As for this second image F2... as is the same with the first image F1, since the shading correction is performed in the shading correction circuit 123, an influence of shading is eliminated.” Niikawa, [0110]

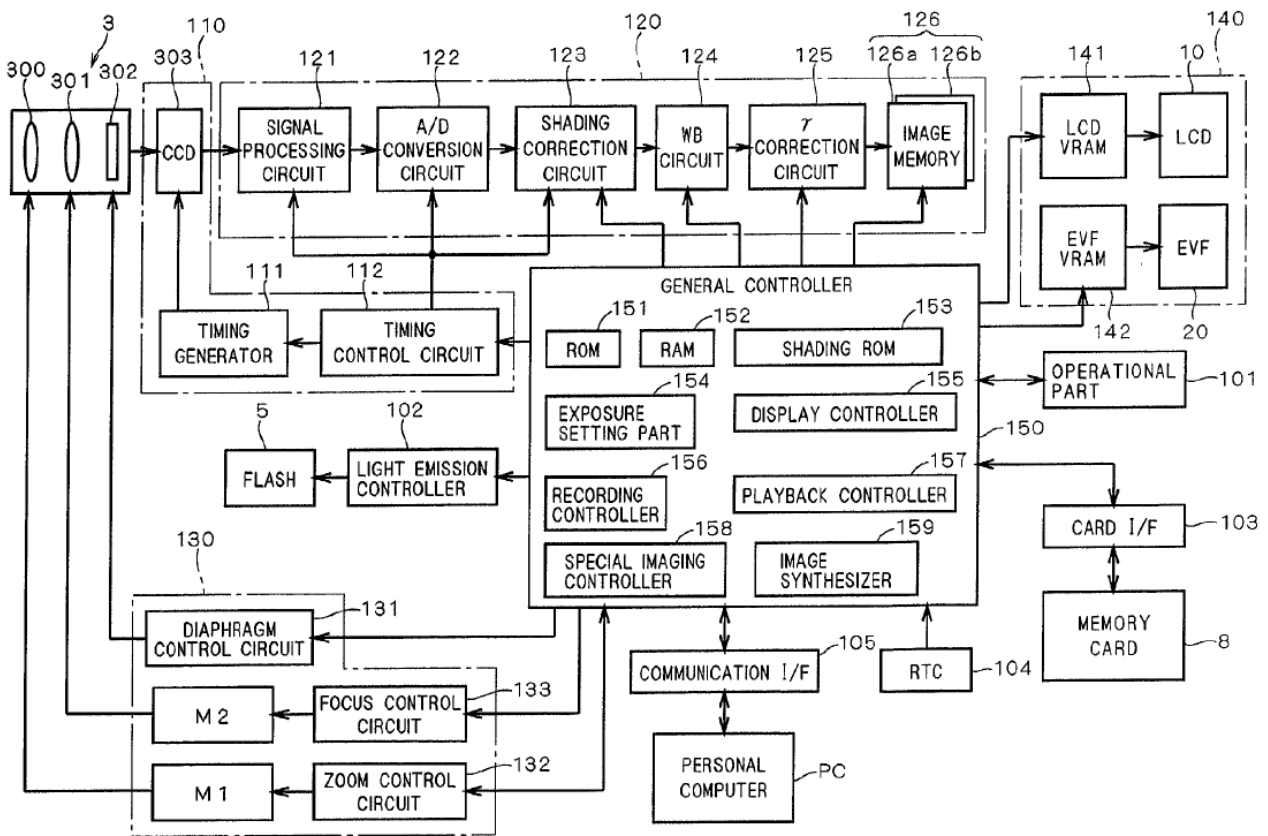
152. Niikawa’s camera also corrects white balance and gamma (γ) in each of these images after shading correction:

“The WB circuit 124 adjusts a white balance of captured image by converting the level of image data of each color component R,G,B with the use of a level conversion table inputted from the general controller 150. The γ correction circuit 125 corrects a γ characteristic of image data. The γ correction circuit 125 corrects the level of each image data using the γ correction table which is preliminarily set.” Niikawa, [0086]

“first image F1 of the subject is captured (step S15). After exposure, an image signal outputted from the CCD 303 is subjected to a predetermined analogue signal processing in the signal processing circuit 121, and converted into pixel data of 10 bits in the A/D conversion circuit 122. Next, in the shading correction circuit 123, correction of shading is executed (step S16)... After that, predetermined processes are executed by the WB circuit 124 and the γ correction circuit 125” Niikawa, [0107]-[0109]

“After the exposure, as is the same with the first image F1, an image signal outputted from the CCD 303 is subjected to a predetermined analogue signal processing in the signal processing circuit 121, converted into pixel data of 10 bits in the A/D conversion circuit 122, subjected to a shading correction in the shading correction circuit 123, subjected to predetermined processes in the WB 123 and the γ correction circuit 125” Niikawa. [0110]

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153. With white balance, gamma, and shading corrected, Niikawa proceeds to adjust positioning of the two images so they can be correctly combined:

“Next, in response to that the second image F2 is stored in the second memory 126b of the image memory, the image synthesizer 159 of the general controller 150 reads out the captured first image F1 and the second image F2 from the image memory and performs positioning of these images (step S22). This positioning process is such that both of the images to be synthesized are positioned so as to synthesize the same patterns in the image accurately in the image Synthesis process. In this positioning process, the second image F2 is moved while referring the first image F1 as a reference image.” Niikawa, [0111]

“Since the first image F1 and the second image F2 have been subjected to shading correction by the shading correction circuit 123 at the time of capturing of images, positioning of images can be achieved without being influenced by a shading.” Niikawa, [0117]

154. With the two images corrected for white balance, gamma, and shading and properly positioned, Niikawa teaches how they are synthesized to correct for the limited dynamic range of the image sensor:

“Next, synthesis process of images having been subjected to positioning process is performed by the image synthesizer 159 of the general controller 150” Niikawa, [0118]

Since the exposure amount is suppressed for the underexposed first image F1, the gradation characteristic is as shown by the characteristic LU, such that the A/D conversion output level is suppressed to low with respect to the brightness level of the subject. On the other hand, as for the overexposed second image F2, the exposure amount is excess, and hence the gradation characteristic will be such that the A/D conversion output level is emphasized to be high with respect to the brightness level of the subject as shown by the characteristic LO.” Niikawa, [0118]

“In the image synthesis process, by adding the image data of the first image F1 and the image data of the second image F2 for every pixel at an appropriate adding ratio[n], image data having desired gradation characteristic within the range interposed between the gradation

characteristic LU and the gradation characteristic LO in FIG. 12A is generated.” Niikawa, [0119]

“FIG. 12B is a view showing a curve R representing adding ratios at various levels on the basis of the level of the overexposed second image F2. As shown in the drawing, the adding ratios are not constant regardless of the level of the image data, and as the level of the overexposed second image F2 decreases, the adding ratio of the overexposed second image F2 increases. The adding ratio of the overexposed second image F2 is made large as described above for making it easier to view dark portions of the subject.” Niikawa, [0119]

155. Niikawa also teaches a configuration in which shading, white balance and γ correction computations are performed “by software” running on the general controller:

“the present invention differs from the first preferred embodiment in that the image data is directly stored in the image memory and the shading correction is executed by software.” Niikawa, [0127]

“The digital camera 1 of the present preferred embodiment has a shading corrector 160 implemented by a processing program of the general controller 150 and for performing a shading correction by software, in place of the shading correction circuit 123.” Niikawa, [0129]

“Also in the same manner, the white balance adjustment process and γ correction process are implemented by software. Therefore, a WB/ γ

corrector 161 is provided as a function implemented by processing programs in the general controller 150 in place of the WB circuit 124 and the γ correction circuit 125. The processes in this WB/ γ corrector 161 are as same as the processes in the WB circuit 124 and the γ correction circuit 125.” Niikawa, [0131]

“the shading corrector 160 of the general controller 150 reads out the first image F1 from the first memory 126a of the image memory 126 and performs shading correction (step S50). This process can be achieved by executing the same multiplication process of the image data and the correction table in the first preferred embodiment by software.” Niikawa, [0138]

Next, the image synthesizer 159 of the general controller 150 reads out the shading corrected first image F1 and the second image F2 from the image memory and performs positioning and synthesis processes of these images (step S52, S53). These processes are as same as those in the steps S22 and S23 in FIG. 9.” Niikawa, [0139]

“Next, the WB/ γ corrector 161 of the general controller 150 performs adjustment of white balance and γ correction on the generated synthesized image (step S54). The following process of step S55 is as same as in step S24 of FIG 9.” Niikawa, [0140].

156. Niikawa also teaches a camera configuration which stores the two images without processing, then allows the user to select which stored images to correct:

“In contrast to the aforementioned gradation control processing mode in the above preferred embodiment, the gradation control exposure mode is a mode limited to capturing two images of different exposures for the same subject in different timings, and recording the respective images onto the memory card 8.” Niikawa, [0147]

“an image file wherein tag information is attached to the captured image data of the [C]CD-RAW form and a thumbnail image is generated for each of the two images, and the image files are stored in the memory card 8.” Niikawa, [0148]

“When the playback mode is selected by the power switch 14, and the menu display switch 34 is pressed down, a playback menu screen as shown in FIG. 17A is displayed on the LCD 10. On the playback menu screen, it is possible to select special playback methods other than the normal playback display of captured image. These special playback methods include a gradation control process. The user operates the four-gang switch 15 to move a cursor C1 displayed on the LCD 10 so as to point at the gradation control process, and presses down the execute switch 32 to give a direction for the gradation control process to the digital camera 1 (step S61).” Niikawa, [0152]

“When the image captured in the gradation control exposure mode is displayed, the user operates the four-gang switch 15 and the switch group 16 to move a cursor C2 displayed on the LCD 10 and designate the first image F1 and the second image F2 to which the gradation control process is to be executed (Step S65).” Niikawa, [0156]

“When the first image F1 and the second image F2 to which the gradation control process is to be executed are designated, the playback controller 157 reads out designated two captured image data of the CCD-RAW form and stores them in the image memory 126 so as to allow the subsequent process to be executed (step S66).”

Niikawa, [0157]

“Next, the shading corrector 160 of the general controller 150 reads out the first image F1 from the image memory 126 and performs shading correction thereon (Step S68).” Niikawa, [0158]

“Next, the image synthesizer 159 of the general controller 150 reads out the first image F1 and the second image F2 that have been subjected to the shading correction from the image memory 126, and performs positioning and synthesis of these images to generate a gradation-controlled synthesized image. These processes are as same as steps 22 and 23 in FIG. 9 (steps S70, S71).” Niikawa, [0159]

“The generated synthesized image is displayed on the LCD 10, and the user confirms the result of the synthesis process by referring to the LCD 10 (step S72).” EX 1006, [0159]

“Next, when a predetermined time has elapsed after the synthesized image was displayed on the LCD 10, LCD 10 displays a screen which enables the user to select whether or not the generated synthesized image is to be recorded.” Niikawa, [0160]

“The signal processor 120 executes a predetermined analogue Signal processing and digital signal processing with respect to an image

signal outputted from the CCD303. The signal processing of image signal is executed for every light reception signal of each pixel constituting the image data. The signal processor 120 has the signal processing circuit 121, the A/D conversion circuit 122, the shading correction circuit 123, an WB circuit 124, a γ correction circuit 125 and an image memory 126.” Niikawa, [0079]

157. All of these operate under the control of a microprocessor:

“The general controller 150 is implemented by a microcomputer and performs centralized control of the exposure function and playback function. The general controller 150 is connected with the memory card 8 via a card interface 103.” Niikawa, [0093]

“The general controller 150 has a ROM 151 which stores processing programs for executing a variety of concrete processings in the exposure function and the playback function” Niikawa, [0096]

158. Niikawa also teaches a configuration in which images are corrected in a computer which receives those images from the camera:

“according to the present preferred embodiment, the gradation control process is performed by an image processing apparatus configured by a personal computer or the like. That is, an image processing apparatus such as digital camera having image pickup means just makes continuous exposures of two images to be used for synthesis, and an image processing apparatus configured by a personal computer or the like performs gradation control process such as positioning of these two images and image synthesis process.” Niikawa, [0164]

“the personal computer 60 stores a gradation control program for synthesizing data of two captured images of different amounts of light exposure in a stationary disk inside the computer main body 61 and generating a synthesized image having a desired gradation.” Niikawa, [0169]

159. In this embodiment, Niikawa teaches user control over the adding ratio for synthesizing the high-dynamic-range image:

“by moving the slider 209 in the right and left direction using the mouse cursor C3, the curve R representing the adding ratio characteristic in FIG. 12B is shifted in the up and down direction, and thereby the synthesis ratio is desirably set. Concretely, as the slider 209 is moved to the right from the center point, the synthesis ratio of the overexposed second image F2 increases, whereas as the slider 209 is moved left, the synthesis ratio of the underexposed first image F1 increases.” Niikawa, [0183]

160. Niikawa teaches that this same approach to gradation control processing can be performed in the camera:

“in the present preferred embodiment, the process was performed in the image processing apparatus in which a personal computer executes the gradation control program, however, the above process may be performed by making a digital camera execute the like gradation control program.” Niikawa, [0206]

161. For all these corrections, Niikawa constructs, stores, and uses correction tables containing the information needed to correct images:

“A plurality of correction tables for different parameters which are the optical conditions such as focal length and f-number at the time of imaging are prepared and stored in a shading ROM 153 provided in the general controller 150. The general controller 150 performs selection of correction table from the shading ROM 153 in accordance with the optical condition such as focal length and f-number at the time of imaging.” Niikawa, [0084]

“a correction table which corresponds to the optical conditions of focal length and f-number at the time of exposure is selected and inputted to the shading correction circuit 123 by the general controller 150. The shading correction circuit 123 performs shading correction by executing multiplication process of image data outputted from the A/D conversion circuit 122 and the inputted correction table (see FIG. 6).” Niikawa, [0108]

“the correction table has 1,920,000 correction coefficients (actually, inverses of correction coefficients) for corresponding to the respective 1,920,000 pixels of 1,600 pixels x 1,200 pixels of the CCD 303. Each correction coefficient corresponds to the rate of decrease in level of each pixel data shown in FIG. 1, and the inverse of the correction coefficient is held in the correction table in advance. When each pixel shown in the curve of FIG. 1 is multiplied by the inverse of the correction coefficient, the curve is converted to a straight line in which the levels of image data are constantly 1. That is, by subjecting every pixel data to the multiplication by the inverse of the correction coefficient (coefficient process), the shading can be corrected.”

Niikawa, [0083]

“The personal computer 60 stores a plurality of correction tables used for the shading correction in a stationary disk which is a predetermined memory device in the computer main body 61. These correction tables each are associated in advance with the type of digital camera that is assumed to capture images for use in the gradation control process (digital camera having a function of capturing two images while varying the exposure amount for the same subject, hereinafter, referred to as “assumed camera”). Furthermore, a plurality of correction tables are stored for each of parameters or optical conditions such as focal length and f-number at the time of capturing an image in an assumed camera.” Niikawa, [0168]

“The WB circuit 124 adjusts a white balance of captured image by converting the level of image data of each color component R,G,B with the use of a level conversion table inputted from the general controller 150. The γ correction circuit 125 corrects a γ characteristic of image data. The γ correction circuit 125 corrects the level of each image data using the γ correction table which is preliminarily set.” Niikawa, [0086]

B. Watanabe JP

162. JP 2004-192178 (EX1005, “Watanabe-JP”) discloses improvements to digital cameras including:

- automatically updating the software and control data in a digital camera;

- carrying out such updates and delivery of stored images by wireless connection between the camera and a computer of the like; and
- keeping the camera's battery wirelessly charged by providing a cradle to hold the camera when not in use.

1. Watanabe-JP's Software Version Management

163. Watanabe-JP teaches that camera software may need to be updated from time to time so the camera must be able to receive and store such updates:

“information equipment operates based on programs stored in its internal memory, but there are cases in which the version of a program may be upgraded by eliminating defects or adding new functions that were not considered when the program was designed. For this reason, a system has been proposed in which the memory in which the program is stored in the information equipment is rewritable, the information equipment is connected to a storage device that stores the version upgraded program, and the version upgraded program is sent to the information equipment to upgrade the version of the program of the information equipment” Watanabe-JP, [0004]

“the version of the program data that operates the digital camera 1 is updated from time to time and stored in the personal computer 2. Moreover, the updated program data is provided by the manufacturer of the digital camera 1 to the user of the digital camera 1 via the Web or recorded on media.” Watanabe-JP, [0048]

164. Watanabe-JP teaches that conventional digital camera software updates via a physical connection between the digital camera and a device on which updated program data is stored were inconvenient, requiring a specific connector to be provided to upgrade the camera, and unreliable because physical connections can be inadvertently disconnected before an update process completes, potentially resulting in problems operating the camera due to an incomplete program update:

“if the connector is inadvertently disconnected during transmission of program data, transmission of program data will stop. If the transmission of program data is stopped in this way, not only will the program not be updated, but also the program may be updated in an incomplete form, which may cause problems in the operation of the information equipment. In addition, it is necessary to provide a connector to properly connect the information equipment and the storage device.” Watanabe-JP, [0009]

165. Watanabe-JP addresses these issues by providing wireless communication between the camera and the computer or the like storing updated program data:

“The data management system according to this invention has information equipment equipped with... a second transmission means for data communication by wireless method, and a host device provided with a... fourth transmission means for performing wireless data communication” Watanabe-JP, [0012]

“data communication is performed between the fourth transmission means and the second transmission means based on this storage information, and data management of the prescribed data is performed. For this reason, data management can be performed without the need for a connector to connect the information equipment and the host device. In addition, wireless data communication does not lose communication status even when the distance is several meters, so even if the information equipment and the host device are separated, data communication will not be immediately lost during data management, and thus data management can be performed stably.” Watanabe-JP, [0028]

166. Watanabe-JP teaches that this wireless updating can be carried out automatically as needed and unnoticed by the user, by the camera communicating the version of the program data currently stored in the camera, the computer determining that a later version is available, and a session carried out to update the camera:

“since data communication is performed based on the storage information about the prescribed data, data management can be performed only when the prescribed data requires data management.” Watanabe-JP, [0029]

“when the digital camera 1 is set in the cradle 4... a version signal representing the version of the program data stored in the program memory 17 are transmitted to the personal computer 2. Wireless LAN data communication between the wireless LAN communication unit

33 of the digital camera 1 and the wireless LAN communication device 25 connected to the personal computer 2 is performed based on the transmitted signal, to perform the image data management process and version management process.” Watanabe-JP, [0073]

“the image data management process and version management process can be performed during the daily charging of the digital camera 1. This allows the user of the digital camera 1 to perform image data management processing and version management processing in the course of daily operations without having to be particularly aware of it.” Watanabe-JP, [0076]

167. To further ensure stable software updates, Watanabe-JP discloses wirelessly transmitting updated program data sequentially in program segments and ensuring that each segment is transmitted successfully before transmitting the next segment, so that the update process can be resumed from the last successfully transmitted segment in the event of interruption:

“if a program has multiple operations, a program is created for each operation, and multiple programs for each operation are grouped together to constitute one program data. In such a case, it is possible to divide the program data into multiple program data, and in this invention, the program data for each operation shall be referred to as a ‘segment.’” Watanabe-JP, [0025]

“if the aforesaid updated program data consists of multiple segments, the aforesaid data management means is a means of sequentially sending the aforesaid multiple segments to the aforesaid information

equipment during aforesaid data management, and the aforesaid host device is further equipped with a transmission management means that detects the remaining capacity of the aforesaid storage battery when the aforesaid third transmission means is brought into proximity with the aforesaid first transmission means, and only if the said remaining capacity is above the prescribed threshold, data communication is performed between the aforesaid fourth transmission means and the aforesaid second transmission means, the aforesaid updated program data is sent to the aforesaid information equipment, and if the proximity state between the aforesaid third transmission means and the aforesaid first transmission means is released during the transmission, the transmission of the segment being transmitted is completed, and then the transmission of the aforesaid updated program data is stopped.” Watanabe-JP, [0024]

“there are cases in which the program data is stored in the program memory 17 up to the halfway segment, in which case the segment not stored in the program memory 17 is received and stored. This is done by sending the information representing the segment currently stored from the wireless LAN communication unit 33 to the personal computer 2 via the wireless LAN communication device 25, and then the personal computer 2 sends only the segment not stored in program memory 17 to the digital camera 1 based on the information representing the segment.” Watanabe-JP, [0068]

“the control unit 12 monitors whether the proximity status of the transmission unit 31 and the transmission unit 42 is maintained in the background of the process of receiving and storing the program data

(step S40)... If step S40 is denied, the control unit 12 receives program data up to the segment currently being received (step S41). The received segment is stored in the program memory 17 (step S42), and then... the wireless LAN communication unit 33 is stopped (step S47)” Watanabe-JP, [0069]-[0072]

168. Watanabe-JP teaches that transmitted program segments are held in the camera and only applied to upgrade the camera’s software after all segments have been successfully received so that interruption will not leave the camera in an unstable state:

“The wireless LAN communication unit 33 of the digital camera 1 receives the program data (step S38) and stores it in the program memory 17 (step S39). Moreover, here, the program data is only stored in the program memory 17, and no update of the program data is performed... Following step S39, the control unit 12 determines whether or not it has completed receiving the program data (step S45); if step S45 is affirmed, the received program data is set up and the program data currently stored in program memory 17 is updated (step S46); then, the wireless LAN communication unit 33 is stopped (step S47), and the process is terminated.” Watanabe-JP, [0068]-[0072]

2. Watanabe-JP’s Image Management

169. Watanabe-JP also discloses downloading images stored on the camera to a personal computer via the wireless connection. The camera communicates information about captured images stored on the camera to the personal computer

(or other device) to determine whether new images have been captured since the last download:

“the date information assigned to the image data S1 stored in the memory card 5 is transmitted as a date signal to the personal computer 2 via the transmission unit 31 and the transmission unit 42 of the cradle 4 (step S4).” Watanabe-JP, [0056]

“Referring to the date information represented by the date signal, the personal computer 2 determines whether or not new image data S2 acquired after the date on which the latest image data stored in the personal computer 2 was acquired is stored in the memory card 5 (step S5). If step S5 is affirmed, the personal computer 2 superimposes signals indicating the transmission of new image data S2 on electromagnetic waves, and then transmits them to the digital camera 1 via the transmission unit 42 and the transmission unit 31 (step S6).” Watanabe-JP, [0057]

“When the digital camera 1 receives this signal, the control unit 12 starts the wireless LAN communication unit 33 (step S7), and in order to enable transmission of new image data S2 that is not stored in the personal computer 2, the wireless LAN communication unit 33 is placed in standby state (step S8), followed by the start of transmission of image data S2 (step S9). Moreover, if there is multiple image data S2, the transmission of all multiple image data S2 will be started.” Watanabe-JP, [0058]

“The wireless LAN communication device 25 connected to the personal computer 2 receives the image data S2 and inputs it to the

personal computer 2, and then the personal computer 2 saves the image data S2 input from the wireless LAN communication device 25 in the prescribed folder (step S10).” Watanabe-JP, [0059]

170. Only those images that have not previously been transferred are transmitted to reduce the time (and battery drain) needed to download images stored on the camera:

“According to the data management system in Claim 2, the data management means has an image data storage means to store image data, and data management is performed in a manner that only image data not stored in the image data storage means is sent from the information equipment to the host device based on the storage information... thus reducing the communication time for sending and receiving image data.” Watanabe-JP, [0030]

“The personal computer 2 compares the version of the program data represented by the version signal with the version of the program data stored in the personal computer 2 and determines whether or not an update of the program data is necessary because the version of the program data stored in the program memory 17 is old (step S23). If step S23 is affirmed, the personal computer 2 determines whether the storage battery 19 has sufficient remaining capacity to receive the program data” Watanabe-JP, [0062]

3. Watanabe-JP’s Wireless Charging

171. Watanabe-JP discloses a wireless charging cradle that can take the form of a “flat plate” on which the camera can be placed for charging by

electromagnetic induction without requiring the user to physically connect the camera to the charger:

“The digital camera 1 is equipped with... a transmission unit 31 that generates power by electromagnetic induction and transmits/receives data using electromagnetic waves to/from the personal computer 2”
Watanabe-JP, [0037]

“The cradle 4 consists of a cradle body 41 having a shape that conforms to the external form of the digital camera 1 so that the digital camera 1 can fit into the cradle body; a transmission unit 42, which outputs electromagnetic waves superimposed with signals toward the transmission unit 31 of the digital camera 1 and receives signals superimposed on the electromagnetic waves output by the transmission unit 31; and a control circuit 43 that controls the drive of the transmission unit 42. Moreover, the transmission unit 42 is provided in a position close to the transmission unit 31 of the digital camera 1 when the digital camera 1 is fitted in the cradle body 41. In addition, the transmission unit 42 is driven by the cradle 4 being connected to the power supply to generate the electromagnetic waves.” Watanabe-JP, [0050]

“Moreover, in this invention, since power is supplied and signals are transmitted and received by electromagnetic induction, the transmission unit 31 of the digital camera 1 and the transmission unit 42 of the cradle 4 may be brought into close proximity, and it is not necessary to position the transmission unit 31 and transmission unit 42 precisely to make contact with each other. For this reason, the cradle

body 41 is not limited to those having a shape that conforms to the external form of the digital camera 1. The cradle body 41 may be formed as a flat plate, and a mark may be added at a position corresponding to the transmission unit 42 to indicate the presence of the transmission unit 42 thereon so that the transmission unit 31 and the transmission unit 42 can be brought into close proximity.”

Watanabe-JP, [0051]

172. Data can also be exchanged over the wireless charging channel, providing a convenient way to initiate the above-described image and version management processes automatically:

“The cradle 4 consists of a cradle body 41 having a shape that conforms to the external form of the digital camera 1 so that the digital camera 1 can fit into the cradle body; a transmission unit 42, which outputs electromagnetic waves superimposed with signals toward the transmission unit 31 of the digital camera 1 and receives signals superimposed on the electromagnetic waves output by the transmission unit 31.” Watanabe-JP. [0050]

“since power is supplied and signals are transmitted and received by electromagnetic induction, the transmission unit 31 of the digital camera 1 and the transmission unit 42 of the cradle 4 may be brought into close proximity, and it is not necessary to position the transmission unit 31 and transmission unit 42 precisely to make contact with each other.” Watanabe-JP, [0051]

“The transmission unit 42 consists of a coil that receives electromagnetic waves and generates electromagnetic waves corresponding to the signal to be transmitted when transmitting the signal; a rectification matching circuit that matches the signal transmitted by the digital camera 1 superimposed on the received electromagnetic waves; a transmitting control circuit that encodes the signal to be transmitted to the digital camera 1 and supplies it to the coil; and a receiving control circuit that decodes the received signal, etc.” Watanabe-JP, [0052]

“Moreover, the signal transmitted from the personal computer 2 to the digital camera 1 includes a signal indicating the transmission of a date signal and a version signal, and a signal indicating the transmission of image data.” Watanabe-JP, [0053]

“When the cradle 4 is connected to a power supply, power is supplied to the transmission unit 42, and then the transmission unit 42 outputs electromagnetic waves (step S1). The electromagnetic waves are superimposed with a signal indicating the transmission of a date signal and a version signal.” Watanabe-JP, [0055]

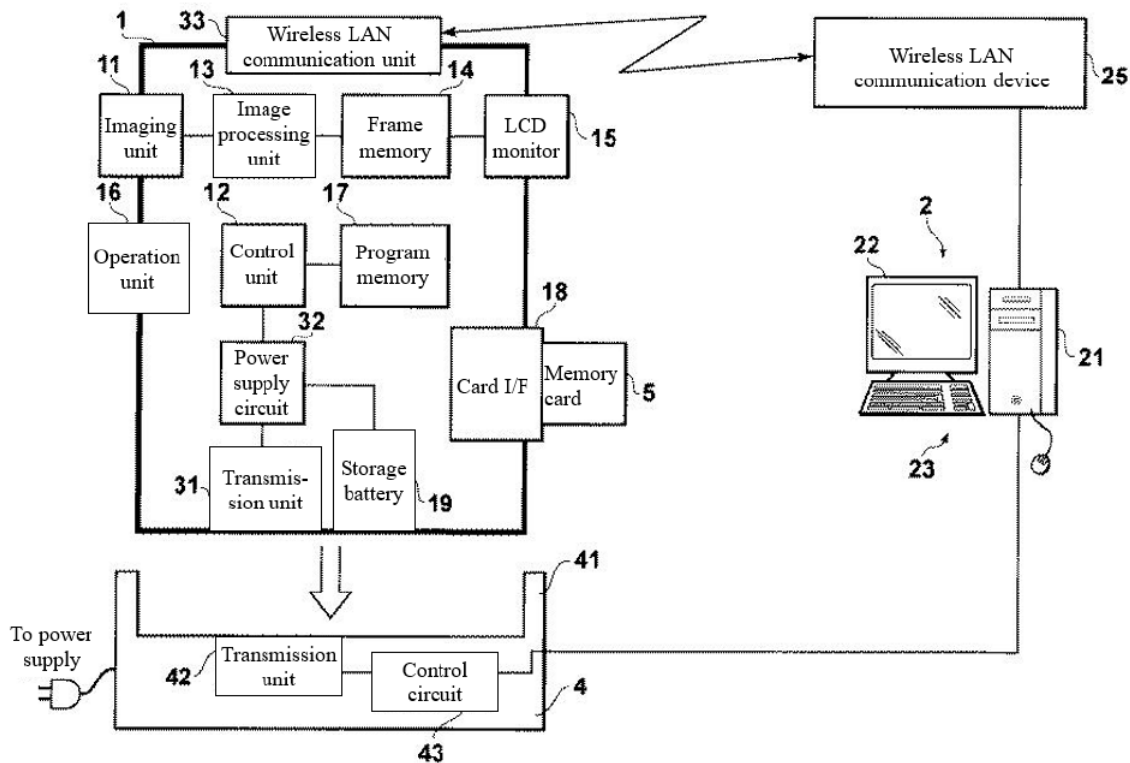
“The transmission unit 31 of the digital camera 1 receives electromagnetic waves and generates power (step S2). This power is input to the control unit 12 by the power supply circuit 32, which causes the control unit 12 to start operation (step S3), and then the date information assigned to the image data S1 stored in the memory card 5 is transmitted as a date signal to the personal computer 2 via the transmission unit 31 and the transmission unit 42 of the cradle 4

(step S4). Moreover, the date signal is superimposed on the electromagnetic waves output from the transmission unit 31 and then transmitted to the transmission unit 42.” Watanabe-JP, [0056]

“Referring to the date information represented by the date signal, the personal computer 2 determines whether or not new image data S2 acquired after the date on which the latest image data stored in the personal computer 2 was acquired is stored in the memory card 5 (step S5). If step S5 is affirmed, the personal computer 2 superimposes signals indicating the transmission of new image data S2 on electromagnetic waves, and then transmits them to the digital camera 1 via the transmission unit 42 and the transmission unit 31 (step S6).” Watanabe-JP, [0057]

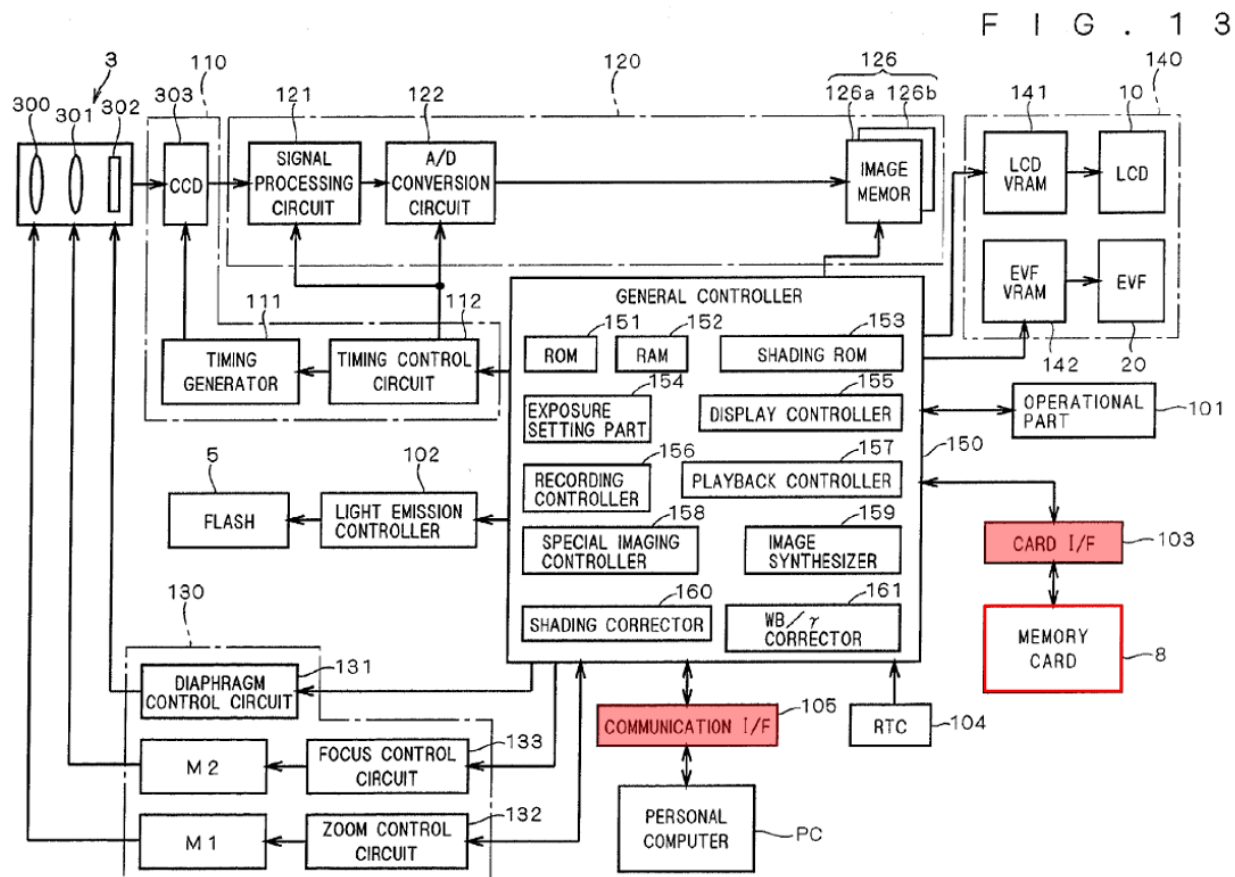
“when the digital camera 1 is set in the cradle 4, the transmission unit 31 of the digital camera 1 and the transmission unit 42 of the cradle 4 are brought into close proximity, then, power is supplied to the digital camera 1 by electromagnetic induction, and a date signal representing the date information of the image data S1 stored in the memory card 5 and a version signal representing the version of the program data stored in the program memory 17 are transmitted to the personal computer 2. Wireless LAN data communication between the wireless LAN communication unit 33 of the digital camera 1 and the wireless LAN communication device 25 connected to the personal computer 2 is performed based on the transmitted signal, to perform the image data management process and version management process.” Watanabe-JP, [0073]

173. FIG. 1 illustrates a digital camera 1 implementing Watanabe-JP's image and version management system. Control unit 12 controls camera 1's image capture components and communications via wireless LAN communication unit 33 to receive updates to the camera's program data stored on program memory 17 and to transfer images stored on memory card 5 to an external device (e.g., personal computer 2 in FIG. 1) and communications via transmission unit 31 configured for wireless charging and data exchange with transmission unit 42 of charging cradle 4.



C. Reasons to Modify Niikawa with Teachings of Watanabe-JP

174. As shaded in red in FIG. 13 below, Niikawa's digital camera includes conventional external communication interfaces in the 2001 timeframe in which Niikawa was filed: (1) a "communication interface 105" to connect to a personal computer PC and; (2) a "card interface 103" to connect to a detachable memory card 8 for storing captured images (Niikawa, [0095]-[0096]) that can be subsequently stored externally by manually transferring memory card 8 to an external device's card reader. Niikawa, [0167], [0173]. Niikawa's software programs can be installed via either interface. Niikawa, [0096].



“The general controller 150 is implemented by a microcomputer and performs centralized control of the exposure function and playback function. The general controller 150 is connected with the memory card 8 via a card interface 103. Also a personal computer PC is externally connected via a communication interface 105.” Niikawa, [0095]

“The general controller 150... is so configured that program data recorded on a memory card 8 which is a recording medium can be read out via the card interface 103 to be stored in the ROM 151. Therefore, these processing programs and control programs can be installed into the digital camera 1 from the memory card 8. The processing programs and the control programs may be installed from the personal computer PC via the communication interface 105.” Niikawa, [0096]

“the recording controller 156 generates an image file in which tag information is attached to compressed captured image and thumbnail image, and records the image file onto the memory card 8.” Niikawa, [0100]

“The personal computer 60 has a computer main body 61... Furthermore, the computer main body 61 has... a memory card reader 61b for performing read of a memory card.” Niikawa, [0167]

“This file button 204 is clicked, and then a file designating window opens, allowing designation of image files of the first image F1 and the second image F2 to be subjected to the gradation control process

from a memory card or the like attached to the memory card reader 61b.” Niikawa, [0173]

1. Benefits of Watanabe-JPs Wireless Image Transfer

175. A POSA would have been motivated to modify Niikawa with the teachings of Watanabe-JP’s wireless LAN communication unit 33 to provide more convenient image transfer to a wider range of external devices and circumstances, such as devices without a card reader and devices to which a physical connection cannot be made (Watanabe-JP, [0009], [0073]):

“in the systems described in Patent Documents 3 and 4 above, if the connector is inadvertently disconnected during transmission of program data, transmission of program data will stop. If the transmission of program data is stopped in this way, not only will the program not be updated, but also the program may be updated in an incomplete form, which may cause problems in the operation of the information equipment. In addition, it is necessary to provide a connector to properly connect the information equipment and the storage device.” Watanabe-JP, [0009]

“when the digital camera 1 is set in the cradle 4, the transmission unit 31 of the digital camera 1 and the transmission unit 42 of the cradle 4 are brought into close proximity, then, power is supplied to the digital camera 1 by electromagnetic induction, and a date signal representing the date information of the image data S1 stored in the memory card 5 and a version signal representing the version of the program data stored in the program memory 17 are transmitted to the personal

computer 2. Wireless LAN data communication between the wireless LAN communication unit 33 of the digital camera 1 and the wireless LAN communication device 25 connected to the personal computer 2 is performed based on the transmitted signal, to perform the image data management process and version management process. For this reason, the image data management process and version management process 10 can be performed without having to provide a connector for data communication between the digital camera 1 and the personal computer 2. In addition, since wireless data communication does not lose communication status even when the distance is several meters, even if the digital camera 1 and personal computer 2 are separated from each other, communication will not suddenly be disconnected in the middle of data management, and thus data management can be performed stably.” Watanabe-JP, [0073]

176. A POSA would have further recognized the benefit of Watanabe-JPs wireless LAN unit 33 in implementing Watanabe-JP’s techniques for automatically identifying and transferring only newly captured images to simplify image management and reduce download times (Watanabe-JP, [0056]-[0059], [0074], [0076]):

“When the cradle 4 is connected to a power supply, power is supplied to the transmission unit 42, and then the transmission unit 42 outputs electromagnetic waves (step S1). The electromagnetic waves are superimposed with a signal indicating the transmission of a date signal and a version signal.” Watanabe-JP, [0055]

“the date information assigned to the image data S1 stored in the memory card 5 is transmitted as a date signal to the personal computer 2 via the transmission unit 31 and the transmission unit 42 of the cradle 4 (step S4).” Watanabe-JP, [0056]

“Referring to the date information represented by the date signal, the personal computer 2 determines whether or not new image data S2 acquired after the date on which the latest image data stored in the personal computer 2 was acquired is stored in the memory card 5 (step S5). If step S5 is affirmed, the personal computer 2 superimposes signals indicating the transmission of new image data S2 on electromagnetic waves, and then transmits them to the digital camera 1 via the transmission unit 42 and the transmission unit 31 (step S6).” Watanabe-JP, [0057]

“When the digital camera 1 receives this signal, the control unit 12 starts the wireless LAN communication unit 33 (step S7), and in order to enable transmission of new image data S2 that is not stored in the personal computer 2, the wireless LAN communication unit 33 is placed in standby state (step S8), followed by the start of transmission of image data S2 (step S9).” Watanabe-JP, [0058]

“The wireless LAN communication device 25 connected to the personal computer 2 receives the image data S2 and inputs it to the personal computer 2, and then the personal computer 2 saves the image data S2 input from the wireless LAN communication device 25 in the prescribed folder (step S10).” Watanabe-JP, [0059]

“only image data S2 that is not stored in personal computer 2 is sent from digital camera 1 to the personal computer 2 based on the date signal, so in case a portion of the image data S1 stored on the memory card 5 is stored on the personal computer 2, it is no longer necessary to send and receive all the image data S1 stored on the memory card 5 during the image data management process, thereby reducing the communication time for sending and receiving the image data.”

Watanabe-JP, [0074]

“In addition, since the storage battery 19 is charged along with the image data management process and version management process, the image data management process and version management process can be performed during the daily charging of the digital camera 1. This allows the user of the digital camera 1 to perform image data management processing and version management processing in the course of daily operations without having to be particularly aware of it.” Watanabe-JP, [0076]

177. Thus, a POSA would have had had multiple beneficial reasons to implement Watanabe-JPs wireless LAN communication in Niikawa’s camera.

178. Further, as discussed in detail in §VIII.D.4 above, wireless image transfer was a conventional feature of digital cameras with well-known benefits and implementing Watanabe’s JP wireless unit would merely have been the use of a known and familiar component for its intended purpose to yield the predicted and

intended result of providing wireless communication between Niikawa's digital camera and external devices.

2. Benefits of Watanabe-JPs Wireless Software Update

179. As discussed in detail in §IX.A above, Niikawa discloses that general controller 150 is “so configured that program data recorded on a memory card 8 [] can be read out via the card interface 103 to be stored in the ROM 151” and “[t]herefore, these processing and control programs can be installed into the digital camera 1 from the memory card 8” or “installed from the personal computer PC via the communication interface 105” so new or updated program data is installed on digital camera 1 to perform Niikawa's processing and control techniques (Niikawa, [0022], [0095]-[0104], [0129]-[0131]):

“the present invention is directed to a program product containing a program for executing an image processing.” Niikawa, [0022]

“The general controller 150 is connected with the memory card 8 via a card interface 103. Also a personal computer PC is externally connected via a communication interface 105.” Niikawa, [0095]

“The general controller 150 has a ROM 151 which stores processing programs for executing a variety of concrete processings in the exposure function and the playback function and control programs for controlling drivings of the above-mentioned members of the digital camera 1, and a RAM 152 which is a work area for executing a number of operations in accordance with the processing programs and

the control programs. Also, it is so configured that program data recorded on a memory card 8 which is a recording medium can be read out via the card interface 103 to be stored in the ROM 151. Therefore, these processing programs and control programs can be installed into the digital camera 1 from the memory card 8. The processing programs and the control programs may be installed from the personal computer PC via the communication interface 105.” Niikawa, [0096]

“The digital camera 1 of the present preferred embodiment has a shading corrector 160 implemented by a processing program of the general controller 150 and for performing a shading correction by software” Niikawa, [0129]

“in the same manner, the white balance adjustment process and γ correction process are implemented by software. Therefore, a WB/ γ corrector 161 is provided as a function implemented by processing programs in the general controller 150” Watanabe-JP, [0131]

180. A POSA would have recognized the benefits of also configuring Niikawa’s general controller 150 to receive updated program data wirelessly as taught by Watanabe-JP (as discussed in detail in §IX.B.1 above) and would have been motivated to do so to provide an additional and/or more convenient way to upgrade Niikawa’s digital camera without the drawbacks of using physical connections.

181. This ability to perform software upgrades wirelessly as taught by Watanabe-JP also provides further motivation to use Watanabe-JP's wireless LAN unit in Niikawa's camera.

182. A POSA would have been further motivated to implement Watanabe-JP's wireless software updates to take advantage of Watanabe-JP's version management techniques that, as discussed in detail in §IX.B.1 above, automatically compare version information and prompts the user when newer versions are available, for example when "updated program data is provided by the manufacturer [] via the Web" (Watanabe-JP, [0048]). Watanabe-JP, [0062]-[0065], [0068]-[0072].

3. Benefits of a Charging Station

183. Niikawa's camera uses four AA batteries for power:

"The digital camera 1 uses a power battery E in which four AA cells E1 to E4 are serially connected as a driving Source." Niikawa, [0066]

184. A POSA would have recognized the benefits and convenience of Watanabe-JP's approach to powering and charging a digital camera independent of batteries that must be regularly replaced, and would have been motivated to modify Niikawa to include Watanabe-JPs rechargeable battery and wireless charging system as discussed in detail in §IX.B.3 above to take advantage of the benefits

disclosed in Watanabe-JP including proximity charging without needing to use connectors to physically connect the camera to the charging source.

185. Watanabe-JPs wireless charging system also enables wireless data exchange between the camera and the charging station that Watanabe-JP beneficially employs to (1) exchange time/date and version information to PC 2 ([0041]-[0042]) ; (2) monitor power levels before and during software update tasks ([0069]); and (3) automatically perform image and version management processes in the course of routine camera charging ([0073]-[0076]):

“the signals transmitted from the transmission unit 31 to the personal computer 2 in this embodiment include a signal indicating the date and time of photographing multiple image data S1 stored in the memory card 5 (hereinafter referred to as the date signal) and a signal indicating the version of program data stored in the program memory 17 (hereinafter referred to as the version signal). The date and time of photographing are described in the header of the image data S1. In addition, the date signal and the version signal are generated by the control unit 12 and output to the transmission unit 31.” Watanabe-JP, [0042]

“the signal transmitted from the personal computer 2 to the digital camera 1 includes a signal indicating the transmission of a date signal and a version signal” Watanabe-JP, [0053]

“In the version management process, the control unit 12 first checks the remaining capacity of the storage battery 19 (step S21).”

Watanabe-JP, [0061]

“the personal computer 2 determines whether the storage battery 19 has sufficient remaining capacity to receive the program data”

Watanabe-JP, [0062]

“The digital camera 1 receives the check signal, checks the remaining capacity of the storage battery 19 (step S29), and sends a signal indicating the remaining capacity to the personal computer 2 via the transmission unit 31 and the transmission unit 42 (step S30).”

Watanabe-JP, [0064]

“when the digital camera 1 is set in the cradle 4, the transmission unit 31 of the digital camera 1 and the transmission unit 42 of the cradle 4 are brought into close proximity, then, power is supplied to the digital camera 1 by electromagnetic induction, and a date signal representing the date information of the image data S1 stored in the memory card 5 and a version signal representing the version of the program data stored in the program memory 17 are transmitted to the personal computer 2. Wireless LAN data communication between the wireless LAN communication unit 33 of the digital camera 1 and the wireless LAN communication device 25 connected to the personal computer 2 is performed based on the transmitted signal, to perform the image data management process and version management process.”

Watanabe-JP, [0073]

“only image data S2 that is not stored in personal computer 2 is sent from digital camera 1 to the personal computer 2 based on the date signal, so in case a portion of the image data S1 stored on the memory card 5 is stored on the personal computer 2, it is no longer necessary to send and receive all the image data S1 stored on the memory card 5 during the image data management process, thereby reducing the communication time for sending and receiving the image data.”

Watanabe-JP, [0074]

“In addition, based on the version signal, only when the version of the program data stored in the program memory 17 is old, the updated program data will be sent to the digital camera 1 for updating the program data, so the program data can be updated stably. In addition, if the version of the program data stored in the program memory 17 is the same as the version of the program data stored in the personal computer 2, since program data is not sent or received, wasteful sending and receiving of program data can be eliminated.” Watanabe-JP, [0075]

“since the storage battery 19 is charged along with the image data management process and version management process, the image data management process and version management process can be performed during the daily charging of the digital camera 1. This allows the user of the digital camera 1 to perform image data management processing and version management processing in the course of daily operations without having to be particularly aware of it.” Watanabe-JP, [0076]

186. Thus, a POSA would have had multiple further reasons to implement Watanabe-JPs wireless charging and communication to facilitate more convenient image transfer and program update management.

D. Niikawa in view of Watanabe-JP Combination

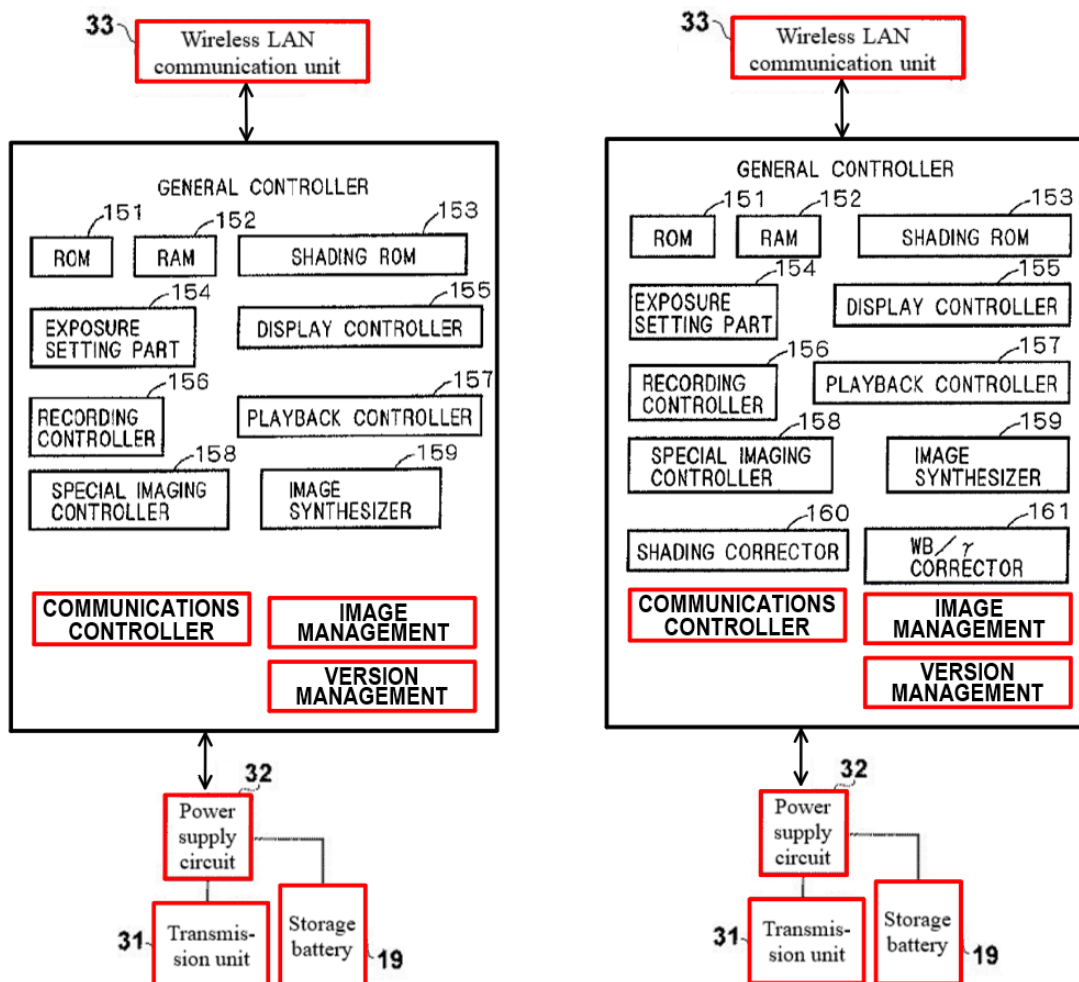
187. For the reasons discussed in detail in §IX.C above, a POSA would have been motivated by the teachings of Watanabe-JP to modify Niikawa by:

- (1) implementing Watanabe-JP's wireless LAN communication unit 33, transmission unit 31, rechargeable storage battery 19 and power supply circuit 32 (as discussed in detail in §IX.B.3 above) in Niikawa's digital camera 1 (e.g., Watanabe-JP, [0037], [0041], [0049], [0079]);
- (2) configuring Niikawa's general controller 150 with Watanabe-JP's corresponding control programs and the processing programs that perform Watanabe-JPs image data and version management processes (as discussed in detail in §§IX.B.1-2 above) (e.g., Watanabe-JP, [0055]-[0073]); and
- (3) utilizing Watanabe-JPs wireless charging cradle (as discussed in detail in §IX.B.3 above) (e.g., Watanabe-JP, [0050]-[0052]).

188. Exemplary implementations of Niikawa in view of Watanabe-JP are illustrated below showing the teachings of Watanabe-JP applied to Niikawa's

digital camera 1 outlined in red for both Niikawa's Fig. 5 and Fig. 13

configurations:



189. A POSA would have had a reasonable expectation of success in making the above Niikawa in view of Watanabe-JP combination because modifying Niikawa's camera to include Watanabe-JP's wireless communication units and programming Niikawa's general controller 150 to perform Watanabe-JPs image data and version management processes was straightforward and routine in the art, requiring only conventional skills.

190. Wireless charging as taught in Watanabe-JP was known in 2006 as was wireless communication of program and image data (as discussed in detail in §§IX.B.1-2 above), so a POSA would know how to implement these in Niikawa's camera.

191. Niikawa's camera was (as discussed in detail in §IX.A above) already controlled by software, so implementing the additional control and communication procedures taught by Watanabe-JP would only have required programming in addition to that already in place in Niikawa's camera.

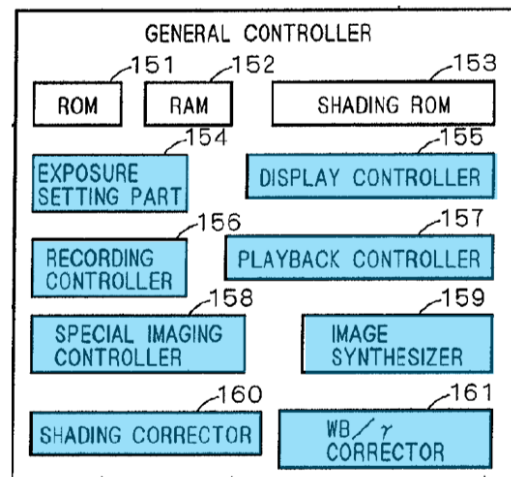
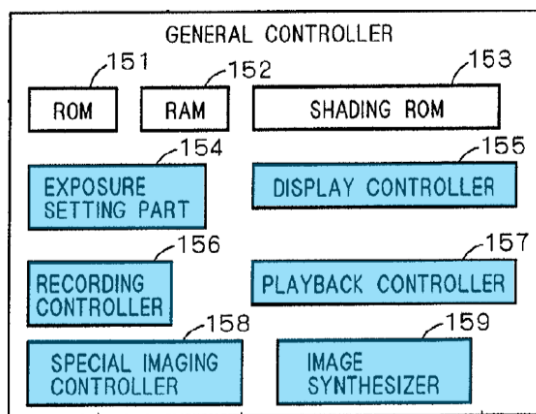
E. Claim 1

192. Claim 1 can be parsed into limitations as follows:

#	Limitation
1[PRE]	A method of processing one or more images with a digital camera comprising:
[1A]	digitally processing at least one captured image, the processing using in-camera hardware and software that is configured to:
[1A1]	perform a plurality of image correction algorithms,
[1A2]	process image correction data stored in a database system,
[1A3]	receive updated software and image correction data, and
[1A4]	upgrade the digital camera with the updated software and image correction data;
[1B]	storing in memory one or more corrected images resulting from digitally processing the at least one captured image; and
[1C]	wirelessly transmitting at least one of the one or more corrected images,
[1D]	wherein the in-camera software and database system are upgradable to provide improved algorithms and correction data for correction of images.

1. 1[PRE]: “A method of processing one or more images with a digital camera comprising:

193. Niikawa in view of Watanabe-JP meets 1[PRE] because, as discussed in detail in §IX.A above, Niikawa’s digital camera 1 includes general controller 150 that executes “processing and control programs” ([0096]) that control digital camera 1 to capture images and processes those captured images in multiple ways, including performing shading, white balance and γ correction processes, image positioning and image synthesis processes, etc.—e.g., the programs represented as “functional blocks” ([0097]) shaded blue in Niikawa’s general controller 150 excerpted from FIG. 5 (below left) and FIG. 13 (below right):



2. [1A]: “digitally processing at least one captured image, the processing using in-camera hardware and software that is configured to:”

194. Niikawa in view of Watanabe-JP meets limitation [1A] as follows:

195. As discussed in detail in §IX.A above, Niikawa's general controller 150 is "implemented as a microcomputer" (Niikawa, [0095]) and executes "processing and control programs" stored in ROM 151 (Niikawa, [0096]) to process image data captured by CCD 303 and converted to digital images by A/D converter 122 (Niikawa, [0077]-[0081]), so Niikawa's camera "digitally process[es] at least one captured image [] using in-camera hardware and software," as claimed. Niikawa, [0095]-[0104], [0129]-[0132]

196. General controller 150's digital processing of captured images includes (1) performing, as discussed in detail in §IX.A above, shading, white balance (WB), γ correction and image synthesis processes in hardware (general controller 150) and software programs shaded blue in FIGS. 5 and 13 as shown in §IX.E.1 above); and (2) digitally processing live view images captured by the digital camera to perform Niikawa's AF and AE processes and to display live video to the user (Niikawa, [0084]-[0086], [0095]-[0120], [0129]-[0142], [0148], [0157]-[0159]):

"The exposure setting part 154 for executing an exposure control process and determines a brightness of the subject using image data of G color component of the live view image and calculates an exposure control value based on the determination result." Niikawa, [0098]

"when the shutter button 9 is pressed half way down, a focal point of the lens group 30 of the imaging lens 3 is adjusted for a main subject,

an exposure control value is calculated by using a live view image and a white balance adjustment value is set.” Niikawa, [0106]

“when the shutter button is pressed halfway down, as preparation for image capturing, a focal point of the lens group 30 of the imaging lens 3 is adjusted for a main subject, an exposure control value is calculated by using a live view image and a white balance adjustment value is set.” Niikawa, [0134]

“the image data is read out by the general controller 150, transferred to the LCD VRAM 141 and the EVF VRAM 142 after being subjected to data size adjustment, and displayed on the LCD 10 and the EVF 20 in the form of a live view display. This allows the user to visually recognize the subject image.” Niikawa, [0092]

197. As discussed in detail in §IX.D above, Niikawa’s general controller 150 can be configured to perform Watanabe-JP’s program update and wireless image download techniques and thus the “in-camera hardware and software” Niikawa in view of Watanabe-JP is configured to perform each of limitations [1A1]-[1A4] and meets [1A].

i. [1A1]: “perform a plurality of image correction algorithms”

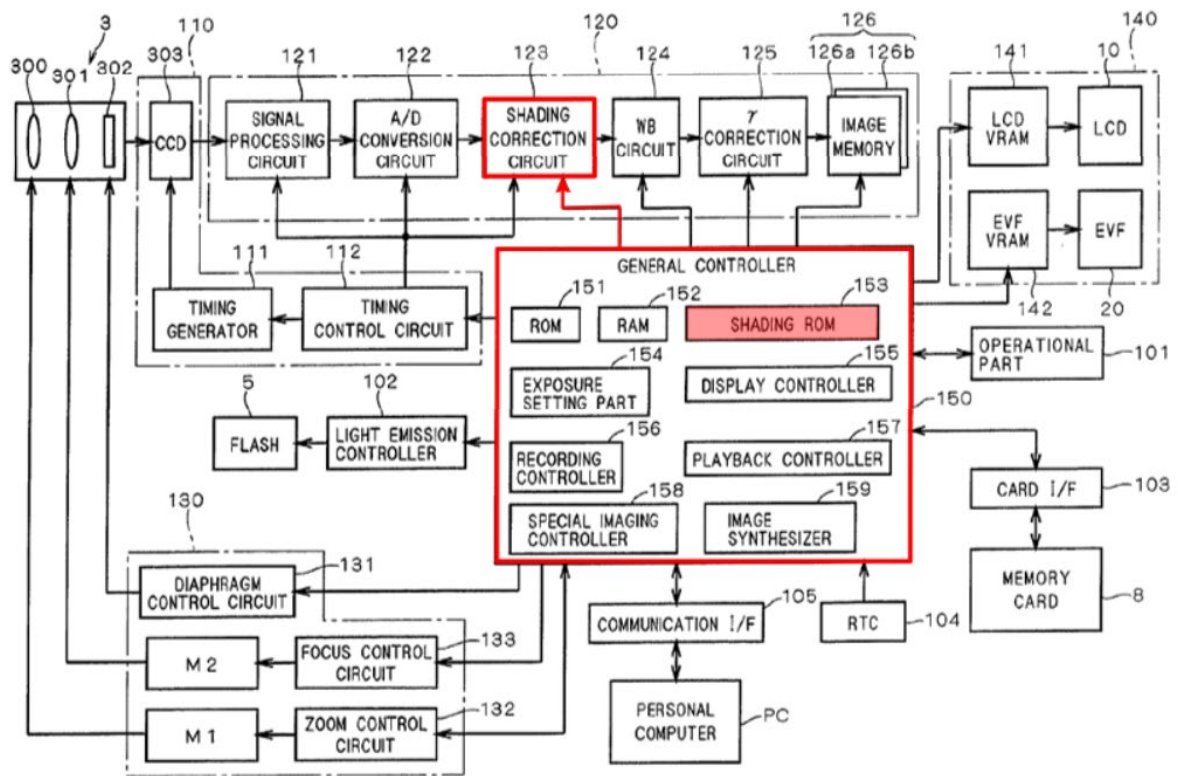
198. Niikawa in view of Watanabe-JP meets [1A1] because as discussed in detail in §IX.D above, Niikawa’s general controller 150 performs multiple “image correction algorithms” on captured images, including shading, white balance (WB), γ , positioning, and dynamic range correction.

(1) Shading Correction Process

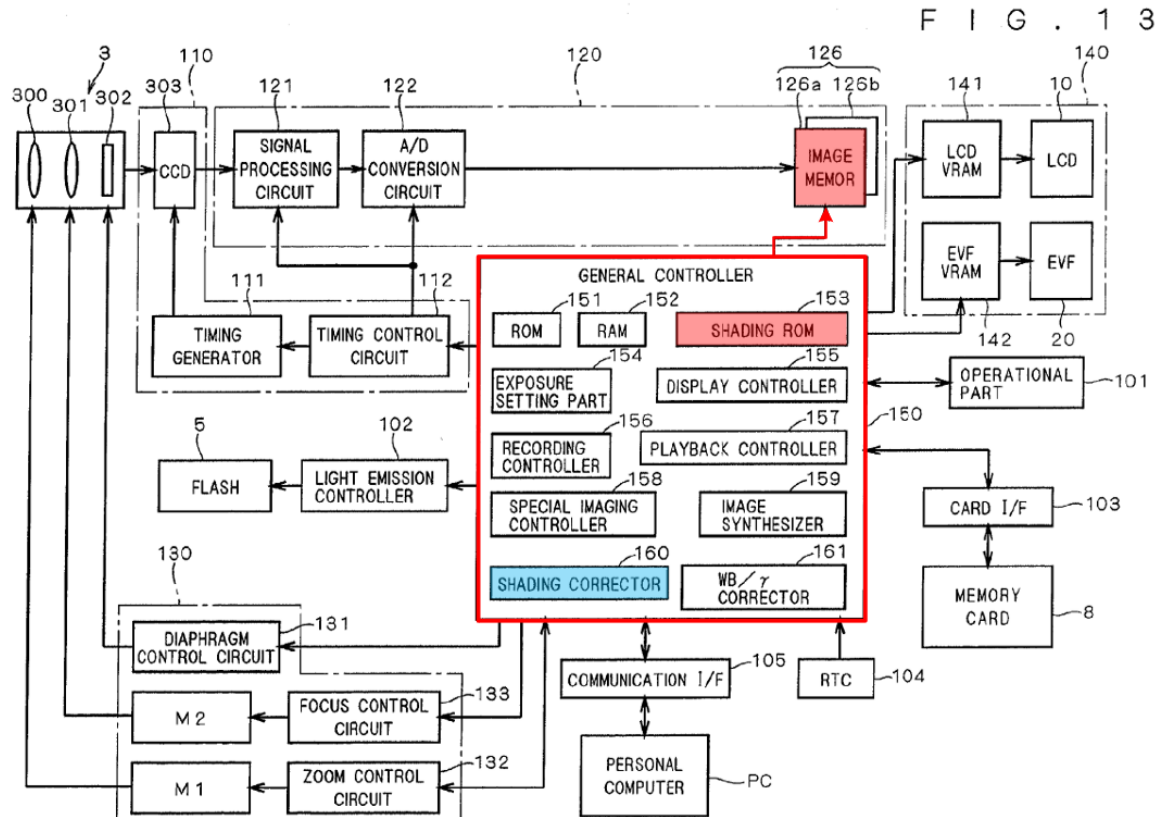
199. Niikawa’s “shading correction process” (steps described in detail in §IX.A above) corrects for variable lens shading effects on captured images by multiplying captured image data with “correction coefficients” stored in a “correction table” selected from “plurality of correction tables” stored in shading ROM 153 to remove the influence of shading (Niikawa, [0083]-[0084])—i.e., Niikawa’s shading correction process is an image correction algorithm. Niikawa, [0108]-[0110], [0129]-[0130], [0138], [0158].

200. Niikawa discloses configuring general controller 150 to perform the above-described shading correction algorithm in two ways. In the configuration illustrated in FIG. 5 (annotated below), “general controller 150 performs selection of correction table from the shading ROM 153 in accordance with the optical condition such as focal length and f-number at the time of imaging” (Niikawa, [0084]). General controller 150 inputs the selected correction table to “shading correction circuit 123” with dedicated multiplication circuits to perform fast multiplication of the “correction coefficients” stored in the selected correction table and corresponding pixel values in the captured image—i.e., “a coefficient processing hardware circuit” (Niikawa, [0030]). Niikawa, [0083]-[0084], [0108], FIG. 6.

FIG. 5



201. In the configuration illustrated by FIG. 13 (annotated below), general controller 150 executes the “shading corrector 160” process program (shaded blue) to select a correction table from ROM 153 and perform multiplication of the correction coefficients with captured image data read from memory 126 in “software” (Niikawa, [0129]-[0130]). Thus, shading correction multiplications (i.e., multiplications between correction coefficients in the selected correction table and corresponding pixel values in a captured image) is performed using general controller 15’s computation unit instead of “a coefficient processing hardware circuit”—i.e., shading correction circuit 123. Niikawa, [0030], [0138], [0158].



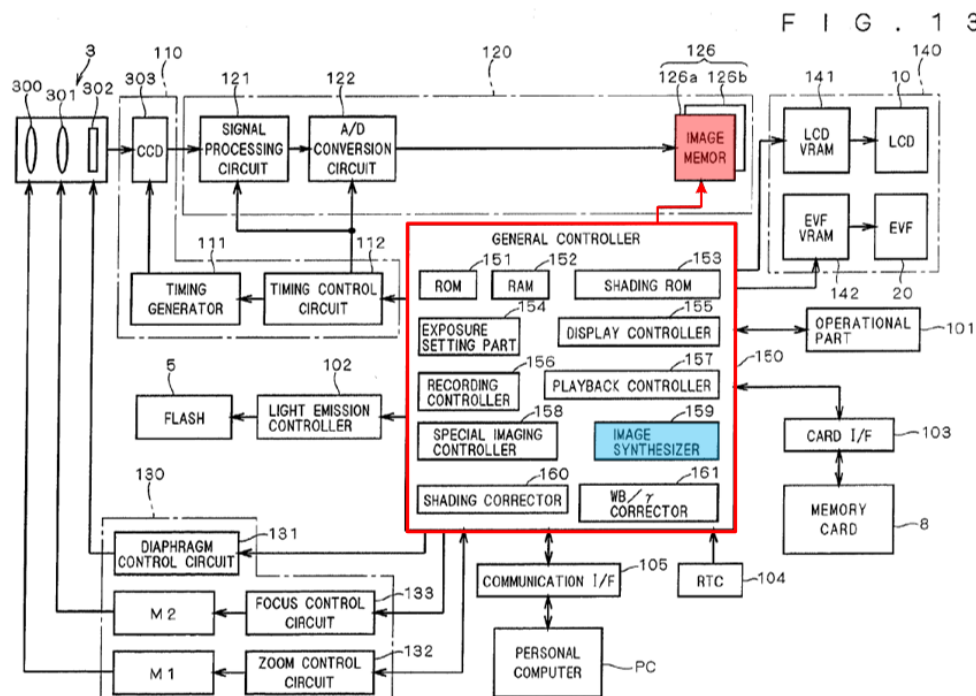
202. In both the configuration illustrated in FIG. 5 and FIG. 13, general controller 150 performs selection of the correction table by executing its control/processing programs—i.e., software that controls general controller 150 to obtain the desired correction table from the plurality of correction tables stored in ROM 151 in both configurations. Niikawa, [0084], [0095]-[0096], [0129]-[0130].

(2) WB and γ Correction

203. Niikawa's WB correction process (steps described in detail in §IX.A above) corrects for different light conditions by adjusting “the level of image data of each color component R, G, B” using “a level conversion table” obtained by general controller (Niikawa, [0086]) and an automatic white balance value (“AWB

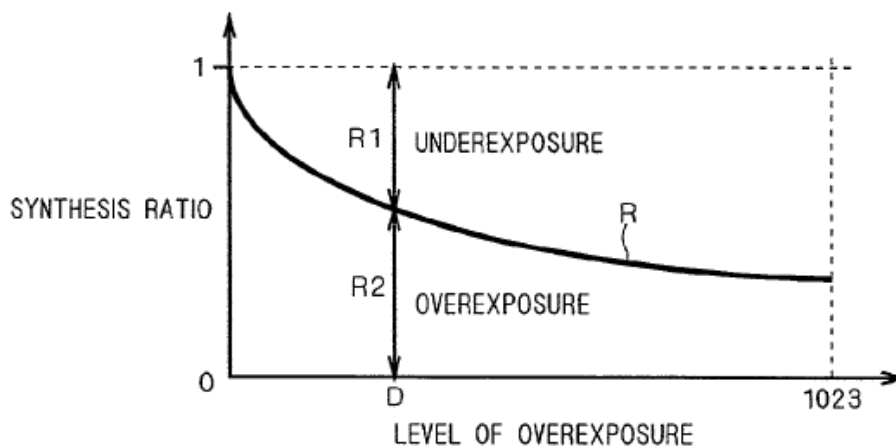
(3) Dynamic Range Correction

205. As described in detail in §IX.A above, to correct for the effects of the “narrow dynamic range” of the sensor (Niikawa, [0061]) on captured images, Niikawa’s general controller 150 controls the camera to captures two images of the same subject at respective different exposure settings. Niikawa, [0074], [0107]-[0110], [0135]-[0137], [0147]. Niikawa’s dynamic range correction algorithm includes general controller 150 performing a “positioning process” to correct for positional differences in the image data due to the different exposure timings (i.e., to align the two images) and an “image synthesis process” to combine the image data to “obtain[] a synthesized image with substantially widened dynamic range” by executing “image synthesizer 161” software in both configurations (see e.g., FIG. 13 annotated below). Niikawa, [0111]-[0120].



206. Niikawa's image synthesis process combines pixel values of the two captured images (i.e., an overexposed and an underexposed image) according to adding ratios R1 and R2 established for different image brightness levels of image data. Niikawa, [0120]. For example, FIG. 12B (below) illustrates a synthesis curve R showing an example of how the adding ratios R1 and R2 vary according to pixel brightness level. Niikawa, [0120]. The brightness level of each pixel in the overexposed image is used to obtain the corresponding adding ratios R1 and R2 that define the relative contribution of respective pixels in the two images to each pixel in the synthesized image. Niikawa, [0120].

F I G . 1 2 B



207. When the user sets the camera to operate in the "normal exposure mode" (Niikawa, [0074]), Niikawa's "processing and control programs" (Niikawa, [0096]) configure general controller 150 to capture a single image and perform shading, WB and γ correction processes on the single image captured by the camera. Niikawa, [0108]-[0110], [0123].

208. When the user set the camera to operate in the “gradation control processing mode” (Niikawa, [0074]), Niikawa’s processing and control programs configure general controller 150 to perform shading correction (shaded blue), WB and γ correction (shaded green), positioning (shaded purple), and image synthesis (shaded red) processes on the two images captured by the camera as shown in the gradation control processes illustrated in FIG. 9 ([0107]-[0120]) for the FIG. 5 configuration and FIG. 14 ([0129]-[0140]) for the FIG. 13 configuration.

FIG. 9

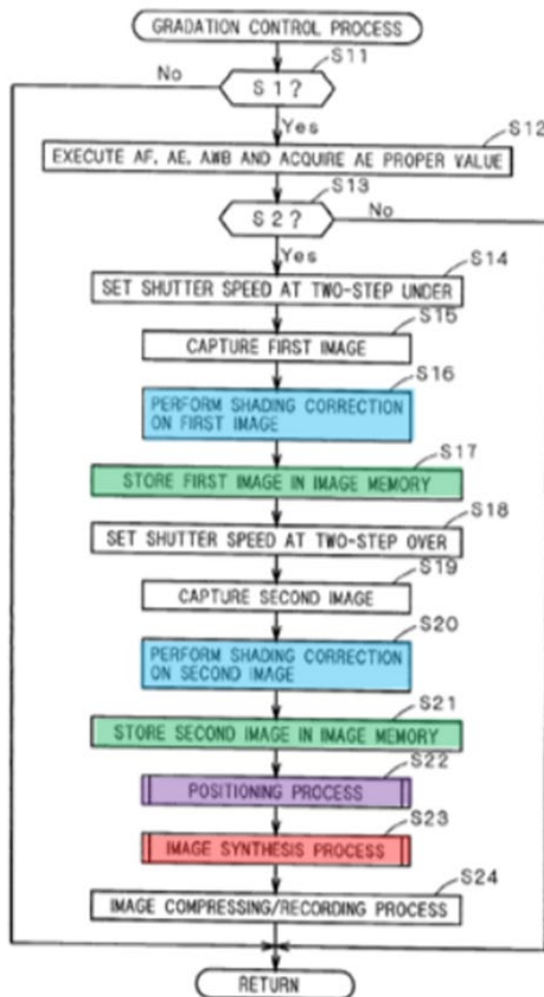
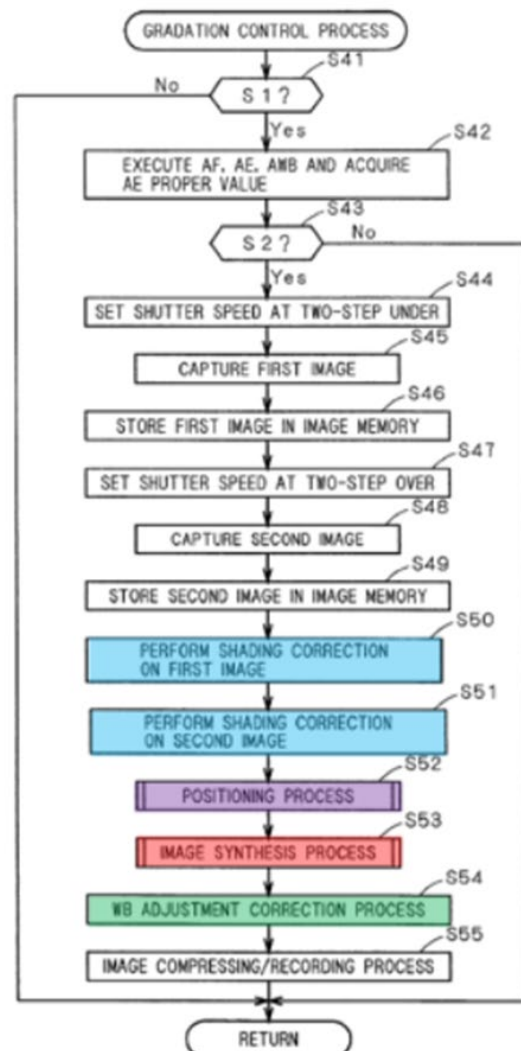


FIG. 14



209. Thus, Niikawa in view of Watanabe-JP meets [1A1] because general controller 150 executing its “processing and control programs” stored in ROM 151 (Niikawa, [0096]) is configured to perform “*a plurality of image correction algorithms*”—i.e., each of the multiple image correction algorithms discussed in §§IX.E.2.i(1)-IX.E.2.i(3) above. Niikawa, [0095]-[0104], [0129]-[0131].

ii. [1A2]: “process image correction data stored in a database system”

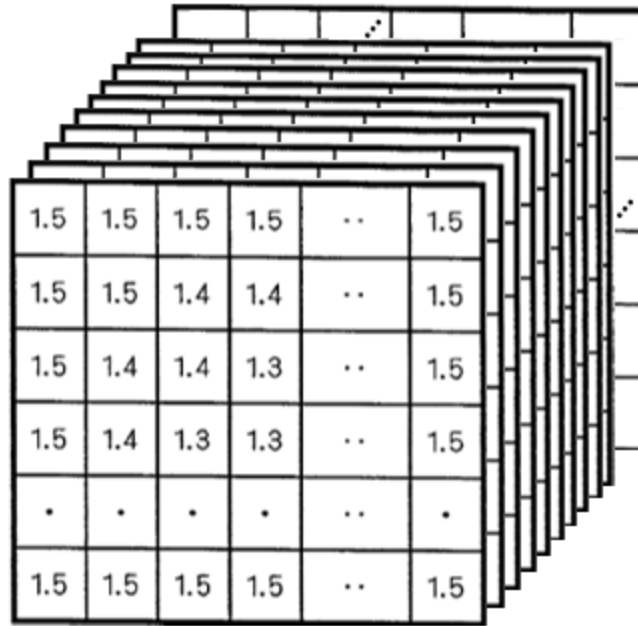
(1) Niikawa’s Shading Correction Process Meets [1A2]

210. As discussed in detail in §IX.A above, to perform shading correction Niikawa’s general controller 150 accesses a “plurality of correction tables” stored in shading ROM 153 and selects therefrom the specific “correction table” corresponding to “the focal length and f-number at the time of imaging.” Niikawa, [0084]. As illustrated in Niikawa’s FIG. 7 (below left), each correction table stores “correction coefficients” that correct for shading at the corresponding pixel location in an image for a given focal length and f-number. Niikawa, [0083]-[0084].

FIG. 7

1.5	1.5	1.5	1.5	..	1.5
1.5	1.5	1.4	1.4	..	1.5
1.5	1.4	1.4	1.3	..	1.5
1.5	1.4	1.3	1.3	..	1.5
.	.	.	.	..	.
1.5	1.5	1.5	1.5	..	1.5

211. Niikawa discloses that “a plurality of correction tables for different parameters which are the optical conditions such as focal length and f-number at the time of imaging are prepared and stored in a shading ROM 153” (Niikawa, [0084])—i.e., Niikawa’s stores a plurality of FIG. 7’s correction tables that each store correction coefficients that correct for shading at different focal length and f-number parameter as illustrated by the drawing below created using FIG. 7’s correction table for illustration.



1.5	1.5	1.5	1.5	..	1.5
1.5	1.5	1.4	1.4	..	1.5
1.5	1.4	1.4	1.3	..	1.5
1.5	1.4	1.3	1.3	..	1.5
.	.	.	.	..	.
1.5	1.5	1.5	1.5	..	1.5

Illustration of Niikawa’s “Shading ROM 153”

212. Niikawa’s “general controller 150 performs selection of correction table from the shading ROM 153 in accordance with the optical condition such as focal length and f-number at the time of imaging” (Niikawa, [0084]) and performs a “coefficient process” (Niikawa, [0083]) that multiplies the correction coefficients, also referred to as “correction data” (Niikawa, [0085], [0158]), stored in the selected correction table with corresponding pixel values in a captured image to correct for the shading effect produced by the optical conditions at which the image was capture. Niikawa, [0083]-[0084], [0108], [0129]-[0130], [0138], [0158].

213. As discussed in §IX.E.2.i(1) above, general controller 150 inputs the selected correction table to shading correction circuit 123 to perform the coefficient process multiplications in the FIG. 5 configuration (see also FIG. 6) and

performs the multiplications using its own computation unit in the FIG. 13 configuration.

214. Thus, Niikawa's general controller 150 is configured to "process image correction data" as claimed because general controller 150 is configured to select a correction table from shading ROM 153 and perform the coefficient process on the captured image to correct for shading.

215. Niikawa's "plurality of correction tables" stored in shading ROM 153 in accordance with different focal length and f-number parameters is a database as that term would be understood by a POSA:

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

EX1024 ("Bestgen"), 2:8-12;

"**database** A collection of data structured and organized in a disciplined fashion so that access is possible quickly to information of interest." EX1055 ("Newton's Telecom Dictionary"), p. 238

"a database is a repository for stored data." EX1074, 5:57-58.

216. In the field of digital cameras, the term "database" was conventionally used to describe a collection of data stored in the digital camera's memory that is accessed by the camera's processing elements:

- For example, EX1027 ("Sasaki") describes a digital camera 1 comprising "image processing section 17" with "various kinds of digital circuits which

conduct a gamma correction, a color space converting process, outline emphasizing process, image signal processing, compression coding process and the like,” an “AWB (auto white balance) circuit for correcting a color temperature,” that accesses a “ROM 10” that **“stores a database and various setting data required by the image processing section 17”** (9:26-43). Sasaki’s ROM 10 stores: (1) a “distance data base 47” that stores “distance information” corresponding to different “reference values” that is accessed by the cameras “AF control section 44” (11:56-12:3); and (2) “a reflectance data base 49” (a “data base of correction data”) storing pre-computed probability values for different average brightness values at the center and periphery of an image area (15:1-33).

- As another example, EX1021 (“Walker”) discloses a “camera 600” (illustrated in FIG. 6A) comprising a “processor 605” and a “memory 610” ([0219]) that stores a “program 615 for controlling the processor” and additionally stores: (1) “image data base 635,” and (2) “an acquire condition database 620, an acquired image log 625, and image rating database 630, a compression condition database 640, and a compression tracking data 630” ([0220], [0233]), each database of which is a table as illustrated in FIGS. 7-12. EX1021, [0234]-[0290].

- See also EX1029, [0088]-[0089] (disclosing a digital camera 1 in which the camera's "control unit 7 is configured of a CPU 5 and a nonvolatile memory 6 such as a flash memory (hereinafter referred to simply as the memory 6). The memory 6 has stored therein a program required for the operation of the CPU 5, **a data base for storing various reference tables and templates** used in the process and image data output from the image processing circuit 9 and the CPU 5.").

217. General controller 150's control/processing programs used to access a database of correction tables to obtain the desired correction table meets [1A2]'s "database system" on which Niikawa's shading correction data is stored. Niikawa, [0083]-[0084], [0095]-[0096], [0108]-[0110], [0129]-[0130]. The term "database system" is commonly used to refer to the programs that control access to stored data or both the programs and the data that the programs access.

"A database system is a set of computer programs used by a user to store and retrieve data. Such data is often limited to text (letters, numerals, symbols, and other characters), but may include any data that may be stored by a computer. **Most database systems store data in tables.**" EX1072, 1:12-16.

"As is well known, a database system is a collection of interrelated data files, indexes and a set of programs that allow one or more users to add data retrieve and modify the data stored in these files." EX1073, 1:15-18.

“database system *noun* a series of programs that allows the user to create, modify, manage, and use a database” EX1075, p. 88.

218. Thus, a POSA would have understood that general controller 150’s processing programs that access a database of correction tables comprises a database system on which the correction tables are stored. Further, a POSA would have understood that database systems were designed to implement desired functionality of a given application and that a “database system” does not require a specific set of functionality, type of data, or a particular organization of that data. The specification similarly imposes no specific limitations on a database system. The term “database system” appears once in the specification: “software files are periodically downloaded to the camera in order to update the camera settings and the database system” (29:10-13).

219. The ’266 patent’s embodiments disclose a camera comprising a database that is accessed or referenced by the camera or the camera’s microprocessor to obtain corresponding data stored thereon:

“the camera identifies a specific lens and refers to a database that matches the lens type with the specific aberrations.” EX1001, 10:63-65

“The in-camera digital process works by identifying a specific lens and comparing the lens pattern to an internal database.” EX1001, 13:26-27

“This scene-specific adjustment of exposure greatly increases the tonal range of digital images and is made possible via analysis of the scene and comparison to a database of typical scenes categorized by the in-camera digital processor which effects correction using the methods described herein.” EX1001, 15:11-16

“For a fixed focal length lens, the camera refers to a database of information to provide information to correct specific types of aberrations; for a zoom lens, the camera's database contains multiplex information for each focal length in each respective zoom lens type.” EX1001, 26:56-61

“the camera's microprocessor accesses the database of similar scenes (1310)” EX1001, 33:43-44

“After an analysis of the initial image (2500), the identification of optical aberrations (2510) is made. The camera's database is accessed to retrieve the corrections (2520)” EX1001, 35:46-49

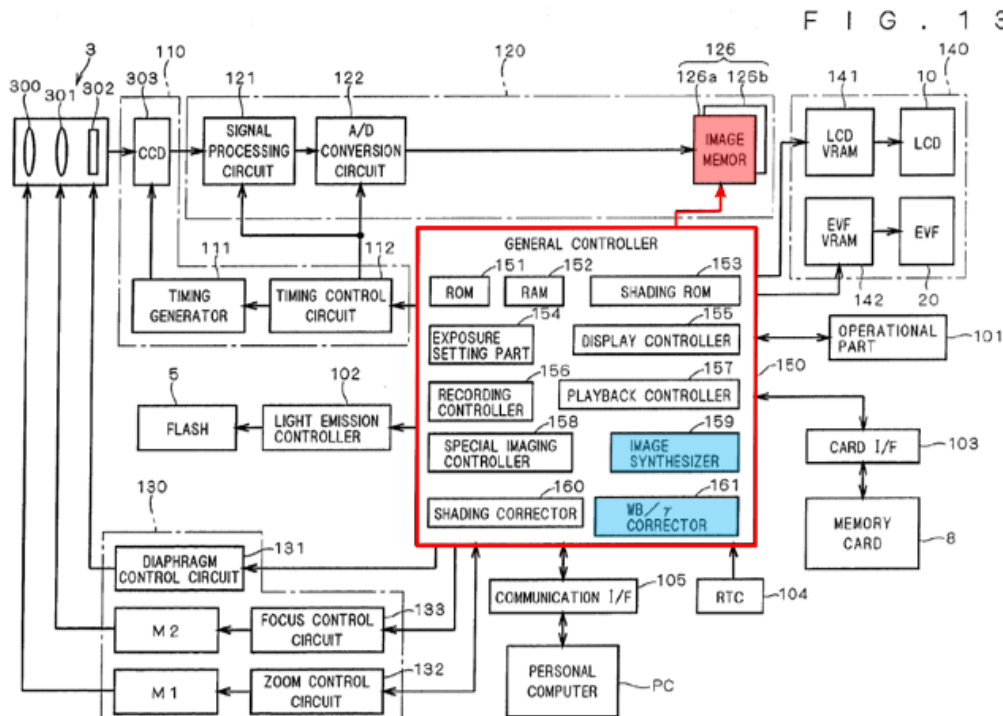
“After a lens detects a zoom lens type (2900), the camera detects a particular focal length setting of the zoom lens (2910) and accesses a data library in the database to modify aberrations to optimize the zoom lens at a specific focal setting (2920).” EX1001, 36:19-23

220. Niikawa's shading correction data stored in a database that is accessed by software executed by general controller-150 to obtain the desired correction table is “stored on a database system” for the same reasons.

221. Thus, Niikawa in view of Watanabe-JP meets [1A2] meets because Niikawa's in-camera hardware and software is configured to "process image correction data stored in a database system," and does so when general controller 150 performs the shading correction process.

(2) Niikawa's White Balance, γ , and Dynamic Range Corrections Additionally Performs [1A2]

222. As discussed in §§IX.E.2.i.(1)-IX.E.2.i.(3) above, Niikawa's general controller 150 is also configured to "process" multiple other types of correction data stored in general controller's ROM, i.e., "a level conversion table" for WB correction, a " γ correction table" for γ correction and adding ratio data (adding ratios R1, R2 at each different image brightness level). Niikawa, [0086], [0131], [0140], [0118]-[0120].



223. Thus, general controller 150's processing programs that access WB/ γ correction tables and image synthesis data stored in ROM to obtain the corresponding correction data also meets [1A2]'s "database system" on which this correction data is stored for reasons discussed in §IX.E.2.ii(1).

224. In particular, Niikawa's WB and γ correction tables and image synthesis data are part of Niikawa's repository of correction data stored in ROM that are accessed by general controller 150's programs when performing normal mode and gradation control processing sequences discussed in §IX.E.2.ii(1) above (see also §IX.A), stored in and accessed by the camera's database system.

225. Limitation [1A2] does not require correction data to be stored in a particular way. Nevertheless, Niikawa stores correction data in tables as was common and conventional for database systems (see §IX.E.2.ii(1)) and in a structured way that a POSA understood to be, individually and collectively, a database—i.e., structured data organized to allow Niikawa's processing programs to quickly and efficiently access the correction values stored therein and apply them to captured image data—as corroborated by the evidence discussed above in §IX.E.2.ii(1) and summarized below.

- EX1074, 5:57-58 ("a database is a repository for stored data").
- EX1029, [0088]-[0089] (disclosing a digital camera 1 with a nonvolatile memory 6 having "stored therein a program required for

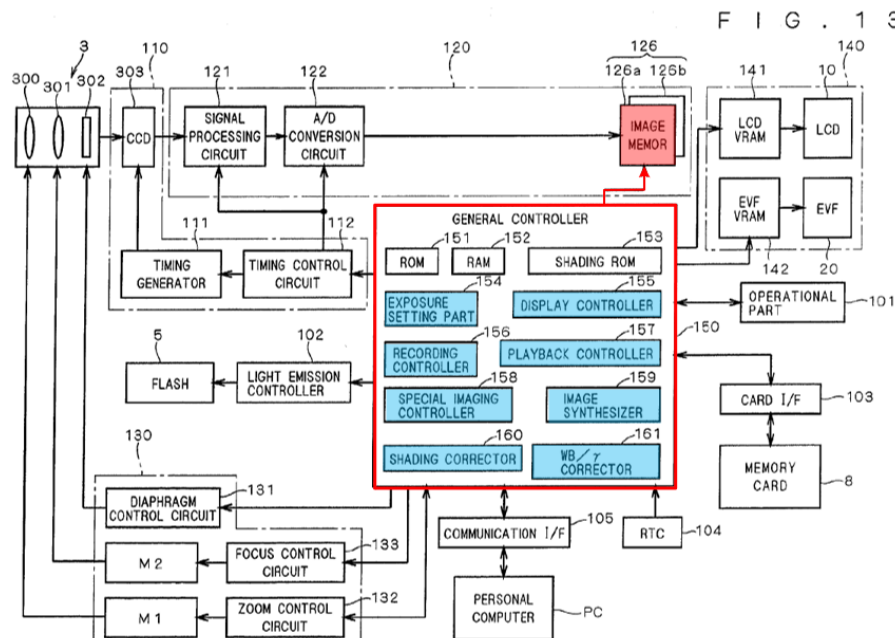
the operation of the CPU 5, **a data base for storing various reference tables and templates** used in the process and image data output from the image processing circuit 9 and the CPU 5.”).

- EX1021, [0219]-[0220], [0232]-[0234], FIG. 6A, 7-12 disclosing that individual tables stored in memory are each a “database.”
- EX1027, 11:56-12:3, 15:1-33 disclosing each collection of values referenced and applied to image data as a data base (i.e., distance data base 47 and reflectance data base 49).

226. Thus, Niikawa in view of Watanabe-JP meets [1A2] for the additional reasons that general controller 150 is configured to “process image correction data stored in a database system” when performing any of Niikawa’s WB, γ and/or image synthesis processes during the image correction processing sequences performed in the normal exposure mode and gradation control processing exposure modes discussed in §IX.E.2.i and in further detail in §IX.A above.

227. Niikawa’s general controller 150 is “implemented by a microcomputer” that performs “centralized control” of the camera (Niikawa, [0095]) by executing control and processing programs that perform the functions represented by “functional blocks” (Niikawa, [0097]) shaded blue in FIG. 13 below that access different types of correction data structured in tables indexed according to camera settings and/or pixel values in captured images when the

functions of shading corrector 160, WB/ γ correction 161 and image synthesizer 159, as discussed in §IX.E.2 above.



228. For the reasons discussed above, Niikawa’s general controller 150 also performs [1A2] each time it performs Niikawa’s shading, WB, γ correction and/or image synthesis processes during any of the image correction processing sequences performed in the normal and gradation control processing modes exposure modes discussed in §IX.E.2.i and in further detail in §IX.A.

229. A POSA would have recognized there were many ways to organize in memory the data structures explicitly disclosed for storing Niikawa’s different correction data and POSA would have known to do so in a way that allowed fast and efficient access to the data.

iii. [1A3]: “receive updated software and image correction data”

230. Niikawa in view of Watanabe-JP (as discussed in detail in §IX.D above) meets [1A3] because Niikawa's general controller 150 is “configured to” ([1A]) receive both updated software and image correction data via physical and wireless connections.

(1) Niikawa’s Program Update

231. As discussed in detail in §IX.C.1 above, Niikawa’s “processing and control programs can be installed into digital camera 1 from the memory card 8” or “from the personal computer PC via the communication interface 105” by storing “program data” received therefrom in digital camera 1’s ROM.

232. A POSA would have understood from this disclosure that:

- (1) Installing the “program data” updates the camera’s program data because there would be no need to install it otherwise. That is, the purpose of installing Niikawa’s program data is to provide functionality that wasn’t previously provided.
- (2) Niikawa’s ROM is writable by general controller 150 (e.g., an EEPROM). Moreover, a POSA would have known to use a rewritable memory in Niikawa’s camera as taught by Watanabe-JP. Watanabe-JP, [0004] (“For this reason [updating the program data], a system has been proposed in which the memory in which the program is stored in the information equipment is rewritable”),

[0040] (“The program memory 17 is memory in which data can be rewritten”).

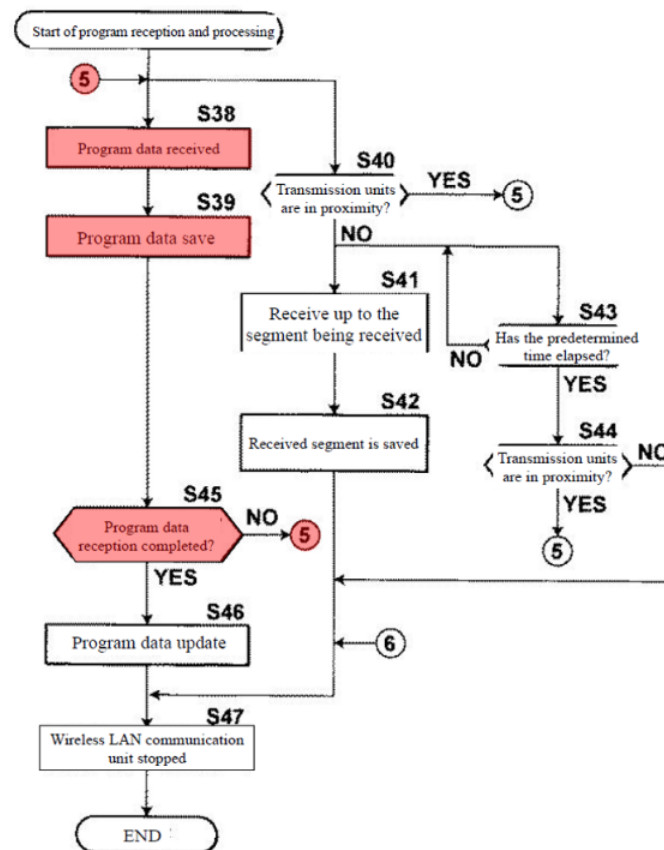
- (3) this updated program data included the image correction data on which Niikawa’s programs operate (see e.g., the correction data discussed in §IX.E.2.ii above), because those programs would otherwise be unable to perform their disclosed functions; and
- (4) Niikawa’s general controller 150 is “configured to” [1A] install subsequent updates to the program data via the same installation process.
- Each of the above also would have been the obvious way to implement and use what Niikawa discloses, as discussed further in §IX.E.2.iii(2) below.

233. Thus, Niikawa in view of Watanabe-JP meets [1A3] because Niikawa’s general controller 150 is “configured to...receive updated software and image correction data” via either memory card 8 or a PC.

(2) Niikawa in view of Watanabe-JP’s Wireless Update

234. As discussed in detail in §IX.D above, in Niikawa in view of Watanabe-JP Niikawa’s camera 1 is modified to include Watanabe-JP’s “wireless LAN communication unit 33” and Niikawa’s general controller 150 is configured to perform wireless software updates as in Watanabe-JP’s “program reception

process” (highlighted in red in FIG. 4 below), so when updated program data is sent wirelessly to digital camera 1, “wireless LAN communication unit 33 of the digital camera 1 receives the program data (step S38)” (Watanabe-JP, [0068]) and stores it in the camera’s program memory. Watanabe-JP, [0004], [0022]-[0025], [0040], [0062]-[0071].



235. A POSA would have understood that updated program data would have included the correction data on which the programs operate. For example, a POSA would have understood (as discussed in detail in §IX.B.1 and §IX.C.2 above) that Watanabe-JP’s “updated program data [] provided by the manufacturer” to upgrade the digital camera (Watanabe-JP, [0048]) included all

data needed to perform the improved functionality or to implement new features of an updated version, which for image processing programs like Niikawa's (and Watanabe-JP's) routinely included improvements to the correction data on which the programs operate, as the examples below demonstrate.

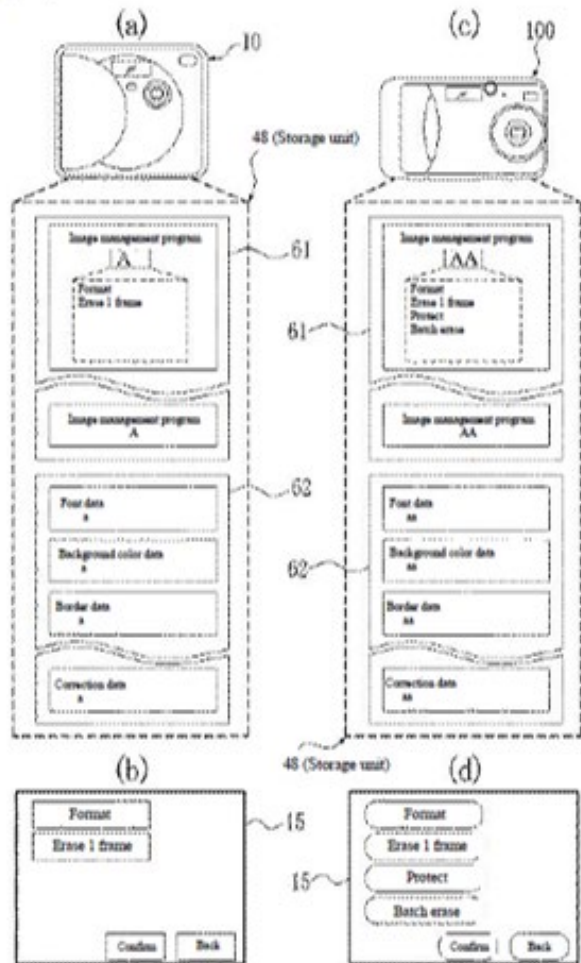
236. Moreover, the obvious and beneficial way to update Niikawa's control and processing programs would have been to update the correction data as improvements are made or new features added, as was conventional and routine, as demonstrated by the example conventional updates to a camera's image correction algorithms by updating the correction data those algorithms operate on.

237. EX1009 describes techniques for updating a camera with new features and functionality, including updating a camera's image processing algorithms by providing updated correction data that the image algorithms utilized, such as enhanced "look-up tables, matrices, compression tables, dynamic range optimization tables, and other files capable of effecting the captured image" (4:51-53). In this way, algorithms such as "color filter array interpolation algorithms, noise reduction algorithms, edge sharpening algorithms, color reproduction algorithms, compression algorithms, or dynamic range optimization algorithms" can be improved by updating the correction data they operate on. EX1009, 4:53-5:1. EX1009 also describes updating a camera to perform particular applications, e.g., "portraits" in which updated data files would provide color reproduction

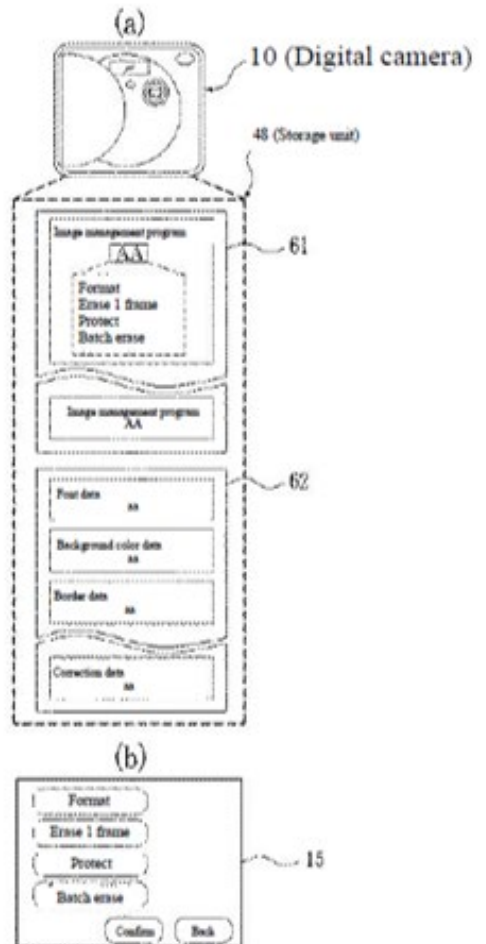
processes “optimized for skin tones” and wherein “the edge sharpening should not be too severe, and the color filter array algorithm should minimize aliasing” (8:50-9:1). EX1009, 2:29-38, 4:37-67, 8:50-9:1.

238. EX1010 discloses a camera-to-camera upgrade technique in which a digital camera storing an older version of the camera’s software is upgraded with a newer version operating on a different camera, including updating the camera’s “correction data used during the execution of the image processing program to perform gamma correction, white balance correction, and the like” ([0022]). EX1010, Abstract, [0003]-[0009], [0017], [0021]-[0022], [0029]-[0036]. As illustrated in EX1010’s FIG. 4 (below left), a camera 10 stores older correction data “a” as compared to the new version of the correction data “aa” stored on camera 100. As shown in EX1010’s FIG. 6 (below right), after camera 10 is upgraded with camera 100’s upgraded program data, camera 10 includes updated correction data “aa” received from camera 100. EX1010, Abstract, [0003]-[0009], [0017], [0021]-[0022], [0029]-[0036].

[Fig. 4]



[Fig. 6]



239. EX1071 stores the digital camera's image correction "knowledgebase" in a "series of look-up-tables (LUTs) which may be embedded in the non-volatile memory of a digital camera" (14:5-9). The patent discloses that it is "desirable that said knowledgebase can be easily updated by a camera manufacturer," which can be performed using wired or wireless connections (14:16-24). EX1071, 14:5-24.

240. In addition to the updated correction data received when Niikawa's control and processing programs are installed on Niikawa's camera (as discussed

in detail in §IX.E.2.iii(1) above), a POSA would have understood it to be beneficial to update Niikawa's shading correction process, white balance and γ correction processes, image synthesis process, etc., with updates to the correction data on which the respective processing programs operate (as discussed in detail in §IX.A above) as improvements are made, to add further image correction processes or new features, etc., as was conventional and routine, and indeed the very purpose of updating a camera. Watanabe-JP, [0004]; see also the known beneficial use of updating a camera's correction data discussed in EX1009, EX1010, and EX1071 above.

241. Thus, Niikawa in view of Watanabe-JP wireless software update meets [1A3] for additional reasons.

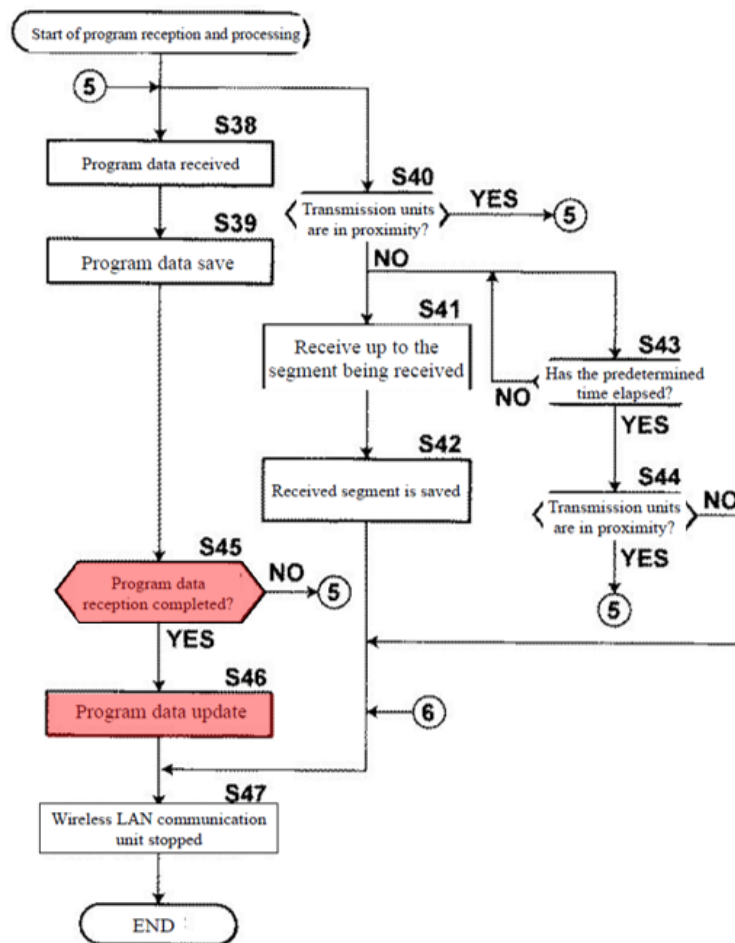
iv. **[1A4]: “upgrade the digital camera with the updated software and image correction data;”**

242. Niikawa in view of Watanabe-JP meets [1A4] because the updated software and correction data that is received (by performing [1A3]) is applied to upgrade the digital camera.

243. As discussed in detail in §IX.D above, Niikawa in view of Watanabe-JP implements Watanabe-JP's program data update technique of sequentially receiving program segments and first storing each program segment before updating the currently installed programs. Program data received from PC 2 “is

only stored in program memory 17, and no update of the program data is performed” until all of the updated program data is successfully received.

244. As shown by steps highlighted in red in Watanabe-JP’s FIG. 4 below, when all of the updated program data has been received (step S45), the “received program data is set up and the program data currently stored in program memory 17 is updated (step 46).”



245. Niikawa in view of Watanabe-JP applies this same technique by configuring general controller 150 to store all received program data (which includes any received correction data) in Niikawa’s ROM (or RAM) without

overwriting any information until all program data has been received as taught by Watanabe-JP and then “upgrade the digital camera with the updated software and image correction data” when it updates the Niikawa’s programs and correction data once all segments have been successfully received.

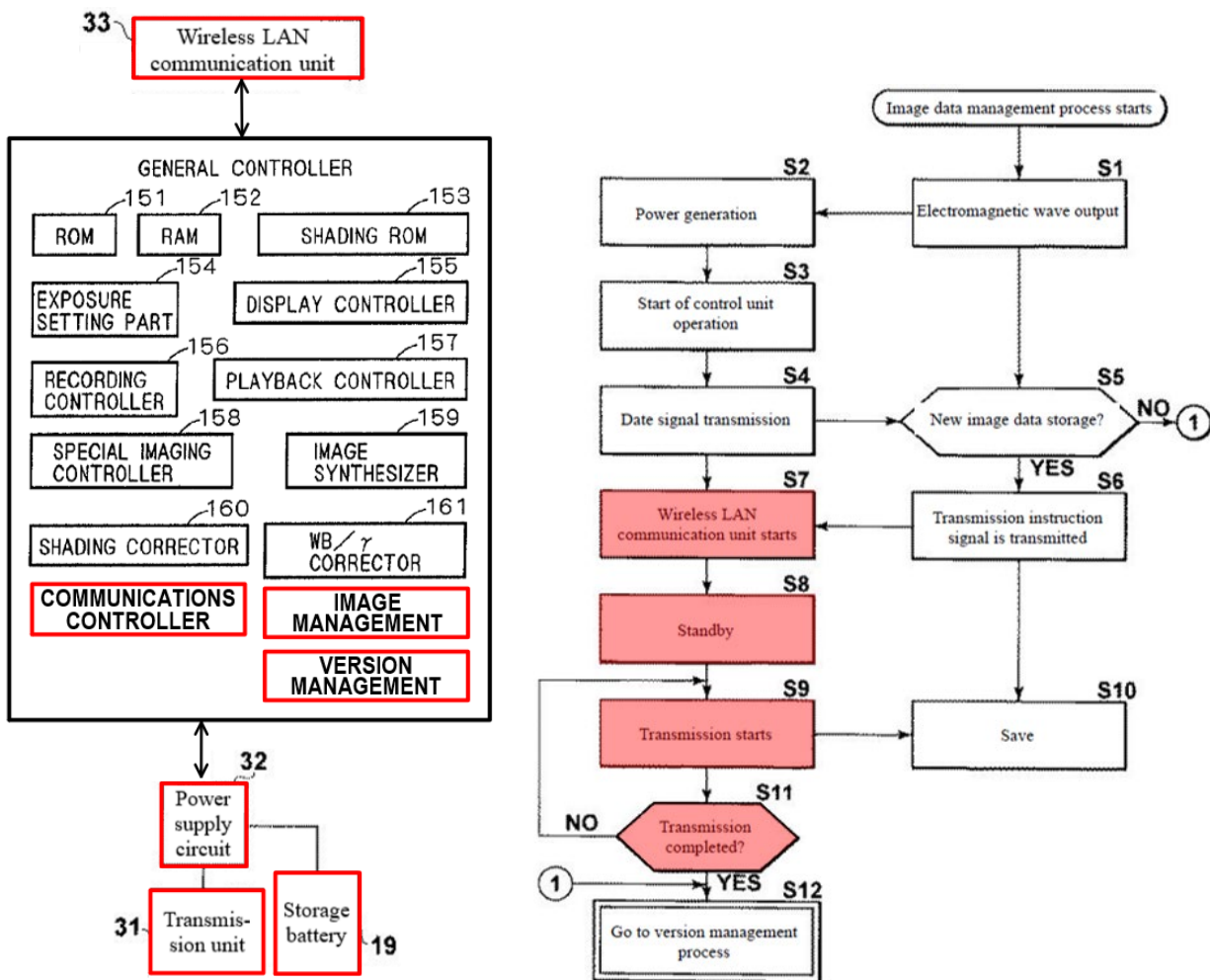
3. [1B]: “storing in memory one or more corrected images resulting from digitally processing the at least one captured image; and”

246. Niikawa in view of Watanabe-JP meets [1B] because Niikawa’s “image memory 126” temporarily stores “image data for which image processing has been completed” (Niikawa, [0087], [0108]-). In addition, the “corrected images” for which shading, white balance and γ correction have been performed in the normal exposure mode, and for which positioning and image synthesis have additionally been performed in the gradation control process mode are stored with respective thumbnails and tag information on Niikawa’s memory card 8. Niikawa, [0100]-[0101], [0121], [0123], [0140], [0159].

4. [1C]: “wirelessly transmitting at least one of the one or more corrected images”

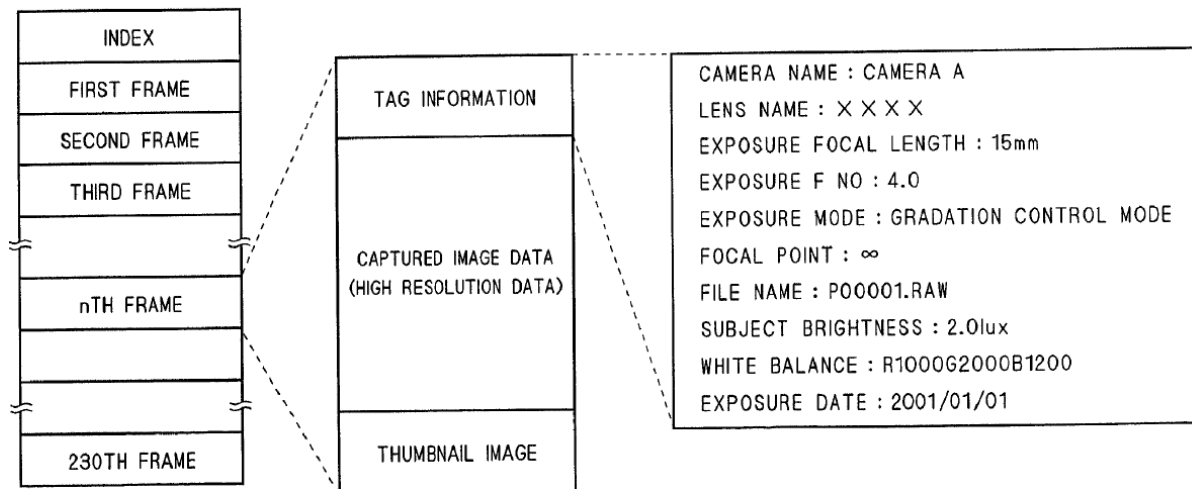
247. Niikawa in view of Watanabe-JP meets [1C] because, as discussed in detail in §§IX.C.1 and IX.D above, Niikawa in view of Watanabe-JP implements Watanabe-JP’s image management processes for wirelessly transmitting images from the digital camera to an external computer.

248. Specifically, as shown in the exemplary implementation of Niikawa in view of Watanabe-JP (below left) and Watanabe-JP's FIG. 2 (below right), Watanabe-JP's image management process implemented on Niikawa's camera determines whether the memory card stores images acquired since the last download using the images' date and time stamps (step S5 in Watanabe-JP's FIG. 2 below). New images are wirelessly transmitted via wireless LAN communication unit 33 implemented on Niikawa's camera, as illustrated by steps S6-S11 (shaded red in FIG. 2 below). Watanabe-JP, [0058]-[0060].



249. Niikawa in view of Watanabe-JP performs [1C] when it wirelessly transmits corrected images stored on Niikawa's memory card 8 acquired since the last download based on the exposure time and date stored in each image's tag information (Niikawa, [0100]-[0101], FIG. 8 below) when a user selects one or more images to be transferred in the usual way wireless cameras allowed wireless image transfer (see discussion of conventional wireless cameras in §VIII.D.4 above.

“the recording controller 156 generates an image file in which tag information is attached to compressed captured image and thumbnail image, and records the image file onto the memory card 8... the tag information includes a camera name, a lens name, a focal length at the time of exposure, an f-number at the time of exposure, an exposure mode, a focal position, a file name, a subject brightness, a white balance adjustment value and a date and time of exposure. The imaging mode represents information whether the image is captured in the normal exposure mode or in the gradation control processing mode.” Niikawa, [0100]-[0101]



Niikawa, FIG. 8

5. [1D]: “wherein the in-camera software and database system are upgradable to provide improved algorithms and correction data for correction of images”

250. Niikawa in view of Watanabe-JP (§IX.D) meets [1D] for the same reasons Niikawa in view of Watanabe-JP meets [1A3] and [1A4] discussed in detail in §IX.E.2.iii-IX.E.2.iv above. Specifically, Niikawa’s camera is “upgradable” for the same reasons program data can be installed on the camera and in view of Watanabe-JP’s teaching of wireless software updates to rewritable memory and the obvious way to update Niikawa’s camera would be to update its software and the corresponding correction data it accesses.

F. Claim 2: “The method of claim 1, wherein the digitally processing at least one captured image further comprises: [2A] electronically reading stored user-adjustable variables;

and [2B] processing image corrections using the user-adjustable variables

251. Niikawa in view of Watanabe-JP meets claim 2 because Niikawa's general controller 150 performs image correction processes (e.g., shading, white balance, γ , and dynamic range corrections) using camera parameters and/or settings set by the user or that change as a result of user input ("user-adjustable variables"), including zoom ratio, focal length and exposure mode settings stored by the camera, and adjustable image synthesis adding ratios.

1. User-Adjustable Focal Length

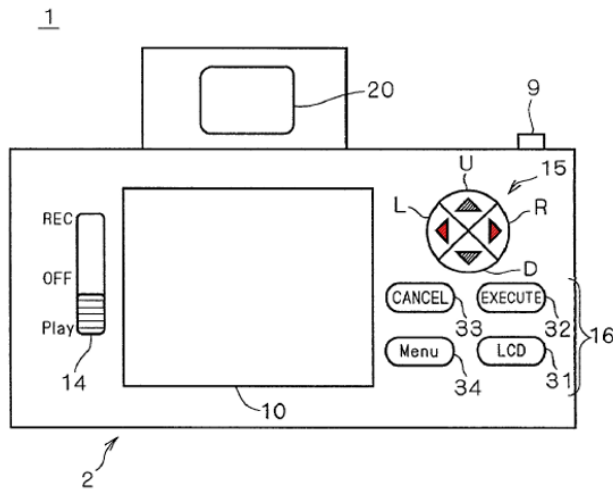
252. The user adjusts the "zoom ratio" (Niikawa, [0067], [0072]) of Niikawa's camera using the L, R buttons (shaded red in Niikawa's FIG. 4 below left) to move zoom lens 300 either to the "tele side" (L) or the "wide side" (R):

"As shown in FIG. 3, the imaging lens 3 which is a zoom lens having a macro function comprises a lens group 30 including a zoom lens 300 and a focus lens 301. On the other hand, inside the camera main body 2 are provided a zoom motor M1 for changing the zoom ratio of the zoom lens 300 and a focus motor M2 for driving the focus lens 301 to achieve focusing." Niikawa, [0067]

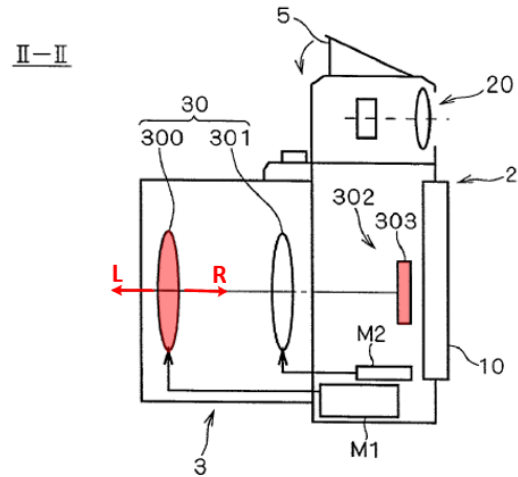
"When the right switch R is pressed down, the zoom lens 300 continuously moves to the wide side being driven by the zoom motor M1 and when the left switch L is pressed down, the zoom lens 300 continuously moved to the tele side by being driven by the zoom motor M1." Niikawa, [0072]

253. As the user adjusts the zoom ratio, the zoom lens 300 moves towards or away from sensor 303 (see annotations in red in Niikawa's FIG. 3 below right), which adjusts the focal length of imaging lens 3 in direct correspondence:

F I G . 4



F I G . 3



254. Zoom ratio and focal length are thus both “user-adjustable variables,” but both reflect the same setting of the imaging lens 3. Zoom ratio is what the user perceives as the L and R switches are pressed, and is thus expressed subjectively as “wide” to “tele.” Focal length is the objective measure of a corresponding setting of imaging lens 3, and is expressed numerically, typically in millimeters:

“The curve L1 represents the case where the focal length is 105 mm (converted value in a 35 mm film camera) and the f-number is 8.0, the curve L2 represents the case where the focal length is 35 mm and the f-number is 8.0, the curve L3 represents the case where the focal length is 105 mm and the f-number is 2.4, and the line L1 represents

the case where the focal length is 35 mm and the f-number is 2.4.”

Niikawa, [0058]

255. Niikawa makes this correspondence clear in teaching the effect of focal length on shading:

“the shorter the focal length (wide side), the larger the influence of shading (influence range and decrease rate of level), whereas the longer the focal length (tele side), the smaller the influence of shading.” Niikawa, [0060]

256. Focal length of the imaging lens 3 must thus be noted when camera 1 captures an image, and taken into account when performing corrections on that image:

“A plurality of correction tables for different parameters which are the optical conditions such as focal length and f-number at the time of imaging are prepared and stored in a shading ROM 153 provided in the general controller 150. The general controller 150 performs selection of correction table from the shading ROM 153 in accordance with the optical condition such as focal length and f-number at the time of imaging. Therefore, the shading correction circuit 123 can perform a shading correction in accordance with the optical condition.” Niikawa, [0084]

“Next, in the shading correction circuit 123, correction of shading is executed (step S16). At this time, a correction table which corresponds to the optical conditions of focal length and f-number at the time of exposure is selected and inputted to the shading correction

circuit 123 by the general controller 150. The shading correction circuit 123 performs shading correction by executing multiplication process of image data outputted from the A/D conversion circuit 122 and the inputted correction table (see FIG. 6).” Niikawa, [0108]

“the shading corrector 160 of the general controller 150 reads out the first image F1 from the first memory 126a of the image memory 126 and performs shading correction (step S50). This process can be achieved by executing the same multiplication process of the image data and the correction table in the first preferred embodiment by software.” Niikawa, [0138]

“the shading corrector 160 of the general controller 150 reads out the first image F1 from the image memory 126 and performs shading correction thereon (step S68). This process is achieved by multiplication of the image data and the correction data by using software as is the same with the second preferred embodiment. The correction table used in this shading correction is selected from the shading ROM 153 using the tag information read out from the file of the first image F1. Since the tag information includes the focal length and the f-number at the time of exposure, it is possible to select the correction table that is suited for the optical condition at the time of exposure.” Niikawa, [0158]

257. The ‘266 patent acknowledges and applies the approach to correction as taught by Niikawa:

“The dynamics of the zooming process present specific difficulties for the purposes of correcting optical aberrations in digital imaging

systems. With fixed-focal length lenses, the camera can detect the lens and provide an immediate consistent modification for a varying range of apertures. In the case of zooms, however, where the focal-length is not fixed, the adjustments must correlate to the changes in the focal length... The changing focal lengths of zoom lenses add a variable to the complex set of variables of the interacting sub systems in the digital imaging system. The digital camera system must therefore track the movement of the changes in the focal lengths in zoom lenses and continuously make modifications to the varied optical aberrations in these types of lenses. Unlike in fixed focal length lenses, the aberrations change at different focal lengths in zoom lenses, and the camera must track these changes. The present system is designed to make the corrections to these changing aberrations in zoom lenses by noting the changed focal length at specific times of each lens. For a fixed focal length lens, the camera refers to a database of information to provide information to correct specific types of aberrations; for a zoom lens, the camera's database contains multiplex information for each focal length in each respective zoom lens type. This is as if each zoom lens contains a combination of multiple lenses of specific focal lengths. When the zoom is moved to a new focal position, the camera reads the lens as a specific focal length and makes corrections to aberrations based on this specific setting.” EX1001, 26:18-66

258. Thus, general controller 150 “process[es] image corrections using the user-adjustable variable[.]” of focal length when it performs shading correction, as recited in [2B].

259. A POSA would have understood that focal length is “stored” in memory and “electronically read[]” by general controller 150 at least from Niikawa’s express disclosure that general controller 150 uses the focal length to select “a correction table that corresponds to the optical conditions of focal length and f-number at the time of exposure” (Niikawa, [0108]). See also Niikawa, [0084], [0138], [0158].

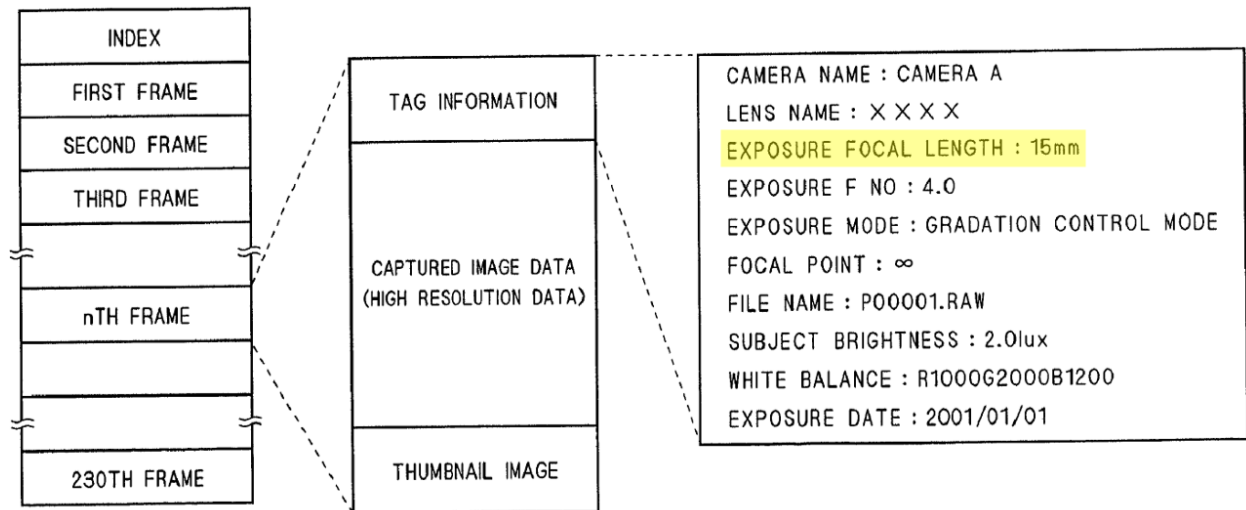
260. Niikawa’s general controller 150 is a microcomputer (Niikawa, [0095]-[0096]) that a POSA would have understood operate by electronically reading and manipulating data stored in memory. A POSA would have therefore understood that general controller 150 “electronically read[s]” the “stored” focal length set at the time of exposure so that it can select the corresponding correction table. Niikawa, [0084], [0108], [0129]-[0130], [0138], [0158].

261. Additionally, the focal length at the time of exposure is also “stored” when recording controller 156 (i.e., a “processing program” executed by the general controller 150 Niikawa, [0097]) generates tag information, which includes the “exposure focal length” (highlighted in Niikawa’s FIG. 8 shown below), and stores the tag information with the processed image data on memory card 8:

“As shown in the drawing, the tag information includes a camera name, a lens name, a *focal length at the time of exposure*, an f-number at the time of exposure, an exposure mode, a focal position, a

file name, a subject brightness, a white balance adjustment value and a date and time of exposure.” Niikawa [0101]

F I G . 8



262. Niikawa’s tag information:

- (1) makes clear that focal length is stored in the camera’s memory so that general controller 150 can access and write it to the image tag when it executes the recording controller 156 program; and
- (2) explicitly shows another instance in which focal length is stored.

263. Regarding (2), Niikawa discloses a gradation control mode in which shading correction is performed on images stored on memory card 8 in which general controller 150 “electronically read[s]” the focal length from the stored tag information to select the corresponding correction table for shading correction,

providing another example of Niikawa electronically reading stored focal length values:

“the shading corrector 160 of the general controller 150 reads out the first image F1 from the image memory 126 and performs shading correction thereon (step S68). This process is achieved by multiplication of the image data and the correction data by using software as is the same with the second preferred embodiment. The correction table used in this shading correction is selected from the shading ROM 153 using the tag information read out from the file of the first image F1. Since the tag information includes the focal length and the f-number at the time of exposure, it is possible to select the correction table that is suited for the optical condition at the time of exposure.” Niikawa, [0158]

2. User-Adjustable Exposure Mode Setting

264. Niikawa’s exposure mode setting selected by the user via a menu displayed on LCD 10 is another of camera 1’s “user-adjustable variables” that is used to “process image corrections” differently depending on the user’s selection (Niikawa, [0070]-[0074]):

“the LCD 10 can display a menu screen for setting an exposure mode”
Niikawa, [0070]

“A user can open the menu screen for selection of exposure mode and select an exposure mode by operating the four-gang switch 15, the switch group 16 and the like. The exposure mode includes a normal exposure mode in which an exposure is made one by one in the usual

manner and a gradation control processing mode. The gradation control processing mode refers to a mode intended for obtaining a synthesized image with substantially widened dynamic range by capturing two images having different exposures for the same subject in different timings, and synthesizing these images in an appropriate adding ratio. A single operation of the shutter button 9 triggers two exposures while changing the exposure condition so as to obtain two images.” Niikawa, [0074]

265. Specifically, as discussed in detail in §IX.A above, when the user sets the camera in “normal exposure mode,” general controller 150 sets the shutter speed to the “proper value” determined by Niikawa’s automatic exposure process to capture a single image on which shading, white balance and γ correction are performed. Niikawa, [0109]-[0110], [0123].

266. When the user sets the camera to the “gradation process control mode,” general controller 150 captures two images at two different shutter speeds, performs the above image correction processes on each image and additionally performs an image synthesis process to increase the dynamic range of the resulting corrected image to correct for effects resulting from the “limited dynamic range” of the sensor.

267. Thus, general controller 150 determines which image correction processes to perform and which to omit depending on the exposure mode set by the

user, which is the same way the '266 patent discloses using user-adjustable variables in processing image corrections:

“While it is possible to produce mathematical algorithms for automatic correction of optical aberrations, it is also useful to have manually adjustable variables. Therefore, the present system includes a function whereby one may omit a specific correction in an image”
EX1001, 12:41-45

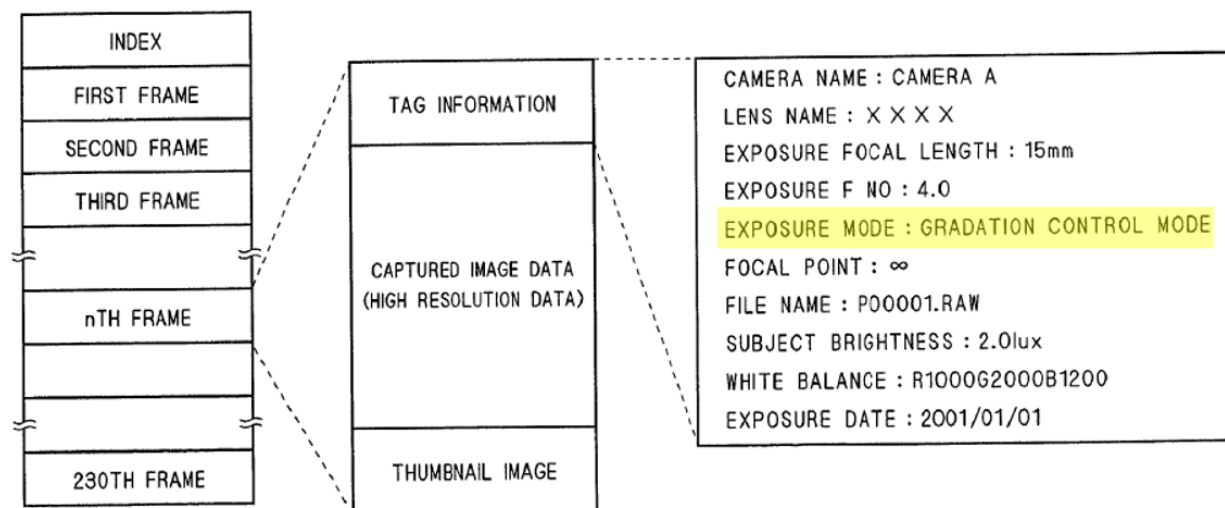
“In the past, these optical filtration processes were added after the production process via editing software such as Photoshop. However, in the present system, these combinations of processes are performed in-camera by user-adjusted settings.” EX1001, 13:19-23

“The type and degree of special effects, which are selected by user-adjustable in-camera software, will be determined by the user's palate *[sic]* of filtration choices.” EX1001, 33:36-40

268. Thus, general controller 150 using the user-adjustable exposure mode setting to determine whether to capture one or two image, which settings to use and whether to perform normal or gradation control processing sequences meets [2B] for the same reasons the '226 patent's embodiments do. Also, a POSA would have understood that the exposure mode set by the user is “stored” and “electronically read” by general controller 150 to determine how to control the camera, which image correction processes to perform, and to write it to the tag information

(highlighted in FIG. 8 below) stored with the corresponding image on memory card 8:

F I G . 8



269. General controller 150 also electronically reads the exposure mode to identify and display image pairs on which the user can choose to perform gradation control:

“the image data of the CCD-RAW form stored in the image memory 126 and just A/D converted is directly subjected to the recording process as the captured image data. Since two captured image data of different exposures are generated by a single shutter operation in the gradation control exposure mode, an image file wherein tag information is attached to the captured image data of the [C]CD-RAW form and a thumbnail image is generated for each of the two images, and the image files are stored in the memory card 8.” Niikawa, [0148]

“On the playback menu screen, it is possible to select special playback methods other than the normal playback display of captured image.

These special playback methods include a gradation control process. The user operates the four-gang switch 15 to move a cursor C1 displayed on the LCD 10 so as to point at the gradation control process, and presses down the execute switch 32 to give a direction for the gradation control process to the digital camera 1 (step S61).” Niikawa, [0152]

“two sets of combination of two thumbnail images captured in the gradation control exposure mode are displayed on the LCD 10” Niikawa, [0155]

“When the image captured in the gradation control exposure mode is displayed, the user operates the four-gang switch 15 and the switch group 16 to move a cursor C2 displayed on the LCD 10 and designate the first image F1 and the second image F2 to which the gradation control process is to be executed (Step S65).” Niikawa, [0156]

“When the first image F1 and the second image F2 to which the gradation control process is to be executed are designated, the playback controller 157 reads out designated two captured image data of the CCD-RAW form and stores them in the image memory 126 so as to allow the subsequent process to be executed (step S66). Furthermore, the playback controller 157 reads out the respective tag information of the designated two image files, and stores them in the RAM 152 (step S67).” Niikawa, [0157]

“Next, the shading corrector 160 of the general controller 150 reads out the first image F1 from the image memory 126 and performs shading correction thereon (Step S68)... The shading corrector 160

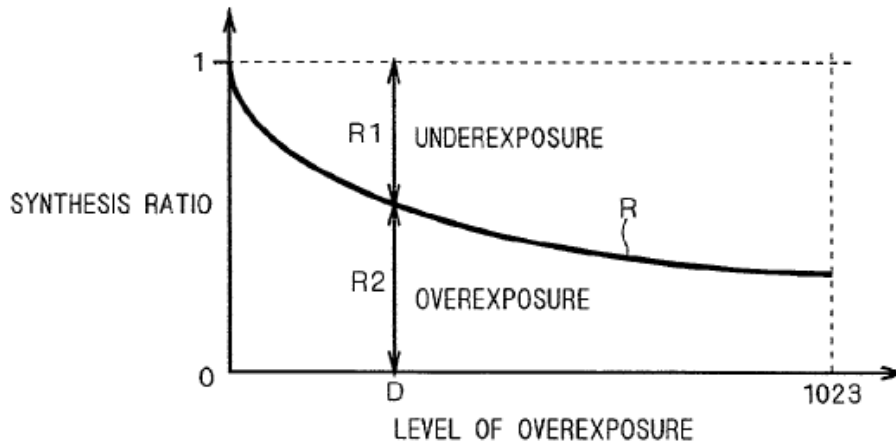
stores the first image F1 that has been subjected to the shading correction in the image memory 126 again, and reads out the second image F2 from the image memory 126 and performs shading correction in the same manner as described above (step S69).” Niikawa, [0158]

“Next, the image synthesizer 159 of the general controller 150 reads out the first image F1 and the second image F2 that have been Subjected to the shading correction from the image memory 126, and performs positioning and synthesis of these images to generate a gradation-controlled synthesized image.” Niikawa, [0159]

3. User Adjustable Synthesis Ratio

270. As discussed in detail in §§IX.A and IX.E.2.i(3) above, Niikawa’s image synthesis process combines pixel values of overexposed and underexposed images according to adding ratios R1 and R2 established for different brightness levels, e.g., different adding ratios that vary according to a desired curve such as the example synthesis ratio curve R shown in FIG. 12B below (Niikawa, [0118]-[0120], [0182]):

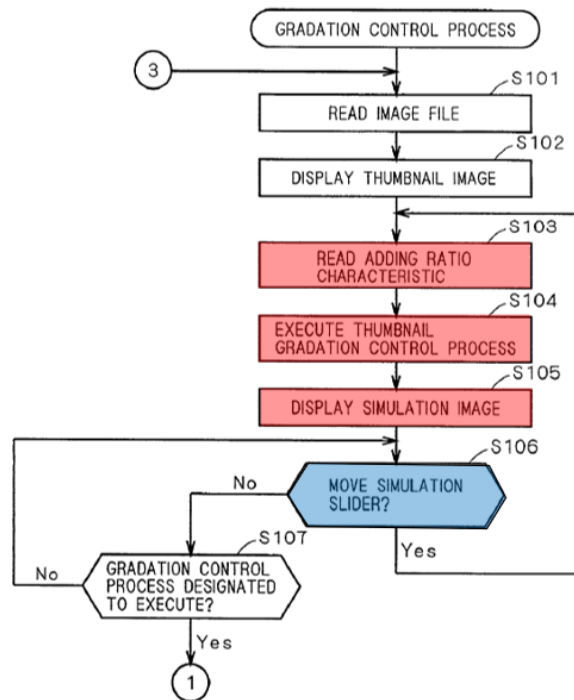
F I G . 1 2 B



271. As discussed in detail in §IX.A above, Niikawa discloses a “fourth preferred embodiment” (Niikawa, [0163]-[0164]) in which the synthesis ratio can be adjusted by the user to obtain desired dynamic range correction. Niikawa, [0182]-[0185], [0203], [0206].

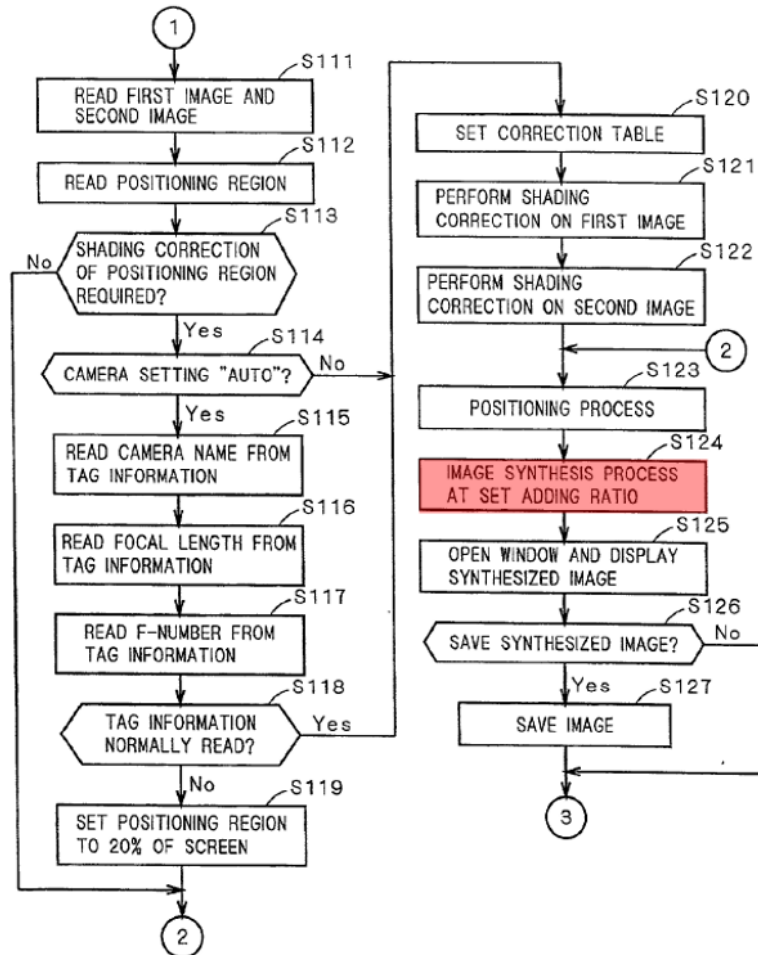
272. In FIG. 22 (annotated below), a user moves a slider control to adjust the adding ratio characteristic used to combine overexposed and underexposed images during image synthesis (step S106 shaded blue). Image synthesis is performed on thumbnails of selected overexposed and underexposed images using the “adding ratio characteristic [] read from the set position of the slider” and the synthesized thumbnail is displayed (S103-S104 shaded red). Niikawa, [0186]-[0187], FIG. 22):

F I G . 2 2



273. When the desired dynamic range correction is achieved (Niikawa, [0187]-[0190]), Niikawa’s image synthesis process “is performed accordance with the adding ratio characteristic set by the slider” on the full images (step S124 shaded red in the gradation control process of FIG. 23 below) (Niikawa, [0203]):

F I G . 2 3



274. The gradation control processes in the fourth embodiment are described as being performed on a personal computer, but Niikawa discloses that digital camera 1 can also be made to execute the described gradation control processes:

“in the present preferred embodiment, the process was performed in the image processing apparatus in which a personal computer executes the gradation control program, however, the above process may be performed by making a digital camera execute the like gradation control program.” Niikawa, [0206]

275. A POSA would have understood “the above process” in this teaching refers to the gradation control process of FIGS. 22 and 23 which include a user-adjustable adding ratio, and so would have understood Niikawa teaches a camera incorporating a gradation control process with user-adjustable adding ratio.

276. In that configuration, general controller 150 “electronically reads” the “stored user-adjustable” adding ratio characteristic set by the user when digital camera 1 is made to execute either image synthesis process illustrated in FIGS. 22 and 23 to perform dynamic range correction, to “process image corrections” as claimed.

277. Thus, Niikawa’s general controller 150 “digitally processing at least one captured image” comprises “electronically reading stored user-adjustable variables,” including lens focal length, exposure mode setting, and synthesis ratio, and “processing image corrections using the user-adjustable variables” for the reasons discussed in detail in §§IX.F.1-IX.F.3 above, and therefore meets claim 2.

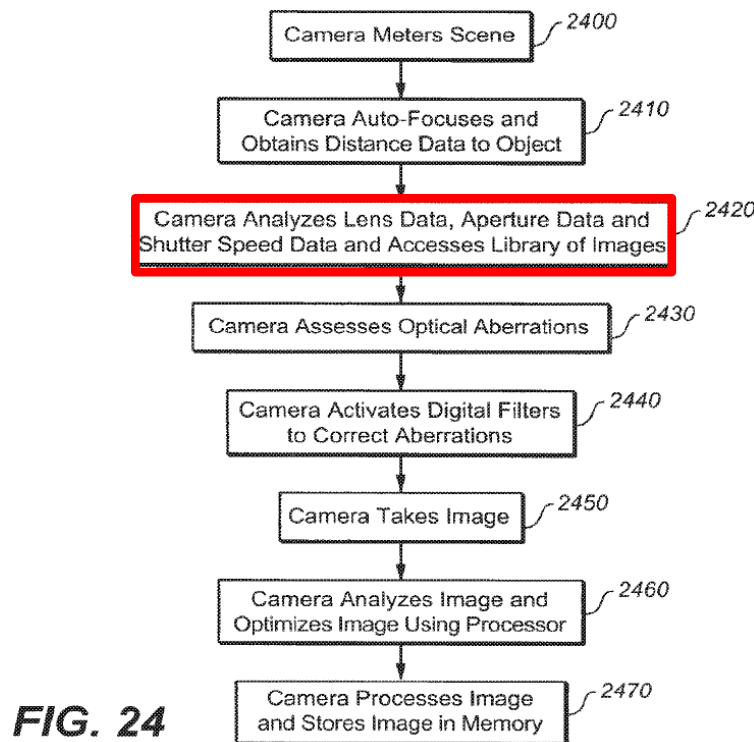
G. Claim 4: “...wherein the user-adjustable variables include lens data.”

278. Niikawa in view of Watanabe-JP meets claim 4 for the same reason discussed in detail in §IX.F.1 above because Niikawa’s user-adjustable focal length is “lens data” as claimed.

279. In the few instances that the ’266 patent uses the term “lens data,” the patent uses the term generically to refer to data about the lens used to optimally

select image corrections without limitation and without providing specific examples of the lens data being referenced:

“Once the camera meters a scene (2400), the camera auto-focuses and obtains distance data to 35 the object (2410), analyzes the lens data, the aperture data and the shutter speed data and accesses the library of images (2420).” EX1001, 35:34-38



EX1001, FIG. 24

“In order to accomplish these complex processes, specific variables, such as aperture data, shutter speed data, lens data, digital sensor data and subject type are registered and analyzed by the camera.” EX1001, 24:4-7

“In this embodiment of the present system, data about a specific lens are provided to the camera in order to correct specific lens aberrations” EX1001,19:17-19

280. Elsewhere and throughout, the '266 patent discloses using “lens focal length” in the manner the '266 patent generically describes using lens data to identify optimal corrections to apply to captured image data, both for fixed-focal length lenses to match the lens type with those stored in a database to obtain corresponding aberration corrections and for variable-focus zoom lenses for which different corrections are stored for different possible focal lengths:

“While the zoom lens presents the need to provide a dynamic solution to the process of making corrections to optical aberrations, video photography provides another case of a process that requires dynamic solutions. The same principles that apply to still photography apply to video; auto-focus variability, aperture and depth-of-field variability aspects, shutter speed variability aspects, differences in lens focal length and artificial lighting variability suggest that video be viewed as merely a very rapid (30 to 60 frames per second) application of still photography.” EX1001, 27:27-36

“The camera applies a correction to a lens setting (2930) and continuously tracks the lens changes in the lens focal length (2940). The camera then applies the changed corrections to the changed focal lengths in the zoom lens (2950)” EX1001, 36:23-27

“Since lenses of the same focal length but with different maximum apertures represent completely different lens designs, modifications of their aberrations will vary relative to each specific lens type.”

EX1001, 11:19-21

“FIG. 4 shows a list of several different wide angle lenses in a database. In the 35 mm domain, the 114 *[sic]* mm (400), 20 mm (410), 24 mm (420), 28 mm (430) and 35 mm (440) lenses, each with f72.8 *[sic]* apertures are listed in the database. Each lens type presents a distinct formulation involving different sets of optical data that require different aberration corrections. 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). As an example, the vignetting effect is corrected by gradually darkening the center of the image in concentric rings (540). FIG. 6 shows the database configuration of several different types of 24 mm f72.8 *[sic]* lenses (600 to 630) with different optical configurations. Each lens type has a different set of manifestations of optical aberrations including vignetting (640), spherical aberration (650), pin cushion distortion (660), barrel distortion (670) and comatic aberration (680). For each lens, there will be a unique combination of optical aberrations compared to each lens type from different optical configurations. The database is accessed to provide the multi-objective optimization solution for correcting several different optical aberrations for each specific lens formula.” EX1001, 31:7-32

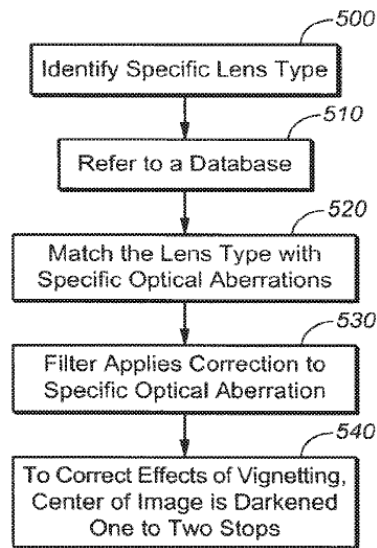


FIG. 5

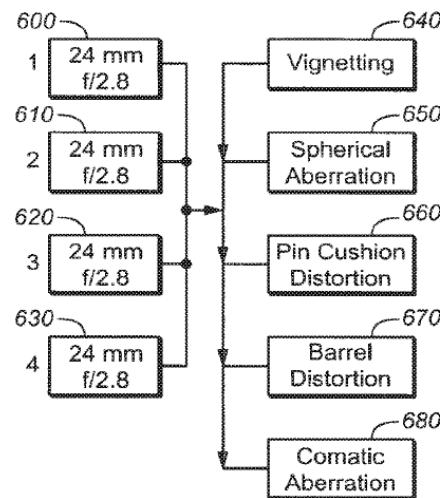


FIG. 6

EX1001, FIGs. 5 and 6

“The dynamics of the zooming process present specific difficulties for the purposes of correcting optical aberrations in digital imaging systems. With fixed-focal length lenses, the camera can detect the lens and provide an immediate consistent modification for a varying range of apertures. 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, 26:18-20

“In FIG. 29, the dynamics of zoom lens corrections are described. After a lens detects a zoom lens type (2900), the camera detects a particular focal length setting of the zoom lens (2910) and accesses a data library in the database to modify aberrations to optimize the zoom lens at a specific focal setting (2920). The camera applies a correction to a lens setting (2930) and continuously tracks the lens changes in the lens focal length (2940). The camera then applies the

changed corrections to the changed focal lengths in the zoom lens (2950)” EX1001, 36:18-27

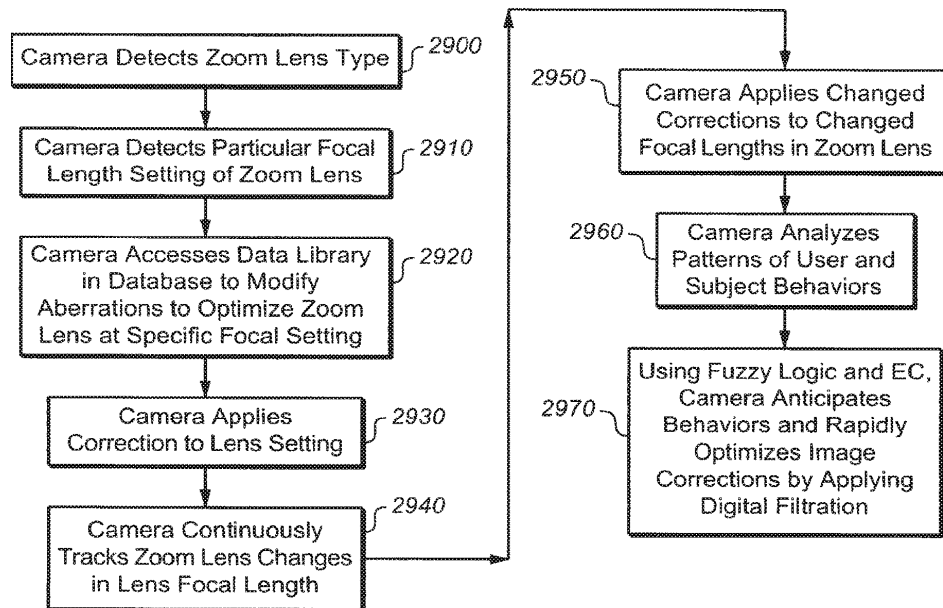


FIG. 29

EX1001, FIG. 29

281. A POSA reading the specification would have understood that “lens data” includes lens focal length, which is also the only lens data disclosed in the patent as cited above that is a “user-adjustable variable” as claimed.

282. This understanding is reinforced by the customary use of the term “lens data” as including focal length:

“the lens data (i.e., data on whether a correction filter lens is in use, open f-number, minimum f-number, focal length, etc.)” US 2006/0158546 A1 (EX1033, “Hirai”), [0086]

“In the lens data ROM 18, there are stored data specific to the interchangeable lens such as data of a type of the lens, an aperture stop value and a focal length.” US 7,677,818 B2 (EX1032, “Akiyama”), 4:15-18

“Detailed lens data used for a zoom lens in various embodiments of the present invention will be described below. Hereinafter, ‘f’ denotes a combined focal length of an entire lens system, Fno denotes an F number, ω denotes a field angle, R denotes a radius of curvature, ‘Dn’ denotes a thickness of a center of a lens or a distance between lenses, ND denotes a refractive index, VD denotes an Abbe’s number, ST denotes a diaphragm or aperture stop, and D1, D2, and D3 denote variable distances between lenses.” US 2006/0245075 A1 (EX1034, “Lee”). [0053]-[0054]

“The lens information includes, for example, information on the minimum aperture, the maximum aperture, the focal length, etc. of the interchangeable lens 80.” US 7,593,634 B2 (EX1036, “Terada”), 5:56-58, 10:19-21.

“controlling the zoom and focus lenses to enable enhanced image capture sequences and/or tracking lens data” EX1035, Abstract

H. Claim 5: “...wherein the user-adjustable variables include shutter speed settings.”

283. Niikawa in view of Watanabe-JP meets claim 5 because, as discussed in detail in §IX.A and §IX.F.2 above, the shutter speed settings are determined in Niikawa based on the user’s selection of exposure mode.

284. Specifically, when the user chooses the “normal exposure mode,” the shutter speed is set to the “proper value” determined by Niikawa’s automatic exposure process (Niikawa, [0109]-[0110]), whereas when the user chooses the “gradation control process mode,” the shutter speed is set at two different values to capture underexposed and overexposed images respectively.

285. The shutter speed setting Niikawa’s camera uses depends on the user’s selection of exposure mode and is thus “user-adjustable” at least to the same extent it is disclosed in the ’266 patent, which at most appears to disclose the user adjusting shutter speed settings by “bracketing” with selected over-and underexposures, as in Niikawa.

“In an additional embodiment of in-camera tonal range corrections, exposure data are bracketed by manipulating the aperture and shutter speed to lower or raise the overall exposure in one-third to one-half stop increments. EX1001, 14:58-60

286. Niikawa’s general controller 150 “electronically read[s]” the “stored” shutter speed value calculated by the Niikawa’s AE process to determine what shutter speed(s) to use depending on the exposure mode, and “process[es] image corrections” using the resulting shutter speed settings as determined by the user’s choice of exposure mode because (1) subsequent image corrections are performed on images captured based on the set shutter speed in both modes, and (2)

Niikawa's image synthesis directly uses the four-stop difference in shutter speed to increase dynamic range.

287. Niikawa in view of Watanabe-JP meets claim 5 and also meets claim 2 for this additional reason.

I. Claim 8: "...wherein the user-adjustable variables include tonal range corrections."

288. A POSA would have understood that what Niikawa terms "dynamic range" and the '266 patent terms "tonal range" refer to the same image characteristic: the range of levels between the darkest and lightest pixels in an image (see e.g., Niikawa, [0061], [0074], [0118]-[0120] with EX1001, 14:17-15:1-4):

"when a subject is photographed by a digital camera or the like, a phenomenon sometimes occurs that light portions in the subject image are too white, while dark portions in the subject image are too black. This phenomenon results from a narrow dynamic range of a general image pickup device and causes deterioration in image quality."
Niikawa, [0061]

"The gradation control processing mode refers to a mode intended for obtaining a synthesized image with substantially widened dynamic range by capturing two images having different exposures for the same subject in different timings, and synthesizing these images in an appropriate adding ratio." Niikawa, [0074]

“For the crucial detail recorded in a scene, film provides far more depth of tonal range. Yet some of this problem-caused by the limits of digital sensors themselves and the way that photons are recorded by electrically charged pixels---can be digitally corrected and optimized in-camera.” EX1001, 14:21-26

“In general, since there is less exposure latitude in digital sensors, as compared to film, the maximum scope is two or three stops in the image tonal range. Consequently, the camera must meter the image within constraints of the tonal range of the digital sensor, with the sacrifice of either shadow detail or highlight detail. In an image with broad exposure range, then, the image will generally be either too light or too dark because metering for one area sacrifices the other tonal category.” EX1001, 14:29-37

“With more detail in the original image, it is possible to interpolate the digital data in the image file by increasing both shadow and highlight detail and to gain an additional stop or two of tonal range.” EX1001, 14:45-48

In an additional embodiment of in-camera tonal range corrections, exposure data are bracketed by manipulating the aperture and shutter speed to lower or raise the overall exposure in one-third to one-half stop increments.” EX1001, 14:57-60

289. As discussed in detail in §IX.F.3 above (claim 2), the user can adjust the dynamic range corrections (“tonal range corrections”) performed by Niikawa’s

gradation control process by adjusting the adding ratio used by Niikawa's fourth-embodiment image synthesis process.

290. Niikawa in view of Watanabe-JP meets claim 8 for the same reasons discussed in detail in §IX.F.3 above.

J. Claim 11: "... wherein the digitally processing the at least one captured image for image correction further comprises adjusting a depth of field of an image"

291. Niikawa in view of Watanabe-JP meets claim 11 because Niikawa digitally processes live view images to determine camera settings that change the depth of field of an image:

292. As discussed in detail in §IX.E.2 above ([1A]), Niikawa "digitally process[es] at least one captured image" when Niikawa's AE process evaluates the scene's brightness by processing a live view image captured by the camera to determine the "correct" f-number and shutter speed settings for an exposure (Niikawa, [0092], [0098], [0106], [0134]):

"the image data is read out by the general controller 150, transferred to the LCD VRAM 141 and the EVF VRAM 142 after being subjected to data size adjustment, and displayed on the LCD 10 and the EVF 20 in the form of a live view display." Niikawa, [0092]

"The exposure setting part 154 for executing an exposure control process and determines a brightness of the subject using image data of G color component of the live view image and calculates an exposure control value based on the determination result." Niikawa, [0098]

“In step S11, when the shutter button 9 is pressed half way down, a focal point of the lens group 30 of the imaging lens 3 is adjusted for a main subject, an exposure control value is calculated by using a live view image and a white balance adjustment value is set. The exposure control value which is calculated at this time is a value to provide correct exposure, and concretely, a shutter speed and an f-number which are correct values are obtained (step S12).” Niikawa, [0106]

“in step S41, when the shutter button is pressed halfway down, as preparation for image capturing, a focal point of the lens group 30 of the imaging lens 3 is adjusted for a main Subject, an exposure control value is calculated by using a live view image and a white balance adjustment value is set. The exposure control value which is calculated at this time is a value to provide correct exposure, and concretely, a shutter speed and an f-number which are correct values are obtained (step S42).” Niikawa, [0134]

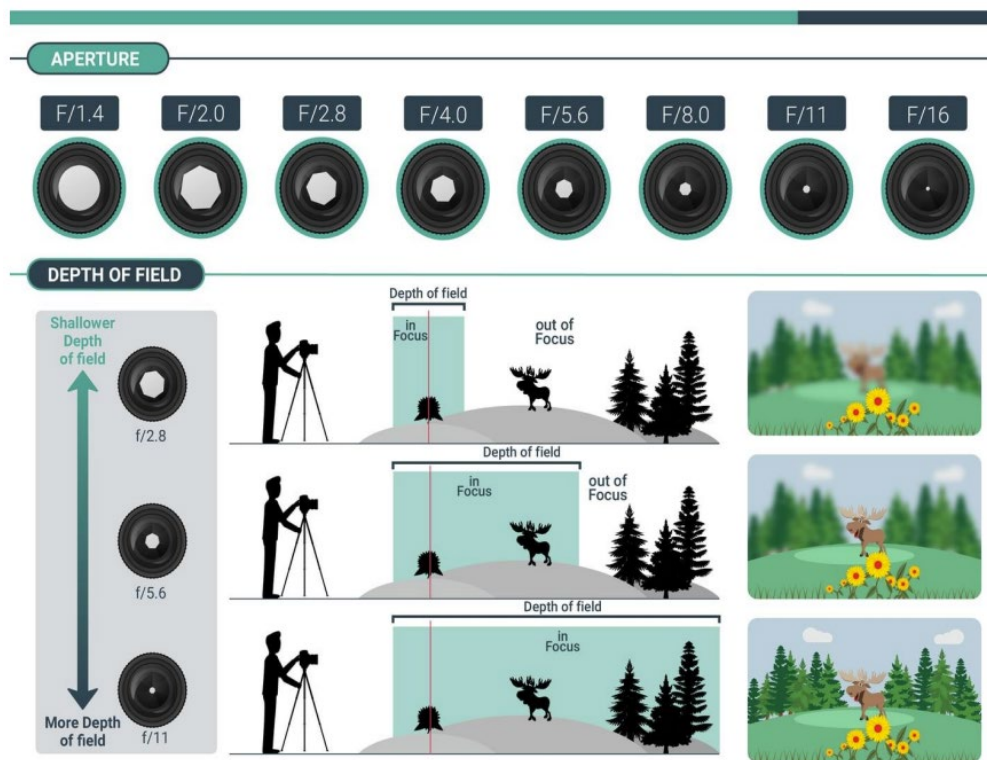
293. Depth of field (DOF), as the '266 patent explains, is “dependent on the aperture setting of the lens” and can be “manipulated... by the camera’s digital processing capability:”

“the present system allows in-camera depth-of-field (DOF) optimization by affecting the aperture of the lens that is used. DOF in an image is dependent on the aperture setting in a lens, in which a moderate DOF range-allowing a subject to be isolated in an image-can be manipulated, that is, extended or narrowed, by the camera's digital processing capability.” EX1001, 13:34-42

294. Specifically, the larger the aperture (i.e., smaller f-number), the narrower the depth of field and vice versa, as illustrated in the drawing below:

“Aperture and Depth of Field: The depth of field is the proportion of the image that is reasonably sharp and in focus.

The larger the aperture you use, the shallower depth of field you’ll be able to capture, meaning that more areas of your images will be out of focus and less sharp. Conversely, the smaller the aperture you use, the greater the depth of field you’ll see in your image, meaning a larger proportion of the image will be in focus.” EX1030, p. 9



EX1030, p. 27

295. Niikawa’s general controller 150 adjusts the depth of field of an image when it adjusts the aperture to the f-number determined by Niikawa’s

automatic exposure process the same way the '266 patent discloses adjusting depth of focus by aperture setting by the camera's digital processing capability:

“the present system allows in-camera depth-of-field (DOF) optimization by affecting the aperture of the lens that is used. DOF in an image is dependent on the aperture setting in a lens, in which a moderate DOF range-allowing a subject to be isolated in an image-can be manipulated, that is, extended or narrowed, by the camera's digital processing capability.” EX1001, 13:34-42

“The camera will effectively identify a type of subject and provide an optimal aperture for this subject.”

296. Thus, the digital processing of live view images performed by Niikawa's AE process “further compris[es] adjusting a depth of field of an image” by adjusting the f-number setting on which the DOF depends, and Niikawa in view of Watanabe-JP therefore meets 11 for the same reasons the '266 patent's embodiments do.

K. Claim 13: “The method of claim 1, wherein the in-camera software processes image corrections based on one or more prior image corrections.”

297. Niikawa in view of Watanabe-JP meets claim 13 because Niikawa's gradation control process (i.e., “in-camera software”) performs positioning and image synthesis on images that have undergone shading correction, and so is based on prior shading corrections. Specifically, as discussed in detail in §IX.A above, prior to performing image synthesis Niikawa first performs “a positioning process”

to correct for positional differences resulting from the small time interval between capturing the underexposed and overexposed images.

298. Niikawa emphasizes the importance of performing shading correction on the images prior to performing positioning because it is “impossible to effect accurate[ly]” without taking the “influence of shading [] into consideration” (Niikawa, [0062]). Niikawa, [0117], [0141].

“However, it is impossible to effect accurate positioning without taking such an influence of shading as described above into consideration. In preferred embodiments as will be described below, the above-mentioned influence of shading is taken into consideration when effecting the positioning on such two images.” Niikawa, [0062]

“Since the first image F1 and the second image F2 have been subjected to shading correction by the shading correction circuit 123 at the time of capturing of images, positioning of images can be achieved without being influenced by a shading.” Niikawa, [0117]

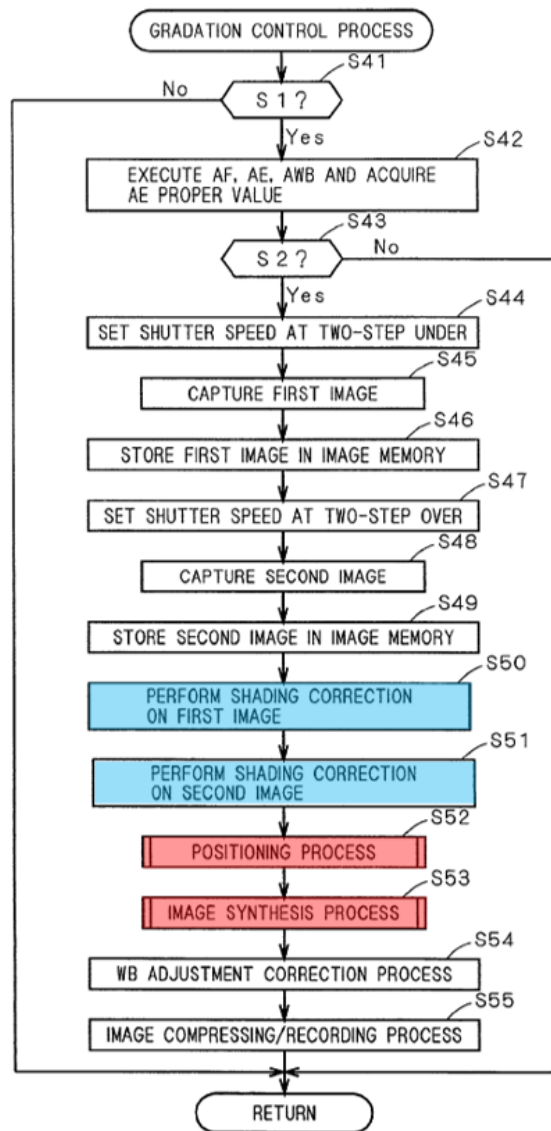
“at the time of capturing image data of two images to be used for synthesis, each of these image data is subjected to shading correction by way of software. Therefore, it is possible to achieve the subsequent positioning process without being influenced by a shading.” Niikawa, [0141]

“an image is read out from the memory card 8 and a shading correction is performed by software before executing the synthesis

process. Therefore, the subsequent positioning can be executed without being influenced by a shading.” Niikawa, [0161]

299. As discussed in detail in §IX.A above and shown below in FIG. 14, Niikawa’s shading correction (steps S50-S51 shaded blue) is performed on both images prior to performing positioning and image synthesis processes (step S52-S53 shaded red) such that the “influence of shading is taken into consideration when effecting the positioning” so that image synthesis combines unshaded and accurately aligned image data to correct for the sensor’s limited dynamic range:

F I G . 1 4



300. Niikawa in view of Watanabe-JP (§IX.D) meets claim 13 as both positioning image corrections (positioning process) and limited dynamic range image corrections (image synthesis process) are processed based on prior shading corrections, so Niikawa “processes image corrections based on one or more prior image corrections.”

L. Claim 14: “The method of claim 1, further comprising changing a variable based on an auto-focus process performed by the camera and electronically storing that changed variable”

301. Niikawa in view of Watanabe-JP meets claim 14 because Niikawa’s auto-focus process changes the focal point of the lens.

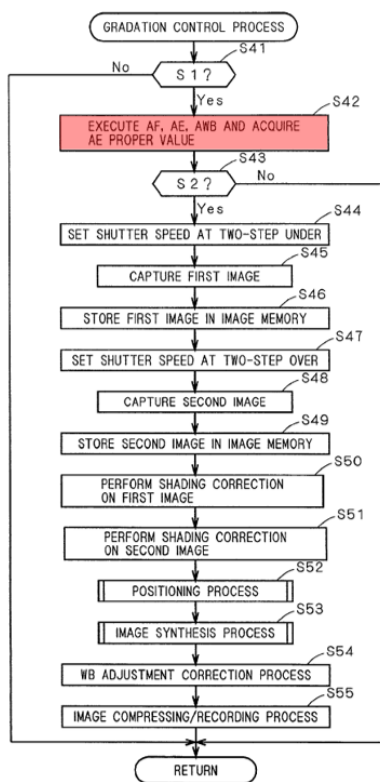
302. As discussed in detail in §IX.A above, when shutter button 9 is pressed half-way, general controller 150 executes an auto-focus “AF” process (step S42 shaded red in FIG. 14 below) in which “a focal point of the lens group 30 of the imaging lens 3 is adjusted for a main subject” (Niikawa, [0106], [0134]) by sending “an AF control signal” to “focus control circuit 133” to set “focus lens 301 at the in-focus position” (Niikawa, [0090]):

“In step S11, when the shutter button 9 is pressed half way down, a focal point of the lens group 30 of the imaging lens 3 is adjusted for a main subject” Niikawa, [0106]

“The focus control circuit 133 controls the amount of drive of the focus motor M2 on the basis of an AF control signal inputted from the general controller 150 and sets the focus lens 301 at the in-focus position.” Niikawa, [0090]

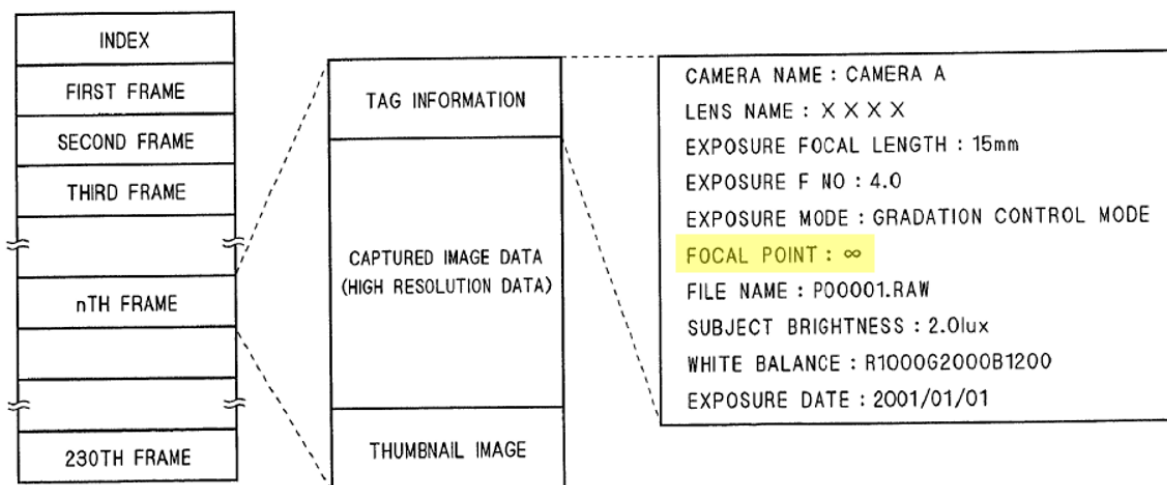
“in step S41, when the shutter button is pressed halfway down, as preparation for image capturing, a focal point of the lens group 30 of the imaging lens 3 is adjusted for a main subject,” Niikawa, [0134]

FIG. 14



303. The focal point variable changed by Niikawa's AF process is “electronically stor[ed]” in the tag information (highlighted in FIG. 8 below) stored with the captured image on memory card 8.

FIG. 8



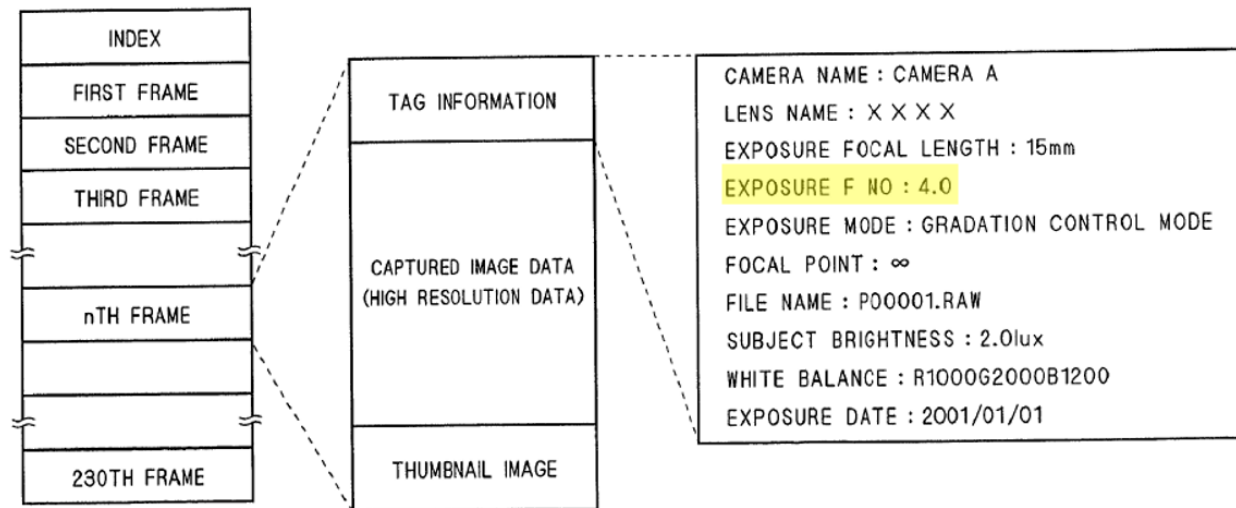
304. Niikawa in view of Watanabe-JP meets claim 14 for this first reason.

305. Niikawa in view of Watanabe-JP also meets claim 14 because Niikawa's exposure control process adjusts the camera's f-number based on the focal point adjustment performed by Niikawa's AF process.

306. Specifically, as discussed in detail in §IX.A above, after executing Niikawa's AF process to focus on the "main subject" general controller 150 executes Niikawa's AE process (e.g., step S42 in FIG. 14 above) that evaluates "a brightness of the subject" from a live view image (Niikawa, [0098]) to determine the "correct" f-number for an exposure. Niikawa, [0106], [0134].

307. A POSA would have understood that moving focus lens 301 to focus on the main subject impacts the brightness of the subject on which the f-number is determined. That determination is affected by the brightness of the main subject. If the user moves from focusing on a white object as the main subject to focusing on a dark object in the same scene, the AE process is likely to open the lens aperture (reduce the f-number) to compensate.

308. Niikawa's AE process thus adjusts the f-number (i.e., "changes a variable") used to capture an image "based on" Niikawa's AF process. The adjusted f-number is also "electronically stor[ed]" in the tag information (highlighted in FIG. 8 below):



309. Niikawa in view of Watanabe-JP meets claim 14 for this additional reason.

M. Claim 15: “The method of claim 1, further comprising changing a variable based on an auto-exposure process performed by the camera and electronically storing that changed variable”

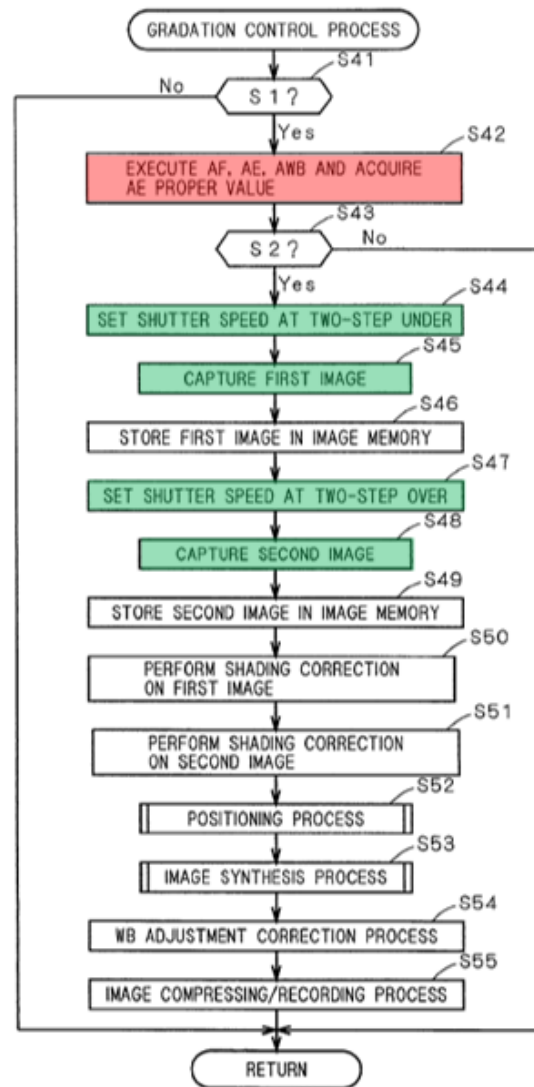
310. Niikawa in view of Watanabe-JP meets claim 15 because both aperture and shutter speed settings are adjusted based on Niikawa’s auto-exposure process.

311. As discussed in detail in §IX.L above (claim 14), when shutter button 9 is half-way pressed, general controller 150 performs an AF process followed by an “AE” process (e.g., step S42 (shaded in red in FIG. 14 below) that determines “a brightness of the subject using image data of G color component of the live

view image” (Niikawa, [0098]) to obtain “a shutter speed and an f-number which are correct” (Niikawa, [0106], [0134]).

312. When the shutter button 9 is fully pressed in the gradation process control mode, the aperture is set to the correct f-number determined by the AE process and the shutter speed is adjusted two steps down and then two steps to capture an “underexposed first image” ([0118]) and an “overexposed second image” ([0119]), respectively (e.g., steps S44-S45 and S47-48 shaded green in FIG. 14 below). Niikawa, [0074], [0135]-[0137], [0109]-[0110], FIGS. 9, 14.

F I G . 1 4



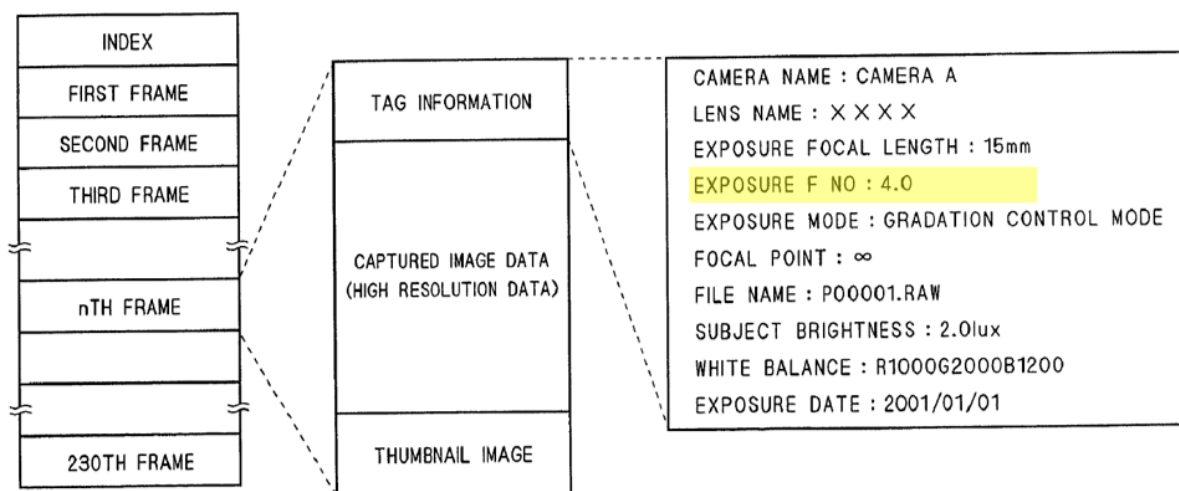
313. In the normal exposure mode, both the f-number and shutter speed setting are set to the “proper value” determined by the Niikawa’s AE process. Niikawa, [0109]-[0110].

314. Niikawa in view of Watanabe-JP “chang[es] a variable based on an auto-focus process performed by the camera” for two independent reasons because Niikawa’s AE process changes both the aperture and shutter speeding settings.

315. As discussed in detail in §IX.H above, the correct shutter speed “obtained” by Niikawa’s AE process is “electronically stored” so that general controller 150 can either set that value or adjust it depending on the exposure mode setting.

316. A POSA would have understood the f-number obtained by Niikawa’s is “electronically stored” for the similar reason that general controller 150 accesses the value to set the aperture accordingly, and for the additional reasons the f-number is (1) accessed by general controller 150 to select “a correction table that corresponds to the optical conditions of focal length and f-number at the time of exposure” (§IX.F.1) and (2) stored in the tag information attached to each image, as illustrated in FIG. 8 below:

F I G . 8



317. Niikawa in view of Watanabe-JP meets claim 15 for at least two independent reasons because each of f-number and shutter speed is “a variable”

that is changed by Niikawa's "auto-exposure process" and each is "electronically stor[ed]" as claimed.

N. Claim 16: "The method of claim 1, further comprising changing a variable based on a depth of field adjustment process performed by the camera and electronically storing that changed camera variable."

318. As discussed in detail in §IX.J above (claim 11), depth of field is adjusted when the f-number is changed.

319. Niikawa in view of Watanabe-JP meets claim 16 by changing the aperture setting to the f-number determined by Niikawa's AE process, which adjusted f-number (i.e., the "changed camera variable") is "electronically stor[ed]" for the same reasons demonstrated discussed in detail in §IX.M above. Niikawa, [0092], [0098]-[0101], [0106]-[0110], [0134].

O. Claims 17-19: "...further comprising digitally processing the at least one captured image using the in-camera software to correct at least one optical image aberration associated with an optical system and the changed camera variable."

320. Claims 17-19 recite the same limitation but depend from claims 14-16, respectively. Niikawa in view of Watanabe-JP meets claims 17-19 because Niikawa's adjusted f-number meets the "changed camera variable" of each of claims 14-16 (as discussed in detail in §§IX.L-IX.N above) and (as discussed in detail in §IX.A above) Niikawa corrects for the shading effect associated with imaging lens 3 and the adjusted f-number set at the time of exposure.

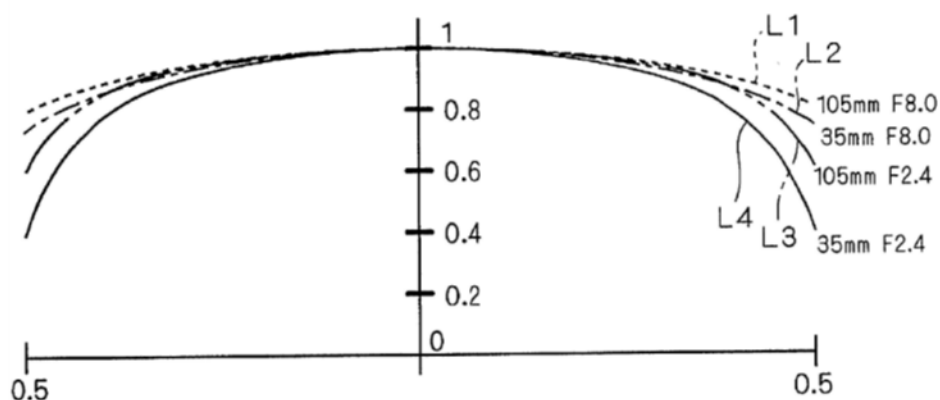
321. Niikawa describes shading thusly:

“it is general that when an image is captured via a lens in a digital camera or the like, so-called ‘shading’ that the level of image data decreases with distance from the center of the image to the periphery.”

Niikawa, [0012]

“FIG. 1 is a view showing an example of an influence of shading on an image captured by means of a certain digital camera. The image depicted in FIG. 1 is such that all the pixels constituting the image receive incident light from the subject of the uniform brightness. The horizontal axis represents distance from the optical axis of each image data, in a relative distance with the distance of diagonal line of the image being 1. That is, the center point of the image which is image data of the optical axis is the origin point. The vertical axis represents level of each image data, in a relative value with the level of image data of the optical axis being 1. It is contemplated that this relative value represents a decrease rate of level of image data due to shading at each pixel position.” Niikawa, [0057]

F I G . 1



Niikawa, FIG. 1

322. The shading effect addressed in Niikawa is also called “vignetting:”

“When subjects are photographed using a digital camera, required amount of shading correction is not only dependent on the photographing lens, but is also dependent on the imaging device. This is because vignetting generally occurs when light transmitted through a photographing lens reaches an imaging device, and vignetting differs depending on the kind of imaging device, and also on the area of the imaging device. Generally, micro lenses are provided on an imaging device, however, it is difficult to prevent vignetting from occurring by using only the micro lenses. Especially, in the case where the imaging device has many pixels, an vignetting can not be corrected by using only the micro lenses, because the area of the photo diodes is small relative to a distance between micro lenses and the photo diodes. Therefore, shading correction based on only the characteristics of a photographing lens, sometimes can not effectively prevent deterioration of the image quality.” EX1014, 1:26-42

323. The peripheral light fall-off Niikawa calls “shading” is also called “vignetting” by the ‘266 patent:

“optical vignetting affects peripheral illumination. Though optical vignetting will affect even retrofocus wide-angle lenses in rangefinders, it is particularly prominent in SLR cameras. According to the cosine law, light fall-off in peripheral areas of an image increases as the angle-of-view increases. While optical vignetting can be reduced by stopping down the lens, the aberrations in rectilinear

wide-angle lenses generally exhibit more distortion the wider the lens.” EX1001, 3:53-61

324. Niikawa discloses that the shading (vignetting) effect caused by imaging lens 3 varies as a function of the focal length and f-number at the time of exposure:

“the influence of shading varies with the focal length and the amount of exposure light. As shown in the drawing, the shorter the focal length (wide side), the larger the influence of shading (influence range and decrease rate of level), whereas the longer the focal length (tele side), the smaller the influence of shading... the smaller the f-number (the smaller the f-stop number of diaphragm), the larger the influence of shading, whereas the larger the f-number (the larger the f-stop number of diaphragm), the smaller the influence of shading.”

Niikawa, [0060]

325. As discussed in detail in §IX.A above, Niikawa corrects for this variable shading effect in an image by selecting from a plurality of correction tables that each correct for the shading effect of imaging lens 3 at the focal length and f-number at the time of exposure and applying the table to the captured image data. Niikawa, [0084], [0129]-[0130], [0138], [0158].

326. Niikawa in view of Watanabe-JP meets claims 17-19 because Niikawa’s shading correction process (which is “in-camera software”) corrects for the shading effect produced by imaging lens 3 at the adjusted f-number set at the

time of exposure by applying a corresponding correction table, so Niikawa in view of Watanabe-JP corrects the specific “optical image aberration associated with an optical system and the changed camera variable” (§§IX.F.1, IX.L-IX.N).

P. Claim 20: “The method of claim 1, wherein the wirelessly transmitting images includes automatically transmitting the at least one of the one or more corrected images”

327. Niikawa in view of Watanabe-JP meets claim 20 because, as discussed in detail in §§IX.B and IX.C above, Watanabe-JPs image management technique automatically transfers newly captured images wirelessly.

328. Watanabe-JP explains that one benefit of the disclosed “image data management process” is that new images captured since the last image transfer can be transferred without the user “having to be particularly aware of it.” Watanabe-JP, [0076]. Specifically, when the camera is placed in proximity to the charging cradle, the process of determining whether there are any new images stored on the memory card and wirelessly transmitting those images to an external PC are performed automatically by programmatic data exchange between the camera and the PC.

329. Niikawa in view of Watanabe-JP implementing Watanabe-JPs image data management process meets claim 20.

Q. Claim 30: The method of claim 1, further comprising:

1. [30A] “digitally processing a plurality of images to correct video taken by the digital camera; and”

330. Niikawa in view of Watanabe-JP meets claim 30 because Niikawa digitally processes and corrects video for the camera’s “live view display.”

In the imaging standby state, each image data of images taken every 1/30 (sec.) by the CCD303 is temporarily stored in the image memory 126 after being subjected to a predetermined signal processing by the signal processor 120. Then, the image data is read out by the general controller 150, transferred to the LCD VRAM 141 and the EVF VRAM 142 after being subjected to data size adjustment, and displayed on the LCD 10 and the EVF 20 in the form of a live view display.” Niikawa, [0092]

“The display controller 155 for executing an image display process performs the above-mentioned display operation of the display part 140, that is, it performs an operation of reading image data temporarily stored in the image memory 126 and transferring the image data to the LCD VRAM 141 or the EVF VRAM 142 after adjusting the image size to adapt to the image size of the display destination as is necessary.” Niikawa, [0099]

331. Niikawa’s live view display meets the ‘266 patent’s description of video:

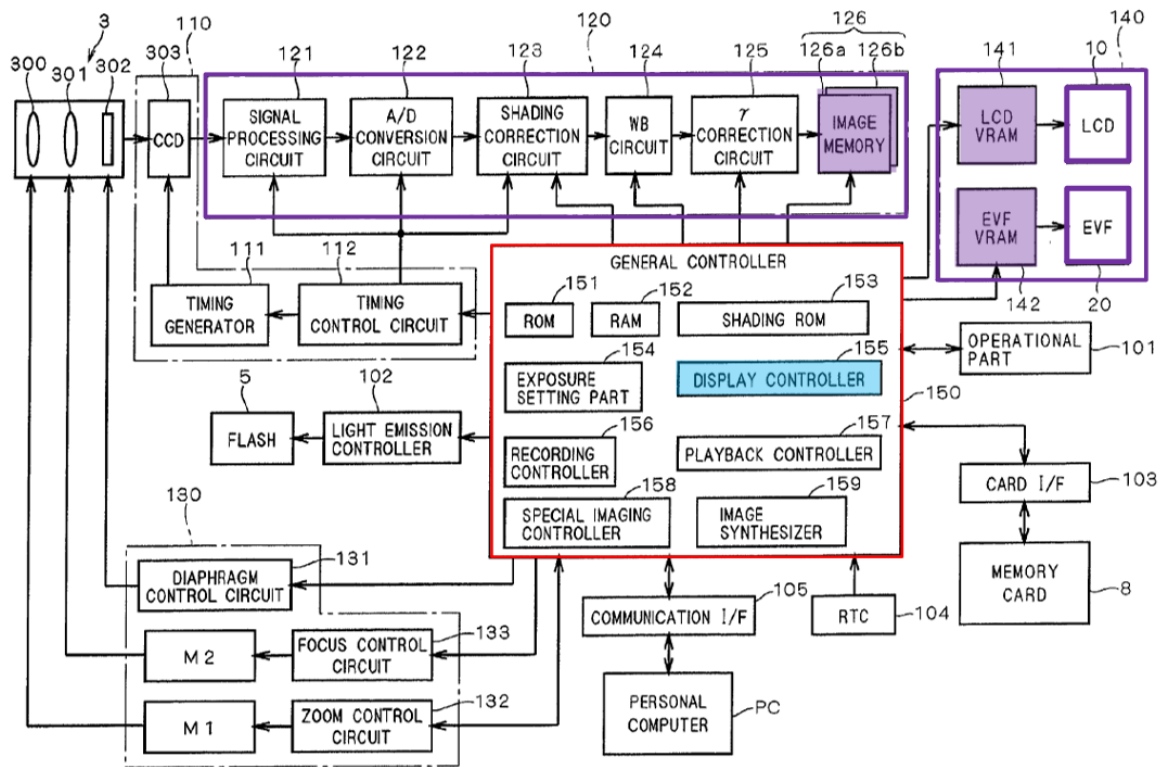
“video be viewed as merely a very rapid (30 to 60 frames per second) application of still photography” EX1001, 27:35-36

332. Niikawa's live view images undergo "predetermined signal processing by the signal processor 120" and are temporarily stored in image memory 126 from where general controller 150 reads out the video, performs "size adjustment" and transfers the video to VRAMs 141, 142 (video memories) of LCD 10 and EVF 20 for live view display. Niikawa, [0092].

333. Niikawa in view of Watanabe-JP meets [30A] when general controller 150 digitally processes the live view images to correct the image size "to adapt to the image size of the display destination" (Niikawa, [0099])—i.e., "to correct the video taken by the digital camera" ([30A]) for proper display on LCD 10 and EVF 20.

334. Additionally, Niikawa's FIG. 5 configuration (annotated below) meets [30A] because signal processor 120's shading correction circuit 123, WB circuit 124 and γ correction circuit 125 are in the data path between CCD 103 and image memory 126, from which in turn the LCD and EVF are fed live view images. A POSA would have understood the "predetermined signal processing" performed on live view images includes the corrections performed by the dedicated circuits in the disclosed data path.

FIG. 5



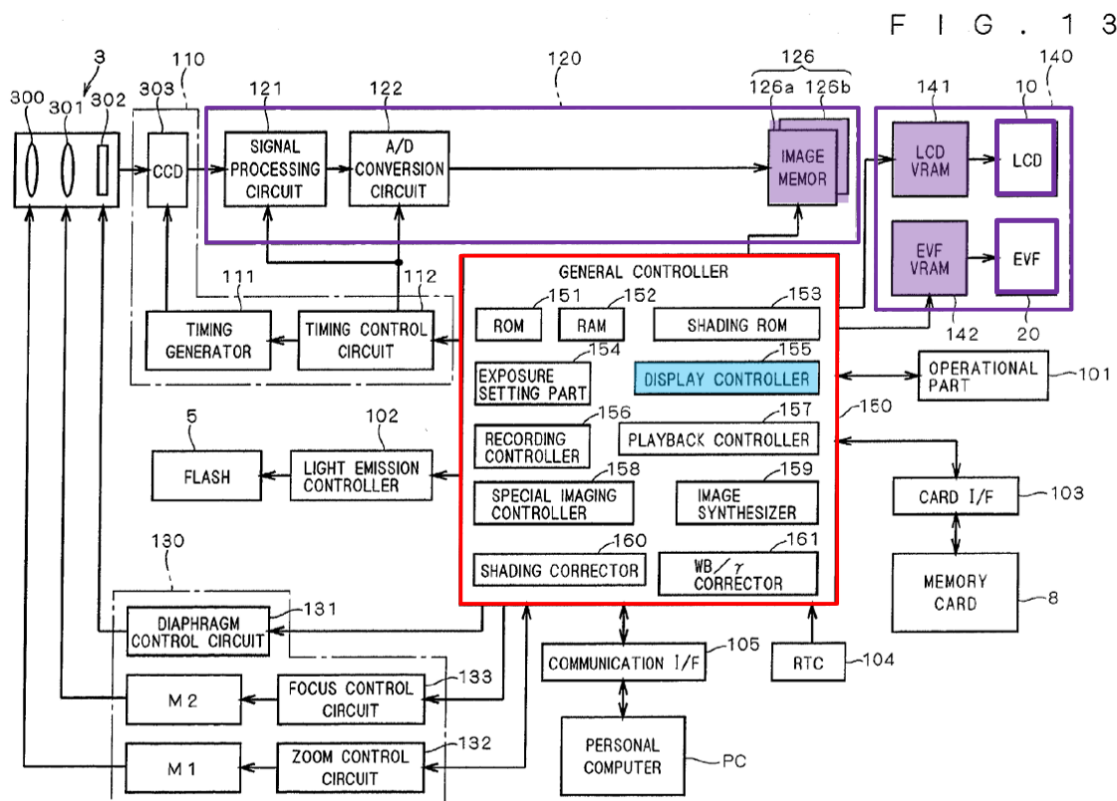
335. Niikawa describes an approach to gradation control processing in which, to reduce the time between capturing the two images, the first image, which is underexposed, is not corrected for shading before the second, overexposed image is captured. Niikawa does not suggest omitting or show a way to bypass white balance or γ correction for either image.

336. Even were there ways to omit or bypass white balance or γ corrections for live view images, a POSA would have found it beneficial to implement Niikawa's live view display using FIG. 5's disclosed signal path on live view images to provide a better quality live view display that accurately shows what the picture will look like as the user views the scene, frames the photo, etc. A POSA

would have also understood that performing those corrections for live view images would improve the accuracy of determining an exposure control value from them:

“The exposure setting part 154 for executing an exposure control process and determines a brightness of the subject using image data of G color component of the live view image and calculates an exposure control value based on the determination result.” Niikawa, [0098]

337. For similar reasons, a POSA would have also recognized the benefits of performing image corrections on live view images in Niikawa’s FIG. 13 configuration (annotated below) by executing desired image corrections on live view images general controller 150 reads from image memory 126 prior to correcting the image size and transferring to the LCD and EVF VRAMs.



2. [30B] “storing a plurality of corrected images”

338. Niikawa in view of Watanabe-JP meets [30B] because, as discussed in detail in §IX.Q.1 above ([30A]), Niikawa’s corrected live view images discussed above are stored in VRAMs 141, 142 (and prior to that are stored in image memory 126 in the FIG. 5 configuration).

R. Claim 22

339. The table below shows the correspondence between limitations in claim 22 that are identical or substantially the same as the corresponding limitation in claim 1 and the corresponding section demonstrating that Niikawa in view of Watanabe-JP meets each limitation.

Claim 22	Claim 1
[22A]	[1A], §IX.E.2 above
[22A1]	[1A1], §IX.E.2.i above
[22A2]	[1A2], §IX.E.2.ii above
[22A4]	[1A4], §IX.E.2.iv above
[22C]	[1D], §IX.E.5 above

340. The differences between claims 1 and 22 are discussed below.

1. [22PRE]

341. To the extent claim 22’s preamble reciting a “method of displaying one or more images captured by a digital camera on an external monitor” is

limiting, Niikawa in view of Watanabe-JP meets the preamble for the same reason it meets the additional language recited in [22B] as discussed in detail below.

2. [22A3]

342. Niikawa in view of Watanabe-JP “store[s] updated software or image correction data or both” as recited in [22A3] for at least the reasons discussed in detail in §§IX.E.2.iii-IX.E.2.iv above that Niikawa in view of Watanabe-JP stores received updated program before (and after) updating any existing software.

3. [22B]

343. Limitation [22B] recites [1C]’s “wirelessly transmitting at least one or more of the corrected images” (which Niikawa in view of Watanabe-JP meets for the same reasons discussed in detail in §IX.E.4 above) and adds “in a format that the external monitor can receive,” which a POSA would have understood to be necessary for the transmission to be successful.

344. Niikawa discloses that images stored on the memory card are either JPEG compressed (stored as .JPG files) or stored in uncompressed “RAW” form (.RAW files):

“FIG. 15 shows an example of configuration of an image file stored in the memory card 8. In FIG. 1, ‘P000001.JPG’, ‘P000002.JPG’ and the like represent the names of image files. In the present preferred embodiment, the name of image file is expressed by ‘PL.M’ and ‘L’ in the ‘PL.M’ represent a 6-order number indicating the order that the image file is generated, and ‘M’ represents an extension indicating the

form of the captured image data. In 'M', 'JPG' represent captured image data compressed in the JPEG form and recorded, and 'RAW' represents captured image data recorded in the CCD-RAW form. The captured image data captured in the normal exposure mode is represented by the extension 'JPG', and the captured image data captured in the gradation control exposure mode is represented by the extension 'RAW'." Niikawa, [0149]

345. A POSA would have understood the .JPG file format was standard, widely used, and that virtually any monitor would be able to receive and display files in that format, even wirelessly:

"The present invention relates to an image expansion and display technique for expanding a J[P]EG compressed digital image data and outputting the data to a monitor built in a system or an external display device." US 2005/0008236 A1 (EX1061, "Hachiyama"), [0001]

"the present invention discloses a method and system for transmitting video data from a portable device, such as a notebook computer, to a display by capturing the computer's graphics device interface (GDI) using a mirror driver and encapsulating it in a proprietary data packet format prior to transmission. This information is then transmitted over an 802.11 wireless link to a data handler at the receiver end where it is pieced back together and rendered to a video display screen at the desired rate. The display system is capable of receiving, decompressing, decoding, and displaying the video images in real-time. More particularly, one embodiment of the present invention uses

optimized digital signal processor (DSP) accelerator
compression/encryption and decoding/decompression techniques and
is capable of compressing, encrypting, transmitting, receiving,
decompressing, decoding, and displaying the video images in real-
time. Highly optimized graphic rendering code and JPEG
decompression code allows the DSP to support the real-time rendering
requirements necessary to provide cable-like connectivity from a
remote device to a wireless projector.” US 2003/0017846 A1 (EX1059
“Estevez”), [1005]-[1006]

346. Further, Niikawa discloses displaying “RAW” images on an external
monitor, specifically in a window on “display 62” of “personal computer 60”
programmed and equipped to perform Niikawa’s gradation control processing as
shown in FIG. 19 below:

“the gradation control process is performed by an image processing
apparatus configured by a personal computer or the like.” Niikawa,
[0164]

“the captured image data underexposed than the correct exposure (the
first image F1) and the captured image data overexposed than the
correct exposure (the second image F2) that have been subjected to
only the A/D conversion and recorded in the CCD-RAW form are
used.” Niikawa, [0165]

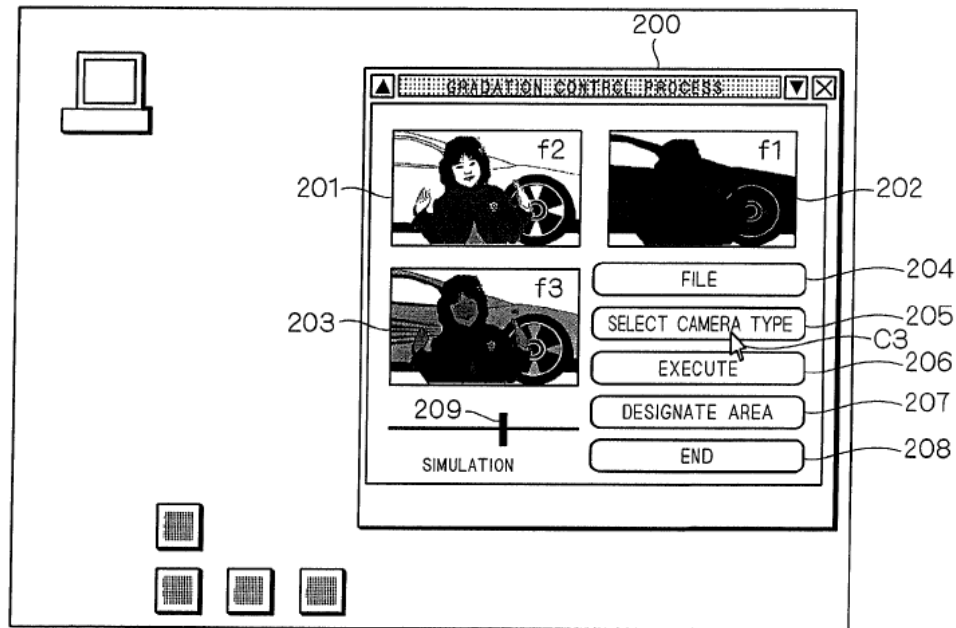
“the image processing apparatus 50 has a personal computer 60... The
personal computer 60 has a computer main body 61, a display 62 for

making various displays... and a memory card reader 61b for performing read of a memory card.” Niikawa, [0166]-[0167]

“The personal computer 60 stores a plurality of correction tables used for the shading correction... Furthermore, the personal computer 60 stores a gradation control program for synthesizing data of two captured images of different amounts of light exposure” Niikawa, [0168]-[0169]

“FIG. 19 is a view showing one example of a work window displayed on the display 62 when the personal computer 60 executes the gradation control program... The display region 201 and the display region 202 are arranged on the upper side of the Screen, and a thumbnail image f2 of the overexposed second image F2 is displayed in the display region 201, and a thumbnail image f1 of the underexposed first image F1 is displayed on the display region 202.” Niikawa, [0170]-[0171]

FIG. 19



Niikawa, FIG. 19

347. Niikawa’s disclosure of formats that a POSA would have understood were standard and widely used is more than the ’266 patent discloses in this respect:

“Whether implemented in a local area network (LAN) or a wide area network (WAN), by using a built-in wireless router, the present digital imaging system may be set to send data files directly and automatically to hard-chive [*sic*] storage either in a device in the same room or uploaded to the Internet for storage around the world. This capability is critical for managing massive files of large sensor data sets and preserving valuable in-camera storage space. When automatically sending data files to a nearby computer, the computer may act as a data-port relay to automatically resend the images to an

Internet site for storage. The system will maintain the option of keeping some images in the camera and sending duplicate copies of digital files of images to another site for storage as a backup. This automatic back-up process provides insurance for the photographer.” EX1001, 28:61-29:9

“The present digital imaging system not only automatically off-loads digital image files to remote locations for storage; the system also will allow one to photograph an image (or sequence of images) in one location (i.e., Paris) and instantly print it in another location (i.e., Los Angeles) for publication in real time.” EX1001, 30:3-8

“In FIG. 34, wireless communication features of the digital imaging system are described. The camera (3400) sends digital image data files wirelessly to a computer (3410).” Niikawa, 36:61-64

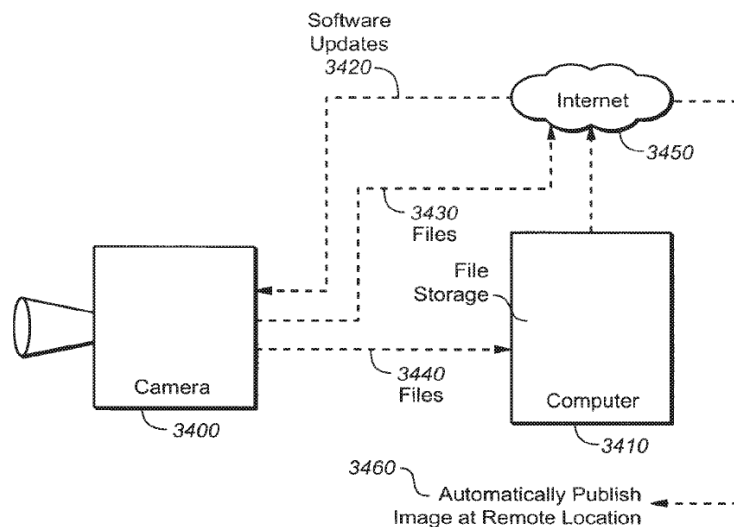


FIG. 34

Niikawa, FIG. 34

348. When Niikawa in view of Watanabe-JP wirelessly transmits corrected images stored on the memory card, those images are “in a format that the external monitor can receive” and therefore meet [22C] for at least the same reason the ’266 patent’s embodiments do.

S. Claim 23

349. Claim 23 recites the same limitations as claim 2.

350. Niikawa in view of Watanabe-JP meets claim 2 for the reasons discussed in detail in §IX.F above.

T. Claim 25

351. Claim 25 recites the same limitations as claim 11.

352. Niikawa in view of Watanabe-JP meets claim 25 for the reasons discussed in detail in §IX.J above.

U. Claim 27

353. Claim 27 recites the same limitation as claim 13.

354. Niikawa in view of Watanabe-JP meets claim 27 for the reasons discussed in detail in §IX.K above.

X. GROUND 2: NIIKAWA IN VIEW OF WATANABE-JP IN VIEW OF BOLLE RENDERS OBVIOUS CLAIMS 1-3, 5-11, 16, 19, 22-25

355. As discussed in detail in §IX.A above, Niikawa’s digital camera provides “point-and-shoot” functionality in which the camera automatically adjusts

the focus and exposure parameters (e.g., aperture, shutter speed, etc.) when the user presses the shutter button 9 half-way.

A. Bolle (EX1007)

356. Bolle discloses that despite the sophistication of digital cameras with auto-setting capabilities (like Niikawa's), poor quality images were still often captured due in part to the user's lack of control in adjusting camera settings needed for, e.g., "compensating for backlighting, setting the depth-of-field appropriately, and the like" because camera controls were either hidden or not provided to the user. Bolle, 1:16-38.

"Traditional electronic cameras have limited controls for adjusting focus, aperture, shutter speed and, in some cases, lens focal length. Later generation cameras are more sophisticated, adjusting parameters that include focus point for an auto-focus camera, meter weighting for exposure control, f-stop correction, depth-of-field, electronic flash parameters, number of exposures composing a given image, and more. In spite of their increased functionality, conventional cameras as discussed above have significant drawbacks. These cameras, for example, require a user to exert an overwhelming degree of control over the picture-taking process in terms of correctly setting the camera parameters. This usually proves too great a task for the amateur photographer. As a result, photographs are often taken with inappropriate settings and thus tend to be of poor quality. For the novice user especially, such sophistication is too intimidating. Even when the camera controls are hidden, either in simple cameras or in

simple modes where everything is automatic, poor photographs may still result because the user does not have the knowledge of photography or the control to compensate for backlighting, to set the depth-of field appropriately, and the like.”

357. Bolle describes a digital camera system that “can run in a fully automatic mode” or a “guided mode” in which the camera provides camera setting suggestions that the user can select, choose alternative, override or “take full manual control” of the camera’s settings:

“A need therefore exists for an automatic system and method, implemented preferably in highly sophisticated electronic cameras, which either automatically sets camera parameters at optimal settings and/or which gives the user the ability to set those parameters in an easy and efficient manner as compared with conventional devices.”

Bolle, 2:4-10

“Advantageously, the system can run in a fully automatic mode choosing the best image parameters, or a “guided mode” where the user is prompted with choices where a number of alternate settings would be reasonable.” Bolle, 2:37-40

“The photographic expert 104 determines the type of photograph that the user is trying to take based on the information from the scene analysis unit, either alone or in conjunction with inputs from auxiliary sensors 111 such as ambient temperature or camera tilt angle. Expert 104, then, indicates its understanding of the scene to the user through Some prompt or display method 105 and the user can give feedback,

override to the expert, or take full manual control through some input device 106.” Bolle, 2:62-3:10

358. The basis for both Bolle’s “automatic” and “guided” modes is a scene analysis unit 103 and photographic expert unit 104 executed by the camera’s digital computer, both of which are shaded blue in Bolle’s camera system illustrated in FIG. 1 below:

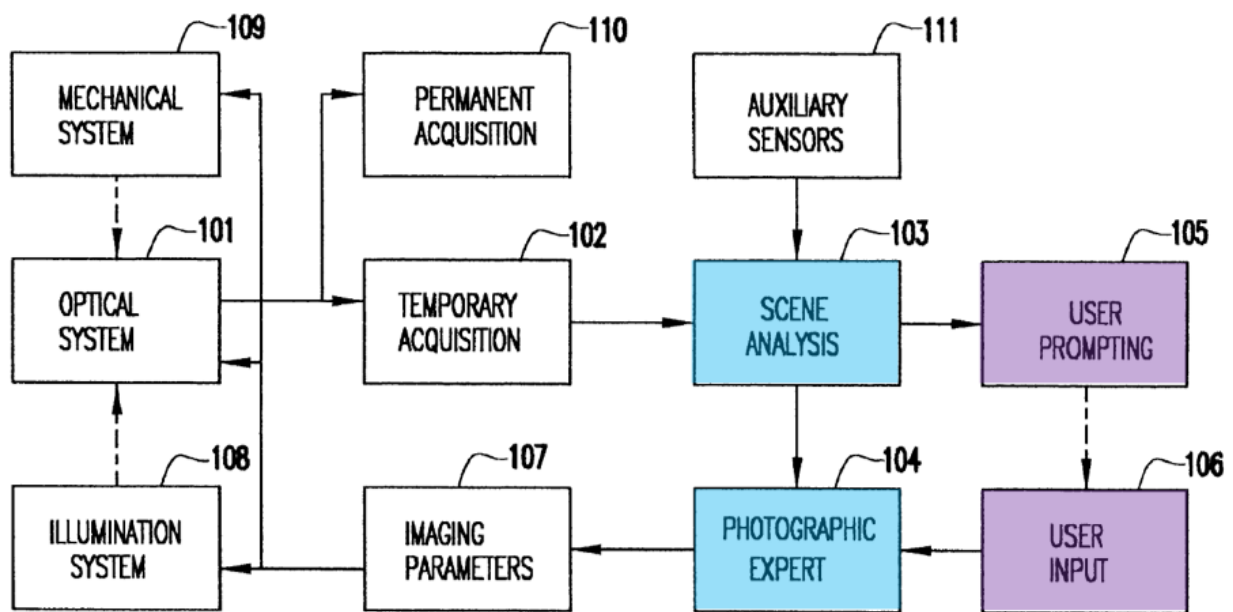


FIG.1

359. Scene analysis 103 receives “a digital color image” acquired by the digital camera’s “CCD or CMOS imaging array” and analyzes the image to extract and evaluate multiple attributes and features to produce one or more hypotheses as to the scene classification, as illustrated in FIG. 2 below. Bolle, 3:27-36, 3:56-4:15.

“the temporary acquisition unit may be a CCD or CMOS imaging array acquiring a digital color image, allowing a digital computer to process and analyze the scene image. For a digital still or video camera system, this imaging array would be used for the permanent and temporary image acquisition. For a conventional still or movie camera, the permanent image would be captured on conventional film. For a video camera, a permanent storage medium might be video tape or a hard disk drive.” Bolle, 3:27-36

“The preferred embodiment of the present invention employs scene analysis 103 the details of which are shown in FIG. 2. Scene analysis includes four components: input attributes, raw features, Scene components, and scene classifications. From the input attributes, the scene analysis unit first extracts raw features. These form the basis for finding and identifying scene components, which in turn are used to generate one or more scene classifications. Such classifications are the output of the scene analysis unit. In particular, the input attributes may include image intensity 201, a depth map 203, image color 230, and a motion map 232. The raw features may include depth map segmentation 204, motion segmentation 205, illumination evaluation 206, color analysis 207, geometric features 208, texture analysis 209, and scale determination 210. The scene components may include face detection 211, person detection 212, building recognition 213, vegetation detection 214, and vehicle recognition 215. Final scene classifications may include portrait 216, close-up portrait 212, group shot 213, action photo 219, natural landscape 220, still life 221, macro 222, crowd scene 223, backlit object 224, and night sky 225. As

described in more detail below, the scene classifications correspond to one or more hypotheses as to the type of scene the user intends to photograph based on the raw features and scene components. If there are multiple hypotheses, a scene classification arbitration method 226, is applied to select the most likely hypothesis.” Bolle, 3:56-4:15

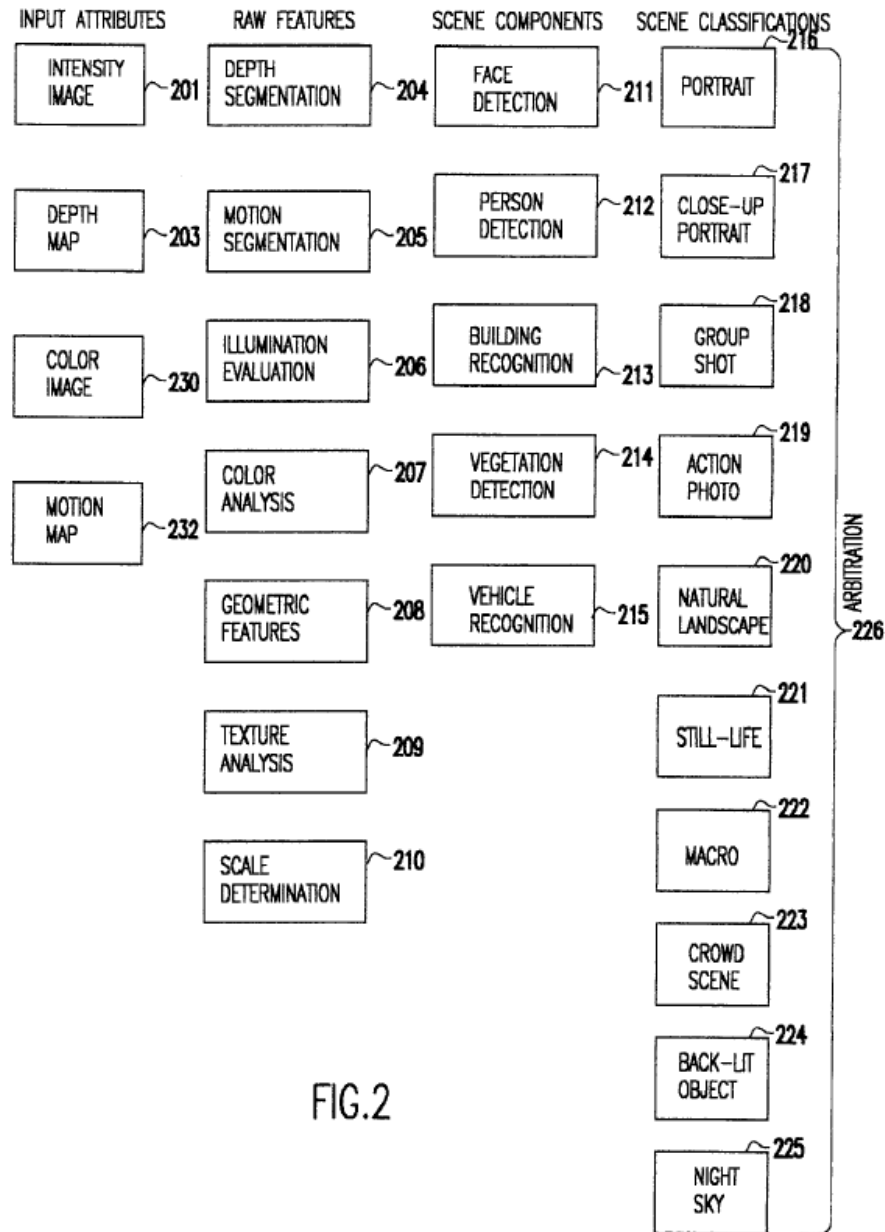


FIG.2

360. Photographic expert 104 (shaded blue in FIG. 1 above) determines an optimal set of camera parameters 107 from the information provided by scene analysis 103 for the type of image expert 104 believes the user is trying to capture, as illustrated in FIG. 3 below. Bolle, 3:2-10, 5:28-6:8.

“The photographic expert 104 determines the type of photograph that the user is trying to take based on the information from the scene analysis unit, either alone or in conjunction with inputs from auxiliary sensors 111 such as ambient temperature or camera tilt angle. Expert 104, then, indicates its understanding of the scene to the user through some prompt or display method 105 and the user can give feedback, override to the expert, or take full manual control through some input device 106.” Bolle, 3:2-10

“As shown in FIG. 3, the photographic expert, 104, takes whatever the final decision of the scene arbitration unit 226 is and uses this to determine a set of values 107, for the imaging parameters in order to yield optimal image capture 301. The photographic expert embodies the domain knowledge of expert photographers as to which imaging parameters are appropriate to different types of subject matter. The photographic expert may also base its decision on a number of other factors, such as the actual lighting conditions, the amount of camera-shake calculated (or directly measured), the depth of objects in the scene, and the like. Here again, a number of rules would suffice for a simple system, but a more sophisticated knowledge representation technique such as a neural network is used in the preferred embodiment because of the number of inputs and outputs to be

interrelated and because of the complexity of those relations.

Regardless of the actual embodiment, the system would perform tasks such as:

determination of a focus setting for the subject matter

choice of a proper exposure for the subject region of the image

selection of a shutter speed based on subject motion and camera

stability

Sometimes the scene arbitration unit, 226, will report several potential scene classifications instead of just one. In such cases the intent of the photographer is often not clear; for example, there might be two people at different depths. Here the photographic expert, 104, must choose a consistent set of imaging parameters in some way. The camera may do this by having some default or "optimal" set of parameters for every situation, with certain hypotheses predetermined to override alternative hypotheses. For instance, it may choose the focus based on the nearest subject or always choose the depth-of-field to keep all subjects in focus when possible. This would be preferable for a camera in the "point-and-shoot" category or for a "zero intervention mode" of a more sophisticated camera. However, for the more experienced user, the choices may be offered to the user through some user interface, 105. For instance, this interface may be a through-the-lens display panel or a camera-top liquid crystal display (LCD) panel. The user would then use simple controls, 106, such as the thumb-wheels or up/down buttons available on many present-day cameras, to select the category intended. In the preferred embodiment the "best-guess" hypothesis would be selected by default so that user intervention is kept to a minimum." Bolle, 5:28-6:8

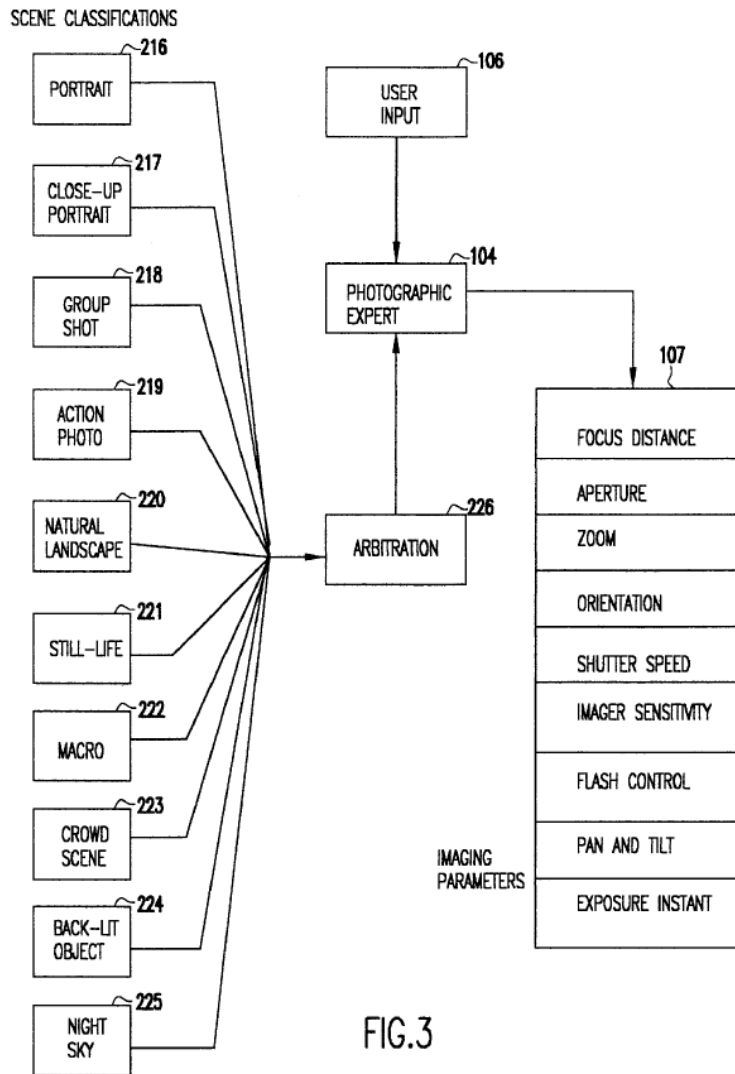


FIG.3

361. In a “fully automatic mode,” expert 104 sets the camera to the optimal set of values 107 for the camera parameters that the expert determined for optimal image capture. Bolle, 2:37-38, 5:28-34, 5:58-65.

“A need therefore exists for an automatic system and method, implemented preferably in highly sophisticated electronic cameras, which either automatically sets camera parameters at optimal settings” Bolle, 2:4-7

“the system can run in a fully automatic mode choosing the best image parameters” Bolle, 2:37-38

“As shown in FIG. 3, the photographic expert, 104, takes whatever the final decision of the scene arbitration unit 226 is and uses this to determine a set of values 107, for the imaging parameters in order to yield optimal image capture 301. The photographic expert embodies the domain knowledge of expert photographers as to which imaging parameters are appropriate to different types of subject matter.” Bolle, 5:28-34

“The camera may do this by having some default or ‘optimal’ set of parameters for every situation, with certain hypotheses predetermined to override alternative hypotheses. For instance, it may choose the focus based on the nearest subject or always choose the depth-of-field to keep all subjects in focus when possible. This would be preferable for a camera in the ‘point-and-shoot’ category or for a ‘zero intervention mode’ of a more sophisticated camera.” Bolle, 5:58-65

362. In a “guided mode,” expert 104 presents its understanding of the scene to the user (e.g., user prompting 105 shaded purple in FIG. 1 above) so the user can “give feedback, override the expert, or take full manual control” via user input 106 (also shaded purple in FIG. 1 above). Bolle, 2:38-39, 3:7-13.

“a ‘guided mode’ where the user is prompted with choices where a number of alternate settings would be reasonable” Bolle, 2:38-39

Expert 104, then, indicates its understanding of the scene to the user through some prompt or display method 105 and the user can give feedback, override to the expert, or take full manual control through some input device 106. The user prompt 105 and the user input 106 together constitute a user interface by which the photographic expert 104 and the user can communicate.” Bolle, 3:7-13

B. Reasons to Combine Niikawa in view of Watanabe-JP and Bolle

1. Benefits to Niikawa’s Automatic Processes

363. A POSA would have recognized the benefit of applying Bolle’s scene analysis 103 and expert 104 in a “fully automatic mode” as discussed in detail in §X.A above to improve Niikawa’s auto-focus and auto-exposure processes like Bolle’s teaches to improve “point-and-shoot” features of a camera. Bolle, 5:58-65.

364. For example, a POSA would have understood that Niikawa’s AF process (which adjusts the “focal point of the lens group 30 of the imaging lens 3” to bring a “main subject” into focus, Niikawa, [0090], [0106], [0134]) would have benefitted from Bolle’s scene analysis 103 and expert 104 that detects the types of object in the scene to determine an optical focus distance and an optimal depth of field for that type of scene. Bolle, 5:36-39, 61-63, 7:20-42.

365. Similarly, a POSA would have recognized the benefit to Niikawa’s AE process (which assesses the brightness of the scene from the G color component of a live view image) of Bolle’s techniques that, in addition to “image

intensity 201” analyzes further “input attributes, raw features, scene components and scene classifications” to determine optimal exposure settings under a variety of conditions (e.g., by assessing whether the scene is back-lit, whether the scene is a portrait or group shot, whether the scene is a sunset or landscape, etc.).

2. Benefits of Implementing Bolle’s Automatic Mode

366. A POSA would have been motivated to configure Niikawa’s general controller 150 with Bolle’s scene analysis 103 and expert 104 programs in an automatic mode in which the camera settings determined by expert camera 104 are automatically used (e.g., Bolle, 2:4-7, 5:52-65), thus beneficially preserving Niikawa’s point and shoot functionality and improving Niikawa’s automatic processes discussed in §IX.A above:

“A need therefore exists for an automatic system and method, implemented preferably in highly sophisticated electronic cameras, which either automatically sets camera parameters at optimal settings” Bolle, 2:4-7

“Scene analysis includes four components: input attributes, raw features, scene components, and scene classifications. From the input attributes, the scene analysis unit first extracts raw features. These form the basis for finding and identifying scene components, which in turn are used to generate one or more scene classifications. Such classifications are the output of the scene analysis unit. In particular, the input attributes may include image intensity 201, a depth map 203, image color 230, and a motion map 232. The raw features may include depth map segmentation

204, motion segmentation 205, illumination evaluation 206, color analysis 207, geometric features 208, texture analysis 209, and scale determination 210. The scene components may include face detection 211, person detection 212, building recognition 213, vegetation detection 214, and vehicle recognition 215. Final scene classifications may include portrait 216, close-up portrait 212, group shot 213, action photo 219, natural landscape 220, still life 221, macro 222, crowd scene 223, backlit object 224, and night sky 225.” Bolle, 3:38-4:9

“Sometimes the scene arbitration unit, 226, will report several potential scene classifications instead of just one. In such cases the intent of the photographer is often not clear; for example, there might be two people at different depths. Here the photographic expert, 104, must choose a consistent set of imaging parameters in some way. The camera may do this by having some default or ‘optimal’ set of parameters for every situation, with certain hypotheses predetermined to override alternative hypotheses. For instance, it may choose the focus based on the nearest subject or always choose the depth-of-field to keep all subjects in focus when possible. This would be preferable for a camera in the ‘point-and-shoot’ category or for a ‘Zero intervention mode’ of a more sophisticated camera.” Bolle, 5:52-65

3. Benefits of Implementing Bolle’s Guided Mode

367. A POSA would have additionally recognized the benefit implementing Bolle’s “guided mode” (discussed in detail in §X.A above) that allows the user to control the camera settings by “feedback” (e.g., selecting among proposed camera settings), by providing an “override to the expert” or by taking

“full manual control” through an input device, thus providing an additional and desirable capability to Niikawa’s camera. Bolle, 2:4-10, 2:37-40, 5:65-6:8.

368. A POSA would also have been motivated to configure general controller 150 to additionally operate in Bolle’s “guided mode” (e.g., Bolle, 2:8-10, 2:35-40, 3:7-19, 3:43-55, 5:66-6:8) to allow the user to adjust the “set of values 107” for the camera’s imaging parameters such as the “basic controls” shaded red in Bolle’s FIG. 8 below (e.g., Bolle, 3:7-19), accept or select expert 104’s assessment of the subject matter in the scene (e.g., scene classifications shaded blue) on which expert 104 determines the imaging parameters (e.g., Bolle, 5:66-6:8), etc., which user-adjustments further allows expert 104 to learn user preferences to improve the future recommendations for analogous imaging situations:

“If the photographic expert 104 receives user feedback, a decision override, or manual control inputs, it uses this to learn user preferences (or optionally store the inputs directly) and then automatically apply similar corrections to future analogous imaging situations.” Bolle 3:43-47

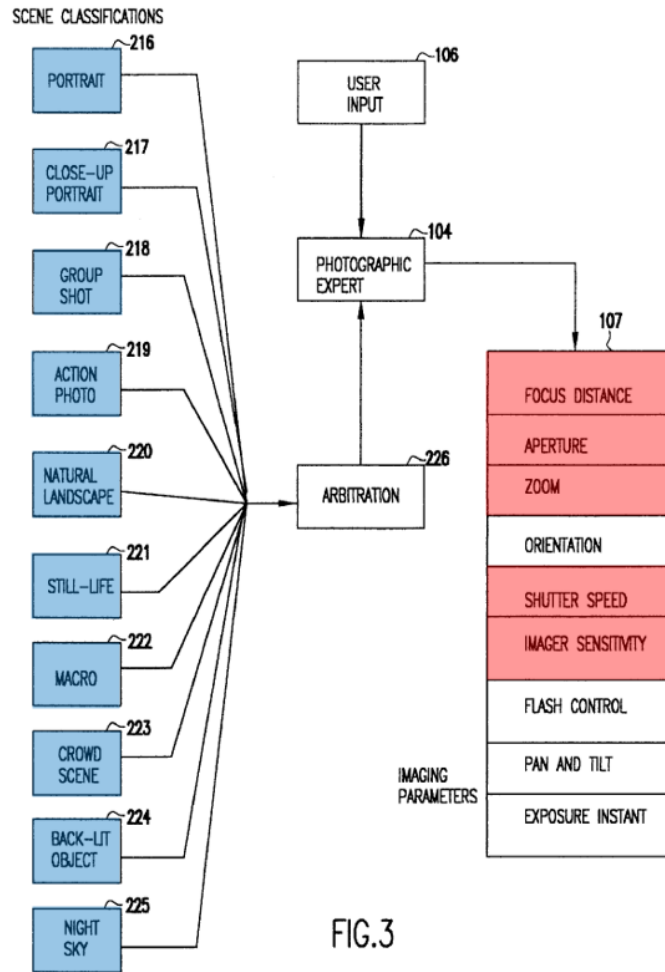


FIG.3

4. Reasonable Expectation of Success

369. Implementing Bolle’s techniques in Niikawa would have required nothing more than conventional and routine programming skills—e.g., configuring general controller150 with Bolle’s scene analysis 103 and expert 104 programs, configuring general controller150’s “display controller” to use Niikawa’s LCD 10 and interface controls to provide the “user interface” by which the user provides feedback:

“The user prompt 105 and the user input 106 together constitute a user interface by which the photographic expert 104 and the user can communicate.” Bolle, 3:11-13

“this interface may be a through-the-lens display panel or a camera-top liquid crystal display (LCD) panel.” Bolle, 6:1-2

C. Niikawa in view of Watanabe-JP in view of Bolle Combination

370. A POSA would have been motivated to implement Bolle’s scene analysis 103 and expert 104 in the two ways expressly taught by Bolle: (1) an automatic mode in which the camera settings determined by scene analysis 103 and expert camera 104 are automatically used to improve Niikawa’s automatic processes and (2) a “guided mode” in which the user can select or modify proposed camera settings or take full manual control.

371. Niikawa’s camera would thus beneficially operate in the point-and-shoot manner in the automatic mode, but with the improved performance of Bolle’s scene analysis 103 and expert 104, and would include the capability of the user to modify the camera settings and/or select a different scene category as taught by Bolle’s guided mode.

D. Claims 1 and 2

372. Niikawa in view of Watanabe-JP in view of Bolle meets claims 1 and 2 for the same reasons discussed in §§IX.E-IX.F (Ground 1) for Niikawa in view of Watanabe-JP.

E. Claim 2

373. Niikawa in view of Watanabe-JP in view of Bolle meets claim 2 for additional reasons because, as discussed in detail in §§X.B.3 and X.C above, it implements a guided mode as taught by Bolle in which the user can select camera settings determined by expert 104, choose alternative settings, or take full manual control over the camera parameters 107 used to capture images, thus providing multiple additional “user-adjustable variables” that are “stored,” “electronically read” ([2A]) and used by general controller 150 to “process image corrections” ([2B]).

374. Specific examples of Niikawa in view of Watanabe-JP in view of Bolle’s additional user-adjustable variables (highlighted in FIG. 3 below) that each provide an additional reason Niikawa in view of Watanabe-JP in view of Bolle meets claim 2 are discussed further in §§X.F-X.K below in connection with claim 2’s dependent claims 3-10.

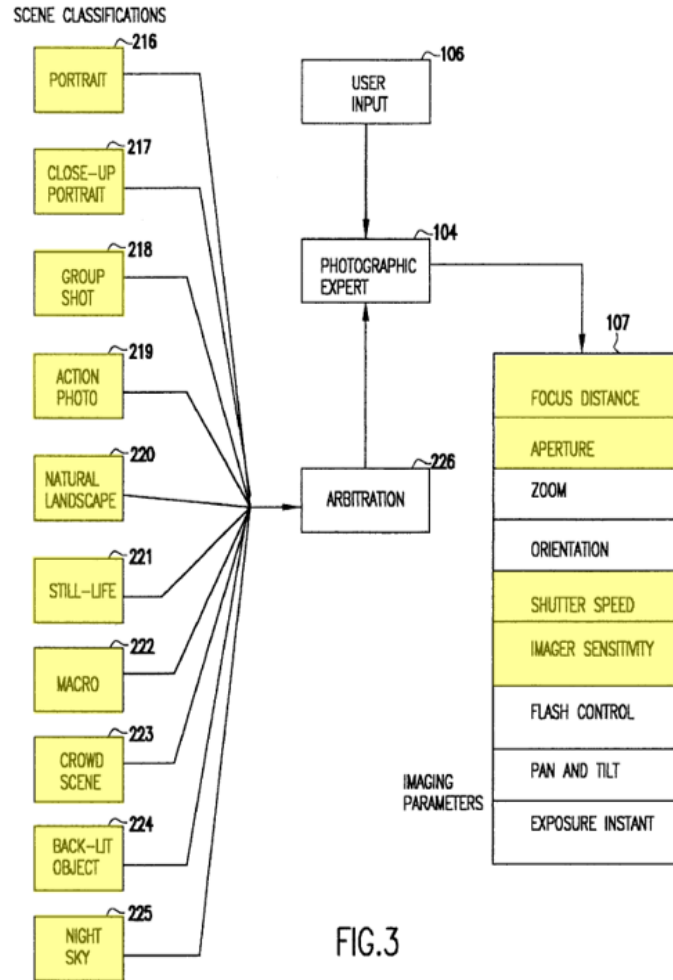


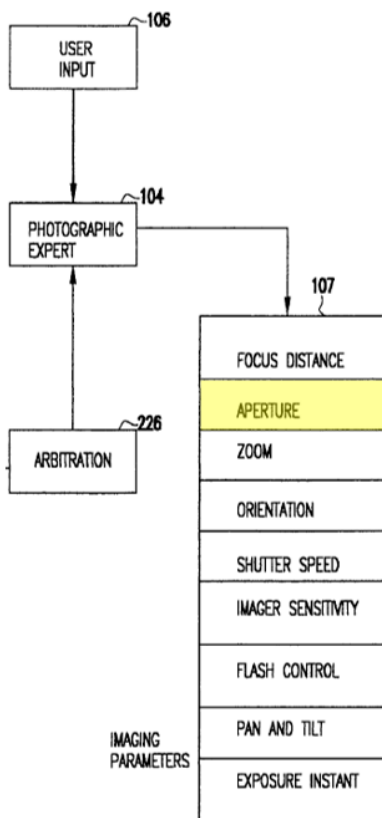
FIG.3

F. Claim 3: “...wherein the user-adjustable variables include an aperture setting.”

375. Niikawa in view of Watanabe-JP in view of Bolle meets claim 3 because the user can adjust the aperture setting used in processing image corrections in the guided mode.

376. As discussed in detail in §X.A above and highlighted in the portion of Bolle’s FIG. 3 below, aperture is one of the “basic controls” set by general controller 150 based on the user’s input, i.e., that is “user-adjustable” by the user

accepting the expert 104's proposed aperture setting, selecting from “a number of alternative settings” or by taking “full manual control” over the camera's settings:



377. Aperture (f-number) is a fundamental camera setting that users conventionally and beneficially manipulated to capture desired images and POSA's would have recognized the benefit of allowing the user to adjust the f-number to obtain a desired exposure not just in Niikawa's normal exposure mode, but also in the gradation control mode to allow the user to determine the proper value for the aperture setting at which two images are captured.

378. Niikawa's general controller 150 uses the “focal length and **f-number** at the time of imaging” (Niikawa, [0084]) to select the corresponding correction

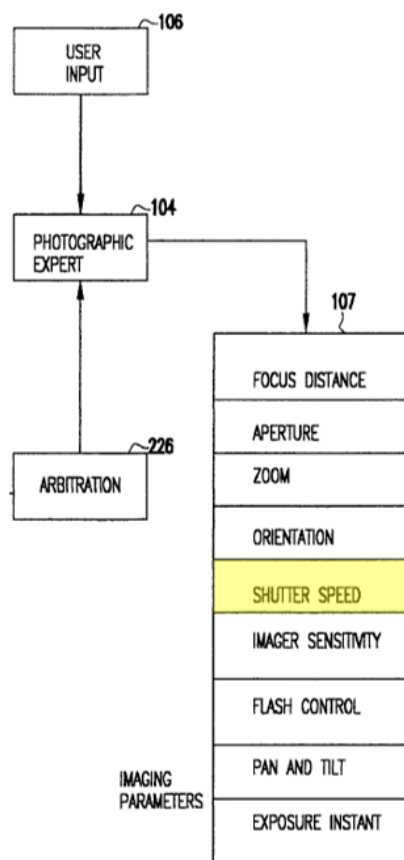
table using to perform Niikawa's shading correction process (Niikawa, [0084], [0108]-[0110], [0129]-[0130], [0138], [0158]) and to do so general controller 150 "electronically read[s]" the "stored" ([2A]) f-number set at the time of exposure (including by the user) to select the corresponding correction table to correct for shading ([2B]). See also §IX.M (showing f-number is stored).

379. Niikawa in view of Watanabe-JP in view of Bolle (1) meets claim 2 for this additional reason, and (2) meets claim 3.

G. Claim 5: "...shutter speed settings."

380. Niikawa in view of Watanabe-JP in view of Bolle meets claim 5 because the user can set the specific shutter speed value used to process image corrections in the guided mode (§X.A).

381. As highlighted in the portion of Bolle's FIG. 3 below, shutter speed is another camera parameter set by general controller 150 executing Bolle's expert 104 in Niikawa in view of Watanabe-JP in view of Bolle that is adjustable by the user (as discussed in detail in §§X.C, X.E).



382. Shutter speed is another fundamental camera setting that users conventionally and beneficially manipulated to capture desired images and POSA’s would have recognized the benefit of allowing the user to adjust the f-number to obtain a desired exposure not just in Niikawa’s normal exposure mode, but also in the gradation control mode to allow the user to set the reference shutter speed from which Niikawa’s obtains the overexposed and underexposed images.

383. Niikawa in view of Watanabe-JP in view of Bolle “electronically read[s]” the “stored” ([2A]) shutter speed and uses the shutter speed setting in “processing image corrections” ([2B]) for the same reasons Niikawa in view of Watanabe-JP does as discussed in detail in §IX.H above.

384. Niikawa in view of Watanabe-JP in view of Bolle (1) meets claim 2 for this additional reason and (2) meets claim 5.

H. Claim 6: “...wherein the user-adjustable variables include ISO settings.”

385. Niikawa in view of Watanabe-JP in view of Bolle meets claim 6 because it implements a guided mode in which the user can adjust the ISO used in processing image corrections.

386. In Niikawa in view of Watanabe-JP in view of Bolle, ISO is another camera parameter set by general controller 150 executing Bolle’s expert 104 (the “imager sensitivity” highlighted in the portion of Bolle’s FIG. 3 below) that is adjustable by the user (as discussed in detail in §§X.C, X.E above).

387. A POSA would have understood that Niikawa’s gain control circuit (Niikawa, [0080]) adjusts the ISO setting of the sensor.

388. In the context of cameras, ISO is a numerical measure of the sensitivity of the image receiver, whether film or digital. In a digital camera, ISO is adjusted by changing the gain of the amplifier receiving the electrical signal from the CCD image sensor. This gain can be changed automatically, as in Niikawa’s camera, or in response to a user adjustment of ISO:

“In a digital still camera, an image quality selection screen is displayed on a LCD panel by depressing a function button. A color reproducing condition, ISO sensitivity of a CCD image sensor, and the number of recording pixels are selected from among various

image quality adjustment items.” US 2004/0189825 A1 (EX1060, “Kawashima”), Abstract

“A CCD image sensor 43 as an imaging device is disposed behind the image pickup optical system.” Kawashima, [0032]

“An analog image signal captured from the CCD image sensor 43 is converted to digital image data by an A/D converter 47 after being amplified with the gain in response to the ISO sensitivity”
Kawashima, [0034]

“The user can select the intended image quality by adjusting the three items: the color reproducing condition, the ISO sensitivity, and the number of recording pixels in the image quality selection screen 31. The user operates the general keys 17 to move the cursor, and thereby selects the image quality. Both the color reproducing condition and the ISO sensitivity are well known as the selection criteria of the photo film in the prior art photographic film camera, so that the user can select these items as if to select the photo film.” Kawashima, [0038]

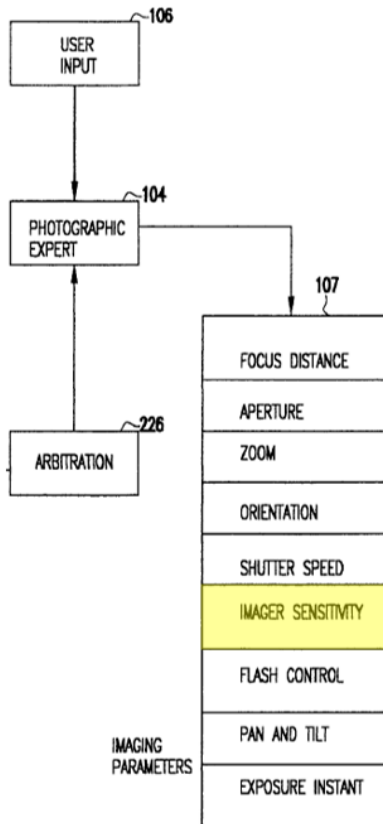
“The CCD image sensor 43 converts the subject image to an electric signal within the charge accumulation time corresponding to the brightness of the subject. The electric signal is sent to the image processor 51 after amplified with the gain in response to the ISO sensitivity” Kawashima, [0040]

389. A POSA would have understood the benefit of allowing the user to adjust the ISO setting when taking full manual control of the camera as taught by Bolle.

390. Increasing the ISO permits using a higher shutter speed, which suits sports and action photography as well as handheld photography in dark conditions, but the higher amplifier gain increases the visibility in the image of electronic noise from the CCD sensor.

391. Lowering the ISO reduces visible noise, improving image quality, but requires lowering the shutter speed, this will cause fast-moving objects to become blurred in the image, so low ISO is better suited to portrait, still life, or other relatively stationary subjects and bright conditions.

392. Niikawa in view of Watanabe-JP in view of Bolle includes “user-adjustable [] ISO settings” as claimed.



393. Niikawa in view of Watanabe-JP in view of Bolle uses ISO setting in “processing image corrections” for at least the same reasons the ’266 patent does. The ’266 patent neither discloses that ISO is a user-adjustable setting, nor does the ’266 patent describe using the ISO setting in “processing image corrections.” Most mentions of ISO in the ’266 patent have no relevance to this claim:

“One effect of the nano-grid is to manually expand or narrow the range of a set of pixel buckets; this process in turn effectively modifies not only the exposure range but also sharpness at high ISO, thereby dramatically reducing noise.” EX1001, 19:44-48

“In one application of the nano-grid, the problem of vignetting in wide-angle lenses may be solved by activating nano-filaments in

nano-grid(s) primarily in the corners to correct for the darkening from the limits of the optical aberrations, while still maintaining very low noise in a high ISO (low light) photographic situation.” EX1001, 20:16-21

“The challenge with current technologies is to balance details in shadow and highlight areas, particularly to achieve low noise at relatively high ISO speeds.” EX1001, 21:32-35

394. In the one instance the '266 patent mentions adjusting ISO, it is performed by the camera to set optimal camera settings for tracking an object:

“After selecting specific objects to track, the system follows the objects as they move from location to location, appropriately modulating the focus, the lens focal length, the ISO and the exposure settings. As the subject moves from one section of a grid to another, the sensors are coordinated to "hand off" the object to other sensors on the grid, much like a cellular phone network hands off calls between cells.” EX1001, 28:37-43

395. Niikawa in view of Watanabe-JP in view of Bolle meets claim 6 for at least the reasons the '266 patent's embodiments do, and meets claim 2 for this additional reason.

I. Claim 7: “...wherein the user-adjustable variables include subject type.”

396. Niikawa in view of Watanabe-JP in view of Bolle meets claim 7 because it implements a guided mode (§§X.B.3, X.C) in which the user can select

the category or classification of the image to be captured, the “subject type” as claimed.

397. As discussed in detail in §X.C above, Niikawa in view of Watanabe-JP in view of Bolle implements Bolle’s guided mode technique allowing the user to select the scene classification corresponding to the subject type of the scene (e.g., portrait, landscape, group photo, night sky, etc. highlighted in FIG. 3 below) of the image via an LCD in which expert 104’s “best guess” based on the scene components detected in the image (e.g., faces, buildings, vegetation, etc.) is presented, but can then be modified or overridden by the user:

“Scene analysis unit 103 then extracts certain information about the image acquired by the device 102. The photographic expert 104 determines the type of photograph that the user is trying to take based on the information from the scene analysis unit, either alone or in conjunction with inputs from auxiliary sensors 111 such as ambient temperature or camera tilt angle. Expert 104, then, indicates its understanding of the scene to the user through some prompt or display method 105 and the user can give feedback, override to the expert, or take full manual control through some input device 106. The user prompt 105 and the user input 106 together constitute a user interface by which the photographic expert 104 and the user can communicate.”

Bolle, 2:67-3:13

“for the more experienced user, the choices may be offered to the user through some user interface, 105. For instance, this interface may be a

through-the-lens display panel or a camera-top liquid crystal display (LCD) panel. The user would then use simple controls, 106, such as the thumb-wheels or up/down buttons available on many present-day cameras, to select the category intended. In the preferred embodiment the ‘best-guess’ hypothesis would be selected by default so that user intervention is kept to a minimum.” Bolle, 5:66-6:8

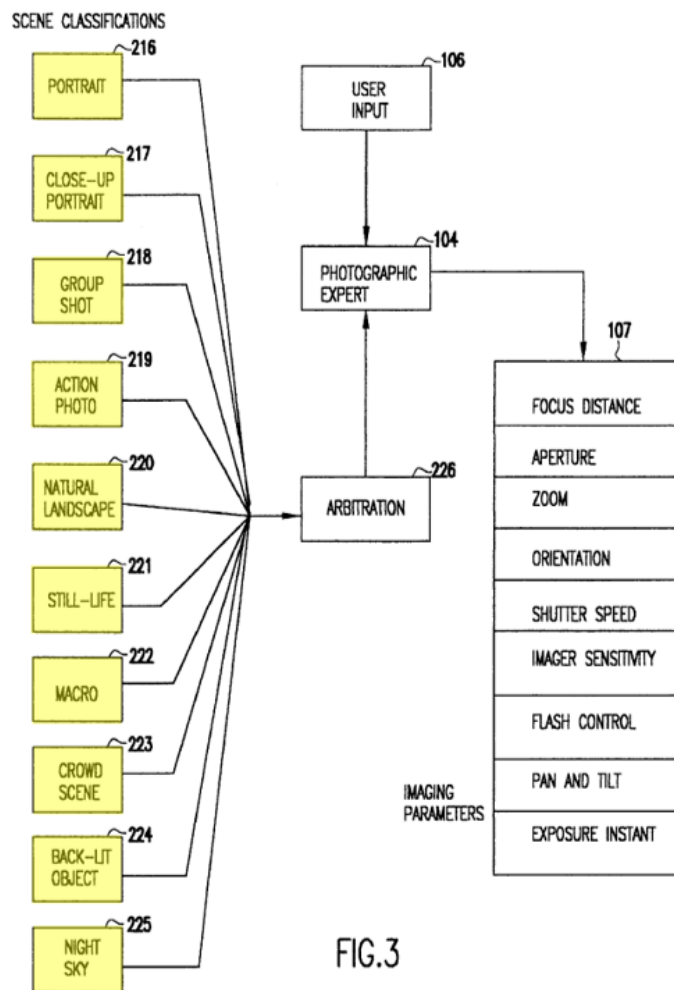


FIG.3

398. Niikawa in view of Watanabe-JP in view of Bolle includes “user-adjustable [] subject type” that are “stored” and “electronically read” at least because they are displayed to the user and the user selection is then applied to set

the camera parameters, and then used to “process image corrections” for at least the reasons discussed in §X.H above.

399. Niikawa in view of Watanabe-JP in view of Bolle meets claim 7 and meets claim 2 for this additional reason.

400. Additionally, the selected subject type is used to “process image corrections” because the user-selected image category selected controls the “filter application” and “filter parameters” used to correct the captured images, as discussed in §X.J below for claims 8-9.

J. Claims 8-9

401. Niikawa in view of Watanabe-JP in view of Bolle meets claim 9 because it implements Bolle’s expert 104 that determines optimal “filter application” and “filter parameters” to which the user can provide feedback and therefore Niikawa in view of Watanabe-JP in view of Bolle includes “user-adjustable [] filter settings:”

“The image capture may include one or more of the following: focus distance, aperture, shutter speed, zoom, filter application, filter parameters and imager sensitivity.” Bolle, 2:31-33

“the system can run in a fully automatic mode choosing the best image parameters, or a ‘guided mode’ where the user is prompted with choices where a number of alternate settings would be reasonable.” Bolle, 2:37-40

402. In addition to full manual control, the user can adjust filter settings by selecting the scene type, e.g., selecting the landscape category for which “a dynamic controllable filter [is] activated” so that different portions of the image appear correctly illuminated (e.g., “dimming of upper portion of the image corresponding to the sky”) or “color balance may be adjusted” when objects of known color characteristics are identified “to achieve maximum resolution in the relevant part of the spectrum” to achieve optimal tonal range for relevant colors:

“A landscape may be detected and a dynamic controllable filter activated in the imaging system so that both sky and land are correctly illuminated (e.g., dimming of upper portion of the image corresponding to the sky).” Bolle 7:54-57

“If objects with known color characteristics were detected, e.g., vegetation, color balance may be adjusted accordingly to achieve maximum resolution in the relevant part of the spectrum.: Bolle, 7:58-61

403. Niikawa in view of Watanabe-JP in view of Bolle also meets claim 8 because the user-adjustable filter settings include “tonal range settings” (in this context, “color balance” settings). Niikawa in view of Watanabe-JP in view of Bolle’s filter settings are “stored” and “electronically read” because these settings are accessed and manipulated by general controller 150 executing expert 140 and

used to “process image corrections” by correcting the image illumination and/or color characteristics in the image as cited above.

K. Claim 10: “...wherein the user-adjustable variables include special effects”

404. Niikawa in view of Watanabe-JP in view of Bolle meets claim 10 for same reasons discussed in detail in §X.J above for claim 9 because Niikawa in view of Watanabe-JP in view of Bolle’s user-adjustable filter settings include “special effects.”

405. The ’266 patent includes “color enhancing” among the “main categories” of special effects:

“there are several main categories of special effects optical filters, including color enhancing” EX1001, 15:21-22.

406. The ’266 patent mentions color enhancing as “special effects optical filter” but then states:

“It is possible to reproduce these special effects by using the digital post-capture production processes in the camera. In this case, the camera digitally emulates the special effect by applying user-adjustable filter settings.” EX1001, 15:29-33

407. Though the specific example provided by the ’266 patent of digital emulation of a special effects optical filter is diffusion, the statement cited above can apply to any other special effects filter.

408. As discussed in detail in §X.J above, user-adjustable filter settings in Niikawa in view of Watanabe-JP in view of Bolle include adjustments to the “color balance” of detected objects with known color characteristics “to achieve maximum resolution in the relevant part of the spectrum” so the colors are enhanced in the range of colors for those detected objects.

409. Niikawa in view of Watanabe-JP in view of Bolle includes “user-adjustable [] special effects” as recited in claim 10 that are stored, electronically read and used by general controller 150 to process image correction because the user adjusts filter settings that are then used by general controller 150 in applying the corresponding correction.

L. Claims 11 and 25

410. Niikawa in view of Watanabe-JP in view of Bolle implements Bolle’s scene analysis 103 and expert 104 to analyze Niikawa’s live view images to determine optimal camera settings for image capture, including analyzing objects in the scene to determine an optimal depth of field.

411. Bolle’s scene analysis and expert adjustments work from what Bolle calls a “temporary image:”

“According to the invention, a temporary image acquisition unit acquires a temporary image, a scene analysis unit extracts information from the temporary image and generates at least one scene hypothesis from the extracted information, a photographic expert unit adjusts

image capture parameters based on the scene hypothesis, and a permanent image acquisition unit acquires a permanent image based on the image capture parameters adjusted by the photographic expert unit.” Bolle, 2:20-28

“the temporary acquisition unit may be a CCD or CMOS imaging array acquiring a digital color image” Bolle, 3:27-28

412. A POSA would have understood Niikawa’s live view image to serve as Bolle’s temporary image for implementation of the rest of Bolle’s process, including determination of depth of field.

413. When expert 104 determines that the scene includes multiple objects of interest, the “aperture and focus settings are adjusted to give appropriate depth of field”, or when a closely framed face is detected, expert 104 “focuses on the face” and “chooses a narrow depth of focus:”

“Multiple objects are determined to be of interest and the aperture and focus settings are adjusted to give appropriate depth of field.” Bolle, 7:20-29

“The scene analyzer detects human faces and sets the camera appropriately for portraits, groups, etc. For instance, when a face is closely framed by the user, the camera focuses on the face, chooses a narrow depth of field, and sets the exposure for the face region not for the dark/lightness of the background.” Bolle, 7:36-42

414. Niikawa in view of Watanabe-JP in view of Bolle meets “digitally processing” of live view images that “further comprises adjusting a depth of field of an image,” and therefore meets claims 11 and 25.

M. Claim 16

415. Niikawa in view of Watanabe-JP in view of Bolle meets claim 16 for reasons discussed §X.L above for claim 11; e.g., the “aperture and focus settings are adjusted to give appropriate depth of field” (Bolle, 7:27-29) for the objects identified in the scene.

416. The aperture (f-number) and focus settings (which determine focal length) adjusted by Niikawa in view of Watanabe-JP in view of Bolle’s expert 104 are “electronically stor[ed]” for at least the reasons discussed in §§IX.L and X.F above.

N. Claim 19

417. Niikawa in view of Watanabe-JP in view of Bolle meets claim 19 for the same reasons discussed in detail in §IX.O above because Niikawa in view of Watanabe-JP in view of Bolle’s changed aperture value (f-number) and focal length (as discussed in §X.M above for claim 16) set at the time of exposure are used in shading correction in the same way Niikawa in view of Watanabe-JP uses these settings: to select the corresponding correction table for correcting the specific shading effect.

O. Claims 22 and 23

418. Niikawa in view of Watanabe-JP in view of Bolle meets claim 22 for the reasons discussed in §IX.R above and meets claim 23 for the reasons discussed in §§IX.S and for the additional reasons discussed in X.E-X.K above.

P. Claim 24

419. Claim 24 recites the user-adjustable variables recited in claims 3-6 and therefore Niikawa in view of Watanabe-JP in view of Bolle meets claim 24 for the reasons discussed in §§IX.F-IX.H, X.F-X.I above.

XI. GROUND 3: NIIKAWA IN VIEW OF WATANABE-JP IN VIEW OF NG RENDERS OBVIOUS CLAIMS 1, 11-12, 21-22, 25-26

420. It was known that conventional auto-focus processes that focused the camera on a single object, like Niikawa's AF process that adjusts the "focal point of the lens" to bring a "main subject" into focus (Niikawa, [0106], [0134]), often left other parts of the scene and/or off-center objects of interest out of focus:

"For still-imaging applications, typical imaging devices capturing a particular scene generally focus upon a subject or object in the scene, with other parts of the scene left out of focus. For video-imaging applications, similar problems prevail, with a collection of images used in video applications failing to capture scenes in focus." EX1008 ("Ng"), 1:21-25

"Modern cameras, however, are almost always auto-focused. However, in such simplified cameras where the focus control is removed from the user, there is no simple way to specify which object

in the scene should be focused upon, resulting in pictures where an off-center subject is out of focus. Sophisticated cameras tackle this problem by reintroducing some complexity -a focus lock button, or manual selection of the focus point. There is still, however, a control for focus, it is just specified in a different manner.” Bolle, 1:46-55

421. In addition, there are issues challenging even sophisticated photographers, such as balancing depth of focus (which increases as lens aperture is made smaller) versus shutter speed (which must reduce, increasing blurring of moving objects, to compensate for less light forming the image as lens aperture is made smaller)

422. The '266 patent reflects a common but incorrect assumption that, whether it results from struggling automation or thoughtful compromise, the depth of field in a previously captured image can't be changed:

“in the digital paradigm, by contrast, one can narrow an image's surplus DOF range in-camera by manipulating the aperture. This process can only be done in the camera, because once the digital file is sent to post-production editing, the aperture and DOF is already set and incapable of being changed.” EX1001, 13:44-49

A. Ng (EX1008)

423. Ng teaches techniques for refocusing images captured by a digital camera using a virtual camera model and image captured by the camera's suitably constructed sensor to compute multiple images at different depths of field (e.g., by

varying a “virtual aperture”) that can be combined “to produce an extended depth of field image” (20:26-28) that brings objects at different depths into focus—i.e., a captured image in which objects of interest are not in focus can be brought into focus by computationally extending the depth of field of the image.

“For example, a camera having lenses (optics) that focus an image upon a photosensor array (sensors) located at an imaging plane can be used to sample the space of light rays.” Ng, 6:22-24

“FIGs. 13A and 13B show a refocusing approach, according to another example embodiment of the present invention. This approach may be implemented, for example, with a computational/processor component of an imaging system, such as the sensor data processing circuitry 140 in FIG. 1.” Ng, 15:30-33

“a variety of different computational approaches are chosen for different applications... In another example embodiment, an imaging methodology for each output pixel for a particular imaging system corresponds to a virtual camera model in which a virtual film is rotated or deformed, arbitrarily and/or selectively, and a virtual main lens aperture is correspondingly moved and modified in size as appropriate... FIG. 26 shows an approach to manipulating a virtual lens plane, according to another example embodiment of the present invention. A virtual lens plane 2630 and/or virtual film plane 2660 selectively tilted, relative to a physical main lens or other reference. An image computed using this approach has a resulting world focal plane that is not parallel to the imaging plane. In another example

embodiment, as exemplified in FIG. 27, the virtual film 2560 need not be planar, but may take any shape... In one example embodiment, the virtual aperture on the virtual lens plane is a generally circular hole, and in other example embodiments, the virtual aperture is generally non-circular and/or is implemented with multiple distinct regions of any shape... To compute the value of a point on a virtual film, all rays that start at different points on the virtual lens and converge on the point on the virtual film are weighted by the virtual aperture function and summed. In various other embodiments, the final value is computed with an arbitrary computational function that depends on the ray values... in one example embodiment, parameters including the orientation of a virtual lens plane and the size of the virtual aperture are varied continuously for each output pixel. In another example, as illustrated in FIG. 32, the virtual aperture function used to integrate rays for each output pixel is varied from pixel to pixel... In one specific embodiment, the function is chosen to mask out rays from undesired portions of a particular scene, such as an undesired object in the foreground. In another example embodiment, a human user chooses virtual aperture parameters interactively, with light data processed in accordance with the selections... In another example embodiment, an image with extended depth of field is computed by focusing on more than one subject at the same time. In one implementation, the depth of field of the output image is extended by simulating conventional photographic imaging with a stopped-down (reduced size) main lens aperture. For each output pixel, an evaluation is performed using the rays of light that would have converged at the

output pixel through an aperture (on the virtual lens plane) that is smaller than the aperture used in ray sensing.” Ng, 17:8-19:20

“FIGs. 14A and 14B illustrate an approach to computing images with different depths of field, in connection with one or more example embodiments. FIG. 14A shows an image and close-up computed with refocusing. Note that the face in the close-up is blurry due to shallow depth of field. The middle row of FIG. 14B shows the final image computed with an extended depth of field approach such as that described in the previous paragraph.” Ng, 20:1-6

“FIG. 8 is a process flow diagram for another computational approach to extending the depth of field in an image, according to another example embodiment of the present invention. At block 810, a set of images refocused at all focal depths in a particular scene is refocused. At block 820 and for each pixel, a pixel is determined from a set of images that has the highest local contrast. At block 830, the pixels having the highest local contrast are assembled into a final virtual image. With this approach, a desirable signal-to-noise ratio (SNR) can be obtained, using a relatively high number of pixels (e.g., relative to selecting a single pixel (photosensor) for each microlens in a microlens array). Referring to FIG. 14C, the example image shown is produced using an approach similar to that described in connection with FIG. 8 and exhibits relatively low image noise.” Ng, 20:7-17

“In one alternative embodiment, a minimum set of refocused images to compute is defined as follows, in terms of the distance between a virtual film plane for each refocused image and the principal plane of

the main lens via which the light for the image is passed to the virtual film plane... In another example embodiment, refocused images are combined to produce an extended depth of field image at each final pixel to retain the pixel that is best focused in any of the set of refocused images. In another embodiment pixels to retain are chosen by enhancing the local contrast and coherence with neighboring pixels... In another example embodiment of the present invention, an extended depth of field image is computed as follows. For each output image pixel, a refocusing computation is performed at the pixel to focus at different depths. At each depth, a measure of the homogeneity of the rays that converge is computed. The depth that produces the (relative) maximum homogeneity is chosen and kept for that pixel value... FIG. 34 is a process flow diagram for extending the depth of field in an image, according to another example embodiment of the present invention... In another example embodiment, the above process is adapted so that the selection of final pixel values takes into account the neighboring pixel values, and the homogeneity of the associated rays that are combined to compute those pixel values. In other example embodiments of the present invention, the depth of field is extended by focusing each pixel on the depth of the closest object in that direction... In some embodiments involving the extension of the depth of field, a value at each output pixel is computed by disregarding light rays that originate at depths closer than the depth of a desired object to mitigate or eliminate artifacts such as those generally referred to as "blooming" or "halo" artifacts around the borders of objects closer to the lens." Ng, 20:1-22:10

“In a variety of example embodiments, light data is processed in the frequency domain, with certain approaches directed to computational approaches to refocusing that operate in the Fourier domain... The first step is to compute the discrete 4D Fourier transform 2020 of the light field... The next step, which is executed once for each depth at which we wish to refocus the image, is to extract appropriate 2D slices 2030 of the 4D Fourier transform, and compute the inverse 2D Fourier transforms of the extracted slices, which are photographs focused at different depths 2040... The values on the extracted 2D slice are determined by the depth at which we want to refocus.” Ng, 25:22-26:12

424. Ng’s techniques determine the angles at which rays originating from various distances or objects impinge on the photosensor array. This can be done by adapting known microlens and photosensor array technologies to produce an image sensor which is a stack with the microlens array standing slightly away from the photosensor array, and sized so each microlens serves a small array of photosensor pixels, as illustrated in Ng’s FIG. 1:

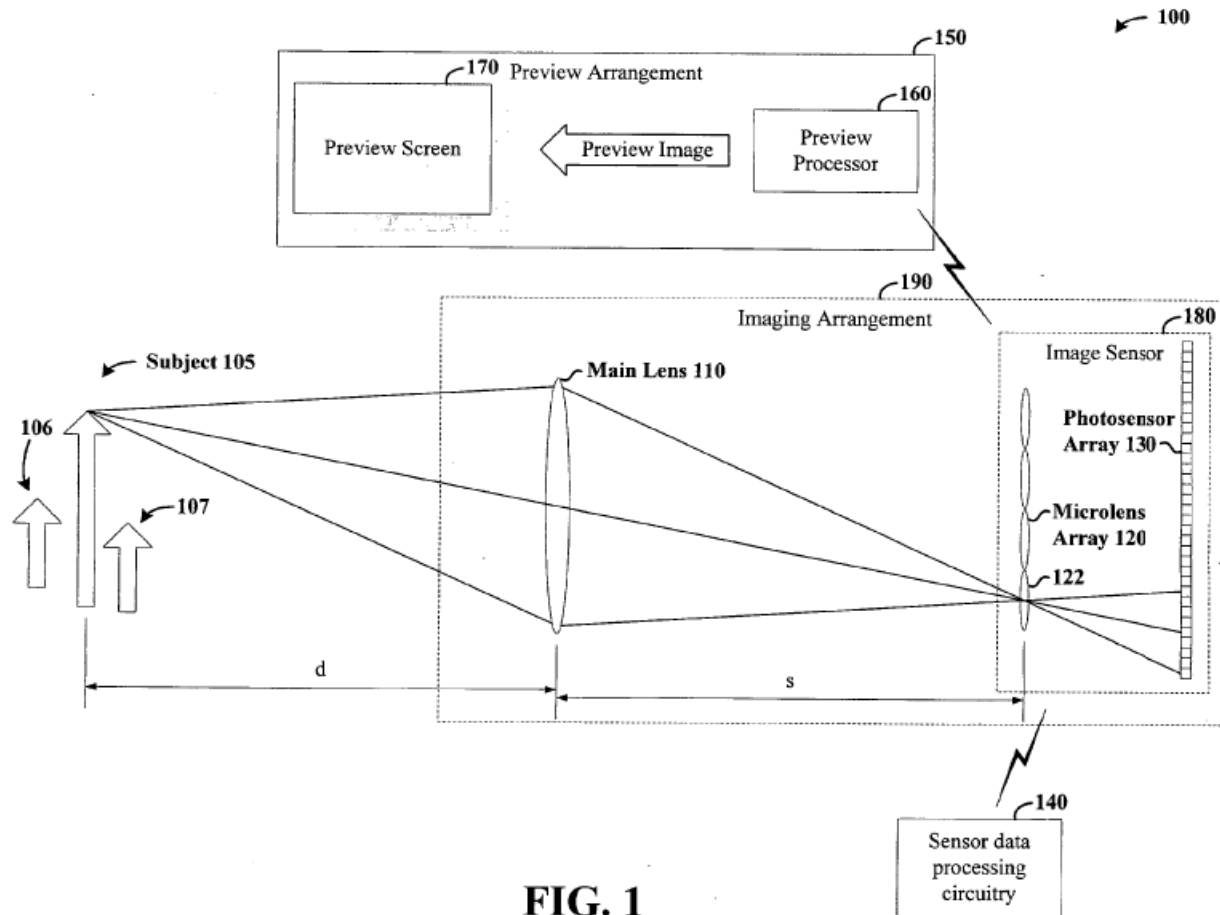


FIG. 1

B. Niikawa in view of Watanabe-JP in view of Ng Combination

425. A POSA would have recognized the benefit of implementing Ng's refocusing techniques in Niikawa in view of Watanabe-JP (§IX.D) to bring into focus objects of interest at different depths, specifically objects at depths different from the detected "main subject" brought into focus by Niikawa's AF process.

426. To take advantage of Ng's refocusing techniques, a POSA would have (1) configured general controller 150 to execute Ng's camera model to perform Ng's virtual aperture functions; (2) stored Ng's pre-computed "database of

weights” (Ng, 24:30-25:21) in general controller 150’s ROM; and (3) included Ng’s microlens array and circuitry for detecting light direction.

427. Combinations of microlens arrays and photosensor arrays which were conventional in imaging sensors and different arrangements were known. One known structure included a microlens for each pixel or photosite of the photosensor array and the microlens array resting on the photosensor array:

“An embodiment of the invention is a semiconductor die having a number of photodetecting sites. A microlens structure is positioned above each one of the photodetecting sites with a color filter above the microlens structure” EX1052, 1:64-67

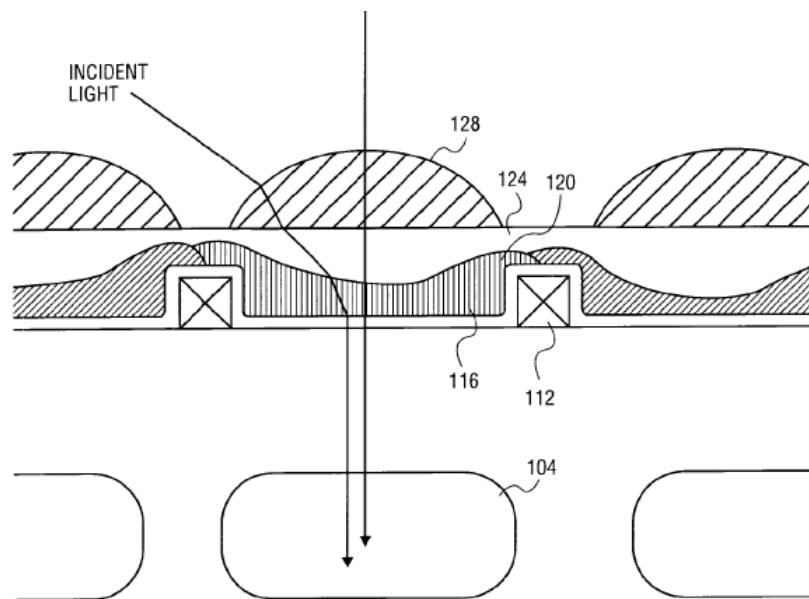
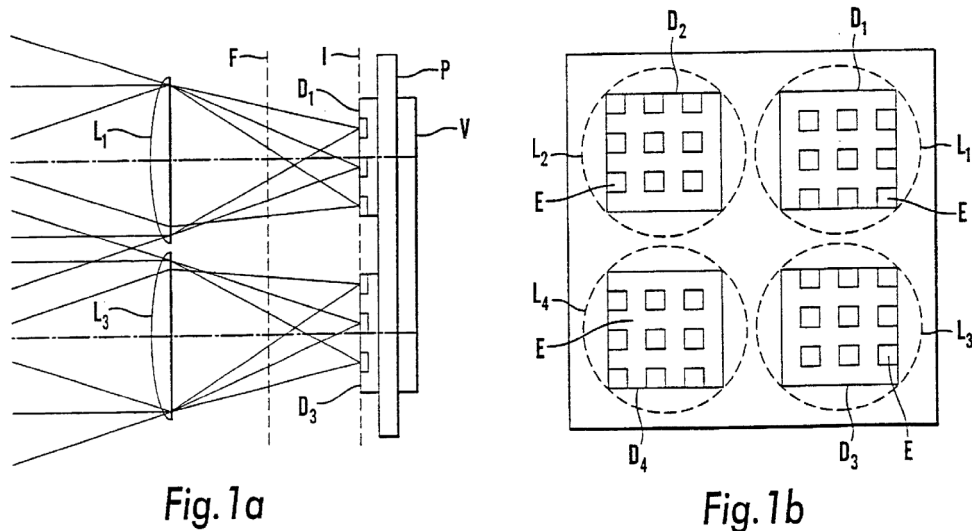


FIG. 1
(PRIOR ART)

EX1052, FIG. 1

428. Microlens arrays spaced away from the photosensor array and one microlens for a small array of pixels or photosites, were also known:

“The basic concept for the camera according to the invention is shown in FIG. 1 which schematically renders a first embodiment in a side view in FIG. 1a and a front view in FIG. 1b. The camera employs a number of optical active structures, for instance in the form of microlenses or the lenslets L, the camera objective system being shown as an array of four such lenses L_1 - L_4 . To each of the lenses a detector device is assigned with respective detectors D_1 - D_4 ” US 6,765,617 B1 (EX1056, “Tangen”), 8:31-40



Tangen, Figs. 1a and 1b

429. A POSA would have recognized the benefit of providing an option in Niikawa’s playback mode for the user to select images on which to perform Ng’s refocusing techniques to correct out-of-focus images (e.g., via an interface like Niikawa’s user-selection of images gradation control).

430. Additionally, this Niikawa in view of Watanabe-JP in view of Ng combination would merely have been the use of a known technique to yield the predicted and intended result of refocusing images captured by Niikawa's camera.

431. A POSA would have had a reasonable expectation of success because programming general controller 150 to perform Ng's processor-implemented algorithms required only conventional and routine software programming techniques.

C. Claims 1 and 22

432. Niikawa in view of Watanabe-JP in view of Ng meets claims 1 and 22 for the reasons discussed in detail in §§IX.E, IX.R above in Ground 1 and for two additional reasons: (1) general controller 150 performs an additional "image correction algorithm[]" ([1A1], [22A1]) when it performs Ng's refocusing techniques to "generate focused and/or corrected image data" (Ng, 31:13-15); and (2) general controller 150 also "process[es] image correction data stored in a database system" ([1A2], [22A2]) when it accesses the "database of weights" (Ng, 24:30-25:21) stored in general controller 150's ROM to perform Ng's "correction processes."

"In certain applications, the ray-direction processor 226 is implemented to process the sensor data received at the signal processor 220 to rearrange the sensor data for use in generating focused and/or corrected image data." Ng, 31:13-15

“It is worth noting that example correction processes have been described in terms of ray-tracing for conceptual simplicity; a variety of other approaches are implemented with correction. In one embodiment, for each desired output pixel, the set of photosensor values that contribute are pre-computed along with their relative weights. As described above, these weights are a property of a number of factors that may include the optics, sensor, desired set of rays to be weighted and summed for each output pixel and desired light field reconstruction filter. These weights are precomputed, selectively using ray-tracing, and stored. A corrected image is formed by weighting and adding the appropriate sensed light field values for each output pixel. FIG. 29 and FIG. 30 illustrate other example embodiments for use in connection with the above correction approach. FIG. 29 is a process flow diagram for pre-computing a database of weights associated with ray (light) sensors and an output pixel value associated with each ray sensor. In the first two blocks 2910 and 2920, a data set (e.g., in a database) is received for a desired image formation process consisting (for each output image pixel) of a set of ideal world light rays to be summed to produce an output image pixel value, and a specification for real main lens optics used to physically direct light rays to a light ray sensor. At block 2925, an image pixel is chosen. For the output value of this pixel, the associated set of world rays is computationally traced at block 2930 through a virtual representation of the main lens optics to the ray sensor. This results in a set of weights to be applied to each ray sensor value to compute the output pixel value. These values are stored in an output database in block 2940. Block 2950 checks whether all pixels

have been processed, returning to block 2925 if not. If all pixels have been processed, the final block 2960 saves the completed database. FIG. 30 is a flow diagram for a process that computes an output image using a database of weights that may have been computed by a process as in FIG. 29. In block 3010 and 3020, the process receives the database and a set of ray sensor values captured with the main lens optics used in computing the database. At block 3025, a pixel in the output image is selected, so that its final image value may be computed. For the selected pixel, block 3030 uses the database to find the set of ray sensor that contributes and their weights. In block 3040, each sensor value given in 3020 is weighted and added to a sum for that image pixel value. At block 3050, a check is performed to see whether all image pixels have been processed. If not, the process returns to block 3025, and if so, the output image is saved at block 3060.” Ng, 24:21-25:21

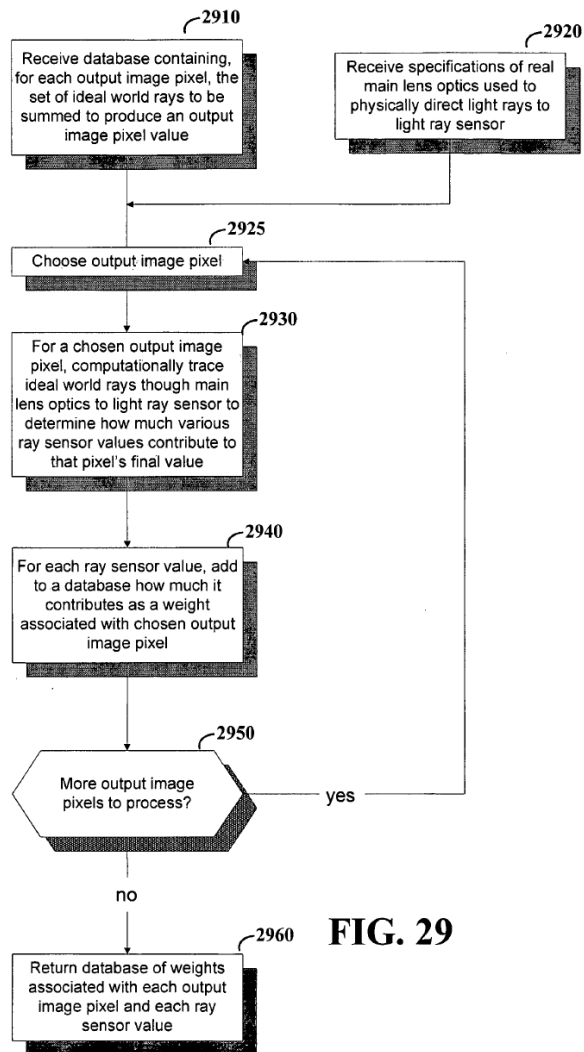


FIG. 29

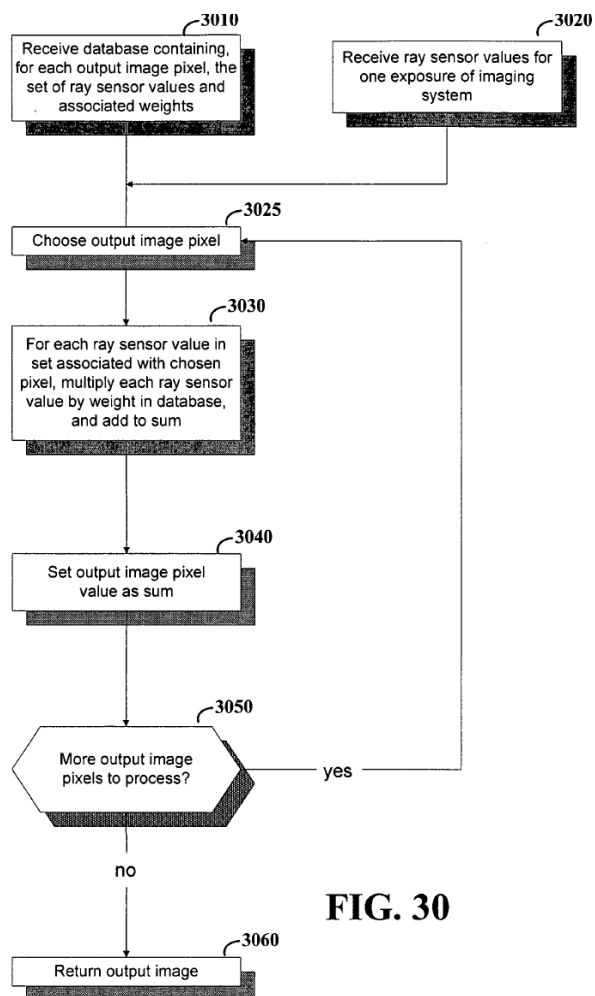


FIG. 30

Ng, FIGs 29 and 30

D. Claims 11 and 25:

433. Niikawa in view of Watanabe-JP in view of Ng also meets claims 11 and 25 for the additional reason that Niikawa in view of Watanabe-JP in view of Ng implements Ng's refocusing techniques (discussed in detail in §XI.A above) for "extending the depth of field in an image" after an image is captured at the setting set by the camera.

E. Claims 12 and 26: “...further comprising adjusting a depth of field of an image after capture of the image using the in-camera software”

434. Niikawa in view of Watanabe-JP in view of Ng meets claims 12 and 26 because general controller 150 computationally refocuses an image after the image is captured using Ng’s software processing techniques and camera model (discussed in detail in §XI.A above) “to produce an extended depth of field image.”

F. Claim 21: “wherein the image processing algorithms include a fast Fourier transform”

435. Niikawa in view of Watanabe-JP in view of Ng meets claim 21 because it implements Ng’s refocusing process that uses a “Fast Fourier Transform (FFT) algorithm” (discussed in detail in §XI.A above) in processing captured images to extend the depth of field to bring into focus objects at different depths in the image that appear “blurry due to misfocus:”

“In one implementation involving the example system 100 shown in FIG. 1, the depth of field is extended by extracting a photosensor value under each microlens image, where each photosensor is located at the same relative position within each microlens image. With respect to FIG. 1, extending the depth of field produces an image in which not only the subject 105 is in focus (due to the correlation between the distances “d” and “s”) but also objects at a different depth, such as subjects 106 and 107, which may otherwise be blurry due to misfocus.” Ng, 19:24-27

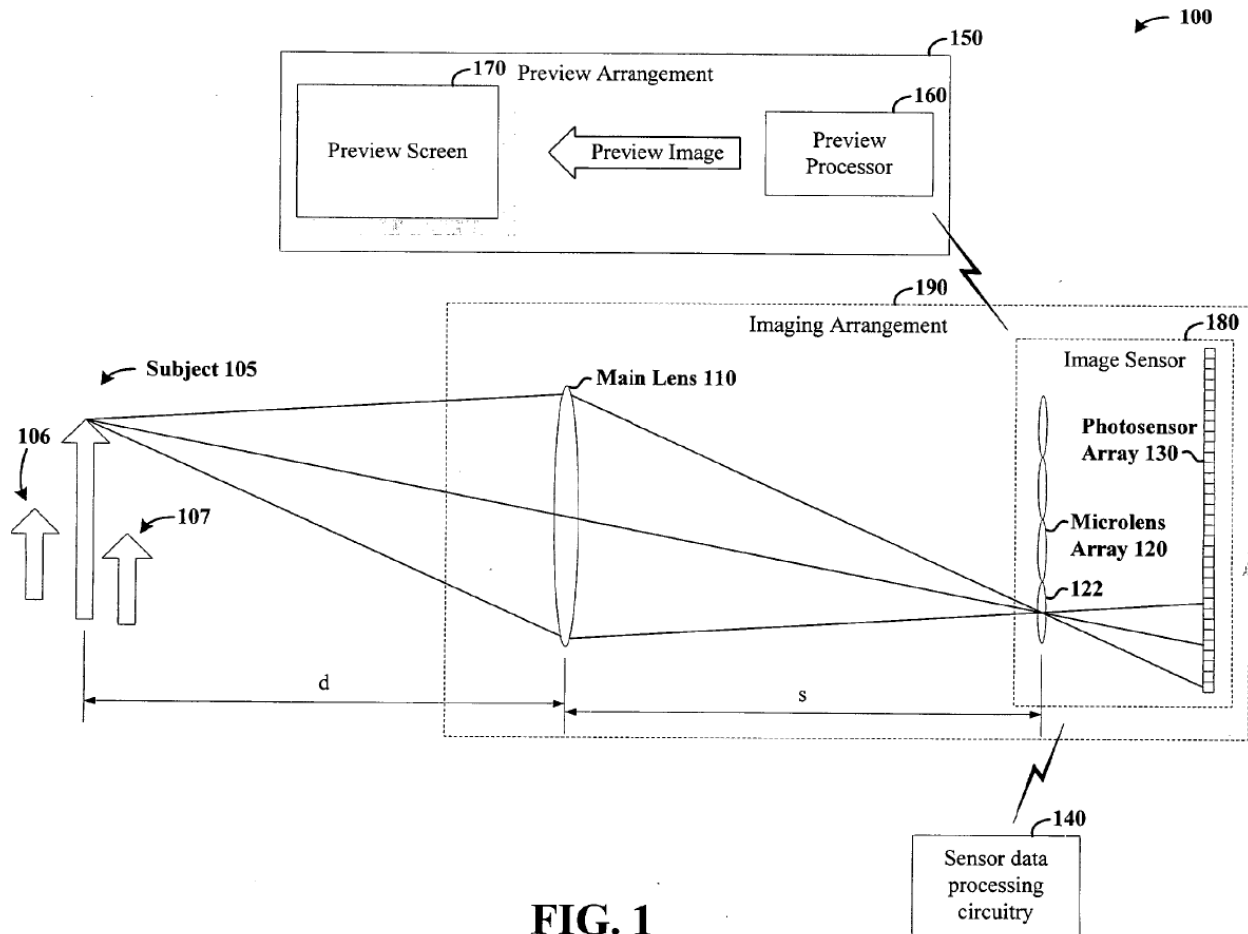


FIG. 1

Ng, FIG. 1

XII. GROUND 4: NIKAWA IN VIEW OF WATANABE-JP IN VIEW OF IRIE RENDERS OBVIOUS 1, 29 AND 30

436. Imaging sensors for digital cameras have millions or tens of millions of pixels to provide desired image resolution. Users expect all these pixels to operate properly to deliver a clean image, but some pixels may have permanent defects incurred during manufacturing or subsequent damage, be obscured by dust adhesion, or otherwise not work properly, resulting in erroneous pixel values in captured images:

“Conventionally, solid-state image capture components of digital cameras, which serve as image capture devices, convert light corresponding to subjects to electronic signals by photoelectric conversion with pluralities of photoelectric conversion elements, and output the electronic signals. Among such photoelectric conversion elements, there may be defects (defective pixels) due to adhesion of dust, damage and the like, and due to crystal defects and the like. Hence, it may not be possible to output signals which accurately correspond to light amounts of incident light with these defective pixels. Among such defective pixels, a defective pixel which is caused by dust, damage or the like is a defective pixel with a static characteristic, which is not affected by conditions of operation of the image capture device. On the other hand, a defective pixel which arises due to a crystal defect is a defective pixel with a dynamic characteristic, in which there is a greater effect of deterioration in image quality when a duration of exposure of the solid-state image capture component is longer.” EX1011, [0005]

“Many problems are caused by dust in particular and blemishes in general on imaging devices in general and digital imaging devices in particular. In the past, two distinct forms of image processing included providing means to detect and locate dust, scratches or similar defects and providing means to remedy the distortions caused by the defects to an image. It is desired to have an advantageous system that combines these functions, and can automatically detect and correct for the effects of dust, scratches and other optical blemishes.” EX1071, 1:45-54

“Most image sensor integrated circuits are manufactured by utilizing a complimentary metal oxide semiconductor (CMOS) process.

Unfortunately, as with any manufacturing process, image sensor parts have defective pixels. Customers of these parts do not wish to have any obvious defective pixels. EX1012, [0003]

“In recent years, a digital camera having a solid state imaging device such as a CCD sensor or a CMOS sensor is used. Since such solid state imaging device has at least millions of pixels, it is practically difficult to produce the solid state imaging device with no defect pixel. Accordingly, there is a need to use the solid state imaging device in view of the presence of certain defect pixels. The defect pixel is a pixel which does not output the signal correctly corresponding to subject brightness. For example, there are a white defect pixel which generates signal (charge) even when the light is not entered and a black defect pixel which does not generate signal (charge) even when the light is entered. The white defect makes a picture pixel brighter, and the black defect makes a picture pixel darker. To prevent a deterioration of image quality caused by the defect pixel, it is already developed a digital camera which compensates the signals of defect pixels by software process.”

EX1039, 1:12-29

“An imaging device using a CCD or the like has its light-receiving area formed by integrating many hundred of thousands to millions of very small light-receiving elements, and it is therefore difficult to produce an imaging device having no defective light-receiving element, i.e., defective pixel.” EX1040, [0008]

“Image sensors with an increasing number of image sensing photo-detector elements are being used in digital cameras designed to be sold in large quantities to consumers. Although such cameras most commonly utilize sensors having from 2 to 4 megapixels at the present time, it is not uncommon to find digital cameras available that employ image sensors as large as large as 5 to 6 megapixels. And this number will likely increase in the future. Normally, not all the light sensing elements in these sensors work correctly; some are defective. Defective light sensing elements do not react to light properly, and thus distort a resulting image. In some cases, one or more light sensing elements may always produce an output, even though light is not present. In other cases, a few may produce no light output even when very bright light impinges on their surface. The result can be a visible bright or dark spot in the captured image, respectively. In a third case, a light output is produced which is responsive to the light impinging on a sensor's surface, but this output is not correctly related to the light falling on the sensor. These pinpoint imperfections may be isolated or found in clusters. Since each pixel in the usual sensor captures information associated with different colors of the scene being photographed, these defective pixels are often visualized as pixels of the wrong color, not just pixels which are too light or too dark.” EX1041, [0002]

A. Irie (EX1011)

437. Irie discloses a method of correcting erroneous pixel values resulting from static defects of a CCD sensor, e.g., dust adhesion, sensor damage, etc. (Irie,

[0042] below) capable of supporting continuous and video photography modes (Irie, [0035] below). Irie discloses storing in EEPROM 80 LUTs 66A, 78A that record the locations of sensor defects, i.e., "defective pixel locations" that are contiguous and isolated, respectively, as shaded red in FIG. 2 below ([0040]-[0042]). To perform defective pixel correction, pixel values in captured images corresponding to the defective pixel locations read from the LUTs are replaced with neighboring (non-defective) pixel values ([0047]-[0059]).

“Herein, for the present embodiment, the defective pixels corresponding to the position information memorized in the continuous defect correction LUT 66A and the isolated defect correction LUT 78A are explained as: defective pixels which are caused by dust adhering to a light incidence face of the CCD 50, at which black flaws arise due to incident light on pixels that correspond to the positions at which dust is adhered being blocked; defective pixels which are caused by damage or the like to color microfilters, microlenses and the like that are formed at the light incidence face of the pixels, and defective pixels which are caused by white flaws at which desired optical characteristics are not provided locally. These defective pixels are static defect pixels, which are not dependent on temperature, exposure duration and the like.” Irie, [0042]

“the position information representing positions of defective pixels that is stored in the continuous defect correction LUT 66A memorized at the SRAM 66, which is the high-speed memory, is read in.” Irie, [0052]

438. Prior to performing defective pixel correction, LUT 66A is which are read from ROM 80 into (high-speed) SRAM 66 to support continuous and video photography modes, and LUT 78A is read into SDRAM 78, as shaded in blue in FIG. 2 above (Irie, [0047]). Irie's digital camera 10 uses a dual-state shutter button 32 wherein when the half-pressed state is detected, AF, AE and AWB processes are performed (Iried, [0035]) and when the full-pressed state is detected, defective pixel correction is performed on captured image data using LUT 66A in the continuous and video photography modes (Irie, [0040]-[0041], [0047]-[0057], and performed using both LUTs 66A and 78A in the still photography mode (Irie, [0058]-[0060]), and further image processing is performed on the defective pixel corrected images (Irie, [0047]-[0060]).

439. Irie discloses a digital camera which can be operated ("set") in any of three modes. "Still photography" mode causes the camera to capture a single still image when the shutter button is fully pressed. "Continuous photography" mode causes the camera to capture a sequence of a designated number of still images when the shutter button is fully pressed. "Video photography" mode causes the camera to capture a "moving image" (video) while the shutter button is fully depressed. The ability of a digital camera to capture both still and moving images was known at least since 2003:

“ a digital camera 10 which serves as an image capture device of the present invention” Irie, [0032]

“The release switch 32 is pressed for operation by the camera user in order to input a photography command. The mode dial 34 is turned for operation by the camera user when the camera user is selecting a photography mode.” Irie, [0035]

“it is possible to set a still photography mode, which obtains image data of a still image when the release switch 32 is put into the full-pressed state, a continuous photography mode, which performs consecutive image capture of a designated number of images when the release switch 32 is put into the full-pressed state, and a video photography mode, which obtains image data of a moving image when the release switch 32 is put into the full-pressed state” Irie, [0035]

“a digital camera 10 relating to the present embodiment” EX1026 (“Takane”), [0033]

“when the still image photographing mode is selected and the release button 18A is depressed fully, photographing is carried out one time at a predetermined shutter speed and exposure amount, and a still image expressing the subject is photographed... when the dynamic image photographing mode is selected and the release button 18A is depressed fully, it is possible to carry out dynamic image photographing” Takane, [0041]

440. Irie discloses correcting images captured in all three modes (still, continuous, and video):

“in the digital camera 10 of the present embodiment, when the continuous photography mode or the video photography mode is set, which modes require higher-speed processing of image data in which speed is prioritized over image quality than the still photography mode which provides image data of still images, the defective pixel correction processing is carried out on, of the image data of a photographic image, image data that corresponds to respective defective pixels which occur at contiguous positions, according to the defective pixel position information that is stored in the continuous defect correction LUT 66A memorized at the SRAM 66, which is the high-speed memory.” Irie, [0062]

“Further, when the still photography mode is set, which requires acquisition of higher-image quality image data than the continuous photography mode and the video photography mode, correction is applied to, of image data of a photographic image, image data that corresponds to position information of all defective pixels of the CCD 50, according to both the defective pixel position information that is stored in the isolated defect correction LUT 78A memorized at the SDRAM 78, which is a lower-speed memory than the SRAM 66, and the defective pixel position information that is stored in the continuous defect correction LUT 66A memorized at the SRAM 66, which is the high-speed memory.” Irie, [0063]

B. Niikawa in view of Watanabe-JP in view of Irie Combination

441. As discussed above in §XII, defective pixel correction was a well-known feature of conventional digital cameras to account for defects in the

camera's sensor. A POSA would have recognized the benefit implementing defective pixel correction in Niikawa's digital camera to remove erroneous pixel values and improving the quality of the images. A POSA would have been motivated to use Irie's LUT-based approach as a straightforward way of implementing defective pixel correction in Niikawa's digital camera, as discussed in further detail below.

442. As discussed above in §XII.A, providing continuous image capture modes in addition to a still photography mode was also a conventional feature of digital cameras that beneficially extended the functionality of the digital camera. POSA would have recognized the benefit configuring Niikawa's digital camera to capture images in continuous and video photography and would have recognized Irie's photography mode operation as advantageously straightforward to extend the functionality of Niikawa's digital camera to capture continuous photography and video images.

443. In particular, a POSA would have recognized the benefit of Irie's dual-state shutter button image capture operation (Irie, [0035], [0040], [0047]-[0050], [0058]-[0060]) as a straightforward way to allow users to capture and store continuous photography and video image data and to implement defective pixel correction in Niikawa's similar dual-state shutter button operations (Niikawa, [0068], [0106], [0134]).

444. Niikawa's general controller 150 is configured to perform AF, AE and AWB processes upon a half-press of shutter button 9 (like Irie, [0035]) and to control the camera to capture either a single image or two images upon a full-press of shutter button 9 depending on the exposure mode set by the user (Niikawa, [0070]-[0074], [0106], [0134]) and perform corresponding image corrections and the captured image data.

445. Thus, a POSA would have recognized that Irie's continuous and video photography modes would have been advantageously implemented in software with control programs for continuous and video photography image capture that are executed by general controller 150 upon a full-press of shutter button 9 when the user has selected continuous or video photography mode operation (e.g., via addition to Niikawa's selection menus, [0070]-[0074]), as taught by Irie ([0035], [0055]-[0056]), without changing Niikawa's still photography exposure mode operations and requiring only routine and ordinary programming skills.

446. Implementing Irie's defective pixel correction would have likewise have required only the routine and ordinary skills of (1) storing LUTs recording contiguous and isolated defective pixel locations determined for Niikawa's CCD 103 in general controller 150's ROM, (2) including a high-speed SRAM in general controller 150's RAM 152 (Niikawa, [0096]) into which the contiguous location LUT is read to support high-speed photography modes, and (3) configuring general

controller 150 to perform defective pixel correction on image data captured upon full-press of shutter button 9 in accordance with the selected photography mode, as taught by Irie ([0040]-[0042], [0047]-[0060]).

C. Claim 1

447. Niikawa in view of Watanabe-JP in view of Irie meets claims 1 and 22 for the reasons discussed in Ground 1 (as discussed in detail in §IX.E above) and for two additional reasons: (1) general controller 150 performs an additional “image correction algorithm[]” ([1A1]) when it performs defective pixel correction; and (2) general controller 150 is configured to “process image correction data stored in a database system” ([1A2]) when it accesses LUTs stored in general controller 150’s ROM and corrects defective pixels in captured image data at the locations recorded in the LUTs as discussed in detail in §XII.B above.

D. Claim 29: “...correcting for a dead pixel on a digital image sensor of the digital camera”

448. Niikawa in view of Watanabe-JP in view of Irie meets claim 29 at least because Irie’s defective pixel correction as discussed in detail in §§XII.A and XII.B above corrects for “black flaws” of the CCD sensor (dust adhesion, damage, etc.) that reduce the amount of incident light, like the ’266 patent’s “dead pixels” that are “too dark:”

“In another embodiment of the present system, "hot" (too bright) or "dead" (too dark) pixels are interpolated out of the scene using the method described above.” EX1001, 17:4-6

**E. Claim 30: The method of claim 1, further comprising:
[30A] digitally processing a plurality of images to correct
video taken by the digital camera; and [30B] “storing a
plurality of corrected images**

449. Niikawa in view of Watanabe-JP in view of Irie’s defective pixel correction and continuous and video modes in meets claim 30 at least because Niikawa’s general processor 30 “digitally process[es] a plurality of images” when it replaces defective pixel values with neighboring pixel values in the succession of images captured in the continuous photography and video modes (as discussed in detail in §XII.A above) to “correct video taken by the digital camera” ([30A]) and “stor[es] a plurality of corrected images” ([30B]) when images corrected for defective pixels (or any other of Niikawa’s corrected images) are recorded on memory card 8.

**XIII. GROUND 5: NIIKAWA IN VIEW OF WATANABE-JP IN VIEW OF
WATANABE-US RENDERS OBVIOUS CLAIMS 1, 17 AND 22**

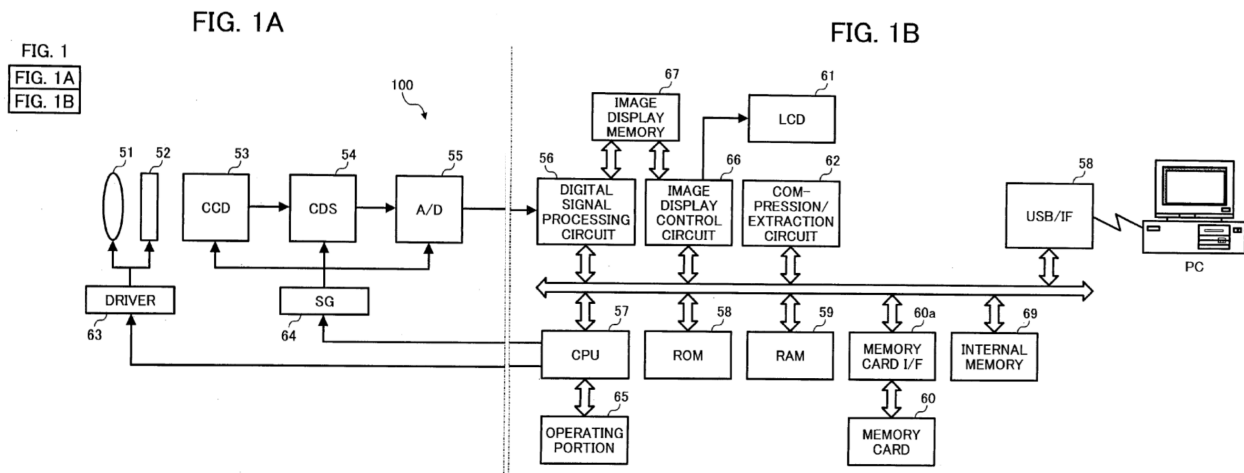
A. Watanabe-US (EX1013)

450. Watanabe-US discloses performing “a distortion aberration correction process” and “a peripheral light intensity correction process” on image data captured by a digital camera 100 using tables 70 stored in the camera’s ROM 58:

“The ROM 58 stores programs, data necessary for executing programs, etc.” Watanabe-US, [0039]

“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... the CPU 57 executes... a correction process on image data” Watanabe-US, [0042]

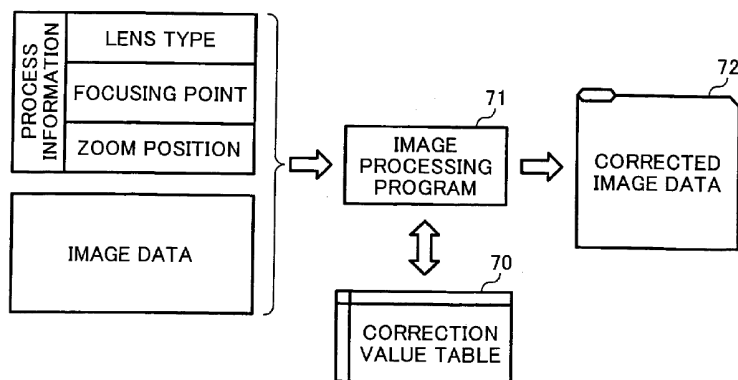
“if information of a lens type, a focusing point and a zoom position are added to the data 1, data 2 and data 3 respectively, and if tables 70 including distortion aberration correction values and peripheral light intensity correction values in accordance with focusing points and zoom positions are prepared 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-US, [0047]



Watanabe-US, FIGs. 1A and 1B.

451. Watanabe-US discloses obtaining “distortion aberration correction values and peripheral light intensity correction values” from tables 70 based on “lens type,” “focusing point” and “zoom position” corresponding to captured image data and applying the “correction values” obtained from tables 70 to provide “corrected image data 72” (Watanabe-US, [0047]), as illustrated in FIG. 3 below:

FIG. 3



B. Reasons to Combine Niikawa in view of Watanabe-JP and Watanabe-US

452. POSA would have recognized the benefit of enhancing Niikawa’s shading correction and correcting for additional lens effects in view of Watanabe-US’s teaching for the reasons discussed below.

1. Improving Niikawa’s Shading Correction

453. Niikawa’s shading correction, which a POSA would have understood corrects for the same lens effect (vignetting) as Watanabe-US’s peripheral intensity correction, accounts for changes in focal length and f-number but recognized that other “optical conditions” could be accounted for:

“it is general that when an image is captured via a lens in a digital camera or the like, so-called ‘shading’ that the level of image data decreases with distance from the center of the image to the periphery.” Niikawa, [0012]

“When a subject is photographed by using an image pickup device such as CCD in an image processing apparatus such as digital camera equipped with an imaging lens, a phenomenon that the level of image data decreases with the distance from the center of the image to the periphery, so-called ‘shading’ occurs. FIG. 1 is a view showing an example of an influence of shading on an image captured by means of a certain digital camera.” Niikawa, [0056]-[0057]

“The shading correction circuit has a multiplier 123a as shown in FIG. 6, performs multiplication of image data converted in the A/D conversion circuit 122 and a correction table inputted from the general controller 150.” Niikawa, [0082]

“A plurality of correction tables for different parameters which are the optical conditions **such as** focal length and f-number at the time of imaging are prepared and stored in a shading ROM 153 provided in the general controller 150.” Niikawa, [0084]; emphasis supplied

454. A POSA would have recognized the benefit of also accounting for the influence of changing focusing points as taught by Watanabe-US (Watanabe-US, [0046]-[0047]) to correct for different shading effects resulting from adjustments

to the “focal point” made by Niikawa’s AF process (Niikawa, [0106], [0134]) to improve Niikawa’s shading correction process.

455. Additionally, a POSA would have recognized that improving Niikawa’s shading correction process by accounting for different focusing points would have the further benefit of improving Niikawa’s image synthesis by eliminating the influence of this additional source of shading variation in Niikawa’s positioning process.

2. Benefits of Watanabe-US’s Distortion Aberration Correction

456. A POSA would have recognized the benefit of additionally correcting for lens distortion aberrations as taught by Watanabe-US to further improve image quality by taking into consideration additional lens effects that degrade the quality of captured images:

“A process such as distortion aberration correction or peripheral light intensity correction may be executed on image data as need arises. As a distortion aberration correction process, generally known is a table look-up method where a lens distortion aberration rate is predetermined at each focusing point and zoom position” Watanabe-US, [0006]

“a distortion aberration correction process is executed according to a lens type, a focusing point and a zoom position” Watanabe-US, [0049]

457. A POSA would have been motivated to include “distortion aberration correction values” as taught by Watanabe-US in Niikawa’s correction tables to correct for additional lens characteristics such as image distortion, which would likewise have improved Niikawa’s image synthesis by further eliminating the influence of position-dependent distortion aberrations. Specifically, lens effects that vary as a function of position (e.g., distance from the optical center) would cause Niikawa’s positioning process to inaccurately assess position changes in the images unless these effects are accounted for prior to performing the positioning process. Adding Watanabe-US’s distortion correction could also improve the accuracy and quality of Niikawa’s positioning correction.

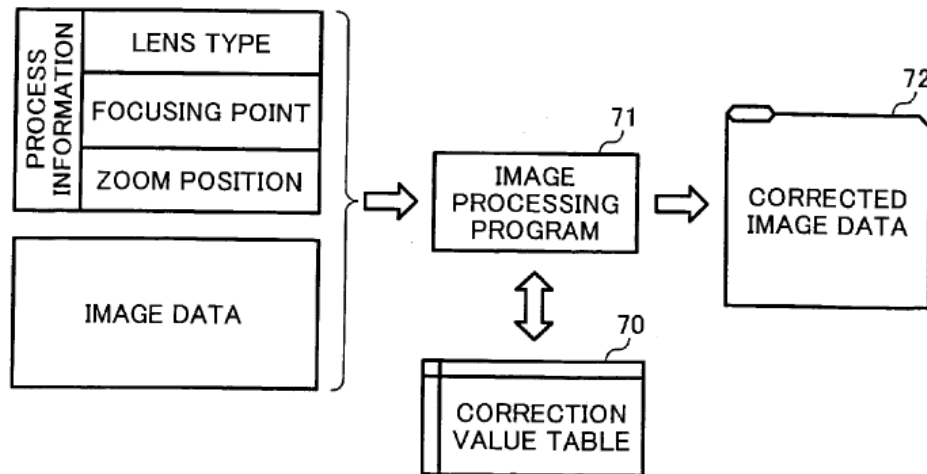
3. Image Correction for Different Lenses

458. A POSA would have recognized the benefit of storing distortion aberration correction values and peripheral light intensity correction values for different lens types, as taught by Watanabe-US:

“as shown in FIG. 3, if information of a lens type, a focusing point and a zoom position are added to the data 1, data 2 and data 3 respectively, and if 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. That is, an image process can be selected by way of Selecting various data (data 1-data N) according to need.”
Watanabe-US, [0047]

FIG. 3



459. Niikawa’s “imaging lens 3 [] is detachably attached to the camera main body 2” but Niikawa does not include lens type in the keys to retrieving correction tables or teach preparing correction tables for various lenses.

460. This was known in the art:

“Lens exchangeable cameras having data to correct shading and so on for their interchangeable lenses, the data being stored in the interchangeable lens, the camera body, or a storage medium, are known. In these cameras, one of the correction data for correcting shading and so on of the photographing lens under usage is selected based on the identification data of the photographing lens.” EX1014, 1:19-25

461. Additionally, storing and applying correction tables prepared for multiple different lens aberrations and different lens types was a known and familiar technique to correct for the different types of lens aberrations that degrade image quality. Including additional tables in Niikawa to correct for additional lens aberrations and lens types would have been nothing more than the use of known and familiar techniques to yield the predicted and intended result of correcting for additional lens effects in Niikawa's capture images.

C. Combination of Niikawa in view of Watanabe-JP and Watanabe-US)

462. A POSA would have been motivated to modify Niikawa in view of Watanabe-JP based on Watanabe-US by (1) including in Niikawa's database of correction tables stored in general controller 150's ROM (i) tables storing shading correction coefficients that account for different focal lengths, f-numbers and focal points (as discussed in detail in §XIII.B.1 above), (ii) tables storing distortion aberration correction values for different focus points and zoom positions; i.e., focal lengths set by the user's choice of zoom ratio (§XIII.B.2), and optionally (iii) tables (i)-(ii) for different lens types (§XIII.B.3); and (2) configuring general controller 150 to access the database of correction tables using the parameters for which correction tables have been stored and apply the obtained correction data to perform distortion aberration correction and shading correction processes.

D. Claims 1 and 22

463. Niikawa in view of Watanabe-JP in view of Watanabe-US meets claims 1 and 22 for the same reasons discussed above in §§IX.E, IX.R for Niikawa in view of Watanabe-JP and for the following additional reasons.

464. In addition to the “plurality of image correction algorithms” ([1A1], [22A1]) discussed above in §IX.E.2.i, general controller 150 is configured to additionally perform “distortion aberration correction” taught by Watanabe-US ([0046]-[0049], §XIII.B).

465. General controller 150 is additionally configured to “process image correction data stored in a database system” ([1A2], [22A2]) when general controller 150 accesses the database of correction tables stored in general controller 150’s ROM using the focal length set by the user’s choice of zoom ratio and the focal point set by Niikawa’s AF process (Niikawa, [0067], [0072], [0090], [0106], [0134], §§IX.F.1, IX.L), and lens type if lens-specific tables are stored (Watanabe-US, [0047]), to additionally obtain “distortion aberration correction values” and applies the obtained correction values to perform distortion aberration correction, as taught by Watanabe-US (§XIII.B).

E. Claim 17

466. Niikawa in view of Watanabe-JP in view of Watanabe-US also meets claim 17 for the additional reasons that the focal point variable changed by

Niikawa's AF process that meets claim 14 (as discussed in detail in §IX.L above) is used to correct for shading and distortion aberrations, both of which are optical aberrations associated with imaging lens 3 and the changed focal point.

XIV. CONCLUSION

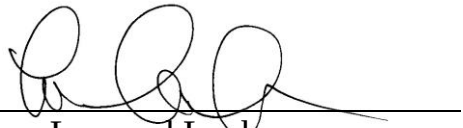
467. It is my opinion that based on the POSA's ordinary level of skill, the scope and content of the prior art, and the differences between the Challenged Claims and the prior art teachings, a POSA would have found the subject matter of claims 1-27 and 29-30 to be well-known and obvious for the reasons explained in the Grounds discussed in this Declaration.

468. 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 POSA 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: 22 June 2024


Leonard Laub

APPENDIX A: U.S. PATENT NO. 10,873,266 CLAIM LIST

Claim 1
[1PRE] A method of processing one or more images with a digital camera, comprising:
[1A] digitally processing at least one captured image, the processing using in-camera hardware and software that is configured to:
[1A1] perform a plurality of image correction algorithms,
[1A2] process image correction data stored in a database system,
[1A3] receive updated software and image correction data, and
[1A4] upgrade the digital camera with the updated software and image correction data;
[1B] storing in memory one or more corrected images resulting from digitally processing the at least one captured image; and
[1C] wirelessly transmitting at least one of the one or more corrected images,
[1D] wherein the in-camera software and database system are upgradable to provide improved algorithms and correction data for correction of images.
Claim 2
[2PRE] The method of claim 1, wherein the digitally processing at least one captured image further comprises:
[2A] electronically reading stored user-adjustable variables; and
[2B] processing image corrections using the user-adjustable variables.
Claim 3
The method of claim 2, wherein the user-adjustable variables include an aperture setting.
Claim 4
The method of claim 2, wherein the user-adjustable variables include lens data.
Claim 5
The method of claim 2, wherein the user-adjustable variables include shutter speed settings.
Claim 6
The method of claim 2, wherein the user-adjustable variables include ISO settings.

Claim 7
The method of claim 2, wherein the user-adjustable variables include subject type.
Claim 8
The method of claim 2, wherein the user-adjustable variables include tonal range corrections.
Claim 9
The method of claim 2, wherein the user-adjustable variables include filter settings.
Claim 10
The method of claim 2, wherein the user-adjustable variables include special effects.
Claim 11
The method of claim 1, wherein the digitally processing the at least one captured image for image correction further comprises adjusting a depth of field of an image.
Claim 12
The method of claim 1, further comprising adjusting a depth of field of an image after capture of the image using the in-camera software
Claim 13
The method of claim 1, wherein the in-camera software processes image corrections based on one or more prior image corrections.
Claim 14
The method of claim 1, further comprising changing a variable based on an auto-focus process performed by the camera and electronically storing that changed variable.
Claim 15
The method of claim 1, further comprising changing a variable based on an auto-exposure process performed by the camera and electronically storing that changed variable.
Claim 16
The method of claim 1, further comprising changing a variable based on a depth of field adjustment process performed by the camera and electronically storing that changed camera variable.
Claim 17
The method of claim 14, further comprising digitally processing the at least one captured image using the in-camera software to correct at least one optical image aberration associated with an optical system and the changed camera variable.

Claim 18
The method of claim 15, further comprising digitally processing the at least one image using the in-camera software to correct at least one optical image aberration associated with an optical system and the changed camera variable.
Claim 19
The method of claim 16, further comprising digitally processing the at least one image using the in-camera software to correct at least one optical image aberration and the changed camera variable.
Claim 20
The method of claim 1, wherein the wirelessly transmitting images includes automatically transmitting the at least one of the one or more corrected images.
Claim 21
The method of claim 1, wherein the image processing algorithms include a fast Fourier transform.
Claim 22
[22PRE] A method of displaying one or more images captured by a digital camera on an external monitor, comprising:
[22A] digitally processing at least one captured image to produce one or more corrected image, the processing using in-camera hardware and software that is configured to:
[22A1] perform a plurality of image correction algorithms,
[22A2] process image correction data stored in a database system,
[22A3] store updated software or image correction data or both, and
[22A4] upgrade the digital camera with the updated software or image correction data or both; and
[22B] wirelessly transmitting at least one of the one or more corrected images in a format that the external monitor can receive,
[22C] wherein the in-camera software and database system are upgradable to provide improved algorithms and correction data for correction of images.
Claim 23
[23PRE] The method of claim 22, wherein the digitally processing at least one captured image further comprises:
[23A] electronically reading stored user-adjustable variables; and
[23B] processing image corrections using the user-adjustable variables
Claim 24
The method of claim 22, wherein the user-adjustable variables include aperture settings, lens data, shutter speed settings, and ISO settings.

Claim 25
The method of claim 22, wherein the digitally processing the at least one captured image for image correction further comprises adjusting a depth of field of an image.
Claim 26
The method of claim 22, further comprising adjusting a depth of field of an image after capture of the image using the in-camera software.
Claim 27
The method of claim 22, wherein the in-camera software processes image corrections based on one or more prior image corrections.
Claim 29
[29PRE] The method of claim 1, further comprising:
[29A] correcting for a dead pixel on a digital image sensor of the digital camera.
Claim 30
[30PRE] The method of claim 1; further comprising:
[30A] digitally processing a plurality of images to correct video taken by the digital camera; and
[30B] storing a plurality of corrected images.

APPENDIX B: MATERIALS CONSIDERED

Exhibit	Description
1001	U.S. Patent No. 10,877,266
1005	Japanese Patent No. 2004-192178 (Cert. Translation) (“Watanabe-JP”)
1006	U.S. Patent Application Publication 2002/0135688A1 (“Niikawa”)
1007	U.S. Patent No. 6,301,440 (“Bolle”)
1008	International Application Publication WO 2006/039486A2 (“Ng”)
1009	U.S. Patent No. 5,477,264 (“Sarbadhikari”)
1010	Japanese Patent No. 2004-186917 (Cert. Translation) (“Kokubu”)
1011	U.S. Patent Application Publication 2006/0050158A1 (“Irie”)
1012	U.S. Patent Application Publication 2002/0149683A1 (“Post”)
1013	U.S. Patent Application Publication 2005/0280877A1 (“Watanabe-US”)
1014	U.S. Patent No. 7,494,293 (“Arimoto”)
1015	U.S. Patent Application Publication 2006/0274170A1 (“Azuma”)
1016	U.S. Patent Application Publication 2005/0001024A1 (“Kusaka”)
1017	Kodak EasyShare-One User’s Guide (“Kodak EasyShare”)
1018	U.S. Patent Application Publication 2003/0065805A1 (“Barnes”)
1019	U.S. Patent Application Publication 2004/0080621A1 (“Fisher”)
1020	U.S. Patent Application Publication 2003/0142215A1 (“Ward”)
1021	International Application Publication WO 2005/065283A2 (“Walker”)
1022	U.S. Patent Application Publication 2006/0268357A1 (“Vook”)
1023	U.S. Patent Application Publication 2010/0002091A1 (“Dutta”)
1024	U.S. Patent No. 9,063,982 (“Bestgen”)
1025	U.S. Patent No. 6,798,449 (“Hsieh”)
1026	U.S. Patent Application Publication 2003/0223007A1 (“Takane”)
1027	U.S. Patent No. 7,224,397 (“Sasaki”)
1028	U.S. Patent No. 7,355,748 (“Arai”)
1029	U.S. Patent Application Publication 2004/0208114A1 (“Lao”)

1030	“A Guide to Mastering the Basics,” Capture the Atlas (e-Book)
1031	U.S. Patent Application Publication 2006/0050335A1 (“Dorrell”)
1032	U.S. Patent No. 7,677,818 (“Akiyama”)
1033	U.S. Patent Application Publication 2006/0158546A1 (“Hirai”)
1034	U.S. Patent Application Publication 2006/0245075A1 (“Lee”)
1035	U.S. Patent No. 7,616,877 (“Zarnowski-2”)
1036	U.S. Patent No. 7,593,634 (“Terada”)
1037	U.S. Patent No. 7,292,370 (“Iwaki”)
1038	U.S. Patent No. 6,665,009 (“Dong”)
1039	U.S. Patent No. 7,602,426 (“Sato”)
1040	U.S. Patent Application Publication 2004/0145664A1 (“Kobayashi”)
1041	U.S. Patent Application 2005/0010621A1 (“Pinto”)
1042	U.S. Patent No. 7,590,305 (“Steinberg-1”)
1043	U.S. Patent No. 7,738,015 (“Steinberg-2”)
1044	Certified Translation Of Japanese Patent No. JPA 2002-190979 (“Kuniba”)
1045	U.S. Patent No. 5,999,330 (“Goosey”)
1046	GUAN et al., <i>Digital Image Correcting Method for Digital Camera</i> (December 2005) (“Ricoh”)
1050	U.S. Patent Application Publication 2006/0054782A1 (“Olsen”)
1051	Comprehensive Dictionary of Electrical Engineering (2d ed. CRC Press 2005)(excerpt)
1052	U.S. Patent No. 6,362,513 (“Wester”)
1053	U.S. Patent Application Publication 2004/0160634A1 (“Watanabe-634”)
1054	U.S. Patent No. 6,920,443 (“Cesare”)
1055	Newton’s Telecom Dictionary (CMP Books, 2005) (excerpt)
1056	U.S. Patent No. 6,765,617 (“Tangen”)
1057	EP Patent Application Publication 0 457 522 A2 (“Murayama”)

1058	U.S. Patent No. 5,990,949 (“Haruki”)
1059	U.S. Patent Application Publication 2003/0017846A1 (“Estevez”)
1060	U.S. Patent Application Publication 2004/0189825A1 (“Kawashima”)
1061	U.S. Patent Application Publication 2005/0008236A1 (“Hachiyama”)
1062	Certified Translation Of Japanese Patent Application Publication JP 2004-328506A (“Kita”)
1063	Certified Translation Of Japanese Patent No. JPH (1999)-313250 (“Yamagata”)
1064	Certified Translation Of Japanese Patent No. JPA 2000-184247 (“Imai”)
1065	U.S. Patent No. 5,444,482 (“Misawa”)
1066	U.S. Patent No. 5,905,530 (“Yokota”)
1067	U.S. Patent No. 7,206,136 (“Labaziewicz”)
1068	U.S. Patent No. 7,245,319 (“Enomoto”)
1069	U.S. Patent Application Publication 2004/0150732A1 (“Yamanaka”)
1070	U.S. Patent Application Publication 2003/0095197A1 (“Wheeler”)
1071	U.S. Patent No. 7,587,085 (“Steinberg-3”)
1072	U.S. Patent No. 5,713,020 (“Reiter”)
1073	U.S. Patent No. 6,208,993 (“Shadmon”)
1074	U.S. Patent No. 6,412,004 (“Chen”)
1075	Dictionary of Computing, 5 th Edition (pg. 88)