

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of:	Takahiro Nakano, et al.	Attorney Docket No.:	18768-0217IP4
U.S. Patent No.:	8,339,493		
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Appl. Serial No.:	12/845,266		
Filing Date:	July 28, 2010		
Title:	ELECTRIC CAMERA		

DECLARATION OF W. LEO HOARTY

I currently hold the opinions set expressed in this declaration. But my analysis may continue, and I may acquire additional information and/or attain supplemental insights that may result in added observations.

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

Dated: December 31, 2024

By: 

W. Leo Hoarty

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I, W. Leo Hoarty, of Morgan Hill, California, declare that:

I. INTRODUCTION

1. I have been retained on behalf of LG Electronics, Inc. and LG Electronics USA, Inc. (collectively “LG”) to offer technical opinions related to U.S. Patent No. 8,339,493 (the ’493 Patent) (LG-1001). I understand that LG is requesting that the Patent Trial and Appeal Board (Board) institute an *Inter Partes* Review (IPR) proceeding of the ’493 Patent.

2. I have been asked to provide my independent analysis of the ’493 Patent in light of the prior art publications cited in this Declaration.

3. I am not and never have been an employee of LG. I received no compensation for this Declaration beyond my normal hourly compensation based on my time actually spent analyzing the ’493 Patent, the prior art publications cited below, and issues related thereto, and I will not receive any added compensation based on the outcome of any IPR or other proceeding involving the ’493 Patent.

4. My analysis here is based on my years of education, research, and experience, as well as my investigation and study of relevant materials, including those cited in this Declaration.

5. I may rely upon these materials, my knowledge and experience, and/or additional materials to rebut arguments raised by the Patent Owner. Further,

I may consider additional documents and information in forming any necessary opinions, including documents that may not yet have been provided to me.

6. My analysis of the materials produced in this proceeding is ongoing, and I will continue to review any new material as it is provided. This Declaration represents only those opinions I have formed to date. I reserve the right to revise, supplement, and/or amend my opinions stated herein based on new information and on my continuing analysis of the materials already provided.

7. In writing this Declaration, I have considered my own knowledge and experience, including my work experience in the fields of electronics engineering and computer science—including professional experience in data communications, consumer electronics product design, digital signal processing, audio and video codecs, electronic circuit design, interactive television systems—and my experience in working with others involved in these fields. Moreover, I have considered my knowledge and experience derived from serving on standards committees, including the Advanced Television Systems Committee (ATSC), the Moving Picture Experts Group (MPEG) of the International Organization for Standardization (ISO), and Institute of Electrical and Electronics Engineers (IEEE).

8. I have analyzed the following publications and materials, in addition to other materials I cite in this Declaration:

- a. U.S. Patent No. 8,339,493 (LG-1001), and its accompanying prosecution history (LG-1002);
- b. U.S. Patent No. 5,444,482 (Misawa '482) (LG-1006);
- c. U.S. Patent No. 6,292,218 (Parulski) (LG-1007);
- d. *Proceedings of 1997 IEEE International Symposium on Consumer Electronics* (Inst. Elec. & Elecs. Eng'rs Dec. 2–4, 1997) (LG-1008);
- e. T. Kurashige et al., *Development of MPEG Camera*, in *Proceedings of 1997 IEEE International Symposium on Consumer Electronics* 218–21 (Inst. Elec. & Elecs. Eng'rs 1997) (LG-1009);
- f. U.S. Patent No. 7,903,162 (Juen) (LG-1011); and
- g. U.S. Patent No. 6,700,607 (Misawa '607) (LG-1012).

9. The article reference Kurashige was published in *Proceedings of 1997 IEEE International Symposium on Consumer Electronics*. LG-1010 ¶¶8–11. I am familiar with both this periodical and its publisher IEEE (of which I am a member). Kurashige would have been available to and disseminated to members of the general technical community at least as of October 2, 1997. *Id.*

II. QUALIFICATIONS AND BACKGROUND INFORMATION

10. I am over the age of 18 and am competent to write this Declaration. I have personal knowledge or have developed knowledge—based upon education, training, or experience—of the technologies of the matters set forth herein.

11. I am currently the Principal of WLH Consulting LLC. My curriculum vitae is provided with this Declaration.

12. I spent two years studying electronic engineering and computer science at the Ohio State University. Over my career since studying at the Ohio State University, I have founded many technology startups, including companies that developed manufacturing automation technology, wireless data transmission technology, MPEG video compression technology, set-top technology, automated content recognition, and digital advertising support systems. While creating new technology companies, I have raised over \$600 million of investment capital from top venture capital firms and from top technology companies such as IBM, Intel, Cisco, Samsung, among others. The companies that I founded have created jobs for thousands of technology workers.

13. I have served on many standards-setting bodies for developing several standards related to processing and transmission of image data, including ISO's MPEG-2 standard, ATSC's high-definition television (HDTV) standard, IEEE's IEEE 802.14 cable modem standard, Electronic Industries Alliance's (EIA) cable TV compatibility (IR pass-through) standard, and cable TV interface standards. I additionally am a member of IEEE, the Society of Motion Picture and Television Engineers (SMPTE), the Society of Cable Telecommunications Engineers (SCTE), and the Association of Computing Machinery (ACM).

14. Moreover, I have published papers in connection with and presented at numerous technical conferences in the U.S., Asia, and Europe including conferences for the National Association of Broadcasters (NAB), National Cable Television Association (NCTA), Society of Cable Telecommunication Engineers (SCTE), International Broadcast Conference (IBC), the Montreux International Television Symposium, and IEEE.

15. A significant part of my professional work has focused on developing set-top technology and digital advertising support systems. In 1990, I founded an interactive cable television technology company, called ICTV Inc., renamed ActiveVideo Networks (AVN) in 2003. The company developed video-on-demand (VOD) and virtual cable TV set-top cloud-based systems to deliver video and interactive program guides over managed (cable TV) and unmanaged (Internet) networks. The company's technology has been active in over 25 million cable TV households of the Time-Warner and Charter Cable systems (now called Spectrum).

16. I founded the Dotcast company in 1999 and served as President and CTO. The company developed a set-top box technology and service, called MovieBeam, that received both over-the-air (OTA) and broadband (Internet) delivery of feature films stored on an internal hard drive in the set-top box. At the time, movie data was delivered slower than real-time on a 24/7 schedule using a process called trickle filled cache. Metadata about each movie was stored in the

file header on the internal hard drive. This information included the usual fields of title, actors, director, and, importantly, the rating for which the set-top box provided parental controls. Consumers selected programming from an internal user interface guide and rented movies under similar rules as Blockbuster. Service was live from 2004 to 2007 in the top 50 television markets in the U.S. and was backed by all nine major movie studios at the time, led by the Walt Disney Company.

17. In 2015, I was granted a patent for an audio-based automated content recognition (ACR) system and sold it to Vizio, Inc. I was then contracted by the company to assemble a software development team and create the system based on the patent that would run in a smart TV. This system generates fingerprints from TV audio and sends the fingerprints to a cloud-based server system. I also wrote much of the server-side software that receives the streaming fingerprints in real-time from the TVs and identifies content currently playing. The Vizio ACR technology is and was widely used, at one point and is being concurrently run on the inside of over 20 million smart TVs. This technology is utilized by the Inscape division of the TV maker, Vizio, to produce precision daily audience measurement products widely used in the television and advertising industry including by the A.C. Nielsen Company, a company considered the gold standard of audience measurement. In some services provided by Vizio using the ACR technology,

media related to currently playing programming is returned to the smart TV for display of supplemental information and for targeted advertising.

18. In 2018, I developed and patented a novel technology for video watermarking which places invisible data into the video signal for identification of the video segment. Under contract, I helped develop the software for a dynamic ad insertion system using the video watermarks. The technology has been used by major broadcast networks under the name Project OAR. Client software runs on smart TVs that detect and decode video watermarks and then communicates over the Internet to Content Delivery Network (CDN) servers to download a specific TV ad to substitute for the existing ad based on certain combinations of zip code, demographic profiles, and time of day. Ad swapping actions occur in less than a tenth of a second. Information about the ad, including whether the ad was viewed in its entirety, or whether the person switched the channel, is passed back to the advertiser.

19. Additional technology I developed and patented for Vizio includes a TV ad attribution system using what is colloquially known as “tracking pixels.” The technology allows third-party verification of individual TVs displaying specific TV ads, a service of high value to advertisers.

20. Throughout my career I have received a variety of awards including, for example, the National Cable Television Association (NCTA)—Best New

Technology 1996 for ICTV's interactive TV and VOD service; Consumer Electronics Society (CES)—Best of Show in 2005 and 2006 for the MovieBeam set-top and service; 2023 Emmy Award went to Vizio, Inc for their precision audience measurement service which utilizes my patented audio ACR technology for high-resolution monitoring of household TV viewing.

21. I am an inventor on over 40 patents and my patent portfolio has been extensively cited by over a hundred third-party patents. My past work has been cited in many technology articles on cable television as well as on consumer electronics.

III. SUMMARY OF CONCLUSIONS FORMED

22. This Declaration explains the conclusions that I have formed based on my analysis. To summarize those conclusions:

- a. **Ground 1:** Based upon my knowledge and experience and my review of the prior art publications listed above, I believe that claims 5–14 of the '493 Patent are rendered obvious by Misawa '482 in view of Parulski.
- b. **Ground 2:** Based upon my knowledge and experience and my review of the prior art publications listed above, I believe that claims 5, 7–10, and 12–14 of the '493 Patent are rendered obvious by Kurashige in view of Parulski.

- c. **Ground 3:** Based upon my knowledge and experience and my review of the prior art publications listed above, I believe that claims 5, 7–10, and 12–14 of the '493 Patent are rendered obvious by Juen in view of Misawa '607.

IV. BACKGROUND KNOWLEDGE ONE OF SKILL IN THE ART WOULD HAVE HAD PRIOR TO THE PRIORITY DATE OF THE '493 PATENT

23. My analysis and conclusions set forth in this Declaration are based on the perspective of a person of ordinary skill in the art having the level of knowledge and skill as of the date of invention of the '493 Patent (POSITA). Based on instruction from Counsel, I have applied the filing date of the '493 Patent—March 8, 2000 (Critical Date)—as the invention date. My analysis and conclusions in this Declaration, however, would remain the same if the invention date were earlier than the Critical Date, including if the invention date were before October 27, 1999. Indeed, my analysis and conclusions would hold true even if the invention date occurred earlier than October 27, 1999, as evidenced by at least the publication dates or filing dates of the prior art documents that I rely on, including Misawa '482, Parulski, Kurashige, Juen, and Misawa '607.

24. In rendering the opinions set forth in this Declaration, I was asked to consider the patent claims and the prior art through the eyes of a POSITA at the Critical Date. I understand that the factors considered in determining the ordinary

level of skill in a field of art include the level of education and experience of persons working in the field; the types of problems encountered in the field; the teachings of the prior art, and the sophistication of the technology at the Critical Date. I understand that a POSITA is not a specific real individual, but rather is a hypothetical individual having the qualities reflected by the factors above. I understand that a POSITA would also have knowledge from the teachings of the prior art, including the art cited in this Declaration.

25. Taking these factors into consideration, based on my knowledge and experience in the field and my review of the '493 Patent and file history, I believe that a POSITA in this matter would have had at least a combination of (1) a Bachelor's Degree (or a similar Master's Degree, or higher degree) in computer science, electrical engineering, computer engineering, or a related field or equivalent work experience, and (2) one to two years of practical experience in the field of digital image processing, digital cameras, electronic imaging, or a related field. Additional education or industry experience may compensate for a deficit in one of the other aspects of the requirements stated above.

26. While I do not meet the specific educational requirements, I have more than the equivalent work experience. I have over 40 years of professional experience in both electronics engineering and computer science, including, as discussed above and illustrated in my curriculum vitae, significant experience in

technical roles in the field of data communications and telecommunications. *See supra* Section II; LG-1015. Based on my experiences, I have a good understanding of the capabilities of a POSITA. Indeed, I have participated in organizations and worked closely with many such persons over the course of my career. Based on my knowledge, skill, and experience, I have an understanding of the capabilities of a POSITA. Furthermore, I possess those capabilities myself.

V. LEGAL PRINCIPLES

27. I am not a lawyer and I will not provide any legal opinions in this IPR. Although I am not a lawyer, I have been advised that certain legal standards are to be applied by technical experts in forming opinions regarding the meaning and validity of patent claims.

A. Claim Construction

28. I understand that claim terms are generally given their plain and ordinary meaning in light of the patent's specification and file history as understood by a POSITA as of the invention date. In that regard, I understand that the best indicator of claim meaning is its usage in the context of the patent specification as understood by a POSITA. I further understand that the words of the claims should be given their plain meaning unless that meaning is inconsistent with the patent specification or the patent's history of examination before the U.S. Patent and Trademark Office (Office). I also understand that the words of the

claims should be interpreted as they would have been interpreted by a POSITA at the invention date.

B. Anticipation

29. I have been informed that a patent claim is invalid as anticipated under pre-AIA 35 U.S.C. §102 if each and every element of a claim, as properly construed, is found either explicitly or inherently in a single prior art reference. Under the principles of inherency, if the prior art necessarily functions in accordance with, or includes the claimed limitations, it anticipates.

30. I have been informed that a claim is invalid under pre-AIA 35 U.S.C. §102(a) if the claimed invention was known or used by others in the U.S., or was patented or published anywhere, before the date of applicant's invention. I further have been informed that a claim is invalid under pre-AIA 35 U.S.C. §102(b) if the invention was patented or published anywhere, or was in public use, on sale, or offered for sale in this country, more than one year prior to the filing date of the patent application. And a claim is invalid, as I have been informed, under pre-AIA 35 U.S.C. §102(e), if an invention described by that claim was described in a U.S. patent granted on an application for a patent by another that was filed in the U.S. before the invention date of that claim.

C. Obviousness

31. I understand that a patent claim is invalid if the claimed invention would have been obvious under pre-AIA 35 U.S.C. §103 to a POSITA. Thus, even if all of the claim limitations are not found in a single prior art reference that anticipates the claim, the claim can still be invalid.

32. I have been informed that a patent claim is invalid as obvious in light of one or more prior art references if it would have been obvious to a POSITA, taking into account (1) the scope and content of the prior art, (2) the differences between the prior art and the claims, (3) the level of ordinary skill in the art, and (4) any so called “secondary considerations” of non-obviousness, which include: (i) “long felt need” for the claimed invention, (ii) commercial success attributable to the claimed invention, (iii) unexpected results of the claimed invention, and (iv) “copying” of the claimed invention by others. For purposes of my analysis, I have applied a date of March 8, 2000—the Critical Date—as the invention date in my obviousness analyses, although, as explained above, in many cases the same analysis would hold true even at an earlier time than the Critical Date.

33. I have been informed that a claim can be obvious in light of a single prior art reference or multiple prior art references. To be obvious in light of a single prior art reference or multiple prior art references, there must be a reason to modify the single prior art reference, or combine two or more references, in order

to achieve the claimed invention. This reason may come from a teaching, suggestion, or motivation to combine, or may come from the reference or references themselves, the knowledge or “common sense” of one skilled in the art, or from the nature of the problem to be solved, and may be explicit or implicit from the prior art as a whole. I have been informed that the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. I also understand it is improper to rely on hindsight in making the obviousness determination.

34. I have been informed by Counsel and understand that if a technique has been used to improve one device, and a POSITA would have recognized that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond their skill.

35. I have been informed by Counsel and understand that practical and common sense considerations should guide a proper obviousness analysis, because familiar items may have obvious uses beyond their primary purposes. I have been informed by Counsel and understand that a POSITA looking to overcome a problem will often be able to fit together the teachings of multiple prior art references. I have been informed by Counsel and understand that obviousness analysis therefore takes into account the inferences and creative steps that a POSITA would have employed.

36. I have been informed by Counsel and understand that a proper obviousness analysis focuses on what was known or obvious to a POSITA, not just the patentee. Accordingly, I understand that 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.

37. I have been informed by Counsel and understand that a claim can be obvious in light of a single reference, without the need to combine references, if the elements of the claim that are not found explicitly or inherently in the reference can be supplied by the common sense of a POSITA.

VI. TECHNOLOGY BACKGROUND

38. The technology in the '493 Patent at issue generally relates to an electric camera that (1) can be operated to record an image in a static image mode, monitor an image in the static image mode, and record an image in a moving video mode, and (2) includes an image sensing device, a signal processing unit, and a display. Prior to the invention date of the '493 Patent, there existed numerous products, publications, and patents that implemented or described the functionality claimed in the '493 Patent.

A. Overview of Digital Cameras

39. At the invention date, digital cameras were understood to be capable of recording imagery. Digital cameras could record still imagery (e.g., a still

image, a static image, etc.), moving imagery (e.g., moving images, motion pictures, movies, etc.), or both, and could record such imagery in a non-transitory recording medium (e.g., an optical disk or memory card). Such cameras used image sensors, discussed in more detail below, to capture the imagery. These image sensors served as transducers to convert optical signals (e.g., in an optical image formed on the image sensor) into electrical signals (e.g., analog and digital signals carrying information representative of the optical image). *See* LG-1006 at 3:14–17. Digital cameras could use a combination of hardware and software processing elements to generate, transform, or otherwise process these electrical signals. *See* LG-1007 at 5:1–19; LG-1016 at 3:37–50. These electrical signals could then be recorded or could be used to directly drive a display.

40. Users could control settings of a digital camera by operating user interface elements of the digital camera that were connected to electrical components of the digital camera. For example, such user interface elements could include physical buttons, physical switches, or touch screens and could be used for initiating capture of and recording of imagery, controlling a mode of operation of the digital camera (e.g., selecting between recording static imagery or moving imagery), controlling settings of electrical components (e.g., processors, the image sensor, etc.), controlling settings of optical components (e.g., lenses, apertures, etc.), or performing other operations for controlling the digital camera. *See* LG-

1006 at 5:9–16; LG-1007 at 3:27–29; LG-1011 at 10:45–55; LG-1012 at 7:31–34; LG-1016 at 6:63–7:10.

41. Well-known and well-understood modes of operation for digital cameras included (1) still image capture modes (e.g., for recording still or static images) (LG-1006 at 1:16–19; LG-1007 at 1:16–24; LG-1009 at 1 tbl.1, 2 §2.2; LG-1011 at 1:46–67; LG-1016 at 1:11–17) and (2) movie capture modes (e.g., for recording moving images or movies) (LG-1006 at 1:19–23; LG-1009 at 1 tbl.1, 2 §2.2; LG-1011 at 1:46–67; LG-1016 at 1:11–17). Some digital cameras could be operated in both a still image capture mode to capture still imagery and a movie capture mode to capture moving imagery. *See, e.g.*, LG-1006 at 1:44–49; LG-1009 at 1 tbl.1, 2 §2.2; LG-1011 at 1:46–67; LG-1016 at 1:11–17.

B. Displays for Digital Cameras

42. Digital cameras could present imagery on a display. For example, liquid crystal displays (LCDs) could be used to present imagery representative of imagery captured by an image sensor or image sensing device of the digital camera. *See* LG-1007 at 1:27–34. And some digital cameras had built-in LCDs for displaying such imagery. *Id.* at 1:27–28; LG-1011 at 3:45–55; LG-1012 at 8:2–3; LG-1017 at 4:10–25. The imagery presented on the LCDs could be playback imagery (e.g., imagery previously recorded by the digital camera) or imagery of a

current view of the digital camera. *See* LG-1007 at 3:29–38; LG-1011 at 3:49–55; LG-1012 at 6:63–7:1.

43. LCDs typically had a rectangular array of display pixels for presenting an image. *See* LG-1007 at 1:39–52. LCDs would be specified based on their resolutions, which described a horizontal pixel dimension and a vertical pixel dimension of the rectangular array. *See, e.g., id.* at 1:49–52; LG-1009 at 1 tbl.1. For example, an $N \times M$ display would have been understood to have N pixels in a row of pixels and M such rows of pixels, although a POSITA would have understood that the resolution could sometimes be expressed with the vertical dimension first and the horizontal dimension second, e.g., as an $M \times N$ display. A POSITA would have understood from context whether the resolution was being expressed as $N \times M$ or $M \times N$.

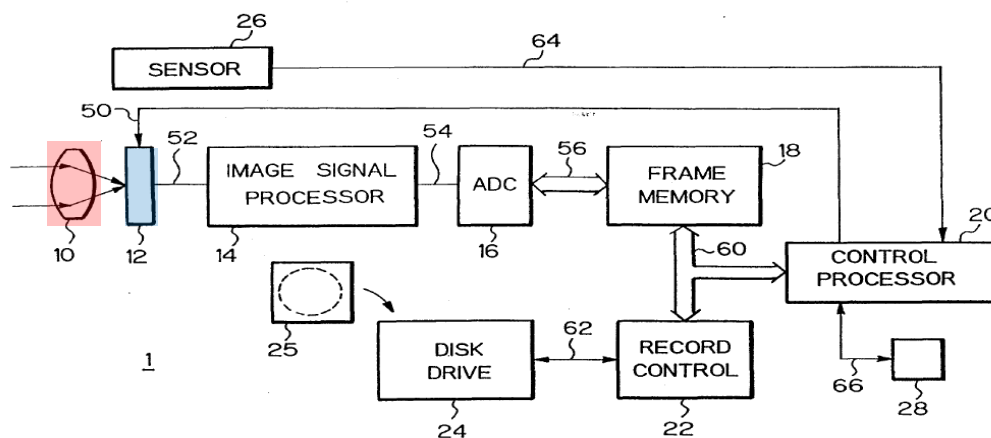
C. Electrical Signal Processing in Digital Cameras

1. Image Sensing Devices for Digital Cameras

44. To capture imagery, digital cameras commonly included image sensors or image sensing devices that, as discussed above, convert optical signals into electrical signals. Image sensors included photosensitive arrays of pixels that produced electric charges associated with an optical image formed on the photosensitive array. For example, as shown in Figure 1 of Misawa '482 below,

this optical image could be formed by an **optical lens 10** that focused the optical image on the photosensitive array of the **image sensor 12**. LG-1006 at 2:55–61.

Fig. 1



Id. fig.1 (annotated).

45. A charge coupled device (CCD) was a common type of image sensor that received the optical image formed through the optical lens and converted this optical image into electric charges. *See id.* at 3:22–27. The CCD included photoelectric elements (e.g., photodiodes) arranged in an array, with each photoelectric element generating an electric charge corresponding to a pixel of the optical image formed through the optical lens. *See id.* at 3:30–38; LG-1012 at 3:14–29.

46. The array of photoelectric elements typically included horizontal lines of photoelectric elements that were evenly spaced in a vertical direction. The

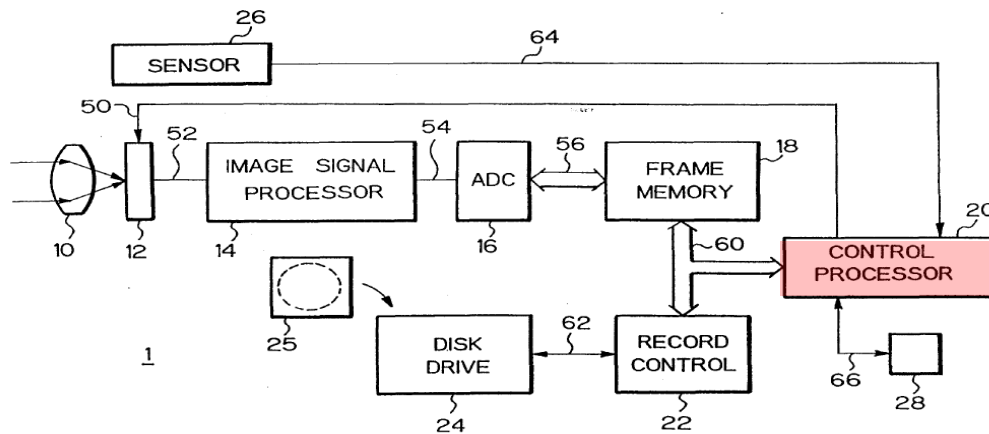
photoelectric elements in the horizontal lines were evenly spaced in a horizontal direction.

47. Like a typical arrangement for pixels of an LCD, a typical arrangement for the array of photoelectric elements of an image sensor was a rectangular array. And like the array of pixels for an LCD, this rectangular array was defined in the image sensor's specification by a resolution represented by two numbers: a horizontal dimension corresponding to the number of photoelectric elements horizontally arranged in a row (or the number of columns of photoelectric elements) and a vertical dimension corresponding to the number of pixels arranged in a vertical direction (or the number of rows of photoelectric elements).

48. For example, an $N \times M$ image sensor would have been understood to have N pixels in a row of photoelectric elements or pixels and M such rows of photoelectric elements or pixels, although a POSITA would have understood that the resolution could sometimes be expressed with the vertical dimension first and the horizontal dimension second, e.g., as an $M \times N$ image sensor. A POSITA would have understood from context whether the resolution was being expressed as $N \times M$ or $M \times N$. For an $N \times M$ image sensor, an 768×512 image sensor resolution indicated that the image sensor had 768 photoelectric elements per row and 512 vertically arranged rows, while a 1280×960 image sensor resolution indicated that the image sensor had 1280 photoelectric elements per row and 960 vertically arranged rows.

49. Digital cameras could control an electrical output from the image sensor. For example, digital cameras could, e.g., using a drive controller or control processor such as the **control processor 20** shown in Figure 1 of Misawa '482 below, drive the image sensor to read all of the electric charges or selectively read some of the electric charges generated by the array of photosensitive elements of the image sensor to form the output of the image sensor. *See* LG-1006 at 6:7–14, 6:38–65, 8:40–52; LG-1007 at 3:48–57, 4:35–46; LG-1012 at 7:43–9:4.

Fig. 1



LG-1006 fig.1 (annotated).

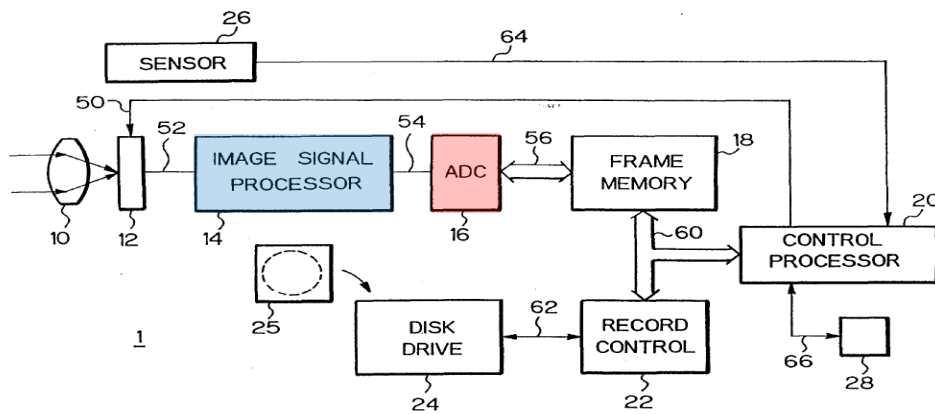
50. Pixel resolutions of LCDs were often different from pixel resolutions of CCD sensors of digital cameras. *See* LG-1007 at 2:24–53; LG-1011 at 3:35–38, 3:45–55, 5:63–6:2; LG-1012 at 8:53–9:14; *see also* LG-1001 at 2:26–35 (admitting that there was a trend toward increasing number of pixels for image sensing devices and that the number of pixels for the image sensing devices did not

necessarily match the number of scanning lines for a display). Because LCDs on digital cameras were generally small compared to external displays (such as monitors and televisions), such built-in LCDs would generally be low-resolution displays. *See* LG-1007 at 4:42–46, 7:8–11; LG-1012 at 1:65–2:20. As a result, digital cameras could convert the number of pixels to a resolution that matched that of the desired LCD. *See* LG-1007 at 2:31–35, 4:42–54; LG-1012 at 8:53–9:14; LG-1017 at 7:8–32; LG-1016 at 7:11–32.

2. Processing of Output of Image Sensing Devices

51. Digital cameras could perform additional processing on the output generated by the image sensor. For example, the image sensors typically produced an analog signal output, and digital cameras would convert the output generated by the image sensor to a digital image signal, e.g., using an analog-to-digital converter (ADC) such as the **ADC 16** shown in Figure 1 of Misawa '482 below. *See* LG-1006 at 2:61–65; LG-1007 at 3:57–63; LG-1012 at 6:42–6:50. Before converting the analog signal output from the image sensor to a digital image signal, digital cameras could perform other processing in the analog domain, e.g., using an image signal processor such as the **image signal processor 14** shown in Figure 1 of Misawa '482 below. *See* LG-1006 at 3:30–38; LG-1007 at 3:57–60; LG-1012 at 6:42–50.

Fig. 1

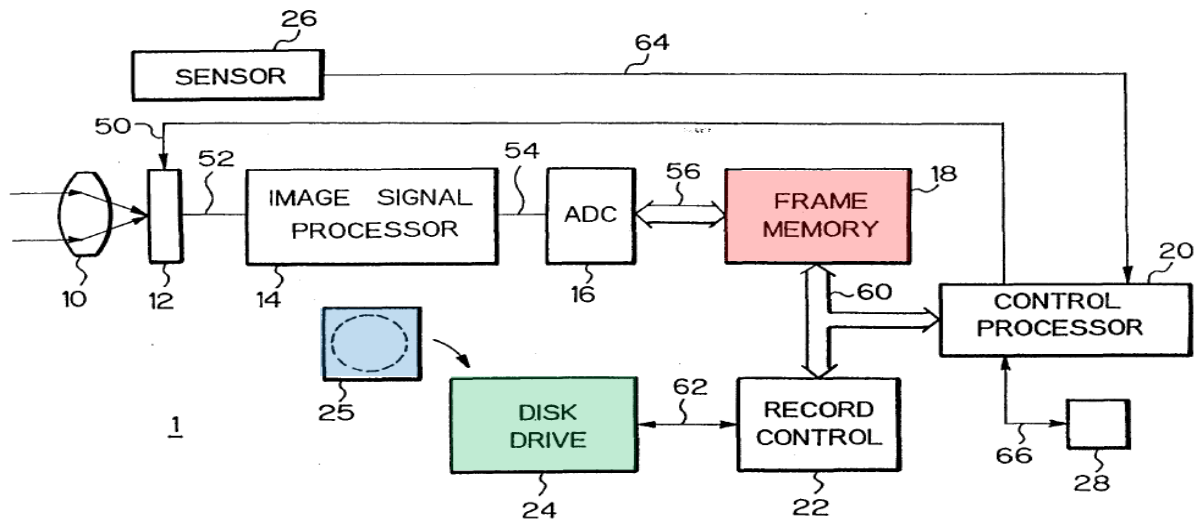


LG-1006 fig.1 (annotated).

52. Processing performed by the digital cameras could occur in the analog domain, as described above, or alternatively could occur in the digital domain, or alternatively could occur in both the analog domain and the digital domain. *See* LG-1012 at 6:42–56; LG-1016 at 5:18–28; LG-1017 at 3:50–59. The processing in the analog domain or the digital domain could involve amplifying the signal, adjusting luminance, adjusting color characteristics or gamma characteristics, forming image signals suitable for reproduction, or performing other image processing steps that were well understood by a POSITA. *See, e.g.,* LG-1006 at 3:39–46; LG-1007 at 3:57–60, 3:63–64, 4:21–31; LG-1012 at 6:42–56; LG-1016 at 5:18–5:28. And as discussed above, digital cameras were known to use hardware, software, or both to process electrical signals. *See* LG-1007 at 5:1–19; LG-1012 at LG-1016 at 3:37–50.

53. After performing certain processing steps in the analog domain and/or the digital domain and then converting the output of the image sensor to the digital domain, digital cameras would store, temporarily, the digital signals in temporary memory such as the **frame memory 18** shown in Figure 1 of Misawa '482 below. *See* LG-1006 at 2:64–66; LG-1007 at 3:60–63; LG-1011 at 4:16–21; 5:15–21; LG-1012 at 6:56–60; LG-1016 at 5:31–35, 7:21–32; LG-1017 at 3:55–59. The digital signals could then be read out from the temporary memory to be recorded on a memory card, an optical disk, or other recording medium such as the **optical disk 25** in the **disk drive 24** shown in Figure 1 of Misawa '482 below. *See* LG-1006 at 3:2–7; LG-1007 at 3:45–47, 3:63–67; LG-1011 at 7:18–24, 9:41–44, 10:14–19, 10:55–62; LG-1012 at 7:8–11; LG-1017 at 3:60–67. The digital camera could selectively read out the digital signals stored in the temporary memory. For example, all or part of the digital signals stored in the temporary memory can be read out from the temporary memory. *See* LG-1006 at 4:1–3, 6:66–7:18, 7:30–48, 8:60–9:8, 9:57–10:2; LG-1016 at 7:11–32.

Fig. 1



LG-1006 fig.1 (annotated).

3. *Generating Reduced Number of Pixel Lines Relative to Number of Pixel Lines of Image Sensing Device*

54. Because the image sensors were often high resolution and thus would generate output containing relatively high amounts of information, digital cameras would sometimes reduce the amount of information used from the output of the image sensors to alleviate the memory storage burden of recording imagery or to reduce the computational load of processing electrical signals representative of the imagery. For example, to generate image signals for presenting on displays or for recording in memory, digital cameras could generate electrical signals representing

a reduced number of pixel lines relative to the number of pixel lines of the image sensor. *See, e.g.*, LG-1006 at 6:66–7:18; LG-1007 at 4:49–54, 6:15–45; LG-1011 at 6:10–13, 7:51–59; LG-1012 at 4:1–2; LG-1016 at 4:37–42, 7:11–17, 8:22–29; LG-1017 at 7:8–18. The digital camera could generate these electrical signals with the reduced number of pixel lines by, for example, using information corresponding to only a subset of the pixel lines of the image sensor (*see, e.g.*, LG-1006 at 6:66–7:18; LG-1007 at 6:15–45; LG-1012 at 4:1–2; LG-1016 at 4:37–42, 7:11–17, 8:22–29; LG-1017 at 7:8–18) or combining (e.g., mixing) information corresponding to multiple pixel lines of the image sensor (*see, e.g.*, LG-1007 at 4:49–54, 8:12–27; LG-1011 at 6:10–13, 7:51–59). A process for generating the reduced number of pixel lines could involve controlling the image sensor itself (*see, e.g.*, LG-1007 at 6:15–45; LG-1012 at 4:1–2; LG-1016 at 4:37–42, 7:11–17, 8:22–29), controlling the digital signals read from the temporary memory (*see, e.g.*, LG-1006 at 6:66–7:18; LG-1017 at 7:8–18), or processing signals elsewhere in the electrical signal processing steps for generating image signals for presenting on displays or for recording in memory (*see, e.g.*, LG-1007 at 4:49–54; LG-1011 at 6:10–13, 7:51–59).

VII. OVERVIEW OF THE '493 PATENT

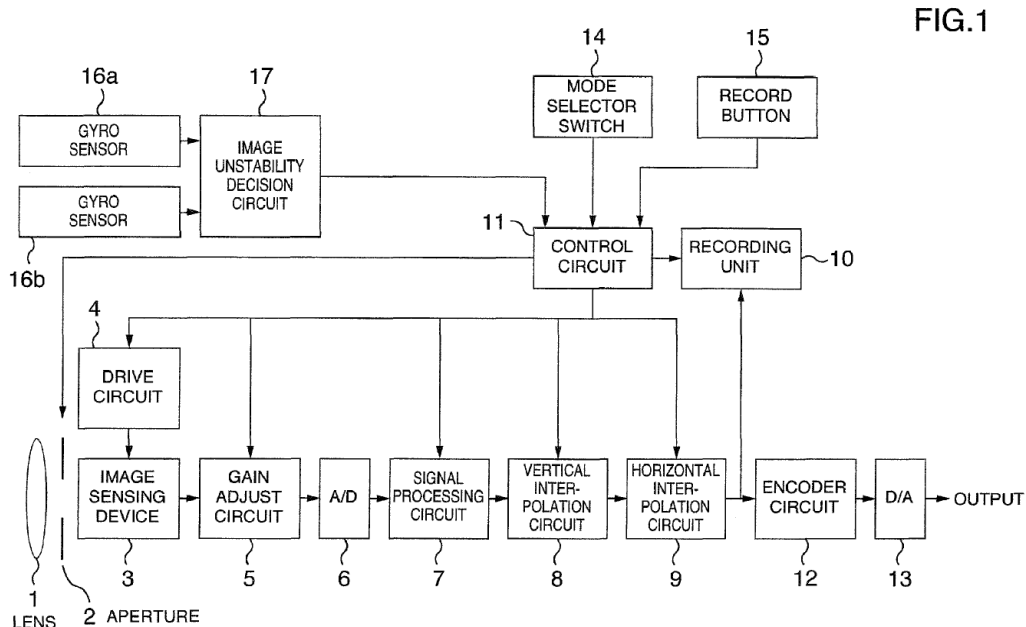
A. Technology Background and the Admitted Prior Art

55. According to the '493 Patent, at the time of the alleged invention, electric cameras that use solid-state image sensors, such as CCDs were available. *See* LG-1001 at 1:23–29. Such cameras included both (1) video cameras for taking moving images that also had a still image taking function and (2) digital still cameras for taking still images that also had a moving image taking function. *Id.* When photographing a still image, a camera user would need to monitor the image, and thus the camera would have to generate signals that conform to a display. *Id.* at 2:5–9; *see id.* at 2:26–32. In other words, the '493 Patent admits that prior art cameras were capable of (1) capturing still images, (2) capturing a video or a moving image, and (3) providing signals for monitoring a still image. *See also id.* at 2:26–32 (explaining that for a digital still camera designed for taking still images, “there has been a trend in recent years toward an increasing number of pixels used on the moving video image sensing device in order to obtain higher resolution static image signals” and that “[w]hen taking a moving image or monitoring the video, it is necessary to generate signals that conform to the television system”). The '493 Patent acknowledges that prior art cameras could mix vertically adjoining pixels inside or outside an image sensing device to

generate a quantity of scanning lines that match a display, such as a television monitor. *See id.* at 1:30–34, 1:45–50, 2:46–53.

B. Description of the '493 Patent

56. The '493 Patent is directed to “[a]n electric camera includ[ing] an image sensing device.” *Id.* at 1 code (57). As shown in Figure 1 below, to capture a moving video or a static image using an embodiment of the electric camera disclosed in the '493 Patent, an image sensing device 3 (e.g., a CCD) converts received light into an electric signal. *Id.* at 3:41–43, 4:34–37, 4:64–67, 7:27–30, 7:65–66. A mode selector switch 14 selects between a moving video mode and a static image mode. *Id.* at 4:64–66, 7:27–30.



Id. fig.1.

57. In an embodiment of the moving video mode, a horizontal transfer unit in the image sensing device 3 mixes four pixels to reduce a number output signals from the image sensing device 3 to conform to the number of effective scanning lines of a television system. *Id.* at 4:66–5:9, 4:56–60. A gain adjust circuit 5 adjusts the gain of the electrical signal from the image sensing device 3, and then an analog-digital (A/D) conversion circuit 6 converts this adjusted signal into a digital signal on which a signal processing circuit 7 in turns performs a color signal and luminance signal processing. *Id.* at 6:8–15. A vertical interpolation circuit 8 receives the output of the signal processing circuit 7 without processing the output, and a horizontal interpolation circuit 9 performs interpolation on the signals in the horizontal direction to produce signals conforming to a television system. *Id.* at 6:60–7:1. An encoder circuit 12 and a digital-analog (D/A) conversion circuit 13 then produce analog signals for output on the television system so that a user can monitor the angle of view. *Id.* at 7:1–4, 7:31–34. In response to operation of a record button 15, a recording unit 10 records the signals in a Moving Picture Expert Group (MPEG) format. *Id.* at 7:4–8.

58. In an embodiment of the static image mode, for monitoring an angle of view for the electric camera, the horizontal transfer unit in the image sensing device 3 mixes five pixels to reduce a number output signals from the image sensing device 3 to conform to the number of effective scanning lines of the

television system. *Id.* at 7:40–45, 7:60–62. Akin to the process for the moving video mode, for monitoring in the static image mode, the process for static image monitoring continues with the gain adjust circuit 5, the A/D conversion circuit 6, and the signal processing circuit 7 performing subsequent processing. *Id.* at 7:66–8:3. The vertical interpolation circuit 8 performs interpolation on the output in a vertical direction while the horizontal interpolation circuit 9 receives the output without processing it. *Id.* at 7:26–34, 8:4–7, 8:38–44. Then, the encoder circuit 12 and the D/A conversion circuit 13 produce analog signals for output on the television system. *Id.* at 8:44–46.

59. By comparison, for recording the static image, all pixels are read out independently from the image sensing device 3, and the recording unit 10 records signals in a Joint Photographic Expert Group (JPEG) format. *Id.* at 8:51–58, 9:3–15. For capturing the static image in response to a request by the record button 15 in the static image mode, the process for recording the static image differs from the process for monitoring the static image in that: (1) the mixing process is not performed and, instead, all pixels are read out independently from the image sensing device 3, (2) the output passes through both the vertical interpolation circuit 8 and the horizontal interpolation circuit 9 without being processed, and (3) the recording unit 10 records signals in the JPEG format. *Id.*

60. For recording the moving video and monitoring the static image, the '493 Patent describes that in lieu of mixing, the number of lines of output signals could be reduced by a culling operation. *Id.* at 10:9–12.

C. Prosecution History

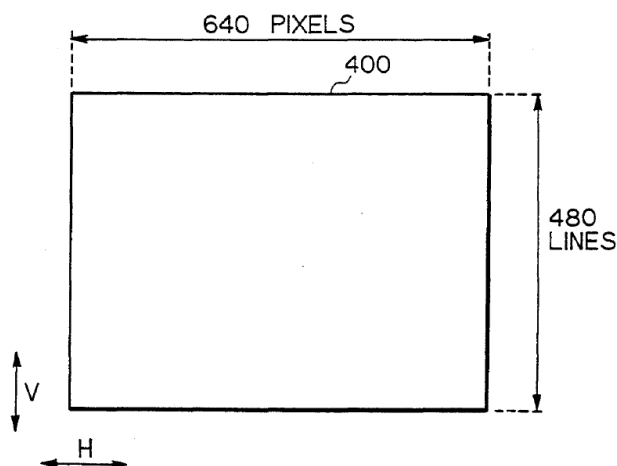
61. The initial application for the '493 Patent included claims 1–16, with as-filed claims 1–5, 7–11, and 13–16 corresponding to issued claims 1–14. LG-1002 at 235–40. In a non-final Office Action dated March 14, 2012, in addition to making several formal objections to the claims, the Office rejected claims 6 and 12 as failing to comply with the enablement requirement, rejected claims 1–5, 7–11, and 13–16 under the doctrine of obviousness-type double patenting as being unpatentable over certain claims of U.S. Patent No. 6,756,616 ('616 Patent), and rejected claims 6 and 12 as being unpatentable under the doctrine of obviousness-type double patenting over certain claims of the '616 Patent in view of prior art U.S. Patent No. 6,906,746. *Id.* at 159–61, 161–65. The applicant amended the claims to address the claim objections, canceled claims 6 and 12, and filed a terminal disclaimer with respect to the '616 Patent. *Id.* at 123–25, 130–34, 140–48. In a Notice of Allowance, the Office made several examiner's amendments to the claims. *Id.* at 111–13.

VIII. SUMMARY OF THE PRIOR ART

A. Misawa '482

62. Misawa '482 discloses a digital electronic camera including (1) an optical lens for forming the optical image of an object to be captured and (2) an image sensor for producing pixel signals associated with the optical image. LG-1006 at 2:36–44, 2:55–61. As illustrated in Figure 4A below, Misawa '482's image sensor includes a photosensitive array having an imaging field including 640 photosensitive cells or pixels extending in a horizontal direction (H) to form a horizontal line and 480 of these horizontal lines extending in a vertical direction (V). *Id.* at 3:30–34. As Misawa '482 describes, the image sensor is adapted to transduce the optical image of the object formed on the photosensitive array into corresponding pixel signals. *Id.* at 3:14–17.

Fig. 4A



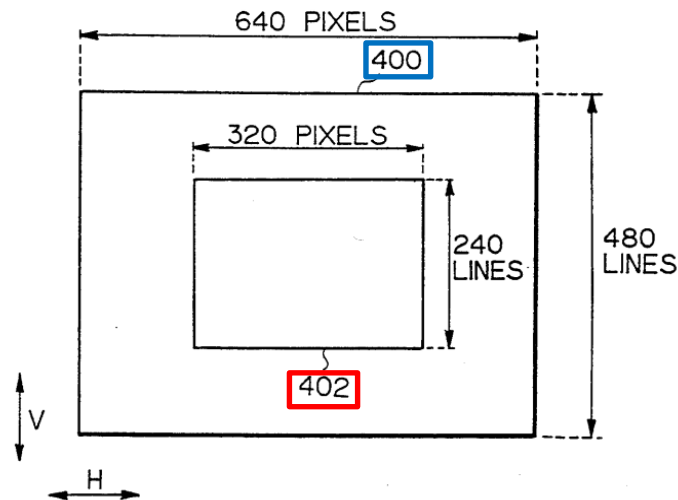
Id. fig.4A.

63. Misawa '482's camera operates in a still picture mode and a movie picture mode. *Id.* at 5:54–6:5, 6:15–38. In the still picture mode, a read-out processor reads out image data corresponding to an entire area of the imaging field of the image sensor. *Id.* at 7:1–7, 8:60–9:8. Specifically, the read-out processor reads out a frame of image data—corresponding to the entire area of the imaging field of the image sensor—when the read-out processor is informed of a first condition signal from a condition detector. *Id.* at 7:1–5. The condition detector produces the first condition signal in response to a shutter button member 74 being pressed to a first position shown in Figure 2B of Misawa '487. *Id.* at 5:54–5:58, 5:64–67, 6:15–22.

64. In the movie picture mode, the read-out processor reads out part of image data corresponding to part of an imaging field of the image sensor, specifically, corresponding to a smaller **area 402** in an **image frame 400** shown in Figure 4B below. *Id.* at 7:8–13. The read-out processor, in particular, reads out the part of the imaging field when the read-out processor is informed of a second condition signal from the condition detector. *Id.* at 7:1–5. The condition detector produces the second condition signal in response to a shutter button member 74 being pressed to a second position shown in Figure 2C of Misawa '487. *Id.* at 5:58–5:64, 5:67–6:2, 6:15–22. According to Misawa '482, the area 402 for

capturing the movie picture has a 4:3 aspect ratio, having 320 pixels in a horizontal direction and 240 horizontal lines extending in a vertical direction. *Id.* at 7:13–15. A POSITA would have understood the image frame 400 and the area 402 to have an aspect ratio of 4:3. An aspect ratio is calculated by dividing the generally larger horizontal pixel dimension by the smaller vertical dimension. The aspect ratio for the movie picture is therefore 320 divided by 240, or 4:3. Additionally, the aspect ratio captured from the image sensor is also 4:3, i.e., 640 divided by 480.

Fig. 4B



Id. fig.4B (annotated).

B. Parulski

65. Parulski discloses a camera including (1) a LCD with a pixel resolution of 312 pixels by 240 pixels and (2) an image sensor (e.g., having 512 lines with 768 pixels per line) for producing images processed by a preview mode

processing circuit that generates “relatively low resolution, spatially subsampled digital image data” for directly driving the “relatively low resolution” LCD. LG-1007 at 3:23–26, 4:37–46, 5:49–52, 8:11–12. As Parulski describes, the LCD can have fewer display pixels than the image sensor and normally has a 4:3 image aspect ratio. *Id.* at 8:3–11. When Parulski describes that the digital image data is “spatially subsampled,” Parulski is describing that only a subset of the pixels of the image sensor are used to produce the signals for driving the LCD. According to Parulski, “a preferred image sensor is the Kodak model CCD KAI-0400CM image sensor, which has approximately 512 active lines with approximately 768 active pixels per line and an image aspect ratio of 3:2.” *Id.* at 5:49–52.

66. Parulski discloses a still image mode for capturing and storing a still image from the image sensor and a motion mode for producing a preview image prior to capturing the still image from the image sensor. *Id.* at 1:9–13, 2:25–31, 3:45–47, 6:27–31. In the still image mode, all rows of image pixel charge corresponding to each line on the image sensor are progressively read out through a horizontal register during a single scan. *Id.* at 6:29–31. In other words, all rows and all charges are read to produce the still image in the still image mode.

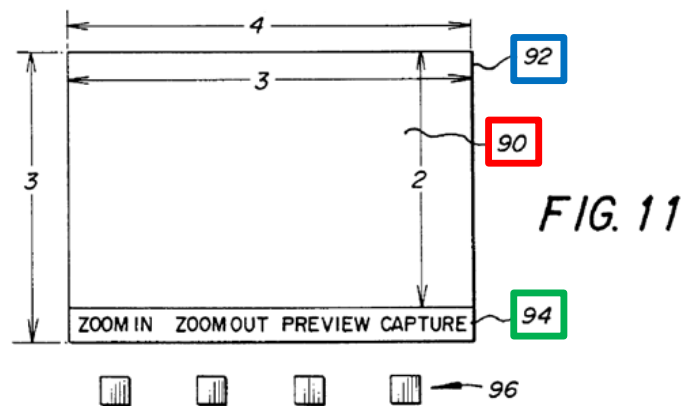
67. In the motion mode, to drive the LCD, Parulski implements a line-skipping process in which a fast dump structure eliminates some of the vertically arranged lines of image charge from the image sensor prior to readout. *Id.* at 6:32–

34. Parulski describes that a timing and control section is operable in the still image mode and the motion mode and that, in the motion mode, controls the fast dump structure. *Id.* at 4:35–37, 6:27–34. The fast dump structure is between vertical and horizontal registers—which receives accumulated charge from the image sensor—and allows lines of charges to be eliminated. *Id.* at 6:6–17, 6:24–27. The timing and control section 27, also referred to as a timing and control application-specific integrated circuit (ASIC), performs the image processing to create the imagery for the motion mode. *Id.* at 4:61–63.

68. Parulski describes several examples of line-skipping processes having varying line-skipping patterns. *Id.* at 6:38–43, 6:45–50, 10:5–10. In one example, Parulski describes that two or more consecutive vertically arranged lines of image charge from the image sensor are eliminated for every one or more vertically arranged lines of image charge read out from the image sensor. *Id.* at 6:38–43. In another embodiment, Parulski discloses alternately eliminating two or four consecutive lines of image charge for every pair of lines of image charge read out from the image sensor. *Id.* at 6:45–50; *see id.* fig.7. And in another embodiment, Parulski discloses eliminating one pair of lines for every four pairs of lines read out from the image sensor. *Id.* at 10:5–10.

69. Parulski describes that after reading out lines from the image sensor using a line-skipping process, those lines are displayed on the LCD. *Id.* at 7:41–61.

For example, after the line-skipping process in which two or four lines are alternately skipped is applied to the 512 lines of the image sensor, the read-out lines are displayed using only 204 of the LCD's approximately 240 lines of pixels, with approximately 36 lines being either masked behind a bezel or behind displayed status information. *Id.* at 7:41–48. As shown in Figure 11 of Parulski below, the line-skipping process maps pixels from an image sensor having a 3:2 aspect ratio to an **area 90** on an **LCD 92** having a 4:3 aspect ratio, with this mapping process leaving a **status area 94** available for other purposes. *Id.* at 7:48–54.

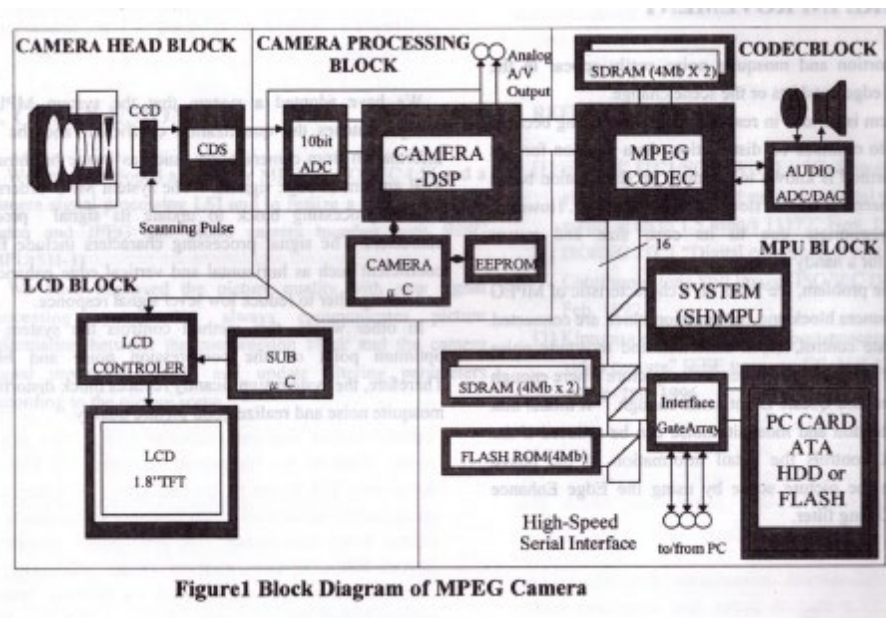


Id. fig.11 (annotated).

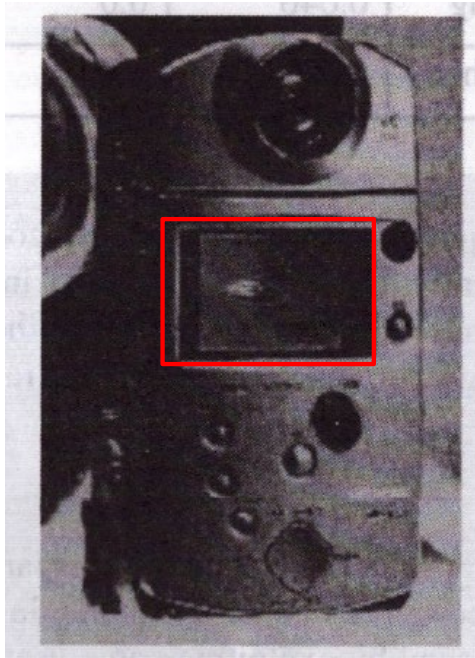
C. Kurashige

70. Kurashige describes a “digital camera to record MPEG-1 video and JPEG still video.” LG-1009 at 1 Abstract. In the block diagram below of Kurashige’s digital camera, Kurashige depicts the flow of data between components of the camera described in Kurashige. *Id.* at 2 fig.1. For example, an

arrow or line between components in the block diagram indicates transmission of data between those components. In the block diagram, Kurashige shows a camera head block, a camera processing block, and a LCD block. *Id.* The camera head block includes a CCD image sensor. *Id.* The camera processing block receives data from the camera head block and includes scanning circuits for both a still picture (JPEG) mode and a moving picture (MPEG) mode. *Id.* at 2 §§2.1–2.2. In the still picture mode, the CCD is driven in a frame or non-line-mixed readout, and in the moving picture mode, the CCD is driven in a line-mixed readout. *Id.* at 2 §2.2. The LCD has a resolution of 279 pixels by 220 pixels, and the LCD block, as shown in the block diagram above, receives data from the camera processing block. *Id.* at 1 tbl.1.



Id. at 2 fig.1. Kurashige describes that its LCD block includes an LCD “to monitor recording image.” *Id.* at 2 §2.5. This LCD is, as shown in the picture below, a **rectangular LCD**. *Id.* at 1.



Id. (annotated).

71. Kurashige provides the digital camera’s specifications in the table below. *Id.* at 1 tbl.1. The image sensor has a resolution of 720 pixels by 480 pixels. *Id.* at 1 tbl.1, 2 §2.1. In the still picture mode, the digital camera produces a 704-pixel by 480-pixel image. *Id.* at 1 tbl.1. And in the movie picture mode, the digital camera produces 352-pixel by 240-pixel imagery.

Table1:Major Specification	
size	83(W) x 143.5(H) x 56(D) mm
weight	385g 540g (Buttery &HDD include)
motion picture	MPEG1(352*240) , IBP / 30fps
still picture	JPEG(704*480)
Audio	MPEG-I layer II
Interface	NTSC analog video PC-CARD (ATA HDD) Hi-Speed Serial (original protocol)
File Format	MS-DOS compatible
Recording capacity	20minute(MPEG system) 3000 photo (260MB HDD) 4hours digital audio
LCD	1.8" TFT (279*220)
PC Adapters	ISA, ECP, SCSI (option)

(home page: <http://www.mpegcam.net>)

Id.

D. Juen

72. Juen is directed to “an electronic camera that records both moving images and still images.” LG-1011 at 1:22–23. Referring to Figure 1 below, Juen discloses an electronic camera 100 including an imaging means 1 that images an object or living subject and converts that image into image information. *Id.* at 3:32–35. A pixel density conversion means 2 converts this image information to a pixel density suitable for a scan format of a display screen. *Id.* at 3:35–38. The electronic camera 100 also includes a moving image recording means 3 that records the output of the imaging means 1 in a recording medium R as a series of moving images and a still image recording means 4 that records the output of the imaging means 1 in the recording medium R as a still image. *Id.* at 3:38–44. Juen describes a display screen 25 that can display image information captured by the

imaging means 1 and converted by the pixel density conversion means 2 to a pixel density compatible with the display screen 25. *Id.* at 3:45–49.

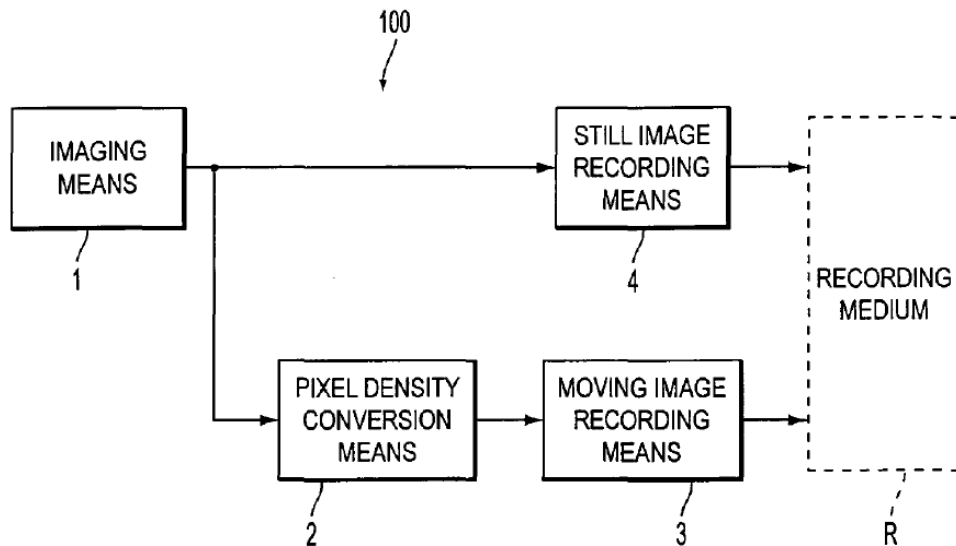


FIG. 1

Id. fig.1.

73. Figure 8 of Juen below shows the **electronic camera 100** including the display screen 25. *Id.* at 3:1–2, 45–49, 5:58–62. Juen describes the **display screen 25** can be an electronic viewfinder and further describes that the display screen 25 can be a monitor screen attached to the case of the electronic camera 100, as shown in Figure 8. *Id.* at 3:49–51. The electronic camera 100 includes (1) an **image recording button 26** for recording lower quality moving images in the moving mode or for recording a higher quality still image in the still mode and (2) a **mode button 27** for switching between the moving mode and the still mode. *Id.* at 6:36–38, 7:36–40, 7:41–8:40, 9:11–17.

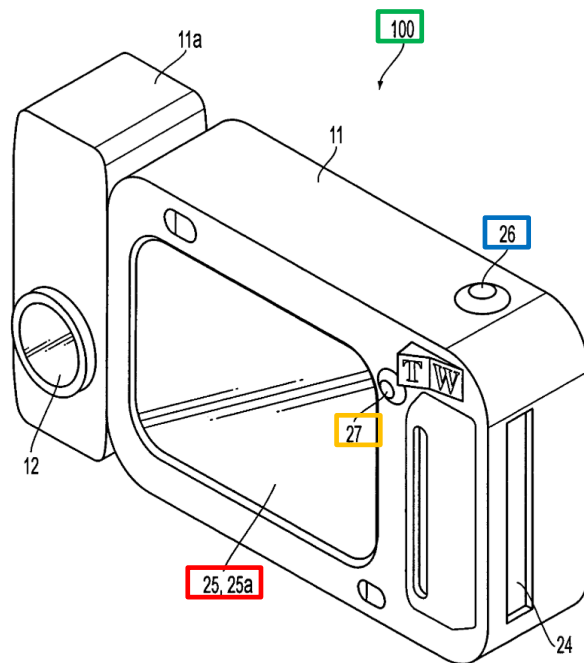


FIG. 8

Id. fig.8 (annotated).

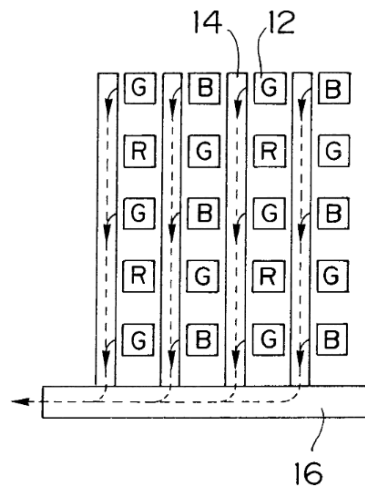
74. Juen's imaging means 1 has a pixel number larger than the scan format of the display screen 25. *Id.* at 3:45–49, 3:64–65. In this regard, the pixel density conversion means 2 reduces the image information produced by the imaging means 1 to a pixel density that is suitable for the scan format of the display screen 25. *Id.* at 3:65–4:1. The image information created in the image means 1 has a pixel density that is higher than the pixel density of the scan format of the display screen 25. *Id.* at 4:1–3; *see also id.* at 4:4–13 (describing that the pixel density is reduced when a moving image is recorded but is kept high when a still image is recorded). For example, an imaging element 13 of the imaging

means 1 is a CCD image sensor and has a pixel resolution of 1280 pixels by 960 pixels. *Id.* at 5:63–6:2. The moving images have a pixel resolution of 640 pixels by 480 pixels. *Id.* at 7:53–59.

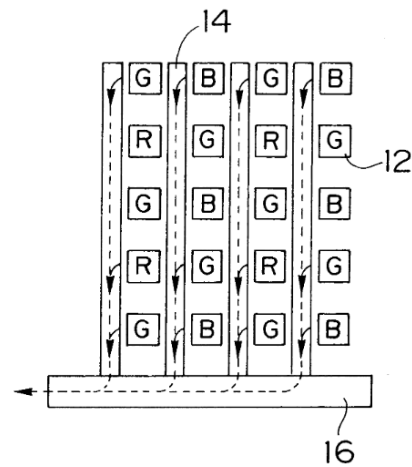
E. Misawa '607

75. Misawa '607 discloses a digital camera 20 including an image sensor or solid-state imaging device and an image display or LCD. LG-1012 at 5:51–60. The imaging device can be a CCD-type imaging device with a resolution of 1280 pixels by 960 pixels, like the resolution of Juen's imaging element 13. *Id.* at 6:16–17. The LCD can have a resolution of approximately 320 pixels by 240 pixels. *Id.* at 8:53–60.

76. Misawa '607 describes examples of driving the imaging device by reducing the number of photoelectric elements of the image sensor read from the image sensor. *Id.* at 4:1–2. For example, to read signals from one half (1/2) of the photoelectric elements 12, every other line of the photoelectric elements 12 is read (Figure 2(a) below), or two horizontal lines are skipped for every two horizontal lines read (Figure 2(b) below). *Id.* at 4:52–53, 5:4–7.



F I G. 2 (a)



F I G. 2 (b)

Id. figs.2(a)–2(b). To read signals from one quarter ($1/4$) of the photoelectric elements 12, three horizontal lines are skipped for every horizontal line read (Figure 3(a) below), or four or two lines are alternately skipped for every one horizontal line read (Figure 3(b) below). *Id.* at 5:12–16, 5:19–23. Misawa '607 describes skipping “two lines or **five** lines alternately,” but Figure 3(b) shows only skipping two or **four** lines alternately. *Id.* at 5:19–20 (emphasis added). A POSITA would have understood that Misawa '607's recitation of “**five** lines” is a typographical error, as alternately skipping two or **four** lines would be the correct line-skipping pattern for reading $1/4$ of the photoelectric elements 12.

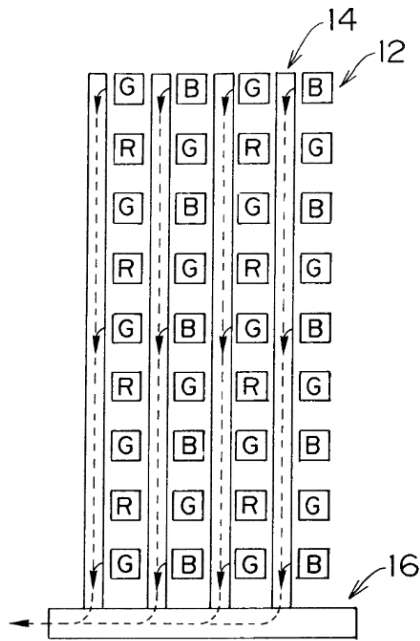


FIG. 3 (a)

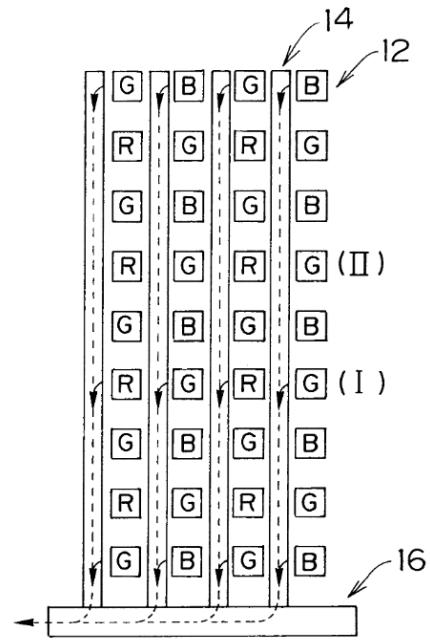
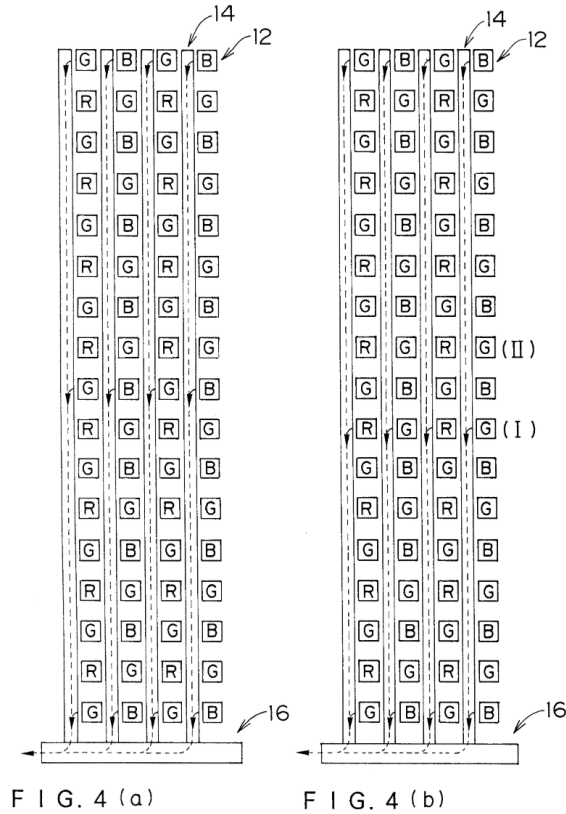


FIG. 3 (b)

Id. figs.3(a)–3(b). Finally, to read signals from one eighth ($1/8$) of the photoelectric elements 12, seven horizontal lines are skipped for every one horizontal line read (Figure 4(a) below), or six or eight horizontal lines are alternately skipped for every one line read (Figure 4(b) below). *Id.* at 5:24–32, 5:36–39.



Id. figs.4(a)–4(b).

77. Misawa '607 describes a normal image-capturing mode in which the imaging device 28 is driven by reading the signals from 1/4 or 1/8 of the photoelectric elements 12, as described above, thereby reading 240 pixel lines if 1/4 of the photoelectric elements are read or 120 pixel lines if 1/8 of the pixel lines are read. *Id.* at 7:52–56, 7:60–65. As Misawa '607 describes, “although the obtained image is rough (if there are 960 pixels in a vertical direction, 240 pixels are read (in 1/4) or 120 pixels are read (in 1/8)), a refresh rate, which is the number of times the images of one screen are refreshed in unit of time, can be high, and a picture composition can be confirmed satisfactorily to the extent that the image is

displayed on the small LCD 40 attached to the digital camera 20.” *Id.* Thus, in this mode, the images can be displayed on the LCD at a relatively high refresh rate. *Id.* at 7:65–8:3. In a macro image-capturing mode, the imaging device is driven by reading 1/2 or all of the photoelectric elements 12. *Id.* at 8:29–32. The macro image-capturing mode enables close range shots between substantially 9 cm and substantially 50 cm. *Id.* at 8:22–24.

78. Misawa ’607 also discloses a shutter release button, a mode switcher or macro key, and a mode setting dial. *Id.* at 7:32–34. Pressing the macro key toggles between the macro image-capturing process and the normal image-capturing process. *Id.* at 8:18–27. As Misawa ’607 describes, “[p]ressing the macro key of the control part 50 sets the camera to the macro image-capturing mode,” and “[a] predetermined mark is displayed on the LCD 40 to indicate the macro image-capturing mode.” *Id.* at 8:19–22. And “[i]f the macro key is pressed again, the macro image-capturing mode is cancelled so that the camera can return to the normal image-capturing mode.” *Id.* at 8:24–27.

IX. ANALYSIS OF MISAWA ’482 IN VIEW OF PARULSKI

A. Misawa ’482-Parulski Combination

79. As a general matter, a POSITA would have found it predictable to combine the teachings of Misawa ’482 and Parulski because both Misawa ’482 and Parulski pertain to digital cameras and describe digital cameras that can be used for

recording movies and still images. LG-1006 at 1:9–14; LG-1007 at 1:9–13. Misawa '482 describes “a digital electronic camera for capturing the image of an object and recording data representative of still and movie images,” LG-1006 at 1:9–14, and Parulski describes “an electronic camera having a ‘motion mode’ for previewing a scene and a ‘still’ mode for capturing a particular image in the scene,” LG-1007 at 1:9–13. Parulski further describes in the “BACKGROUND OF THE INVENTION” section that consumer camcorders with image sensors and LCDs can be used to record analog motion images and record still images. *Id.* at 1:16–24. As Parulski explains, the LCDs can allow a user to properly frame a subject and view images as they are being recorded. *Id.* at 1:27–34. Thus, both Parulski and Misawa describe electronic digital cameras with both a movie image recording function and a static image recording function.

80. A POSITA would have had a motivation to combine the teachings of Misawa '482 and Parulski in several ways. First, a POSITA would have been motivated to replace Misawa '482's image sensor, which has a resolution of 640 pixels by 480 pixels, with Parulski's image sensor, which has a resolution of 768 pixels by 512 pixels. Second, a POSITA would have been motivated to add an LCD, as taught in Parulski, to Misawa '482's camera and use a motion mode, as taught in Parulski, for previewing on the LCD an image to be captured in a still image mode. Third, a POSITA would have been motivated to use a line-skipping

process as taught in Parulski to obtain the movie picture image generated in Misawa '482's movie picture mode.

81. First, as for the image sensor, a POSITA would have been motivated to replace Misawa '482's image sensor with Parulski's higher resolution image sensor. A POSITA would have done so in order to improve the quality of images obtained from the image sensor and improve the quality of these images when displayed on a high-resolution display or printed on a high-quality printer. LG-1007 at 5:5–7. A higher image resolution results in higher quality images. In addition, a higher resolution image sensor can result in higher quality images, particularly when a greater proportion of the pixels of the image sensor are used to produce the corresponding signals for driving the display or to produce the digital image to be printed on the high-quality printer.

82. A POSITA would have been motivated to replace Misawa '482's 4:3 aspect ratio image sensor with Parulski's 3:2 aspect ratio image sensor so that the aspect ratio of the image sensor would match the aspect ratios of the standard 35-millimeter film format and standard 4-inch by 6-inch still prints. *Id.* at 5:57–62. Conventional 35-millimeter film format and standard 4-inch by 6-inch still prints have 3:2 aspect ratios. When capturing still images, digital cameras conventionally captured a full frame from the image sensor. Because digital cameras were intended to substitute for film cameras, users of cameras expected the images

produced using digital cameras to match with images produced using film cameras. Camera users would have desired having the aspect ratio of digital images produced using digital cameras to match the aspect ratio of conventional photography prints. If the aspect ratios matched, a camera user could print a digital image to print media without having to crop or otherwise resize the digital image.

83. Replacing Misawa '482's image sensor with Parulski's image sensor would have had a reasonable expectation of success because both Misawa '482's and Parulski's image sensors are CCDs and thus operate under the same principles and because Parulski's image sensor, as substituted in Misawa '482, would have been used for the same purpose as taught in Parulski—to record images. LG-1006 at 3:17–19; LG-1007 3:38–47, 5:49–53. Digital cameras commonly used image sensors, and the resolutions of these image sensors varied widely. And, CCDs and image sensors were understood to be interchangeable. Moreover, such image sensors could be used for capturing both still images and movies. For example, as Misawa '482 teaches, image sensors, such as CCDs, were known to be usable for producing both still images and moving images. LG-1006 at 3:30–3:38, 6:38–47. A POSITA would have expected image sensors usable for capturing still images to be usable for capturing moving images and vice versa. Moreover, both Misawa '482 and Parulski teach that their image sensors are formed of two-dimensional arrays of pixels, with Misawa '482's image sensor having an imaging

field including 640 pixels in a horizontal direction and 480 lines in a vertical direction and Parulski's image sensor having a two-dimensional array of pixels arranged in rows and columns of image pixels. *Id.* at 2:55–61, 3:30–34; LG-1007 at 5:39–41.

84. Second, as for the LCD, a POSITA would have been motivated to add an LCD, as taught in Parulski, into Misawa '482's digital camera. A POSITA would have made such modification so that the LCD could (1) present a user a preview of an image to be captured in Misawa '482's still picture mode without using complex circuitry, (2) play back previously recorded images without an external monitor, and (3) provide status information or a reconfigurable push-button menu to the user. *See* LG-1007 at 1:27–34, 2:24–53, 3:33–38, 7:41–48; LG-1006 at 1:33–39. LCDs were commonly used in consumer electronic devices to display imagery and provide visual information to a user, including status information about the consumer electronic device. And although consumer electronic devices could be connected to external monitors, built-in monitors for such consumer electronic devices were commonplace. Incorporating Parulski's motion mode in Misawa '482's still image mode would have enabled a user to monitor the image to be captured in the still image mode with a preview image of acceptable quality without requiring complex circuitry. LG-1007 at 2:24–53. Moreover, the display could be used for viewing previously recorded images. *Id.* at

7:43–43. A POSITA would have understood that such displays were used for showing previously recorded still images or previously recorded moving images.

85. The LCD could also be used for presenting information to a user regarding the operation of the camera. *Id.* at 7:43–54. For example, the display can present textual descriptions for the functions of physical buttons on the camera. *See id.* at 7:54–56. And using configuration menus on the camera, a user could reconfigure the functions of the physical buttons on the camera and thereby cause a corresponding change of the descriptive text shown on the display. *See id.* at 7:45–48, 7:52–56.

86. A POSITA would have likewise been motivated to use a preview mode processing circuit and a line-skipping process, as taught in Parulski, to achieve “a relatively less complex digital image processing technique” and “a higher data rate” in the motion mode, to avoid unnecessarily producing high-resolution imagery for the LCD, and to enable more rapid processing of image data. *Id.* at 4:61–5:1, 5:15–24. Specifically, a POSITA would have been motivated to provide two possible processing techniques, a less intensive one for the motion mode that more quickly produces lower quality imagery for display and a more intensive one for the still mode that produces higher quality imagery. *See id.* at 4:61–5:19.

87. A POSITA would have found it desirable for imagery presented on a display to be rapidly refreshed so that a camera user could confirm a composition of image to be captured using the display. For example, as Parulski describes, “the image processing used to create the preview mode is done in the timing and control ASIC 27, since the processing must be done rapidly.” *Id.* at 4:61–63. According to Parulski, “since the image quality of the displayed image is limited by the resolution and color gamut of the LCD screen of the LCD color display 10, there is no need for elaborate image processing.” *Id.* at 4:64–5:1. By comparison, a POSITA would understand image quality to be more important for recorded imagery, as such recorded imagery would be displayed in a physical format larger than a built-in display for a camera. For example, as Parulski describes, “[t]he quality requirements for the still mode are much greater, since these images will be downloaded to a computer, and may be displayed on a high resolution CRT display, or printed on a high quality thermal printer.” *Id.* at 5:4–7. Parulski thus teaches that the digital image processing in the still mode should “be more elaborate” to achieve higher quality imagery in the still mode. *Id.* at 5:8–9.

88. Because Parulski teaches using an image sensor that has more vertically arranged lines (e.g., 512 lines) than the images for monitoring (e.g., 204 lines), a POSITA would have been motivated to use a line-skipping process to eliminate some vertically arranged lines from the image sensor to form monitoring

images. *Id.* at 5:49–52, 7:41–48. For example, Parulski describes that “[a] preferred image sensor is the Kodak model CCD KAI-0400CM image sensor, which has approximately 512 active lines with approximately 768 active pixels per line and an image aspect ratio of 3:2.” *Id.* at 5:49–52. And Parulski describes that, “[a]s the 512 lines of the CCD imager are read out using the special ‘line skipping’ mode, they are displayed using only 204 out of the approximately 240 LCD lines of pixels.” *Id.* at 7:41–43. “The remaining approximately 36 lines can either be masked behind a bezel, so that they are not visible, or preferably may be used to display status information, such as the time-of-day, image number, or a ‘push-button menu’ for the user buttons.” *Id.* at 7:43–48. Because the number of vertically arranged lines for the image sensor is greater than the number of lines for the vertically arranged lines for the LCD, a POSITA would have been motivated to use a line-skipping process to conform the imagery obtained from the image sensor to the number of lines for the monitoring images. *See id.* at 4:42–46, 4:64–5:1 (describing that low-resolution imagery can be used to drive the low-resolution LCD).

89. Both Parulski and Misawa ’482 teach digital cameras that capture still imagery, thus supporting a finding that combining the teachings of Misawa ’482 and Parulski would have had a reasonable expectation of success. For example, Parulski teaches using its LCD and its motion mode in a digital camera that

captures still imagery. *Id.* at 3:29–33. And Misawa '482 similarly teaches capturing still imagery with its digital camera. LG-1006 at 1:9–14, 1:54–58. Thus, incorporating an LCD and a motion mode as taught in Parulski into Misawa '482's camera would have had a reasonable expectation of success.

90. Third, as for the line-skipping process, a POSITA would have been motivated to use a line-skipping process, as taught in Parulski, to generate the movie picture image in Misawa '482's movie picture mode. A POSITA would have done so in order to reduce geometric distortions from obtaining a 4:3 aspect ratio movie picture image from Parulski's 3:2 aspect ratio image sensor, to preserve visual information captured by the image sensor, and to reduce storage requirements for the movie picture image.. *See* LG-1007 at 6:45–50, 7:33–40. A POSITA would have been motivated to incorporate Parulski's line-skipping mode to obtain the movie picture image generated in Misawa '482's movie picture mode so that, in the process of obtaining a 4:3 aspect ratio movie picture image from Parulski's 3:2 aspect ratio image sensor, the resultant movie picture image would have reduced geometric distortions. *Id.* A POSITA would have understood that when the aspect ratio of a desired image does not match the aspect ratio of the image sensor, post-processing of the image signals generated by the image sensor would be required in order to obtain the desired image. Simply cropping the image—by removing the edges of the image—would be a way of achieving the

desired aspect ratio but would reduce the informational value conveyed by the image. *See id.* Moreover, substantial stretching of the image could distort what is shown in the image and thus would be undesirable. *See id.* Thus, a POSITA would have been motivated to use a line-skipping process as taught in Parulski to achieve the desired aspect ratio instead of merely relying on cropping and resizing so as to reduce geometric distortions and increase the informational value of the imagery.

91. A POSITA would have found it desirable to reduce storage requirements for movie pictures. A POSITA would have been motivated to reduce the number of lines, as taught in Misawa '482, to reduce the file size for the movie pictures so as to accommodate memory storage limitations for the digital camera and achieve a higher speed of image capture for the movie pictures. *See* LG-1006 at 1:16–51 (describing the limited storage capacity of memory for digital cameras); LG-1011 at 8:55–53 (describing that memory for a digital camera can have limited capacity). Moreover, a POSITA would have found it desirable to have flexibility in selecting the file size for the movie pictures, e.g., low quality, medium, or high quality. *See* LG-1012 at 3:15–23.

92. Because Misawa '482 and Parulski both teach that image sensors have more vertically arranged lines (480 lines, as taught in Misawa '482, and 512 lines, as taught in Parulski) than the movie picture images (240 lines, as taught in Misawa '482), a POSITA would have been motivated to use a line-skipping

process to eliminate some vertically arranged lines from the image sensor to form the movie picture images. LG-1006 at 7:13–15; LG-1007 at 5:49–52, 7:41–48. A POSITA would have been motivated to select a processing operation that would reduce the number of vertically arranged lines of the image sensor to conform to the desired number of vertically arranged lines for the movie picture images, and would have been specifically motivated to use a line-skipping process as taught in Parulski to achieve this conformance of the vertically arranged lines.

93. These modifications to Misawa '482 would have had a reasonable expectation of success as Parulski teaches using its line-skipping mode with an image sensor like the one taught in Misawa '482 to achieve an aspect ratio akin to the aspect ratio of the movie picture captured in Misawa '482. Misawa '482 teaches using output signals from a CCD-type image sensor to capture a movie picture image, and Parulski similarly teaches implementing its line-skipping mode to process output signals from a CCD-type image sensor. LG-1006 at 2:36–49, 3:17–19; LG-1007 at 5:49–52, 6:15–18, 6:38–45. Parulski teaches using its line-skipping mode to obtain an image having a 4:3 aspect ratio akin to the aspect ratio of the 320-pixel by 240-pixel movie picture obtained in Misawa '482. LG-1007 at 6:45–50; LG-1006 at 7:8–18, 7:33–40.

B. Claim 5

[5.0] “An electric camera comprising:”

94. To the extent the preamble is limiting, Misawa '482-Parulski renders obvious this element. Both Misawa '482 and Parulski describe electric cameras. For example, Misawa '482 discloses a “digital electronic camera 1.” LG-1006 at 2:36–44. Parulski likewise discloses an electronic camera. LG-1007 at 1:9–13.

[5.1] “an image sensing device with a light receiving sensor having an array of pixels arranged vertically and horizontally in a grid pattern, in an N number of vertically arranged pixel lines;”

95. Misawa '482-Parulski renders obvious this element. First, Misawa '482 discloses this feature. Misawa '482's image sensor, which produces pixel signals associated with the optical image, corresponds to *an image sensing device with a light receiving sensor*. LG-1006 at 2:55–61. Moreover, in Misawa '482, the image sensor's array has 640 pixels extending in a horizontal line and 480 horizontal lines extending in a vertical direction (e.g., “*an array of pixels arranged vertically and horizontally in a grid pattern, in an N number of vertically arranged pixel lines*”). *Id.* at 3:30–34.

96. Second, a POSITA would have been motivated to use Parulski's 768-pixel by 512-pixel image sensor in place of Misawa '482's 640-pixel by 480-pixel image sensor. *See supra* Section IX.A (discussing the reasons a POSITA would have substituted Parulski's image sensor for Misawa '482's image sensor). Parulski discloses an image sensor including a two-dimensional array of pixels

arranged in rows and columns and identifies an image sensor having approximately 512 lines with approximately 768 pixels per line as a preferred sensor. LG-1007 at 5:39–41, 5:49–52.

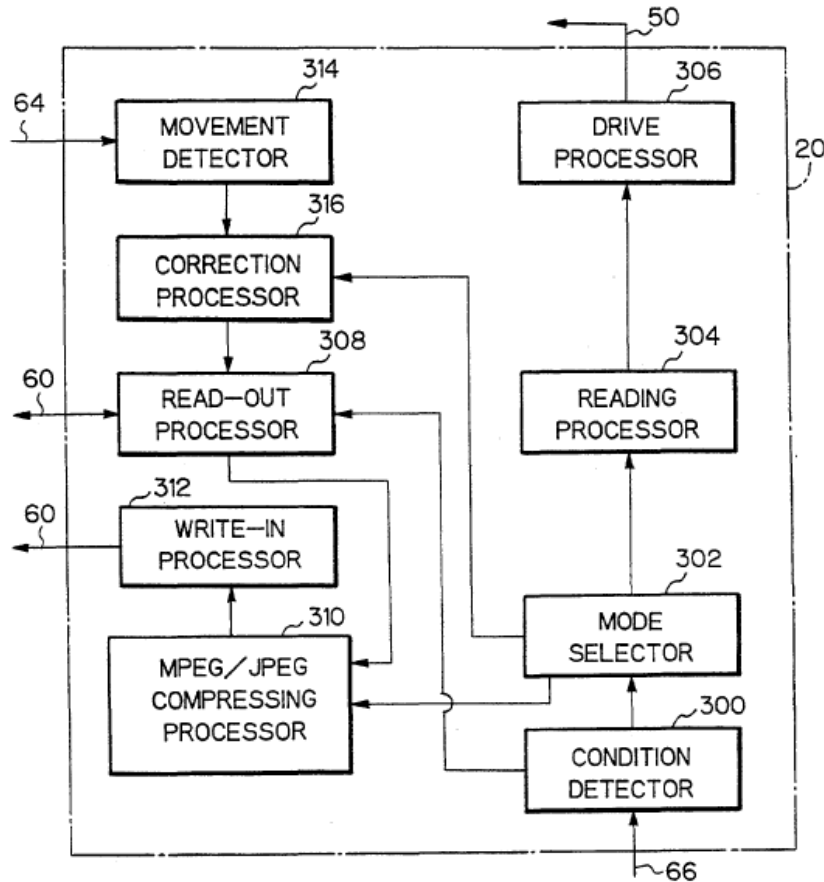
[5.2] “a signal processing unit that generates image signals by processing the output signals of the image sensing device; and”

97. Misawa '482-Parulski renders obvious this element. Misawa '482 discloses the digital electronic camera includes an image signal processor adapted for processing the pixel signals produced by the image sensor to develop image signals representative of the optical image captured, an analog-to-digital converter (ADC) for converting the output from the image signal processor into image data containing corresponding digital values, a frame memory for temporarily storing therein the image data, and a control processor adapted to compress the image data stored in frame memory to record in an optical disk and also to control the overall operations of the digital camera. LG-1006 at 2:55–3:2; *see id.* at 3:39–4:15. For example, the image signal processor “accomplishes image processing onto the pixel signals developed from image sensor 12 to produce suitable image signals.” *Id.* at 3:39–41. The ADC “converts the analog image signals to corresponding digital signals including digital values.” *Id.* at 3:49–51. The frame memory “stores therein the bits of image data” that are “received on input 56 of the frame memory 18” and “are stored in memory 18 on [an] image frame-by-frame basis.” *Id.* at 3:58–61. And the control processor “reads out the image data stored in frame

memory 18 and adapts the readout data to the form of data suitable in recording in optical disk 25” and “controls the overall operations of the circuitry of the digital camera 1,” including compression of image data read out from the frame memory, control of the image sensor, the frame memory, and the record control. *Id.* at 4:1–15.

98. As shown in Figure 3 below, the control processor includes, among other components, a reading processor to set a reading scheme for how electric charges generated by the image sensor are read out, a drive processor that drives the image sensor pursuant to a reading scheme set by a reading processor, a read-out processor that reads out image data stored in the frame memory, a data compressing processor to compress image data transferred from the read-out processor, and a write-in processor that converts image data processed by the data compressing processor to a format appropriate to the optical disk. *Id.* at 6:7–14, 6:38–41, 6:48–54, 6:66–67, 7:49–55, 7:66–8:1, 9:4–5. A POSITA would have understood that Misawa ’482 has *a signal processing unit*—including the image signal processor, ADC, frame memory, and control processor—that *generates image signals by processing output signals of an image sensing device*.

Fig. 3



Id. fig.3.

[5.3] “a display unit with a display screen, that displays an image corresponding to the image signals;”

99. Misawa '482-Parulski renders obvious this element. Misawa '482 discloses capturing an object, recording data representative of still and movie images in a data recording medium, and visualizing the recorded data on an image monitor such as a TV monitor device. *Id.* at 1:9-39.

100. To the extent Misawa '482 does not disclose a display unit with a display screen as part of its camera, Parulski discloses that its image sensor produces images processed by the preview mode processing circuit to generate low resolution, spatially subsampled digital image data to directly drive a LCD that is part of Parulski's camera. LG-1007 at 3:23–26, 4:37–46. For example, Parulski describes that its camera includes an electronic color display, such as a color LCD 10. *Id.* at 3:23–36. And Parulski further describes driving the color LCD 10 with images from the image sensor that are processed by the preview mode processing circuit. For example, in Parulski, the LCD is an electronic color display, such as a color LCD 10. *Id.* at 3:25–27. In Parulski's image mode, the preview mode processing circuit 58 processes images from the image sensor 20. *Id.* at 4:37–38. The preview mode processing circuit 57, in particular, generates low resolution image data that the LCD 10 in turn displays. *Id.* at 4:42–46.

101. Based on this description in Parulski, a POSITA would have understood Parulski's LCD 10 to be a display unit with a display screen—e.g., a display unit including an electronic color display or color LCD. A POSITA would have further understood that Parulski's LCD, by presenting the image data generated by the preview mode processing circuit, displays an image corresponding to image signals generated by Parulski's image sensor.

102. Based on these teachings in Parulski, a POSITA would have been motivated to modify Misawa '482 to include an LCD as a monitor device and to include a preview mode processing circuit that generates image data to drive the LCD. *See id.* at 2:24–53, 3:33–38; *supra* Section IX.A (discussing the reasons why a POSITA would have modified Misawa '482 to include an LCD and to include a preview mode processing circuit).

[5.4] “wherein when recording an image in a static image mode, the signal processing unit generates the image signals by using all signal charges accumulated in all N number of vertically arranged pixel lines of the image sensing device, to provide N pixel lines;”

103. Misawa '482-Parulski renders obvious this element. As discussed above, Misawa '482 discloses an image sensor, or a POSITA would have been motivated to use Parulski's 768-pixel by 512-pixel image sensor in place of Misawa '482's 640-pixel by 480-pixel image sensor. *See supra* Section IX.A (discussing the reasons why a POSITA would have substituted Parulski's image sensor for Misawa '482's image sensor).

104. As taught in Misawa '482, a shutter release button mechanism allows a user to select a still image mode and to select recording of an image in the still image mode. The shutter release button mechanism enables “easy and rapid switching between the still and movie picture modes” and allows a user to choose “an appropriate timing at which he or she intends to capture objective images to achieve easy recording of desired images.” LG-1006 at 11:1–10; *see id.* at 3:9–13.

Manipulation of the shutter release button mechanism causes a first signal to be detected by the control processor, which will in turn select the still picture mode that effects recording of a still picture on the recording medium. *Id.* at 1:59–63. And further manipulation of the shutter release button mechanism causes a second signal to be detected by the control processor, which will in turn select the movie picture mode that effects recording of a movie picture on the recording medium. *Id.* at 1:63–68.

105. For example, in response to a user depressing a shutter button member 74 of the shutter release button mechanism to the position corresponding to the still picture mode, a mode selector 302 selects the still picture mode to cause the reading processor to select a frame transfer mode for reading charges from the image sensor and to record the still picture (e.g., “*when recording an image in a static image mode, the signal processing unit generates the image signals*”). *Id.* at 2:59–63, 4:9–14, 5:9–5:16, 5:54–6:5, 6:23–31. The shutter release button mechanism is responsive to operation of the shutter release button and informs the control processor of when the shutter release button is depressed to allow the image data captured to be recorded on optical disk. *Id.* at 5:9–5:13. And the shutter release button mechanism includes a switch circuit for producing an ON and OFF signal responsive to whether or not the shutter release button is depressed. *Id.* at 5:13–16.

106. A user selects between the still picture mode and the movie picture mode by pressing the shutter button member 74 to different positions. As Misawa '482 describes, the control processor 20 includes a condition detector 300 that delivers first and second condition signals indicative of the still picture mode or the movie picture mode based on the position to which the user depresses the shutter button member 74. *Id.* at 5:54–6:5, 6:15–38. In response to the user depressing the shutter button member 74 to the position corresponding to the still picture mode, the mode selector 302 selects the still picture mode to record the still picture. *Id.* For example, the mode selector 302 is responsive to the condition signals that are delivered from the condition detector 300 to select between the still picture mode and the movie picture mode. *Id.* at 5:23–37.

107. The reading processor is responsive to the mode selected by mode selector 302 to select a reading scheme for how the electric charges generated in the image sensor 12 are read out. *Id.* at 6:38–41. When mode selector 302 selects the still picture mode, the reading processor 304 causes the drive processor 306 to set the frame transfer mode in the image sensor 12. *Id.* at 6:41–44.

108. In the still picture mode and the frame transfer mode, the still image is recorded by reading out image data corresponding to an entire area of the imaging field of the image sensor 12 (e.g., “*generat[ing] the image signals by using all signal charges accumulated in all N number of vertically arranged pixel lines of*

the image sensing device, to provide N pixel lines”). *Id.* at 6:50–54, 7:1–7, 8:60–9:8. Misawa ’482’s still picture mode records the still image by reading out image data corresponding to an entire area of the imaging field of the image sensor 12. *Id.* at 7:1–7, 8:60–9:8. For example, Misawa ’482 describes that in the still picture mode and the frame transfer mode, the drive processor 306 generates a drive signal causing the entire frame of electric charges to be transferred from the photosensitive array 400 of the image sensor 12. *Id.* at 6:50–54. A frame of image data is read out from frame memory 18. *Id.* at 7:1–5. The entire area from the imaging field of the image sensor is read out from frame memory 18. *Id.* at 7:5–7. Because the imaging field of Misawa ’482’s image sensor is a rectangular field with pixels extending in the horizontal direction and lines extending in the vertical direction, reading out an entire frame from the imaging field means that all vertically extending pixel lines of the image sensor are read out. *Id.* at 3:30–35. In other words, all signals from all lines of photosensitive cells of Misawa ’482’s image sensor are used to generate the image signals corresponding to the still image.

109. Alternatively, Parulski discloses a still mode for producing a still image in which all rows of image pixel charges corresponding to each line are progressively read out during a single scan. LG-1007 at 6:27–31. A POSITA would have been motivated to use a still mode as taught in Parulski, e.g., with

Misawa '482's or Parulski's image sensor, so that a high-resolution still image could be produced for display on a high-resolution display. *See supra* Sections IX.B.[5.1], [5.3] (discussing the image sensors and LCDs taught in Misawa '482-Parulski). A POSITA would have been motivated to use Parulski's image sensor with either Misawa '482's still picture mode or Parulski's still mode so that a high-resolution still image could be produced for display on a high-resolution display. Using all the rows of pixels improves the quality of the resultant image, enabling this image to be presented at a higher quality on a high resolution display or to be printed as a high quality image by a high quality printer. LG-1007 at 5:4–9.

110. A POSITA would have found using either Misawa '482's still picture mode or Parulski's still mode with Parulski's image sensor to be predictable and to have a reasonable expectation of success. This combination would have had a reasonable expectation of success because Parulski itself confirms that its image sensor can be driven such that all rows of pixels are read and because Misawa '482 and Parulski's image sensors and still picture modes have similar functions and purposes. LG-1006 at 6:23–31, 7:1–7, 8:60–9:8; LG-1007 at 1:9–13, 3:29–33, 4:35–40, 6:27–31. First, the similarities in function and purpose of Misawa '482 and Parulski's image sensors and still picture modes indicate that this combination would have been predictable and have had a reasonable expectation of success.

Both Misawa '482's and Parulski's still image modes have the same purpose of capturing still images. LG-1006 at 8:60–9:8; LG-1007 at 4:35–40. Capturing these still images in the still image modes in both Misawa '482 and Parulski involves reading all rows of pixels from their image sensors. LG-1006 at 8:60–9:8; LG-1007 at 6:27–31. Both of their image sensors are rectangular image sensors having two-dimensional arrays of pixels. LG-1006 at 2:55–61, 3:30–34; LG-1007 at 5:39–41. Second, Parulski itself confirms that its image sensor can be used in a still picture mode that reads all rows of pixels from the image sensor. LG-1007 at 6:27–31. Furthermore, a POSITA would have understood that a common way of driving an image sensor is to read all electric charges generated by the image sensor so as to maximize the amount of information in the output of image sensor.

[5.5] “wherein when monitoring the image in the static image mode, the signal processing unit generates the image signals by using pixel lines that have been mixed or culled from the N number of vertically arranged pixel lines to only include pixel lines separated from one another by intervals of a first distance; and”

111. Misawa '482-Parulski renders obvious this element. In Parulski, a multiplexer 64 selects image data from the preview mode processing circuit 58, implementing the motion mode, to drive the LCD. LG-1007 at 4:33–34, 4:56–60, fig.2. The multiplexer 64 selects between this image data from the preview mode processing circuit 58 and output from a high speed interface 56 that allows for “suitably preprocessed viewing of stored images.” *Id.* at 4:56–60.

112. In the motion mode, the preview mode processing circuit produces a preview image prior to capturing the still image from the image sensing device and then storing signals indicative of the still image on a memory card (e.g., “*when monitoring the image in the static image mode, the signal processing unit generates the image signals*”). *Id.* at 1:9–13, 2:25–31, 3:40–47, 9:26–41. A POSITA would have been motivated to modify Misawa ’482, based on the teachings of Parulski, to include a motion mode for monitoring a still image to be captured and to use a line-skipping process in this motion mode (e.g., “*generates the image signals by using pixel lines that have been mixed or culled from the N number of vertically arranged pixel lines*”). See *supra* Section IX.A (discussing the reasons why a POSITA would have modified Misawa ’482 to include a motion mode and line-skipping process as taught in Parulski).

113. Moreover, a POSITA would have been motivated, based on the teachings of Parulski, to select any line-skipping pattern that involves cyclically or alternately skipping one or more consecutive lines for every one or more consecutive lines that are read (e.g., “*only include pixel lines separated from one another by intervals of a first distance*”). Parulski teaches skipping lines to reduce the number of lines for an image to be presented on a display, and teaches reducing the number of lines in the output from the image sensor.

114. For example, to drive the display in the motion mode, Parulski implements a line-skipping process that, as discussed above, can involve (1) eliminating some lines, LG-1007 at 6:32–34, (2) cyclically eliminating two or more consecutive vertically arranged lines of image charge from the image sensor for every one or more vertically arranged lines of image charge transferred to the horizontal register, *id.* at 6:38–43, (3) alternately eliminating two or four consecutive lines of image charge for every pair of lines of image charge that are transferred to the horizontal register, *id.* at 6:45–50, or (4) cyclically eliminating one pair of lines for every four pairs of lines read out from the image sensor 20, *id.* at 10:5–10. *See supra* Section VIII.B (discussing the numerous line-skipping processes taught in Parulski). Parulski therefore teaches both cyclically skipping the same number of lines and alternately skipping by a first number of lines or a second number of lines. LG-1007 at 6:38–43, 10:5–10 (describing cyclic skipping); *id.* at 6:45–50 (describing alternate skipping). Parulski similarly teaches the concept of reading one, two, or more consecutive lines between skipped lines. *Id.* at 6:38–43 (one or more read lines); *id.* 6:45–50, 10:5–10 (two read lines). Parulski thus establishes that line-skipping processes and their line-skipping patterns were well-understood in the art.

115. A POSITA would have been motivated to select a line-skipping pattern based on the use case of the imagery and the processing specifications for

that imagery. *See supra* Section IX.A (discussing the reasons why a POSITA would have used line-skipping processes for generating monitoring imagery and movie picture imagery); *infra* Section IX.B.[5.6] (discussing the reasons why a POSITA would have selected particular line-skipping patterns for imagery). For example, if a user intended for the imagery to only be displayed on a small display with a low resolution, a POSITA would have been motivated to select a line-skipping pattern that eliminates more lines. *Cf.* LG-1007 at 1:25–34 (describing display sizes for camcorders can vary). By comparison, if a user intended for the imagery to be displayed on a larger integrated display with a high resolution, a POSITA would have been motivated to select a line-skipping pattern that eliminates fewer lines. *Cf.* LG-1006 at 9:15–27 (describing playback on large screens). Moreover, if imagery presented on a display is to be continuously refreshed (e.g., so that a user could use the display for monitoring a composition of a picture to be captured), a POSITA would have been motivated to skip lines to achieve a desired refresh rate. *See* LG-1012 at 7:65–8:3.

116. Such a selection would have had a reasonable expectation of success, at least because a POSITA would have known how to adapt hardware and software to vary the precise number of skipped lines and read lines. *See* LG-1007 at 2:24–39 (describing that the motion preview mode involves “a relatively more simple digital image processing technique”). A POSITA would have found selecting a

particular line-skipping pattern to be predictable and to have had a reasonable expectation of success. Line-skipping processes, as a POSITA would have understood, could be applied to any image sensor configured as an array including lines of pixels, such as Misawa '482's image sensor or Parulski's image sensor. A POSITA would have additionally understood how to adapt, for example, a preview mode processing circuit as described in Parulski to vary the precise number of skipped lines and read lines. *See id.* at 2:24–39 (describing that the motion preview mode involves “a relatively more simple digital image processing technique”). A POSITA would have understood that the circuitry or the software could be adjusted to achieve the desired line-skipping pattern. *See id.* at 4:61–5:19.

117. Moreover, a POSITA would have been able to easily calculate, using well-known mathematical analysis, the number of resulting lines from selecting a particular line-skipping pattern, and thus, based on the teachings of Parulski, would have found any cyclic line-skipping pattern to be predictable and to have been easy to integrate into a signal processing unit for an image sensing device. The selected line-skipping pattern would not have to generate pixel lines that exactly correspond to the resolution of the display. For example, interpolation systems for resizing the final image to be displayed on the display were well-known. *See, e.g.*, LG-1006 at 7:25–29; LG-1018 at 2:44–3:55. And a POSITA would have found it predictable to adapt Misawa '482's signal processing unit so that it could perform the line-

skipping methods taught in Parulski, as Misawa '482's signal processing unit and Parulski's processing system perform similar functions, including conversion between analog and digital signals, control of camera components, storage of image signals, and readout from the image sensor. See LG-1006 at 2:62–3:7, 3:58–66, 4:1–15; LG-1007 at 3:48–4:5, 6:27–50.

118. Based on the teachings of Parulski, a POSITA would have known to use a line-skipping process that involves cyclically skipping one or more consecutive lines for every one or more consecutive lines that are read (e.g., “*only includ[ing] pixel lines separated from one another by intervals of a first distance*”). See *infra* Section IX.B.[5.6].

[5.6] “wherein when recording the image in a moving video mode, the signal processing unit generates the image signals by using a portion of, or the entirety of, pixel lines which have been mixed or culled from the N number of vertically arranged pixel lines to only include pixel lines separated from one another by intervals of a second distance, where the second distance is different from the first distance.”

119. Misawa '482-Parulski renders obvious this element. As discussed above, Misawa '482's movie picture mode generates a movie picture image (e.g., “*when recording the image in a moving video mode, the signal processing unit generates the image signals*”). LG-1006 at 7:8–15; see *supra* Section VIII.A (describing the movie picture mode in Misawa '482). The shutter release button mechanism enables a user to select the movie picture mode and choose “an appropriate timing at which he or she intends to capture objective images” in the

movie picture mode. LG-1006 at 11:1–10; *see supra* Section IX.B.[5.4] (describing use of the shutter release mechanism in Misawa '482 to select between a movie picture mode and a still image mode). As discussed above, the user can manipulate the shutter release button mechanism to cause the second signal to be detected by the control processor, which will in turn select the movie picture mode that effects recording of a movie picture on the recording medium. LG-1006 at 1:63–68; *see supra* Section IX.B.[5.4].

120. For example, in response to the user depressing the shutter button member of the shutter release button mechanism to the position corresponding to the movie picture mode, the mode selector 302 selects the movie picture mode to cause the reading processor to select a field transfer mode for reading charges from the image sensor to record the movie picture in the optical disk (e.g., “*when recording the image in a moving video mode, the signal processing unit generates the image signals*”). LG-1006 at 1:59–68, 3:2–7, 4:9–14, 5:9–5:16, 5:54–6:5, 6:23–65; *see supra* Section IX.B.[5.4]. When the mode selector 302 selects the movie picture mode, the reading processor 304 causes the drive processor 306 to set the frame transfer mode in the image sensor 12. LG-1006 at 6:44–47.

121. In the movie picture mode and the field transfer mode, pixel signals are transferred from the image sensor on an interlaced field transfer basis. *Id.* at 1:68–2:4; *see id.* at 6:44–58, 9:27–34. A POSITA would have understood that

transferring signals from Misawa '482's 640-pixel by 480-pixel image sensor in the interlaced field transfer basis would have involved generating a field of lines in which every other line of the image sensor is read and thus would have involved generating image signals by using a portion of, or the entirety of, pixel lines which have been culled from the 480 pixel lines of the image sensor. *Id.* at 3:30–38, 6:44–58, 9:27–34. A POSITA would have understood that the interlaced field transfer process described in Misawa '482 would involve generating two fields of lines from the image sensor, with the first field corresponding to the odd-numbered lines and the second field corresponding to the even-numbered lines. *See, e.g.*, LG-1019 at 4:35–42. A POSITA would have understood that, in Misawa '482, either the first field or the second field produced in the interlaced field transfer process would correspond to *a portion of, or the entirety of, pixel lines which have been culled from* the 480 vertically arranged lines in Misawa '482's image sensor. And although Misawa '482 discloses that the movie picture image has a resolution of 320 pixels by 240 pixels corresponding to the smaller area 402, LG-1006, 3:30-38, 7:8-15, Misawa '482 describes that this 320-pixel by 240-pixel area corresponds to a part of image data read out from the frame memory, *id.* at 6:66-7:1, 7:7-15. This operation of reading out image data *from the frame memory* is separate from the operation of transferring electric charges *from the image sensor* in the interlaced field transfer basis, *id.* at 6:48-49, 6:54-58, 6:66-7:1, 7:7-15, and it is this latter

operation that involves *generating image signals by using a portion of, or the entirety of, pixel lines which have been culled from the N number of vertically arranged pixel lines of the image sensing device.*

122. Alternatively, a POSITA would have found “*generating the image signals by using a portion of, or the entirety of, pixel lines which have been mixed or culled from the N number of vertically arranged pixel lines*” to be obvious in view of the teachings of Misawa ’482 and Parulski. Misawa ’482 teaches the movie picture image read out from the frame memory has a reduced resolution relative to the resolution of the image sensor. LG-1006 at 7:8–15. In one example, Misawa ’482 teaches that the movie picture image has a resolution of 320 pixels by 240 pixels—an image with a 4:3 aspect ratio. *Id.* at 3:30–38, 7:8–15, figs.4A–4B. An aspect ratio is calculated by dividing the generally larger horizontal pixel dimension by the smaller vertical dimension. The aspect ratio for the movie picture is therefore 320 divided by 240, or 4:3.

123. Parulski teaches using its line-skipping process so that a greater portion of its image sensor’s 3:2 aspect ratio image can be displayed as an image having a 4:3 aspect ratio and so that the displayed image has fewer geometric distortions. *See* LG-1007 at 6:45–50, 7:8–11, 7:33–40. In one example of a line-skipping process, Parulski describes that “[a]n appropriate video signal which displays the entire 3:2 aspect ratio sensor image on the 4:3 aspect ratio LCD,

without introducing geometric distortion, is generated by alternately eliminating two or four consecutive lines of image charge for every pair of lines of image charge that are transferred to the horizontal register 70.” *Id.* at 6:45–50. In another example of a line-skipping process, Parulski describes “[t]o provide an image to the color LCD display 10, a lower resolution image is suitable, but the update rate must be sufficient to provide good motion rendition and eliminate display flicker.” *Id.* at 7:8–11; *see id.* at 7:11–26. And in this example, “[t]his special ‘line skipping’ readout mode, as shown in FIG. 7, allows the sensor’s 3:2 aspect ratio image to be fully displayed on a 4:3 aspect ratio LCD without ‘geometric distortion’, that is, without stretching the image vertically, and without cropping off the horizontal edges of the image from the image sensor.” *Id.* at 7:33–38. According to Parulski, “[t]his allows the LCD to properly show the entire 3:2 aspect ratio image captured by the sensor, so that an image can be properly composed.” *Id.* at 7:38–40.

124. A POSITA would have been motivated to combine Misawa ’482 and Parulski to use a line-skipping process to generate a 4:3 aspect ratio movie picture from the 3:2 aspect ratio image sensor (“*generating the image signals by using a portion of, or the entirety of, pixel lines which have been mixed or culled from the N number of vertically arranged pixel lines*”). *See supra* Section IX.A (describing the reasons why a POSITA would have used a line-skipping process to generate a

movie picture). And for the reasons discussed above with respect to Element [5.5], a POSITA would have been motivated, based on the teachings of Parulski, to select any line-skipping pattern that involves cyclically or alternately skipping one or more consecutive lines for every one or more consecutive lines that are read (e.g., “*only include pixel lines separated from one another by intervals of a second distance*”). See *supra* Section IX.B.[5.5],

125. A POSITA would have additionally been motivated for *the second distance* (for recording the image in the moving video mode) *to be different from the first distance* (for monitoring the image in the static image mode) and would have been motivated to use different skipping patterns in line-skipping processes for recording the image in the movie video mode and for monitoring the image in the static image mode. A POSITA would have understood that the desired number of lines for monitoring imagery would differ from the desired number of lines for recorded moving video imagery. A POSITA would have been motivated to select the distances for monitoring a still image and capturing a movie picture so that the culled number of vertically arranged pixel lines more closely approximates the desired number of vertically arranged pixel lines, e.g., for the portion of the display for monitoring or for the movie picture. A POSITA would have been motivated to select a larger second distance (for monitoring) and a smaller first distance (for capturing the movie picture) so that, during monitoring, the culled number of

vertically arranged pixel lines more closely resembles the desired number of vertically arranged pixel lines for monitoring on the display (e.g., 204 lines) and, during capture of the movie picture, the culled number of vertically arranged pixel lines more closely resembles the desired number of vertically arranged pixel lines for recording the moving video (e.g., 240 lines). Indeed, as a POSITA would have understood, eliminating lines would be used for the very purpose of achieving the specific geometry and aspect ratio of the final format, e.g., a display aspect ratio and geometry, as Parulski confirms. *See* LG-1007 at 7:33–40. A larger distance would result in a fewer number of lines, and a smaller distance would result in a greater number of lines. Because the number of lines for monitoring is fewer than the number of lines for video capture, a POSITA would have been motivated to have a larger distance for the monitoring, i.e., a larger “first distance.”

126. Because Misawa '482 and Parulski teach a desired number of vertically arranged pixel lines for monitoring (204 lines, as taught in Parulski) is fewer than a desired number of vertically arranged pixels for recording the movie picture (240 lines, as taught in Misawa '482, or 256 lines—one half of the number of lines of Parulski's image sensor—as Misawa '482 and Parulski suggest when considered together), a POSITA would have been motivated to eliminate more pixel lines for monitoring images and eliminate fewer pixel lines for movie picture images. LG-1007 at 7:41–48; LG-1006 at 7:13–15. Parulski teaches using 204

vertically arranged pixel lines for monitoring. LG-1007 at 7:41–48. And Misawa '482 teaches using 240 pixel lines for movie picture images. LG-1006 at 7:13–15. Misawa '482 also suggests using one half of the vertically arranged pixel lines of its image sensor for recording the movie picture images. *Id.* at 3:30–38, 7:8–15, figs.4A–4B. Thus, in Parulski, where the image sensor has 512 vertically arranged lines, Misawa '482 suggests using 256 vertically arranged lines—one half of 512—for recording movie picture images. *See* LG-1007 at 5:49–52. In this regard, Misawa '482 and Parulski together suggest using a number of vertically arranged pixel lines for monitoring (e.g., 204 lines, as taught in Parulski) that is fewer than a number of vertically arranged pixels for recording the movie picture (e.g., 240 lines, as taught in Misawa '482, or 256 lines, as Misawa '482 and Parulski suggest when considered together). Based on this, a POSITA would have been motivated to use line-skipping processes that eliminate more pixel lines for monitoring images and eliminate fewer pixel lines for movie picture images.

127. Moreover, a POSITA would have been motivated to select different first and second distances to satisfy the different requirements for monitoring imagery and recorded movie picture imagery. For example, a POSITA would have understood that the image quality for movie picture imagery is more important than the image quality for monitoring imagery. A POSITA would have desired improving the quality for the recorded movie picture, avoiding unnecessary

processing for the low-quality imagery to be displayed during monitoring, and using fewer lines for monitoring to reserve space on the display for status and operational information to the user. Because the movie picture is recorded for playback, users would want a higher quality movie picture, particularly as compared to the monitoring imagery that is only presented to the user so that the user can confirm the composition for a full frame of imagery to be captured in the static image mode. LG-1006 at 7:19–28; LG-1007 at 7:8–11. And as Parulski describes, it would have been beneficial to reserve lines on the display for status information, such as time-of-day, image number, a push-button menu, and/or text indicating the functions of a reconfigurable control buttons. LG-1007 at 7:41–61.

128. A POSITA would have found selecting a smaller first distance and a larger second distance to have been predictable and to have had a reasonable expectation of success. A POSITA would have understood that selecting the distance could involve simple, well-known mathematical operations based on the initial number of vertically arranged pixel lines (the number of vertically arranged pixels lines of the image sensor) and the desired number of vertically arranged pixel lines (e.g., the desired number of vertically arranged pixel lines for the movie picture or the desired number of vertically arranged lines for the monitoring imagery). A POSITA would have understood that the desired number of vertically arranged pixel lines could vary depending on the specific use case, which as

discussed above, could implicate differing processing requirements for recording movie pictures and monitoring the static image to be captured, differing uses of the movie picture (e.g., for playback) and the monitoring imagery (e.g., for confirmation of a picture composition on a small built-in LCD), and differing space requirements (e.g., ensuring the selected number of lines for the monitoring imagery reserves space for a status bar).

129. Based on Misawa '482-Parulski, a POSITA would have been motivated and would have found predictable (for the reasons discussed above) several different combinations of values for the first distance and the second distance. For example, one predictable combination would involve culling 204 vertically arranged lines for monitoring, as expressly taught in Parulski, and culling 240 vertically arranged lines for recording the movie picture, as expressly taught in Misawa '482. *See supra* Sections VIII.A–B, IX.A.

130. Another predictable combination would involve using a line-skipping process to cull 170 vertically arranged lines for monitoring by skipping two lines for every one line read out—a line-skipping pattern expressly taught in Parulski and thus expressly motivated by Parulski's teachings—and culling 256 vertically arranged lines for the movie picture by skipping one line for every one line read out—a line-skipping pattern that a POSITA would have known to use in view of the numerous variations of line-skipping patterns expressly taught in Parulski or in

view of the interlaced field transfer method taught in Misawa '482. LG-1006, 3:30-38, 6:44-58, 9:27-34; LG-1007 at 6:32-34, 6:38-43, 6:45-50, 10:5-10; *see supra* Sections VIII.B, IX.B.[5.5]. Additionally, line skipping of one line for every line read out (or every other line) was universally known to the POSITA as it had been the basis of processing video for all television formats worldwide in a format known as field interlace (e.g., the format generated using the interlaced field transfer process described in Misawa '472). *See* LG-1006 at 1:68-2:4, 6:44-58, 9:27-34. If a POSITA were to cull 170 pixel lines for monitoring imagery, a POSITA would have understood that these 170 pixel lines could be presented on the display taught in Parulski, as Parulski's display has 240 pixel lines. The remaining 70 pixel lines could be reserved for the status bar or for other operational information to be presented on the display. LG-1007 at 7:41-48. Indeed, it would have been predictable to use any proportion of pixels for display of the status bar and any proportion of pixels for display of the monitoring imagery. In other words, if the culled number of pixel lines for monitoring imagery is less than the number of pixel lines available on the display, a POSITA would have understood that the remaining pixel lines on the display after pixel lines are allocated for display of the monitoring imagery could be used for displaying the status bar.

131. Furthermore, a POSITA would have understood that the resolution of display could be altered to accommodate a desired number of lines for monitoring imagery and a desired number of lines for the status bar. For example, it would have been predictable for a POSITA to have selected a lower resolution display with fewer pixel lines if 170 pixel lines were culled for monitoring imagery in order to obtain a more compact and cheaper digital camera. Displays increase in cost as the resolutions of the displays increase. Thus, using a lower resolution display would reduce the cost of the display, and hence reduce the overall cost of producing the digital camera. A POSITA would have further understood that a compact digital camera would benefit from being more portable for users.

132. A POSITA additionally would have been motivated to use a read-one-skip-one line-skipping pattern in order to obtain a movie picture with one half of the vertical and horizontal pixel dimensions of the image sensor. Indeed, Misawa '482 expressly teaches obtaining a movie picture with one half of the vertical and horizontal pixel dimensions of the image sensor, describing that its movie picture image has a resolution of 320 pixels by 240 pixels while its image sensor has a resolution of 640 pixels by 480 pixels. LG-1006 at 3:30–38, 7:8–15, figs.4A–4B. A POSITA would have been further motivated to use a read-one-skip-one line-skipping pattern in order to obtain a movie picture with one half of the vertical and horizontal pixel dimensions of the image sensor. Such a proportion

between the resolution of a recorded image and the resolution of the image sensor was well known. For example, Misawa '482 expressly teaches such a proportion by describing that its movie picture image has a resolution of 320 pixels by 240 pixels while its image sensor has a resolution of 640 pixels by 480 pixels. LG-1006 at 3:30–38, 7:8–15. Juen also teaches an image sensor having a resolution that is twice the size of the effective resolution of a National Television System Committee (NTSC) standard. *See* LG-1011 at 5:66–6:2.

C. Claim 6

[6.0] “An electric camera according to the claim 5, further comprising: an image-instability detector which detects an image-instability of the electric camera; and”

133. Misawa '482-Parulski renders obvious this element. Misawa '482 discloses a movement sensor 26, e.g., a piezo-electric gyroscopic transducer, that senses how the camera physically moves and produces corresponding electric signals that represent an unintentional movement or vibration of the camera body. LG-1006 at 4:60–5:8.

[6.1] “wherein when recording in the moving video mode, in order to correct the image-instability, the signal processing unit generates the image signals by changing the pixel lines used, and the portion of the pixel lines used, according to an amount of image-instability detected by the instability detector.”

134. Misawa '482-Parulski renders obvious this element. Misawa '482 describes that correction data generated by a correction processor includes correction values to shift an area 402 corresponding to the portion of the imaging

field 400 of the image sensor 12 used for capturing the movie (e.g., “*when recording in the moving video mode, in order to correct the image-instability, the signal processing unit generates the image signals*”). LG-1006 at 8:7–24, 9:49–10:2. In particular, in response to a movement signal generated by the movement sensor 26, the correction processor generates the correction data to compensate for blur due to camera movement when the camera is used to take a movie, and the correction data is generated based on camera movement with both horizontal and vertical components (e.g., “*by changing the pixel lines used, and the portion of the pixel lines used, according to an amount of image-instability detected by the instability detector*”). *Id.* at 8:10–21.

135. A POSITA would have understood that by shifting the area 402 in response to movement with both horizontal and vertical components, Misawa ’482’s correction processor changes the pixel lines used and the portion of the pixel lines used. A POSITA would have understood that by shifting the area 402 both horizontally and vertically, Misawa ’482’s correction processor changes the pixel lines used and the portion of the pixel lines used. For example, Misawa ’482 describes that the “[c]orrection data includes correction values by which area 402 is to be shifted in position and which is calculated on the basis of the moving amount and directional data included in the movement data.” *Id.* at 8:21–24. Misawa ’482 therefore contemplates a user’s unintentional camera

movement that includes both a horizontal component and a vertical component. *Id.* In such a circumstance, to correct for the unintentional camera movement, the shift of the area 402 would also include both a horizontal component and a vertical component. The horizontal component of the shift in area 402 would result in a change in the vertically arranged pixel lines that are used to capture the movie picture. The vertical component of the shift in area 402 would result in a change in the portion of the vertically arranged pixel lines (e.g., the columns of pixels that are used to capture the movie picture).

D. Claim 7

[7.0] “An electric camera according to the claim 5, wherein a value of the first distance is larger than a value of the second distance.”

136. *See supra* Section IX.B.[5.6].

E. Claim 8

[8.0] “An electric camera according to the claim 5, wherein N is equal to or greater than a product of a fixed parameter multiplied by a number of effective scanning lines M of the display screen.”

137. Misawa '482-Parulski renders obvious this element. A POSITA would have been motivated to use Parulski's 768-pixel by 512-pixel image sensor and Parulski's 312-pixel by 240-pixel LCD. *See supra* Sections IX.A, IX.B.[5.1], [5.3]. A POSITA would have understood that Parulski's number of vertically arranged lines on its image sensing device (512 lines) is greater than a product of the number of scanning lines of its display (240 lines) and a fixed parameter, i.e.,

any parameter less than 512 divided by 240 (2.133). A POSITA would have understood that scanning lines of a display are typically horizontal. Thus, for Parulski's display—which has 240 horizontal lines, or said another way, 240 vertically arranged lines—the number of effective scanning lines M would be 240. A POSITA would have understood that Parulski's number of vertically arranged lines on its image sensing device (512 lines) is greater than a product of the number of scanning lines of its display (240 lines) and a fixed parameter. This fixed parameter could be any value less than 512 divided by 240 (2.133).

F. Claim 9

[9.0] “An electric camera according to the claim 8, wherein the fixed parameter is equal to three.”

138. Misawa '482-Parulski renders obvious this element. Although the number of vertically arranged lines on Parulski's image sensing device (512 lines) is less than three times a product of the number of scanning lines of its LCD (240 lines), a POSITA would have been motivated to use a lower resolution display screen that would satisfy this limitation.

139. A POSITA would have been motivated to use a display with a smaller resolution, e.g., any display with fewer than 170.7 vertically arranged lines, so that the digital camera could be more compact and so that the display would be less expensive. Smaller resolution displays generally can have smaller physical dimensions, thus allowing the display to be more compact. Moreover, smaller

resolution displays are generally less expensive. Modifying the LCD to have a smaller resolution would have been straightforward, as it would have involved a simple substitution of a display with a fewer number of scanning lines without any change to the function or purpose of the display. LG-1007 at 2:31–35.

140. A POSITA would have been motivated to decrease the number of vertically arranged lines to a value below 512 divided by 3—170.7 vertically arranged lines. Displays increase in cost as the resolution of the display increases. Thus, using a lower resolution display would reduce the cost of the display, and hence reduce the overall cost of producing the digital camera. A POSITA would have further understood that a compact digital camera would benefit from being more portable for users. Reducing the physical size of the display of the digital camera would allow the overall size of the digital camera to decrease. When the size of the display decreases, the resolution requirements for the display similarly decrease, as a user would be less able to perceive the sharpness of the image presented on the display—thus reducing the need for a high display resolution—as the physical size of the display decreases.

G. Claim 10

[10.0] “A method for operating an electric camera, wherein the electric camera includes the features of an image sensing device with a light receiving surface having an array of pixels arranged vertically and horizontally in a grid pattern with an N number of vertically arranged pixel lines, a signal processing unit that generates image signals by processing the output signals of the image sensing

device, and a display unit with a display screen that displays an image corresponding to the image signals, the method comprising:”

141. See *supra* Sections IX.B.[5.0]–[5.3].

[10.1] “selecting between a static image mode and a moving video mode, and when in the static image mode, selecting an operation from a list including (1) recording the image in the static image mode, and (2) monitoring the image in the static image mode;”

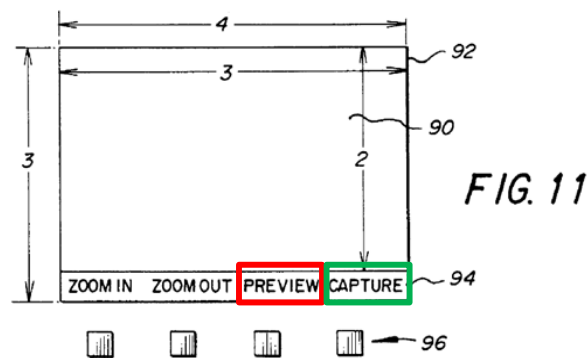
142. Misawa ’482-Parulski renders obvious this element. For example, in Misawa ’482, the user selects between the still picture mode and the movie picture mode by pressing the shutter button member 74 to different positions, and the mode selector 302 in turn selects between the still picture mode and the movie picture mode based on the position to which the user depresses the shutter button member 74 (e.g., “*selecting between a static image mode and a moving video mode*”). LG-1006 at 5:23–37, 5:54–6:5, 6:15–38. The shutter release button mechanism enables “easy and rapid switching between the still and movie picture modes” and allows a user to choose “an appropriate timing at which he or she intends to capture objective images to achieve easy recording of desired images” in either the still image mode or the movie picture mode. *Id.* at 11:1–10; *see id.* at 3:9–13.

143. Misawa ’482’s control processor 20 includes the condition detector 300 that delivers first and second condition signals indicative of the still picture mode or the movie picture mode based on the position to which the user

depresses the shutter button member 74. *Id.* at 5:54–6:5, 6:15–38; *see supra* Section VIII.A. In response to the user depressing the shutter button member 74 to the position corresponding to the still picture mode, the mode selector 302 selects the still picture mode to record the still picture. LG-1006 at 5:54–6:5, 6:15–38. And in response to the user depressing the shutter button member 74 to the position corresponding to the movie picture mode, the mode selector 302 selects the movie picture mode to record the movie picture. *Id.* The mode selector 302, for example, is responsive to the condition signals that are delivered from the condition detector 300 to select between the still picture mode and the movie picture mode. *Id.* at 5:23–37.

144. Parulski discloses a user control section having user control buttons, including a preview button and a capture button. LG-1007 at 3:25–33. The user turns on the camera using a power switch by depressing zoom buttons or a preview button, then composes the picture by repositioning the camera while observing the display image. *Id.* at 3:29–36. And as shown in Figure 11 of Parulski below, Parulski's status area 94 shows text indicating the functions of reconfigurable control buttons 96, including a “**PREVIEW**” function and a “**CAPTURE**” function. *Id.* at 7:48–53. Parulski describes that the user turns on the camera using a power switch by depressing zoom buttons or a preview button, then composes the picture by repositioning the camera while observing the display image. *Id.* at

3:29–36. A user depresses the capture button corresponding to the “CAPTURE” text to cause a processor of the camera to capture (i.e., record) a still image (e.g., “selecting an operation from a list including (1) recording the image in the static image mode”). *Id.* at 3:37–40, 3:60–67, 9:26–28. Specifically, in response to the user depressing the capture button, a digital processor 36 temporarily stores the still images in a DRAM memory 38, then performs image processing on the still images, and then finally stores the processed images on the removable memory card 26 via a memory card interface circuit 40. *Id.* at 3:60–67.



Id. fig.11 (annotated).

145. Based on the teachings of Parulski, a POSITA would have understood that a user depresses the *preview* button described with the accompanying text “PREVIEW” in the status area 94 to cause the preview mode processing circuit and the multiplexer to select a *preview* function that corresponds to the preview mode described throughout Parulski, i.e., the motion mode for monitoring a still image to be captured on the LCD. *Id.* at 4:33–34, 4:56–60, fig.2. Indeed, Parulski

expressly describes that the preview button can be used to turn on the camera so that a user can compose a picture by repositioning the camera while observing the display image. *See id.* at 3:29–36. Moreover, Parulski uses the term “preview” to describe the process of generating preview images in Parulski’s motion mode. *See, e.g., id.* at 4:18–21, 4:33–34, 4:42–54, 4:61–64, 5:1–3, 8:44–48, 9:4–7. A POSITA would therefore have understood Parulski—when describing a “preview” button—as referring to a button that initiates the preview or motion mode for providing preview images that a user can view before operating the camera to record a still image.

146. Based on the teachings of Parulski, a POSITA would have been motivated to modify Misawa ’482 to include Parulski’s preview button and to include the “PREVIEW” and “CAPTURE” text on the LCD corresponding to the preview button and a capture button (e.g., Misawa ’482’s shutter button member 74). A POSITA would have been motivated to make this modification to improve user handling of the camera and to provide status information to the user. *See id.* at 2:19–21, 7:43–48. For example, the preview button would provide an easily accessible user interface element operable by a user to control the monitoring functionality of the camera. The preview button would also permit a user to selectively activate or deactivate the monitoring functionality of the camera. To conserve the digital camera’s battery life, the user could deactivate the

monitoring functionality so that the display is not being driven to provide monitoring images. Furthermore, the button labels on the display allow the user to more easily determine the function of the corresponding buttons. Using the display for button labels would allow the labels to change if the function of a button is changed, e.g., in response to a change to a user-selected setting of the camera or in response to a change in a mode of the camera. A POSITA would have had a reasonable expectation of success of modifying Misawa '482 in this manner because Misawa '482 contemplated user interface buttons on its camera, e.g., the shutter release button 74, and because Parulski teaches using its buttons and its LCD—including the status area—in a digital camera akin to Misawa '482's camera. *See id.* at 3:25–33; *supra* Section IX.A. Physical user interface buttons on consumer electronic devices were common. Furthermore, LCDs that present status information were well known and well understood.

[10.2] “upon selecting the operation of recording the image in the static image mode, using the signal processing unit to generate the image signals by using all signal charges accumulated in all N number of vertically arranged pixel lines of the image sensing device, to provide N pixel lines;”

147. *See supra* Sections IX.B.[5.4], IX.G.[10.1].

[10.3] “upon selecting the operation of monitoring the image in the static image mode, using the signal processing unit to generate the image signals by using pixel lines which have been mixed or culled from the N number of vertically arranged pixel lines of the image sensing device to provide only pixel lines separated from one another by intervals of a given distance; and”

148. *See supra* Sections IX.B.[5.5], IX.G.[10.1].

[10.4] “upon selecting the operation of recording the image in the moving video mode, using the signal processing unit to generate the image signals by using a portion of, or the entirety of, the N number of vertically arranged pixel lines which have been mixed or culled to provide only pixel lines separated from one another by intervals of a second distance, wherein a value of the second distance is different from a value of the first distance.”

149. See *supra* Sections IX.B.[5.6], IX.G.[10.1].

H. Claim 11

[11.0] “11. A method for operating an electric camera of claim 10, wherein when recording in the moving video mode, in order to correct image-instability, the signal processing unit generates the image signals by changing the pixel lines used, and the portion of the pixel lines used, according to an amount of image-instability detected by a instability detector which detects an image-instability of the electric camera.”

150. See *supra* Sections IX.C.[6.0]–[6.1].

I. Claim 12

[12.0] “A method for operating an electric camera of claim 10, wherein the value of the first distance is larger than the value of the second distance.”

151. See *supra* Section IX.D.[7.0].

J. Claim 13

[13.0] “A method for operating an electric camera of claim 10, wherein N is equal to or greater than a product of a fixed parameter multiplied by a number of effective scanning lines M of the display screen.”

152. See *supra* Section IX.E.[8.0].

K. Claim 14

[14.0] “A method for operating an electric camera of claim 13, wherein the fixed parameter is equal to three.”

153. See *supra* Section IX.F.[9.0].

X. ANALYSIS OF KURASHIGE IN VIEW OF PARULSKI

A. Kurashige-Parulski Combination

154. A POSITA would have been motivated to modify Kurashige to use a line-skipping process, as taught in Parulski, , or a line-mixing process, as taught in Kurashige, to obtain the imagery presented on Kurashige's LCD for monitoring the recording of images and to obtain the imagery for capturing the motion picture using Kurashige's camera. A POSITA would have been motivated to incorporate a line-skipping or a line-mixing process to reduce geometric distortions and preserve visual information captured using the image sensor in the resulting monitoring and motion picture images—which have aspect ratios that do not match the 3:2 aspect ratio of Kurashige's image sensor. *See* LG-1007 at 6:45–50, 7:33–40; *supra* Section IX.A (discussing the reasons why a POSITA would have used a line-skipping process for generating monitoring imagery and for generating movie picture imagery).

155. Moreover, a POSITA would have been further motivated to use a line-skipping or line-mixing process to eliminate or mix some of the vertically arranged lines from the image sensor in forming the monitoring images and in forming the moving picture images. Kurashige's image sensor has 480 vertically arranged pixel lines. LG-1009 at 218 tbl.1. Parulski teaches 204 vertically arranged pixel lines for monitoring. LG-1007 at 7:41–48. And Kurashige teaches that the display has 220

vertically arranged lines and the moving picture recording produces images having 240 vertically arranged lines. LG-1009 at 218 tbl.1. Based on this, a POSITA would have understood that the number of vertically arranged lines for monitoring is 220 lines or fewer—i.e., the number of vertically arranged lines on the display or fewer. Because the image sensor has more vertically arranged lines (480 lines, as taught in Kurashige) than the images formed in monitoring (fewer than 220 lines, as taught in Kurashige, or 204 lines, as taught in Parulski) and in motion picture recording (240 lines, as taught in Kurashige), a POSITA would have been further motivated to use a line-skipping process to eliminate or mix some of the vertically arranged lines from the image sensor in forming the monitoring images and forming the motion picture images.

156. For a line-skipping process, a POSITA would have been motivated to select a quantity of lines eliminated for every one or more lines of image charges that is read or a quantity of lines cyclically mixed to generate pixel lines suitable for the monitoring and motion picture images. *See* LG-1007 at 4:42–46, 6:38–45; *supra* Section IX.A (describing the reasons why a POSITA would have implemented in line-skipping processes to generate monitoring imagery and motion picture imagery). Kurashige expressly teaches going from 480 lines on its image sensor to 240 lines for its motion picture images by using a line-mixing readout process. LG-1009 2 §§2.1–2.2. A POSITA would have understood this

line-mixing readout process to involve cyclically mixing two consecutive lines to achieve the 240 lines for the motion picture images. A POSITA would additionally have been motivated to select a quantity of lines to be cyclically mixed to generate pixel lines suitable for monitoring and motion picture images for reasons similar to those discussed above with respect to monitoring—e.g., to achieve a desired number of lines suitable for the resultant imagery. *See supra* Section IX.A.

157. A POSITA would have found such a modification to be predictable and would have had a reasonable expectation of success in making such modifications. Kurashige teaches using output signals from a CCD-type image sensor to capture a monitoring image and a motion picture image, and Parulski similarly teaches implementing line-skipping processes to generate output signals from a CCD-type image sensor. LG-1009 at 1 tbl.1, 2 §§2.1–2.2, 2.5, 2 fig.1; LG-1007 at 5:49–52, 6:15–18, 38–45. Moreover, both Kurashige and Parulski pertain to digital cameras, and thus a POSITA would have found it predictable to implement teachings from Parulski into Kurashige. LG-1007 at 1:9–13; LG-1009 at 1 Abstract.

B. Claim 5

[5.0] “An electric camera comprising:”

158. To the extent that the preamble is limiting, Kurashige-Parulski renders obvious this element. Kurashige discloses a digital camera. LG-1009 at 1 Abstract. As does Parulski. LG-1007 at 1:9–13.

[5.1] “an image sensing device with a light receiving sensor having an array of pixels arranged vertically and horizontally in a grid pattern, in an N number of vertically arranged pixel lines;”

159. Kurashige-Parulski renders obvious this element. Kurashige’s image sensor is a quarter-inch sized “720*480 Inter Line CCD.” LG-1009 at 2 §2.1. A POSITA would have understood this image sensor to be *an image sensing device with a light receiving sensor*.

160. A POSITA would have further understood that the 720-pixel by 480-pixel dimensions of the image sensor disclosed in Kurashige indicates that Kurashige’s image sensor has *an array of pixels arranged vertically and horizontally in a grid pattern*, with a horizontal pixel dimension being 720 pixels and a vertical pixel dimension being 480 pixels. The dimensions indicated for a CCD correspond to a horizontal pixel dimension and a vertical pixel dimension. Moreover, the pixels of CCDs are conventionally arranged in a rectangular array. *See, e.g.*, LG-1007 at 5:39–52; LG-1011 at 5:66–6:2; LG-1006 figs.4A–4B; LG-1012 figs.7–9. Thus, in reviewing Kurashige’s disclosure of a “720*480” image sensor, a POSITA would have understood Kurashige to be describing that its

image sensor has a horizontal pixel dimension of 720 pixels and a vertical pixel dimension of 480 pixels. Kurashige's image sensor therefore has 480 vertically arranged pixel lines.

161. Alternatively, a POSITA would have been motivated, based on the teachings of Parulski, to configure Kurashige's image sensor to have *an array of pixels arranged vertically and horizontally in a grid pattern, in an N number of vertically arranged pixel lines*. Parulski teaches that its image sensor can be a CCD and includes a two-dimensional array of pixels arranged in rows and columns. LG-1007 at 5:39–41, 49–52. A POSITA would have been motivated to arrange the pixels of Kurashige's image sensor in the form of an array, as taught in Parulski, so that the captured information could be more easily mapped onto an image area for rectangular LCDs (such as Kurashige's rectangular display) or for an image area for rectangular photographic prints. *See id.* at 6:57–62, 7:48–51. A POSITA would have known that a conventional arrangement of pixels for LCDs was a rectangular array. *See, e.g., id.* at 6:57–62, 7:48–51; LG-1011 figs.15–17; LG-1012 figs.7–9.

162. Such an arrangement would have been predictable and have had a reasonable expectation of success, as Kurashige's image sensor is a CCD and a two-dimensional arrangement of pixels, as taught in Parulski, is a conventional arrangement for CCDs. *See* LG-1007 at 5:39–41, 5:49–52; *see also* LG-1011 at 5:66–6:2; LG-1006 figs.4A–4B; LG-1012 figs.7–9.

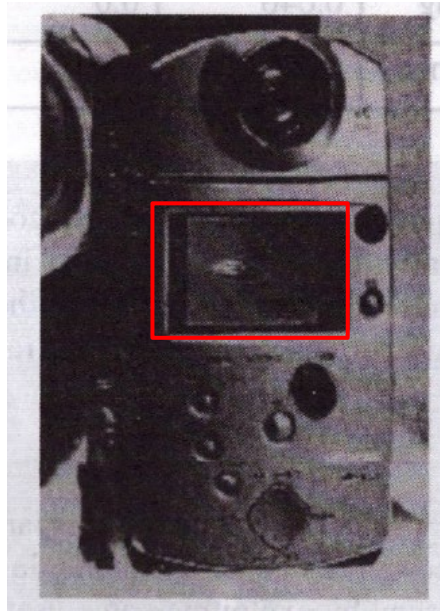
[5.2] “a signal processing unit that generates image signals by processing the output signals of the image sensing device; and”

163. Kurashige-Parulski renders obvious this element. Kurashige’s camera processor block outputs pictures in the motion picture mode or pictures in a still picture mode. LG-1009 at 2.2. As shown in Figure 1 of Kurashige, a CDS (a correlated double sampling block) receives output signals generated by the CCD, and then the camera processing block receives the output signals of the CDS. *Id.* at 2 fig.1. A POSITA would have understood that “CDS” refers to “correlated double sampling.” See, e.g., LG-1020 at 2:10–13. A POSITA would have further understood that the arrow directed from the CCD to the CDS in the block diagram of Kurashige indicates the direction that output data from the CCD is transmitted to the CDS block.

164. In Kurashige, the camera processing block includes CCD scanning circuits for capturing the pictures in the MPEG mode and the JPEG mode, and a POSITA would have understood that these scanning circuits produce scanning pulses for driving the scanning process of the CCD. LG-1009 at 2 §2.2, 2 fig.1. In this regard, a POSITA would have understood that Kurashige has *a signal processing unit*, including the CDS and the camera processing block, *that generates image signals by processing the output signals of the image sensing device.*

[5.3] “a display unit with a display screen, that displays an image corresponding to the image signals;”

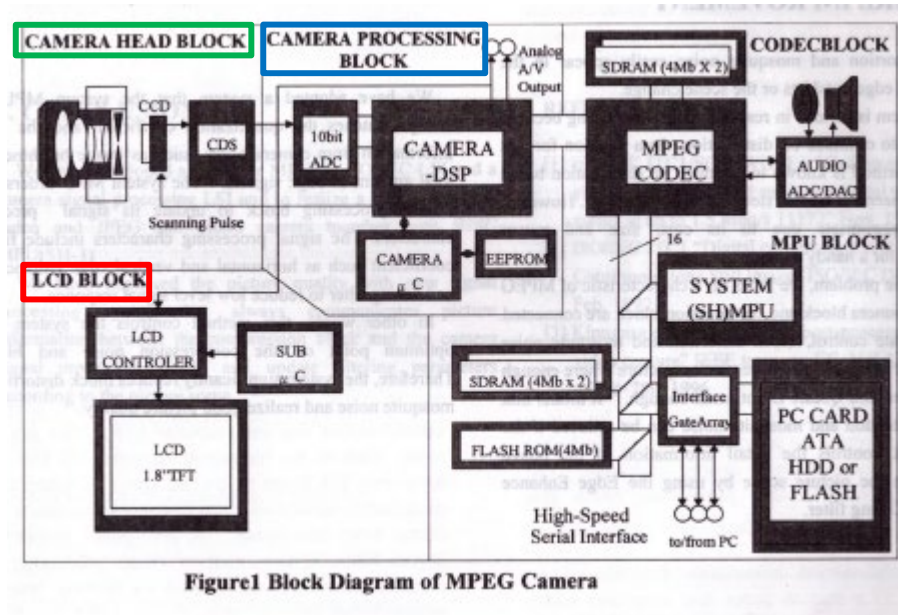
165. Kurashige-Parulski renders obvious this element. As shown in the figure below, Kurashige’s camera includes a 1.8-inch thin-film-transistor **LCD** (e.g., “a display unit with a display screen”) that has a resolution of 279 pixels by 220 pixels. LG-1009 at 1 tbl.1, 2 §2.5. A POSITA would have understood “TFT” to be an abbreviation of “thin-film-transistor.” LG-1021 at 1:13–15.



LG-1009 at 1 (annotated).

166. Kurashige describes that this LCD “is used to monitor recording image, and [to] playback image.” *Id.* at 2 §2.5. As shown in the block diagram below, the **LCD block** of Kurashige’s camera—which includes a LCD controller and a LCD—receives signals from the **camera processing block**, which in turn receives signals generated by the **camera head block** that includes the CCD. *Id.* at

2 fig.1. A POSITA would have understood that the LCD *displays an image corresponding to image signals generated by the signal processing unit*, which includes Kurashige's camera processing block. *See supra* Section X.B.[5.2] (describing the signal processing unit in Kurashige). In the block diagram, the arrow directed from the "DSP" block (digital signal processor) to the LCD controller in the LCD block indicates that output data from the DSP block is transmitted to the LCD controller. The arrow directed from the LCD controller to the LCD indicates that output data from the LCD controller is transmitted to the LCD. A POSITA would have understood that the LCD controller would produce signals to drive the LCD to cause the LCD to display an image. A POSITA therefore would have understood that the LCD *displays an image corresponding to image signals* generated by a signal processing unit in Kurashige, which includes the camera processing block.



LG-1009 at 2 fig.1 (annotated).

[5.4] “wherein when recording an image in a static image mode, the signal processing unit generates the image signals by using all signal charges accumulated in all N number of vertically arranged pixel lines of the image sensing device, to provide N pixel lines;”

167. Kurashige-Parulski renders obvious this element. Kurashige discloses that *when recording an image in a static image mode a signal processing unit generates image signals*. For example, a user operates Kurashige’s camera so that a readout mode for the CCD scanning circuits is selected to generate a still picture in the JPEG format. LG-1009 at 1 tbl.1, 2 §2.2.

168. A POSITA would have been motivated, based on the teachings of Parulski, to modify Kurashige’s camera such that Kurashige’s camera generates the image signals by *using all signal charges accumulated in all N number of vertically arranged pixel lines of the image sensing device, to provide N pixel lines*.

The still picture produced using Kurashige's camera has a resolution of 704 pixels by 480 pixels, while Kurashige's image sensor has a resolution of 720 pixels by 480 pixels. *Id.* at 1. Parulski describes that in its still mode for producing a still image, all rows of image pixel charge corresponding to each line are progressively read out during a single scan. LG-1007 at 6:27–31.

169. A POSITA would have been motivated to modify Kurashige to produce a still image in this manner—by reading all rows of image pixel charges—so that the aspect ratio of the still picture produced by Kurashige's image sensor would be a 3:2 aspect ratio consistent with the aspect ratio of traditional still photography prints produced from 35 mm film format. *Id.* at 5:4–7; *see supra* Section IX.A. This modification would also be desirable to improve the quality of images obtained from the image sensor and improve the quality of these images when displayed on a high-resolution display or printed on a high-quality printer. LG-1007 at 4:35–37, 5:49–52; *see supra* Section IX.A.

170. Such a modification would have had a reasonable expectation of success because Kurashige's and Parulski's image sensors and still image modes have the same purpose of capturing still images. LG-1009 at 1 Abstract, 1 tbl.1, 2 §2.2; LG-1007 at 1:9–13, 3:29–33. In particular, Kurashige and Parulski both provide still image capture modes, and both use their image sensors to capture the still images in this still image capture mode. LG-1009 at 1 Abstract, 1 tbl.1, 2 §2.2;

LG-1007 at 1:9–13, 3:29–33. A POSITA would have understood that Kurashige’s device, as modified, would include a 720-pixel by 480-pixel image sensor that produces a 720-pixel by 480-pixel still image and therefore would *generate image signals by using all signal charges accumulated in all N number of vertically arranged pixel lines of an image sensing device, to provide N pixel lines*, as taught in Parulski.

[5.5] “wherein when monitoring the image in the static image mode, the signal processing unit generates the image signals by using pixel lines that have been mixed or culled from the N number of vertically arranged pixel lines to only include pixel lines separated from one another by intervals of a first distance; and”

171. Kurashige-Parulski renders obvious this element. Kurashige’s “LCD is used to monitor recording image.” LG-1009 at 2.5. A POSITA would have understood that Kurashige’s camera uses its 720-pixel by 480-pixel image sensor to produce image signals to drive its lower-resolution 279-pixel by 220-pixel LCD (e.g., “*when monitoring the image in the static image mode, the signal processing unit generates the image signals*”). See *id.* at 1 tbl.1, 2 §2.5, 2 fig.1; *supra* Sections X.B.[5.1], [5.3].

172. Because a POSITA would have been motivated to use a line-skipping or a line-mixing process to eliminate some of the 480 vertically arranged lines from the image sensor to form a monitoring image with fewer vertically arranged lines (fewer than 220 lines, as taught in Kurashige, or 204 lines, as taught in

Parulski), a POSITA would have been motivated to modify Kurashige to include a motion mode for monitoring a still image to be captured and to use a line-skipping or line-mixing process in this motion mode (e.g., “*generates the image signals by using pixel lines that have been mixed or culled from the N number of vertically arranged pixel lines*”). See *supra* Sections IX.B.[5.5], X.A.

173. Moreover, a POSITA would have been motivated, based on the teachings of Parulski, to select any line-skipping or line-mixing pattern that involves cyclically or alternately skipping one or more consecutive lines for every one or more consecutive lines that are read or that involves cyclically mixing two or more consecutive lines (e.g., “*only include pixel lines separated from one another by intervals of a first distance*”). See *supra* Section IX.B.[5.5]; *infra* Section X.B.[5.6].

174. Additionally, to the extent that Kurashige does not disclose *a signal processing unit generating image signals when monitoring the image in the static image mode*, a POSITA would have been motivated to add to Kurashige a motion mode as taught in Parulski. A POSITA would have been motivated to include such a motion mode so that a preview of the still image to be captured in Kurashige could be presented to the user without using complex circuitry. See LG-1007 at 1:27–34, 2:24–53. Incorporating Parulski’s motion mode in Kurashige’s still image mode would have enabled a user to monitor the image to be captured in the still

image mode with a preview image of acceptable quality without requiring complex circuitry. *Id.* at 2:24–53. Moreover, the display could be used for viewing previously recorded images. *Id.* at 7:43–43. A POSITA would have understood that such displays were used for showing previously recorded still images or previously recorded moving images. The display could also be used for presenting information to a user regarding the operation of the camera. *Id.* at 7:43–54. For example, the display can present textual descriptions for the functions of physical buttons on the camera. *See id.* at 7:54–56. And using configuration menus on the camera, a user could reconfigure the functions of the physical buttons on the camera and thereby cause a corresponding change of the descriptive text shown on the display. *See id.* at 7:45–48, 52–56.

175. Parulski teaches using its motion mode in a digital camera that captures still imagery, and thus incorporating a motion mode into Kurashige’s camera—which itself is a digital camera and is used for monitoring—would have had a reasonable expectation of success. LG-1009 at 1 Abstract, 2 §2.5; LG-1007 at 3:29–33.

[5.6] “wherein when recording the image in a moving video mode, the signal processing unit generates the image signals by using a portion of, or the entirety of, pixel lines which have been mixed or culled from the N number of vertically arranged pixel lines to only include pixel lines separated from one another by intervals of a second distance, where the second distance is different from the first distance.”

176. Kurashige-Parulski renders obvious this element. Kurashige’s CCD scanning circuits are used in the motion picture mode to produce a motion picture (e.g., “when recording the image in a moving video mode, the signal processing unit generates image signals”). LG-1009 at 1 tbl.1, 2 §2.2.

177. Kurashige teaches that its motion picture has a resolution (352 pixels by 240 pixels) that is less than the resolution of its image sensor (720 pixels by 480 pixels). *See id.* at 1 tbl.1, 2 §§2.1–2.2. A POSITA would have been motivated to use a line-skipping process, as taught in Parulski, or a line-mixing process, as taught in Kurashige, for producing Kurashige’s 240-line motion picture image from signals generated by the 480-line image sensor (e.g., “generat[ing] the image signals by using a portion of, or the entirety of, pixel lines which have been mixed or culled from the N number of vertically arranged pixel lines”). *See supra* Section X.A. And for the reasons discussed above with respect to Element [5.5], a POSITA would have been motivated to select any line-skipping pattern that involves cyclically or alternately skipping one or more consecutive lines for every one or more consecutive lines that are read or line-mixing pattern that involves cyclically mixing two or more consecutive lines (e.g., “only include pixel lines

separated from one another by intervals of a second distance”). See *supra* Sections IX.B.[5.5], X.B.[5.5].

178. A POSITA would additionally have found it predictable for *the second distance* (for recording the image in the moving video mode) *to be different from the first distance* (for monitoring the image in the static image mode) and would have been motivated to use different skipping or mixing patterns in line-skipping or line-mixing processes for recording the image in the motion picture mode and for monitoring the image in the still image mode. The same image sensor—Kurashige’s 720-pixel by 480-pixel image sensor—would be used to produce both the images for monitoring and the images for the motion picture. And these images for monitoring have a different resolution than the images for the motion picture. In particular, Kurashige and Parulski teach a number of vertically arranged lines for monitoring (220 or fewer lines in Kurashige and 204 lines in Parulski) that is fewer than a number of vertically arranged pixel lines for recording a motion picture (240 lines in Kurashige). LG-1009 at 1 tbl.1; LG-1007 at 7:41–48. A POSITA therefore would have found it predictable for *the second distance* (for recording the image in the moving video mode) *to be different from the first distance* (for monitoring the image in the static image mode) and would have been motivated to use different line-skipping patterns in line-skipping processes or line-mixing patterns in line-skipping processes for recording the

image in the motion picture mode and for monitoring the image in the still image mode.

179. A POSITA would have been motivated to select the distances for monitoring a still image and capturing a movie picture so that the resultant number of vertically arranged pixel lines—e.g., the culled number of lines or the number of lines resulting from mixing—more closely approximates the desired number of vertically arranged pixel lines, e.g., for the portion of the display for monitoring or for the movie picture. *See* Section IX.B.[5.6]. Because Kurashige and Parulski teach a desired number of vertically arranged lines for monitoring (204 lines in Parulski) that is fewer than a desired number of vertically arranged pixel lines for recording a motion picture (240 lines in Kurashige), a POSITA would have been motivated to eliminate more pixel lines for monitoring images and eliminate fewer pixel lines for movie picture images. LG-1009 at 1 tbl.1; LG-1007 at 7:41–48. Parulski teaches using 204 vertically arranged pixel lines for monitoring. LG-1007 at 7:41–48. Kurashige teaches monitoring images that have 220 or fewer vertically arranged pixel lines. *See supra* Section X.B.[5.5]. Kurashige teaches using 240 vertically arranged lines for recording movie picture images. LG-1009 at 2 §2.1. Kurashige also suggests using one half of the vertically arranged pixel lines of its image sensor for recording the movie picture images. *See id.* at 1 tbl.1, 2 §2.1. Thus in Parulski, where the image sensor has 512 vertically arranged lines,

Kurashige suggests using 256 vertically arranged lines—one half of 512—for recording movie picture images. *See* LG-1007 at 5:49–52. In this regard, Kurashige and Parulski together suggest using a number of vertically arranged pixel lines for monitoring (e.g., 204 lines, as taught in Parulski, or fewer than 220 lines, as taught in Kurashige) that is fewer than a number of vertically arranged pixels for recording the movie picture (e.g., 240 lines, as taught in Kurashige, or 256 lines, as Kurashige and Parulski suggest when considered together). A POSITA would accordingly have been motivated to use line-skipping or line-mixing processes that eliminate or mix more pixel lines for monitoring images and eliminate or mix fewer pixel lines for movie picture images.

180. A POSITA would have been motivated to select a smaller first distance for recording the movie picture and a larger second distance for monitoring to improve the image quality of the recorded movie picture, to avoid unnecessary processing for the low-quality imagery to be displayed during monitoring, and to reserve space on the display for status and operational information for the user during monitoring. *See supra* Section IX.B.[5.6]. Selecting a smaller first distance and a larger second distance would have been predictable and have had a reasonable expectation of success, as a POSITA would have understood that well-known mathematical operations could be used for selecting a

distance that culls or mixes vertically arranged lines in a manner that closely approximates the desired number of lines. *See supra* Section IX.B.[5.6].

181. A POSITA would have been motivated and would have found predictable (for the reasons discussed above) several different combinations of values for the first distance and the second distance. For example, one predictable combination would involve culling or mixing to achieve 204 vertically arranged lines for monitoring, as expressly taught in Parulski, and culling or mixing to achieve 240 vertically arranged lines for recording the movie picture, as expressly taught in Kurashige. *See supra* Sections VIII.B–C, X.A. Another predictable combination would involve obtaining 170 vertically arranged lines for monitoring (e.g., by skipping two lines for every one line read out—a line-skipping pattern taught in Parulski and thus expressly motivated by Parulski’s teachings) and obtaining 256 vertically arranged lines for the movie picture (e.g., by skipping one line for every one line read out—a line-skipping pattern that a POSITA would have known to use in view of the numerous variations of line-skipping patterns expressly taught in Parulski—or by mixing 512 lines into 256 lines for the movie picture as taught in Kurashige). LG-1007 at 6:32–34, 6:38–43, 6:45–50, 10:5–10; LG-1009, 2 §§2.1-2.2; *supra* Sections VIII.B, IX.B.[5.6]. Indeed, in this combination, a POSITA would have been motivated to use a read-one-skip-one line-skipping pattern or a mix-two line-mixing pattern in order to obtain a movie

picture with one half of the vertically arranged pixel lines of the image sensor, a proportion that Kurashige, for example, expressly teaches by describing that its movie picture image has 240 vertically arranged pixel lines while its image sensor has 480 vertically arranged pixel lines. LG-1009 at 1 tbl.1; *see supra* Section IX.B.[5.6].

C. Claim 7

[7.0] “An electric camera according to the claim 5, wherein a value of the first distance is larger than a value of the second distance.”

182. *See supra* Section X.B.[5.6].

D. Claim 8

[8.0] “An electric camera according to the claim 5, wherein N is equal to or greater than a product of a fixed parameter multiplied by a number of effective scanning lines M of the display screen.”

183. Kurashige-Parulski renders obvious this element. The number of vertically arranged lines on Kurashige’s image sensor (480 lines) is greater than a product of the number of scanning lines of Kurashige’s display (220 lines) and a fixed parameter, where the fixed parameter could be any value less than 2.18. LG-1009 at 1 tbl.1, 2 §2.1. A POSITA would have understood that the horizontal lines in Kurashige’s display are scanning lines. Thus, for Kurashige’s display—which has 220 horizontal lines, or said another way, 220 vertically arranged lines—the number of effective scanning lines M would be 220. A POSITA would have understood that Kurashige’s number of vertically arranged lines on its image

sensing device (512 lines) is greater than a product of the number of scanning lines of its display (220 lines) and a fixed parameter. This fixed parameter could be any value less than 512 divided by 220 (2.18).

E. Claim 9

[9.0] “An electric camera according to the claim 8, wherein the fixed parameter is equal to three.”

184. Kurashige-Parulski renders obvious this element. Although the number of vertically arranged lines on Kurashige’s image sensor (480 lines) is less than three times a product of the number of scanning lines of its LCD (240 lines), a POSITA would have been motivated to use a lower resolution display screen that would satisfy this limitation. A POSITA would have been motivated to use a display with a smaller resolution, e.g., any display with 160 or fewer vertically arranged lines, so that the digital camera would be more compact and so that the display would be less expensive. For example, a POSITA would have been motivated to use a display with a smaller resolution so that the digital camera could be more compact and less expensive. Specifically, a POSITA would have been motivated to decrease the number of vertically arranged lines to a value equal to or less than 480 divided by 3—160 vertically arranged lines. Displays increase in cost as the resolution of the display increases. Thus, using a lower resolution display would reduce the cost of the display, and hence reduce the overall cost of producing the digital camera. A POSITA would have further understood that a

compact digital camera would benefit from being more portable and from being easier for users to carry around. Reducing the size of the display of the digital camera would allow the overall size of the digital camera to decrease. When the size of the display decreases, the resolution requirements for the display similarly decrease, as a user would be less able to perceive the sharpness of the image presented on the display as the size of the display decreases. Modifying the resolution and the size of Kurashige's LCD would have been straightforward, as different-sized LCDs were well known in the art. *See supra* Section IX.F.[9.0]; *see, e.g.*, LG-1007 at 7:41–48; LG-1009 at 1 tbl.1; LG-1012 at 8:53–60; LG-1017 at 6:42–49.

F. Claim 10

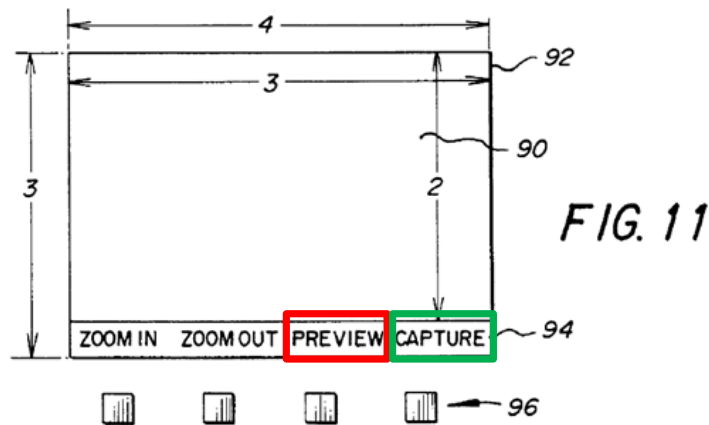
[10.0] “A method for operating an electric camera, wherein the electric camera includes the features of an image sensing device with a light receiving surface having an array of pixels arranged vertically and horizontally in a grid pattern with an N number of vertically arranged pixel lines, a signal processing unit that generates image signals by processing the output signals of the image sensing device, and a display unit with a display screen that displays an image corresponding to the image signals, the method comprising:”

185. *See supra* Sections X.B.[5.0]–[5.3].

[10.1] “selecting between a static image mode and a moving video mode, and when in the static image mode, selecting an operation from a list including (1) recording the image in the static image mode, and (2) monitoring the image in the static image mode;”

186. Kurashige-Parulski renders obvious this element. Kurashige discloses both a still picture mode and moving picture mode that outputs pictures of different

resolutions depending on the mode. LG-1009 at 2 §2.2. A POSITA would have understood that using Kurashige's camera—the MPEG Camera—involves *selecting between a static image mode* (e.g., Kurashige's still picture mode) *and a moving video mode* (e.g., Kurashige's moving picture mode). For example, as shown in the figure below, Kurashige shows that its camera includes **buttons**. LG-1009 at 1.



LG-1007 fig.11 (annotated).

187. A POSITA would have understood that a user operates these buttons to select the still picture mode or to select the motion picture mode and operate these buttons to capture an image. Kurashige describes that its camera is a “***handy digital camera*** to record MPEG-1 video and JPEG still photo.” LG-1009 at 1 Abstract (emphasis). Kurashige describes that the camera has both a still picture mode and a moving picture mode, *id.* at 2 §2.2, and records both MPEG-1 videos and a JPEG still photos, *id.* at 1 Abstract. A POSITA would have understood that

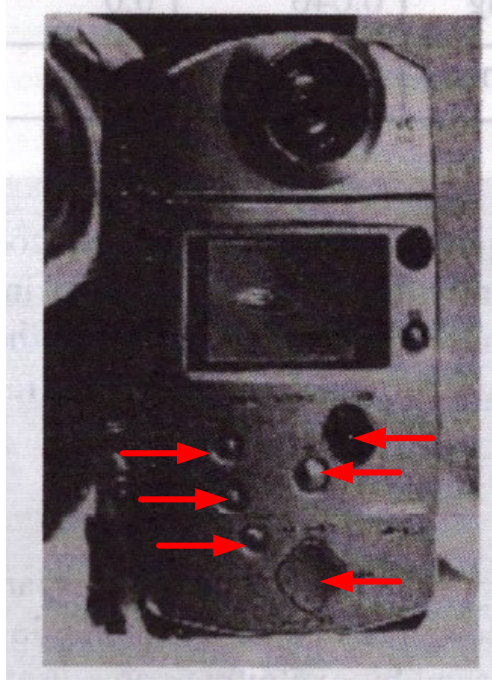
Kurashige's digital camera could be operated by a human user to control these functionalities. For example, a POSITA would have understood a "digital camera" to be a consumer electronic camera that would include user interface elements operable by a human user. *See id.* (describing that "[u]sers are able to arrange, retrieve and playback files on the camera easily using the 1.8 [inch] TFT-LCD and 'Media Navigation System,' the built-in handling function). Indeed, Kurashige's LCD further confirms that Kurashige's camera is intended to be operable by a human user. *See id.* at 2 §2.5. A POSITA would have understood that the numerous buttons provide the user interface elements for controlling the functionalities of Kurashige's camera.

188. A POSITA would have understood that the user operates these buttons to select the still picture mode. *Id.* at 2 §2.2. In particular, in response to the user selecting the still picture mode, the camera processing block selects a non-line-mixed readout mode to drive the CCD to output the still picture. *Id.* And a POSITA would have understood that the user operates these buttons to select the motion picture mode. *Id.* at 2 §2.2. In response to the user selecting the motion picture mode, the camera processing block selects a line-mixed readout mode to drive the CCD to output the motion picture. *Id.*

189. A POSITA would alternatively have been motivated to configure Kurashige's buttons to be operable by a user to select the still picture mode, to

select the motion picture mode, and to capture an image. A POSITA would have been motivated to improve the user's ability to control camera operations *See* LG-1007 at 2:19–21, 7:43–48. And such a configuration would have a reasonable expectation of success, as user-operable buttons for digital cameras were well understood in the art. *See id.* at 3:25–40.

190. Alternatively, Parulski teaches *when in the static image mode, selecting an operation from a list including recording an image in a static image mode and monitoring an image in the static image mode*. A POSITA would have been motivated to modify Kurashige to include a preview button, capture button, a status area on the LCD as taught in Parulski. *See supra* Section IX.G.[10.1] (discussing Parulski's disclosure with respect to these features). A POSITA would have been motivated to make this modification to improve user handling of the camera and to provide status information to the user. *See supra* Section IX.G.[10.1]; LG-1007 at 2:19–21, 7:43–48. A POSITA would have had a reasonable expectation of success because Parulski teaches using its buttons and its LCD—including the status area—in a digital electronic camera akin to Kurashige's camera and because Kurashige itself shows, as shown in the figure below, that its camera includes **buttons**. *See* LG-1007 at 3:25–33; *supra* Section X.A.



LG-1009 at 1.

[10.2] “upon selecting the operation of recording the image in the static image mode, using the signal processing unit to generate the image signals by using all signal charges accumulated in all N number of vertically arranged pixel lines of the image sensing device, to provide N pixel lines;”

191. See *supra* Sections X.B.[5.4], X.F.[10.1].

[10.3] “upon selecting the operation of monitoring the image in the static image mode, using the signal processing unit to generate the image signals by using pixel lines which have been mixed or culled from the N number of vertically arranged pixel lines of the image sensing device to provide only pixel lines separated from one another by intervals of a given distance; and”

192. See *supra* Sections X.B.[5.5], X.F.[10.1].

[10.4] “upon selecting the operation of recording the image in the moving video mode, using the signal processing unit to generate the image signals by using a portion of, or the entirety of, the N number of vertically arranged pixel lines which have been mixed or culled to provide only pixel lines separated from one another by intervals of a second distance, wherein a value of the second distance is different from a value of the first distance.”

193. See *supra* Sections X.B.[5.6], X.F.[10.1].

G. Claim 12

[12.0] “A method for operating an electric camera of claim 10, wherein the value of the first distance is larger than the value of the second distance.”

194. See *supra* Section X.C.[7.0].

H. Claim 13

[13.0] “A method for operating an electric camera of claim 10, wherein N is equal to or greater than a product of a fixed parameter multiplied by a number of effective scanning lines M of the display screen.”

195. See *supra* Section X.D.[8.0].

I. Claim 14

[14.0] “A method for operating an electric camera of claim 13, wherein the fixed parameter is equal to three.”

196. See *supra* Section X.E.[9.0].

XI. ANALYSIS OF JUEEN IN VIEW OF MISAWA ’607

A. Juen-Misawa ’607 Combination

197. As a general matter, a POSITA would have found it predictable to combine the teachings of Juen and Misawa ’607 because both Juen and Misawa ’607 pertain to digital cameras. LG-1011 at 1:22–23; LG-1012 at 1:8–13. For example, Juen discloses that its “invention relates to an electronic camera that

records both moving images and still images.” LG-1011 at 1:22–23. And Misawa ’607 discloses that its “invention relates generally to an image sensor driving method and an electronic camera” LG-1012 at 1:8–13.

198. A POSITA would have been motivated to modify Juen in view of the teachings of Misawa ’607. First, a POSITA would have been motivated to configure Juen’s display to have the display resolution taught in Misawa ’607. Second, a POSITA would have been motivated to use Misawa ’607’s line-skipping methods for producing images for Juen’s display when used as an electronic viewfinder or built-in monitor screen and for capturing moving images in Juen’s movie mode.

199. A POSITA would have found configuring Juen’s display screen to have the display resolution taught in Misawa ’607 (approximately 320 pixels by 240 pixels) to be predictable, as both Juen’s display screen and Misawa ’607’s LCD are described as being used for monitoring an image to be captured in the context of digital cameras. LG-1011 at 3:32–35, 3:49–51; LG-1012 at 5:51–60, 7:63–8:3. For example, Juen describes that the imaging means 1 “images an object or living subject . . . and converts an image thereof to image information” and that “ the display screen 25 can be “an electronic viewfinder” or “a monitor screen attached to the case of the electronic camera.” LG-1011 at 3:32–35, 3:49–51. And Misawa ’607 discloses that “a picture composition can be confirmed satisfactorily

to the extent that the image is displayed on the small LCD 40 attached to the digital camera 20.” LG-1012 at 7:67–8:3. Using a different resolution for Juen’s display screen, including Misawa ’607’s display resolution, would have had a reasonable expectation of success. It would have been well within the capabilities of a POSITA to select a resolution for Juen’s display screen, including Misawa ’607’s display resolution. Displays of different resolutions were well understood in the art. *See, e.g.*, LG-1007 at 7:41–48; LG-1009 at 1 tbl.1; LG-1012 at 8:53–60; LG-1017 at 6:42–49.

200. A POSITA would have been motivated to use a line-skipping process, as taught in Misawa ’607, for producing images on a display used as an electronic viewfinder or built-in monitor screen and for capturing 640-pixel by 480-pixel moving images in Juen’s movie mode. Such modifications would have been desirable to increase the refresh rate for presenting images on the display, to decrease the electricity consumed for generating the images for the display for the moving images, and to increase the processing speed for generating these images. *See* LG-1012 at 10:3–7, 23–29.

201. Moreover, a POSITA would have been further motivated to use a line-skipping process to eliminate some of the vertically arranged lines from the image sensor in forming the monitoring images and recording the moving images. Juen’s image sensor has 960 vertically arranged pixel lines. LG-1011 at 5:63–6:2. Juen

further teaches recording moving images that have 480 vertically arranged lines. *Id.* at 7:53–59. Misawa '607 teaches a similar sensor configuration having 960 vertically arranged pixel lines. LG-1012 at 6:16–17. Misawa '607 suggests using 240 vertically arranged pixel lines for monitoring, a number of pixel lines that corresponds to the number of vertically arranged pixel lines of the display taught in Misawa '607. *Id.* at 7:63–8:3, 8:57–58. Because Juen and Misawa '607 teach using an image sensor that has more vertically arranged lines (e.g., 960 lines, as taught in both Juen and Misawa '607) than the images formed in monitoring (e.g., 240 lines or fewer, as taught in Misawa '607) and the images formed in recording moving images (e.g., 480 lines, as taught in Juen), a POSITA would have been motivated to use a line-skipping process to eliminate some of the vertically arranged lines from the image sensor in forming the monitoring images and recording the moving images.

202. Modifying Juen in this manner would have been predictable and would have had a reasonable expectation of success as a POSITA would have found selecting a line-skipping pattern for monitoring images and for recording moving images to be straightforward based on knowing the number of vertically arranged lines of the image sensor (960 lines) and the corresponding numbers of vertically arranged lines of the monitoring images (240 lines) and the moving images (480 lines). A POSITA would have found selecting a line-skipping pattern

for monitoring images and for recording moving images to mathematically follow from the number of vertically arranged lines of the image sensor (960 lines) and the corresponding numbers of vertically arranged lines of the monitoring images (240 lines) and the moving images (480 lines). A POSITA would have understood that selecting the distance would merely require well-known mathematical operations based on the initial number of vertically arranged pixel lines (the number of vertically arranged pixels lines of the image sensor) and the desired number of vertically arranged pixel lines (e.g., the desired number of vertically arranged pixel lines for the movie picture or the desired number of vertically arranged lines for the monitoring imagery). Indeed, Juen's moving images have one half the number of lines of the image sensor, and the display images have one fourth the number of lines of the image sensor. A POSITA would thus have found implementing Misawa '607's $1/2$ and $1/4$ line-skipping methods for generating the moving images and the display images, respectively, to be straightforward modifications. *See* LG-1012 at 10:20–22 (describing that “reading proportions may be determined freely according to the number of the pixels in the image sensor”).

203. Alternatively, a POSITA would have been motivated to modify Juen's still mode to include Misawa '607's normal image-capturing process and macro image-capturing process and to add Misawa '607's macro key for selecting between the macro image-capturing process and the normal image-capturing

process. A POSITA would have been motivated to include both of these ways of capturing still images to provide flexibility for users in operating the electronic camera, to enable the electronic camera to capture both precise and rough images, and to provide users with a process for confirming a photo composition before initiating recording. *See* LG-1012 at 3:15–23, 6:63–7:1, 7:63–8:3, 9:59–10:2. For example, Misawa ’607 emphasizes the benefit of a user being able to “freely select an image with many pixels at a low refresh rate or a rough image at a high refresh rate. *Id.* at 3:21–23. Misawa ’607 further explains that in the normal image-capturing mode, “the images can be captured at a high refresh rate, and the captured images are rough but satisfactory for confirmation of a picture composition as far as the images are displayed on a compact monitor, etc. attached to the image-capturing apparatus.” *Id.* at 2:1–5.

204. Modifying Juen’s still mode to include Misawa ’607’s normal image-capturing process and macro image-capturing process and to add Misawa ’607’s macro key for selecting between the macro image-capturing process and the normal image-capturing process would have been predictable and would have had a reasonable expectation of success, as Misawa ’607’s macro key and normal and macro image-capturing processes are used in connection with an electronic camera akin to the electronic camera described in Juen. *See id.* at 5:50–60; LG-1011 at 3:32–44.

B. Claim 5

[5.0] “An electric camera comprising:”

205. To the extent that the preamble is limiting, Juen-Misawa '607 renders obvious this element. Juen discloses “an electronic camera that records both moving images and still images.” LG-1011 at 1:22–23.

[5.1] “an image sensing device with a light receiving sensor having an array of pixels arranged vertically and horizontally in a grid pattern, in an N number of vertically arranged pixel lines;”

206. Juen-Misawa '607 renders obvious this element. Juen's imaging means 1 including the imaging element 13 corresponds to *an image sensing device with a light receiving sensor*. LG-1011 at 3:32–35, 5:63–66. The imaging element 13 has a resolution of 1280 pixels by 960 pixels, *id.* at 5:63–67, which a POSITA would have understood to refer to dimensions of *an array of pixels arranged vertically and horizontally in a grid pattern*, where the array has 960 vertically arranged pixel lines. *See id.* at 1:37–42; LG-1012 at 4:6–12.

[5.2] “a signal processing unit that generates image signals by processing the output signals of the image sensing device; and”

207. Juen-Misawa '607 renders obvious this element. As shown in Figure 1 below, Juen includes a **signal processing unit**—including Juen's pixel density conversion means 2, moving image recording means 3, and still image recording means 4—that processes information from the imaging means 1 to record the

information as a series of moving images or as a still image (e.g., “*output signals of the image sensing device*”). LG-1011 at 3:35–44.

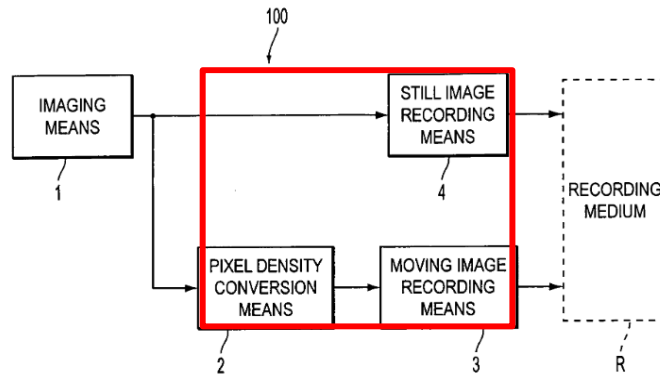


FIG. 1

Id. fig.1 (annotated). Juen’s electronic camera includes other components that a POSITA would consider to be part of a signal processing unit, such as the A/D converter, the picture image signal processor, the image density conversion component, the memory I/O component, the microprocessor, the interface component, the coding conversion component, the memory, the disk drive component, and the magneto-optical recording medium. *Id.* at 6:3–30.

[5.3] “a display unit with a display screen, that displays an image corresponding to the image signals;”

208. Juen-Misawa ’607 renders obvious this element. Juen’s display screen displays image information captured by the imaging means converted by the pixel density conversion means to a pixel density compatible with the display screen . LG-1011 at 3:45–49. Misawa ’607 describes that its LCD can have a resolution of

320 pixels by 240 pixels. LG-1012 at 8:53–59. A POSITA would have been motivated to modify Juen to include such a resolution. *See supra* Section XI.A.

[5.4] “wherein when recording an image in a static image mode, the signal processing unit generates the image signals by using all signal charges accumulated in all N number of vertically arranged pixel lines of the image sensing device, to provide N pixel lines;”

209. Juen-Misawa '607 renders obvious this element. Juen's still image recording means retrieves image information from the imaging means and records it in a recording medium as a still image. LG-1011 at 3:32–35, 42–44. Juen discloses that “when the still image is recorded, the still image recording means 4 records the image information in a state in which the pixel density is high in the recording medium R as a still image.” *Id.* at 4:9–13. When Juen's camera is in its still mode and an image recording button is pressed, the microprocessor “retrieves one frame of a still image from the camera part 11a” (which includes the imaging element 13). *Id.* at 5:63–66, 7:36–40, 9:11–16, fig.11 (elements “S20” and “S21”). A POSITA would have understood that, by retrieving one frame from the imaging element, Juen discloses *using all signal charges accumulated in all N number of vertically arranged pixel lines of an image sensing device, to provide N pixel lines*. A POSITA would have understood that reading a full frame from an image sensor means that all pixel charges are read from the image sensor. A POSITA would alternatively have been motivated to configure Juen's still mode to read all photoelectric elements of the imaging element. Such a configuration of capturing

still images is taught in Misawa '607 teaches as part of its high-quality image confirmation mode or its macro image-capturing mode. LG-1003 ¶209; *see* LG-1012 at 3:6–23, 8:36–43, 9:59–10:2. A POSITA would have been motivated to configure Juen's still mode to read all photoelectric elements of the imaging element so that a precise still image could be produced for display on an external display and for printing on a high-quality printer. *Id.*; *see* LG-1007, 4:35-37, 5:49-52. And a POSITA would have had a reasonable expectation of success in configuring Juen's still mode in this manner. Such a configuration of capturing still images using an image sensor was well-known and well-understood, and a POSITA would have found the teachings of Misawa '607 to be readily applicable to Juen. *See, e.g.*, LG-1006, 6:48– 54, 7:1–7, 8:60– 9:8; LG-1007, 1:9–13, 3:29–33, 4:35–40, 6:23– 31, 7:1– 7, 8:60– 9:8; *supra* Section XI.A.

210. Alternatively, if Juen's static image mode were modified to include both Misawa '607's macro and normal image-capturing processes, capturing a still image in the macro image-capturing process (e.g., "*recording the image in the static image mode*") would correspond to this feature. *See supra* Section XI.A. A POSITA would have understood the macro image-capturing process in which all photoelectric elements are read involves *using all signal charges accumulated in all N number of vertically arranged pixel lines of an image sensing device, to provide N pixel lines*. LG-1012 at 8:28–31; *see supra* Section VIII.E.

[5.5] “wherein when monitoring the image in the static image mode, the signal processing unit generates the image signals by using pixel lines that have been mixed or culled from the *N* number of vertically arranged pixel lines to only include pixel lines separated from one another by intervals of a first distance; and”

211. Juen-Misawa '607 renders obvious this element. Juen describes that its display screen can be an electronic viewfinder or a monitor screen attached to the case of the electronic camera. LG-1011 at 3:49–51. Figure 7 of Juen below shows the **display screen 25** being connected to the same **system bus 19** to which the **imaging element 13** is connected (through the **image signal processor 15** (DSP, or digital signal processor, in Figure 7 below) and the **memory I/O component 17**). *Id.* at 6:3–17, 23–25.

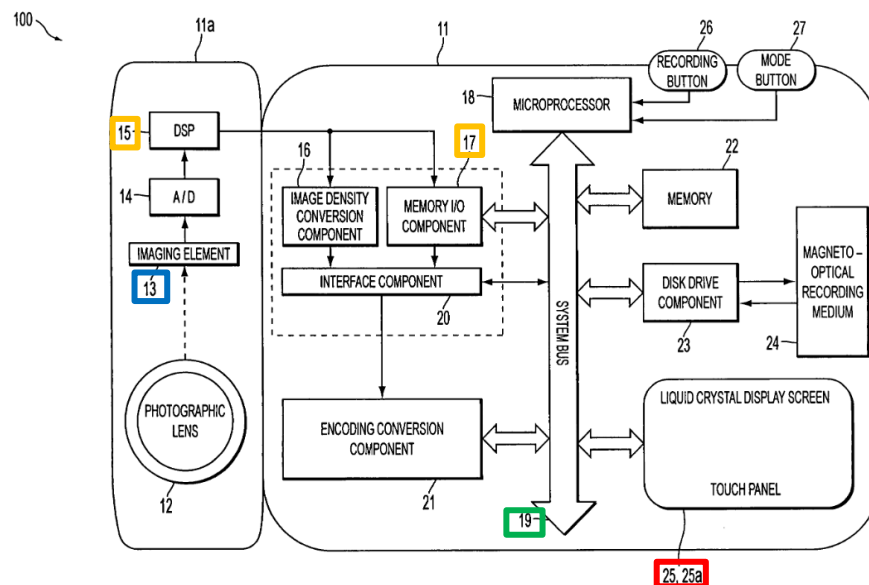


FIG. 7

Id. fig.7 (annotated). A POSITA would have understood that Juen’s *signal processing unit* (which includes the image signal processor 15 and the memory I/O

component 17), *when monitoring the image in the static image mode, generates image signals*. For Juen’s display screen 25 to be used as an electronic viewfinder or built-in monitor screen, a POSITA would have understood that the display screen 25 would receive image signals corresponding to output signals of the imaging element 13.

212. A POSITA would have been motivated to use a line-skipping process, as taught in Misawa ’607, for generating the monitoring imagery for Juen’s display (e.g., “*generat[ing] the image signals by using pixel lines that have been mixed or culled from the N number of vertically arranged pixel lines*”). See *supra* Section XI.A. A POSITA would have found modifying Juen such that it uses a line-skipping process as taught in Misawa ’607 to generate imagery for the display when used an electronic viewfinder or built-in monitor screen to be predictable. Both Juen and Misawa ’607 teach using a display for monitoring imagery. LG-1011 at 3:49–50; LG-1012 at 6:63–7:1. And Misawa ’607 specifically teaches using line-skipping processes to generate imagery for its display, describing a monitoring process in which the LCD displays a rough image at a high refresh rate. LG-1012 at 7:63–8:3. Moreover, in Misawa ’607, “an image captured by the solid-state imaging device 28 is displayed on the LCD 40” such that “[t]he LCD 40 displays . . . an image before the input of the image-recording start signal (a moving image or an intermittent image).” *Id.* at 6:63–7:1. For example, “[i]n the

normal image-capturing mode, the solid-state imaging device 28 is driven by reading the signals from 1/4 or 1/8 of the photoelectric elements 12” *Id.* at 7:60–63.

213. Moreover, a POSITA would have been motivated, based on the teachings of Misawa ’607, to select any line-skipping pattern that involves cyclically or alternately skipping one or more consecutive lines for every one or more consecutive lines that are read (e.g., “*only include pixel lines separated from one another by intervals of a first distance*”). See *infra* Section XI.B.[5.6]. Misawa ’607 teaches a wide variety of line-skipping patterns for its line-skipping processes. Different line-skipping patterns disclosed in Misawa ’607 include (1) cyclically skipping one line for every one line read, LG-1012 at 4:52–53, (2) cyclically skipping two lines for every two lines read, *id.* at 5:4–7, (3) cyclically skipping three lines for every one line read, *id.* at 5:12–16, (4) alternately skipping four or two lines for every one line read, *id.* at 5:19–23, (5) cyclically skipping seven lines for every one line read, *id.* at 5:24–32, or (6) alternately skipping six or eight lines for every one line read, *id.* at 5:36–39. In other words, Misawa ’607 teaches numerous line-skipping patterns, e.g., cyclically skipping one, two, three, or seven lines for every line read, skipping two lines for every two horizontal lines, or alternately skipping two or four lines or six or eight lines for every line read. See *supra* Section VIII.E. Misawa ’607 therefore teaches

both cyclically skipping the same number of lines and alternately skipping by a first number of lines or a second number of lines. LG-1012 at 4:52–53, 5:4–7, 5:12–16, 5:24–32 (describing cyclic skipping); *id.* at 5:19–23, 5:36–39 (describing alternate skipping). Misawa '607 thus establishes that line-skipping processes and their line-skipping patterns were well-understood in the art.

214. A POSITA would have been motivated to select a line-skipping pattern based on the use case of the imagery and the processing specifications for that imagery. *See supra* Section IX.B.[5.5]. And a POSITA would have found selecting a particular line-skipping pattern to be predictable and to have had a reasonable expectation of success, as a POSITA would have understood how to adapt hardware and software to vary the precise number of skipped lines and read lines. *See supra* Section IX.B.[5.5].

215. A POSITA would have been motivated use a 1/4 line-skipping process to generate monitoring imagery. Juen's image sensor, as discussed above, has 960 vertically arranged pixel lines. LG-1011 at 1:37–42. And in Juen-Misawa '607, a POSITA would have been motivated to use a display having 240 vertically arranged lines. *See supra* Section XI.B.[5.3]. Based on these values, a POSITA would have been motivated to use a 1/4 line-skipping process to generate the monitoring imagery. Indeed, Misawa '607 precisely teaches using a 1/4 line-

skipping process to cull 240 vertically arranged pixel lines from 960 vertically arranged pixel lines of an image sensor. LG-1012 at 8:61–63.

216. Alternatively, if Juen’s static image mode were modified to include both Misawa ’607’s macro image-capturing process and Misawa ’607’s normal image-capturing process, monitoring the still image on the display unit in the normal image-capturing process would correspond to this feature. *See supra* Section XI.A. Misawa ’607 describes that images captured in the normal image-capturing process can be “satisfactory for confirmation of a picture composition as far as the images are displayed on a compact monitor, etc. attached to the image-capturing apparatus.” LG-1012 at 2:1–5. A POSITA would have understood the normal image-capturing process—particularly when 1/4 photoelectric elements are read and presented on the display—would involve *using pixel lines that have been mixed or culled from the N number of vertically arranged pixel lines to only include pixel lines separated from one another by intervals of a first distance. Id.* at 6:63–7:1; 7:55–8:3; *see infra* Section XI.B.[5.6].

[5.6] “wherein when recording the image in a moving video mode, the signal processing unit generates the image signals by using a portion of, or the entirety of, pixel lines which have been mixed or culled from the N number of vertically arranged pixel lines to only include pixel lines separated from one another by intervals of a second distance, where the second distance is different from the first distance.”

217. Juen-Misawa ’607 renders obvious this element. Juen’s moving image recording means 3, when in the movie mode, records the output of the imaging

means 1 in a recording medium R as a series of moving images (e.g., “*when recording the image in a moving video mode, the signal processing unit generates image signals*”). LG-1011 at 3:38–44; *see id.* at 7:41–8:40.

218. A POSITA would have been motivated to use a line-skipping process as taught in Misawa ’607 (e.g., the 1/2 line skipping process) for generating the movie in Juen’s movie mode (e.g., “*generat[ing] the image signals by using a portion of, or the entirety of, pixel lines which have been mixed or culled from the N number of vertically arranged pixel lines*”). *See supra* Sections XI.A, XI.B.[5.5]. Moreover, a POSITA would have been motivated, based on the teachings of Misawa ’607, to select any line-skipping pattern that involves cyclically or alternately skipping one or more consecutive lines for every one or more consecutive lines that are read (e.g., “*only include pixel lines separated from one another by intervals of a first distance*”). *See supra* Section XI.B.[5.5]. And, here in particular, a POSITA would have been motivated use a 1/2 line-skipping process to generate the movie imagery. Juen’s image sensor, as discussed above, has 960 vertically arranged pixel lines. LG-1011 at 1:37–42. In Juen’s movie mode, the generated movie has 480 vertically arranged lines. *Id.* at 7:53–56. Based on these values, a POSITA would have been motivated to use a 1/2 line-skipping process to generate the movie imagery. Indeed, Misawa ’607 precisely teaches using a 1/2

line-skipping process to cull 480 vertically arranged pixel lines from 960 vertically arranged pixel lines of an image sensor. LG-1012 at 8:61–63.

219. In Juen-Misawa '607, a POSITA would have understood that using the 1/2 line-skipping process for generating Juen's movie and using the 1/4 line-skipping process for generating monitoring imagery would result in *the second distance being different from the first distance*. In particular, the number of vertically arranged lines for monitoring (240 lines) is fewer than the number of vertically arranged pixel lines for recording the motion picture (480 lines). As a result, the distance between the vertically arranged pixel lines for monitoring (corresponding to the claimed "*first distance*") is different from the distance between the vertically arranged pixel lines for capturing the movie (corresponding to the claimed "*second distance*"). Moreover, a POSITA would have understood that the distance for the 1/2 line-skipping process would be either: (1) a skipped line between consecutive read lines, or (2) a center-to-center distance of two between consecutively read lines. And a POSITA would have understood that the distance for the 1/4 line-skipping process would be either: (1) three skipped lines between consecutive read lines, or (2) a center-to-center distance of four between consecutively read lines.

C. Claim 7

[7.0] “An electric camera according to the claim 5, wherein a value of the first distance is larger than a value of the second distance.”

220. Juen-Misawa '607 renders obvious this element. Because the number of vertically arranged lines for monitoring (240 lines) is fewer than the number of vertically arranged lines for recording a movie picture (480 lines), the distance between the 240 vertically arranged lines for monitoring will be larger than the distance between the 480 vertically arranged lines for recording a movie. *See supra* Section XI.B.[5.6]. Moreover, a POSITA would have understood that because that using the 1/2 line-skipping process for generating Juen's movie and using the 1/4 line-skipping process for generating monitoring imagery would result in *a value of the first distance being larger than a value of the second distance*. *See supra* Section XI.B.[5.6].

D. Claim 8

[8.0] “An electric camera according to the claim 5, wherein N is equal to or greater than a product of a fixed parameter multiplied by a number of effective scanning lines M of the display screen.”

221. Juen-Misawa '607 renders obvious this element. Juen's number of vertically arranged lines on the imaging element (960 lines) is greater than a product of the number of scanning lines of Misawa '607's display (240 lines) and a fixed parameter. *See supra* Sections XI.B.[5.1], [5.3]. A POSITA would have understood that this fixed parameter could be any value equal to four or less to

satisfy this claim element. A POSITA would have understood that scanning lines of a display are horizontal. Thus, for Misawa '607's display—which has 240 horizontal lines, or said another way, 240 vertically arranged lines—the number of effective scanning lines M would be 240. A POSITA would have understood that Juen's number of vertically arranged lines on its image sensing device (960 lines) is greater than a product of the number of scanning lines of the display (240 lines) and a fixed parameter. This fixed parameter could be any value less than 960 divided by 240 (4).

E. Claim 9

[9.0] “An electric camera according to the claim 8, wherein the fixed parameter is equal to three.”

222. See *supra* Section XI.D.[8.0].

F. Claim 10

[10.0] “A method for operating an electric camera, wherein the electric camera includes the features of an image sensing device with a light receiving surface having an array of pixels arranged vertically and horizontally in a grid pattern with an N number of vertically arranged pixel lines, a signal processing unit that generates image signals by processing the output signals of the image sensing device, and a display unit with a display screen that displays an image corresponding to the image signals, the method comprising:”

223. See *supra* Section XI.B.[5.0]–[5.3].

[10.1] “selecting between a static image mode and a moving video mode, and when in the static image mode, selecting an operation from a list including (1) recording the image in the static image mode, and (2) monitoring the image in the static image mode;”

224. Juen-Misawa '607 renders obvious this element. Juen discloses an **image recording button 26** and a **mode button 27**. LG-1011 at 6:31–34. When the mode button 27 is pressed, the microprocessor 18 determines that the electric camera is in the still mode, and when the mode button 27 is not pressed, the microprocessor 18 determines that the electrical camera in the movie mode (e.g., “selecting between a static image mode and a moving video mode”). *Id.* at 7:35–43.

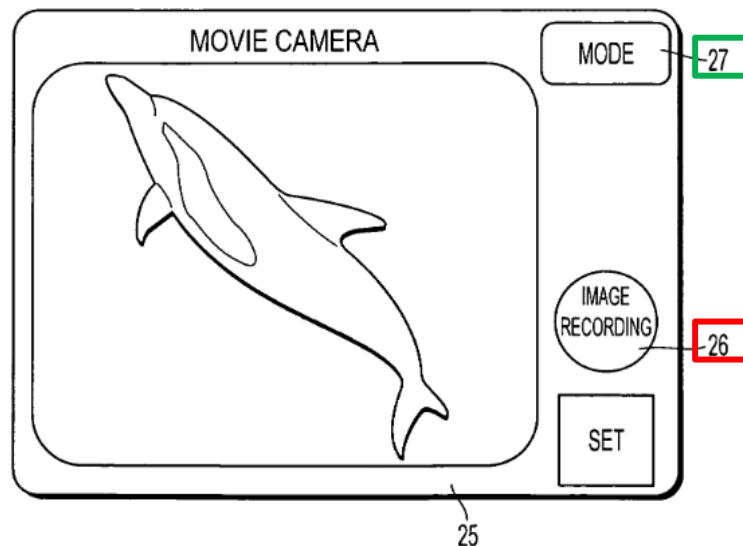


FIG. 16

Id. fig.16 (annotated).

225. In addition to describing that its display screen can be used as an electronic viewfinder or a built-in monitor screen, Juen describes that when the mode button 27 is operated, the display screen 25 changes between Figure 16 above for the movie mode and Figure 17 below for the still mode. *Id.* at 3:49–51, 10:45–55; *see supra* Section XI.B.[5.5]. When the camera is in the still mode, the user operates the image recording button 26 to cause the microprocessor 18 to set the coding conversion component for still image compression and to record a still image. LG-1011 at 9:11–25; *see supra* Section XI.B.[5.4]. A POSITA would have thus understood that Juen discloses *when in the static image mode, selecting an operation from a list includes (1) recording the image in the static image mode, and (2) monitoring the image in the static image mode.*

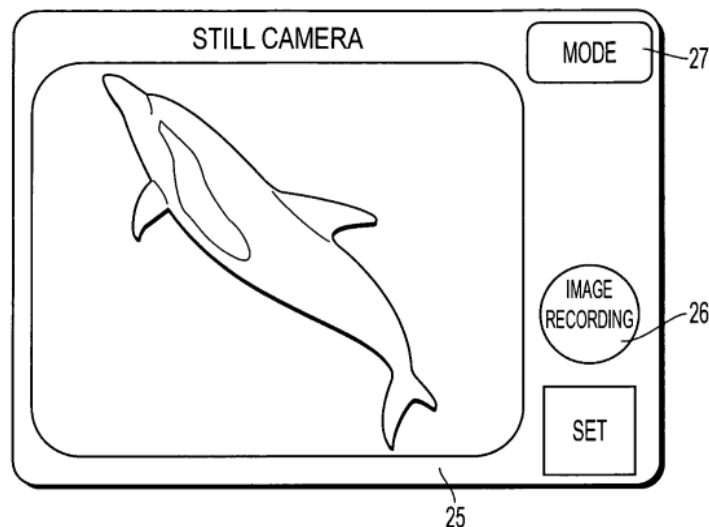


FIG. 17

LG-1011 fig.17.

226. Additionally, Juen's disclosure of this element is commensurate with the '493 Patent's discussion of discussion of examples of this element. For example, the '493 Patent's "mode selector switch [14] to change over the operation mode between the moving video taking and the still image taking" is indistinguishable from Juen's mode button 27. LG-1001 at 4:27–29; LG-1011 at 7:35–43, 10:45–55. And the '493 Patent's "record button [15] to start or stop the recording" is indistinguishable from Juen's image recording button 26. LG-1001 at 4:27–29; LG-1011, 7:44–8:41, 9:3–10.

227. Alternatively, Misawa '607 teaches when in the static image mode, selecting an operation from a list includes (1) recording the image in the static image mode, and (2) monitoring the image in the static image mode. A POSITA would have been motivated to modify Juen's static image mode to include both the macro image-capturing mode and the normal image-capturing mode and to include the macro key for switching between these modes in the static image mode. *See supra* Section XI.A. In this modification, in the static image mode, a user presses the macro key to toggle between the macro image-capturing process (e.g., "*recording the image in the static image mode*") in which all the photoelectric elements 12 can be read and the normal image-capturing process in which 1/4 of the photoelectric elements 12 can be read (e.g., "*monitoring the image in the static image mode*"). LG-1012 at 7:60–63, 8:18–27, 8:28–31.

[10.2] “upon selecting the operation of recording the image in the static image mode, using the signal processing unit to generate the image signals by using all signal charges accumulated in all N number of vertically arranged pixel lines of the image sensing device, to provide N pixel lines;”

228. See *supra* Section XI.B.[5.4].

[10.3] “upon selecting the operation of monitoring the image in the static image mode, using the signal processing unit to generate the image signals by using pixel lines which have been mixed or culled from the N number of vertically arranged pixel lines of the image sensing device to provide only pixel lines separated from one another by intervals of a given distance; and”

229. See *supra* Section XI.B.[5.5].

[10.4] “upon selecting the operation of recording the image in the moving video mode, using the signal processing unit to generate the image signals by using a portion of, or the entirety of, the N number of vertically arranged pixel lines which have been mixed or culled to provide only pixel lines separated from one another by intervals of a second distance, wherein a value of the second distance is different from a value of the first distance.”

230. See *supra* Section XI.B.[5.6].

G. Claim 12

[12.0] “A method for operating an electric camera of claim 10, wherein the value of the first distance is larger than the value of the second distance.”

231. See *supra* Section XI.C.[7.0].

H. Claim 13

[13.0] “A method for operating an electric camera of claim 10, wherein N is equal to or greater than a product of a fixed parameter multiplied by a number of effective scanning lines M of the display screen.”

232. See *supra* Section XI.D.[8.0].

I. Claim 14

[14.0] “A method for operating an electric camera of claim 13, wherein the fixed parameter is equal to three.”

233. *See supra* Section XI.E.[9.0].

APPENDIX A

Expert Witness Consultant—Curriculum Vitae

W. Leo Hoarty
Mountain View, CA

leo@wlhconsulting.llc
408-500-9999

Professional Profile

A professional engineer with over 40 years of experience in both electronics engineering and computer science holding 48 granted US patents in many areas of technology. He is an experienced Expert Witness consultant with over 15 years of experience in multiple patent infringement matters in jury trials as well as with IPRs/PTAB. His background includes considerable experience in the development of all levels of complex software systems as well as designing and bringing to market electronic hardware products. He has authored numerous technology papers on data communications, consumer electronics, and broadcast & cable television technology and he has served on the Standards Committees of ATSC, ISO/MPEG, OpenCable, and IEEE.

Technology Background

Technology Expertise:

Artificial Intelligence (AI/ML), [Enterprise Neurosystem, Vizio]
Audience measurement [Vizio]
Automatic Content Recognition (ACR), audio&video [Viggle, SweetVinyl, Vizio]
Cable and satellite set-top design [Motorola, ActiveVideo, MovieBeam]
Consumer electronics product design [MovieBeam, Mediatronics, SweetVinyl]
DSP, audio/video codecs [ActiveVideo, Dotcast, SweetVinyl, Vizio]
Digital watermarking, digital rights mgmt. [19 Entertainment, MovieBeam, Vizio]
Electronic circuit design [ActiveVideo, Dotcast, SweetVinyl, Enterprise Neurosystem]
Interactive television systems [ActiveVideo, Inscape]
Mobile app development, iOS & Android [Aviga, 19 Entertainment, SweetVinyl]
Speech recognition [Aviga, 19 Entertainment, Vizio]
Video-on-demand [Inscape, ActiveVideo, Google]

Software Languages and Tools:

Languages: all C languages, F#, Java, Python, HTML/CSS/JavaScript
OS: Android, Linux, iOS, MacOS, Windows
VM & Cloud: VMware, AWS
Debug: Android Studio, adb, Eclipse, Understand, Wireshark, Xcode
ML/AI Tools: TensorFlow, PyTorch, OpenAI API; RNN, CNN, Transformer modeling

Expert Witness Summary

Expert witness, PTAB declarations, source code reviews, machine learning source material analysis, depositions, court appearances for:

AC Nielsen, ActiveVideo Networks, Amazon, Arris Corp., DirecTV, DISH Networks, Fandango, Google, LG Electronics, Motorola, Roku, Rovi (TiVo), Solaborate, Vizio

Total cases: 41 | PTAB: 17 | Depositions: 22 | Court appearances: 3

Detailed case history available on request.

Expert Witness Consultant—Curriculum Vitae

Employment History

To Present **WLH Consulting, LLC**
From 2011 Mountain View, CA
Position *Principal*

Expert Witness Consultant: Expert witness consulting for patent litigation matters with significant experience in prior art analysis; expert witness/IPR report generation; software analysis of complex software; analysis of machine learning models to determine sources used for training; court room testimony experience in US federal court and the High Court of England including significant international patent litigation experience.

IP Development Summary: Intellectual property consulting for technology companies drafting patent applications and assisting in patent prosecution. Companies include: Vizio, Google, ActiveVideo Networks, Viggle, epoxy.ai

Technology Consultant in cloud-based media management, automated content recognition (ACR), voice recognition systems, video-on-demand, targeted advertising and dynamic ad insertion, Internet streaming technologies, and mobile and automotive app development. Currently developing machine learning models for biodiversity and water resource management for UN sponsored projects in developing nations.

Technology Manufacturing: Owner and President of SweetVinyl, Inc., a boutique manufacturer of high-end audio products. The company imports Linux-based subsystems from Asia combined with locally manufactured components. Proprietary software integrated with imported subsystem. Published iOS and Android apps for tablets/smart phones for remote control of products.

To 2011 **Interactive Mobile Media Inc.**
From 2007 Campbell, CA
Position *President*

Summary: dba Aviga, company provided development of voice-activated mobile device applications for major media companies as well as embedded systems for automotive applications. Customers included: **19 Entertainment:** (Owner of *American Idol*) developed voice-response music player; **Viggle:** TV affinity iOS & Android app—developed proprietary automated content recognition (ACR) technology for identifying TV programming via a mobile app.

To 2007 **Google Inc.**
From 2006 Mountain View, CA
Position *Technology Consultant*

Summary: Managed special projects group in the development of a new product division for auctioning of television ad time for placement with major satellite and cable television operators. Developed architecture for ad network-connected ingest system that automated the processing of television ads for the Google service.

To 2006 **Dotcast Inc.**
From 2000 Mountain View, CA
Position *Founder, President & Chief Technology Officer*

Summary: Formed company and raised funds of over \$250 million from a mix of strategic partners and VC's including Samsung Electronics, Cisco Linksys, the Walt Disney Company; grew company to over 170 employees; as CTO, built group to developed proprietary TV settop box using custom system-on-a-chip (SoC) for a consumer service called *MovieBeam* that won Best of Show at the Consumer Electronics Show in Las Vegas two years (2004 & 2005). The

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settop was distributed nationwide in top 100 DMAs thru major consumer product outlets and provided first-run (day and date) feature films from all major film studios.

To 1999 **EnCamera Sciences Corp.**
From 1997 Scottsdale, AZ
Position *Partner*

Summary: Developed novel metropolitan-area wireless data transmission technology embedding high-speed data signal in existing TV broadcast channels as well as developed a novel MPEG video compression system. Acquired by The Walt Disney Company, both technologies became foundation for its *MovieBeam* wireless set-top service.

To 1997 **ICTV Inc. (renamed ActiveVideo Networks in 2006)**
From 1990 San Jose, CA
Position *Founder, President & Chief Technology Officer*

Summary: Developed and deployed one of the first interactive TV and video-on-demand systems for cable TV. Designed and built custom interactive TV settop box integrated with GI/Motorola base. Worked with CableLabs on many cable TV standards including the OpenCable initiative. Partnered with IBM and deployed the first interactive TV/VOD system on Cox Cable in 1994.

To 1989 **PaineWebber**
From 1986 New York, NY
Position *Vice President, Capital Market Systems*

Summary: VP in charge of the development of advanced real-time equities trading and hedging advisory system. Deployed one of the first functioning artificial intelligence-based system on Wall Street providing real-time hedging advisories to the equities block desk.

To 1986 **Goldman Sachs & Co.**
From 1984 New York, NY
Position *Vice President, Trading Support Systems*

Summary: Developed real-time securities information systems. Designed and supervised trading systems installations in branch offices in London and Tokyo. Designed financial data analysis system working with the noted economist, Fischer Black, to develop real-time equities hedging analysis using the Black-Scholes pricing model.

To 1984 **United Nations**
From 1979 New York, NY
Position *Technical Advisor, United Nations Development Program (UNDP)*

Summary: served as Technical Advisor in Computer Methods in support of various projects in developing nations, based at UN headquarters in New York and Geneva. Traveled extensively to countries in Africa, South America, the Caribbean, and Asia to assist with providing computer automation for UNDP field projects including population census, agricultural surveys, and water resource development.

To 1979 **ACM Technology**
From 1973 San Francisco, CA
Position *Owner*

Summary: Operated a contract electronics engineering firm. Designed custom computer numerically controlled (CNC) systems using microprocessor and minicomputer-based controllers. Provided automation to medical research lab, professional photo printing, and wood products

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manufacturer. Contracted by the United Nations to design and build a digital voting system for the General Assembly Hall.

Extracurricular Activities:

To current **Enterprise Neurosystem (sponsored by the Red-Hat division of IBM)**
From 2022 San Francisco, CA
Position *Data Acquisition, Signal Processing & ML Consultant*

- Designed biological monitoring systems for agricultural and climate monitoring projects. Developed novel system for monitoring beehives using MEMS-based ultrasonic acoustic sensors. System design also includes atmospheric sensors to measure temperature, humidity, methane, CO₂, among other parameters. An on-site processor system digitizes and preprocesses the data for transmission to a machine learning system.
- Beehive clusters from all over the world will link to an IBM federated learning ML system allowing scientists to better understand stresses on honeybee colonies and help mitigate the significant decline in the honeybee population. The system will also be useful for monitoring regional climate change.
- The USDA announced collaborating with our group at the COP27 conference in Egypt (11/22). We co-sponsored in May 2023 a smart agriculture technology summit with the USDA called “AIM4C”. I presented a paper on sensor systems for monitoring nature’s networks. Al Gore and John Kerry both spoke at the conference along with Agriculture Secretary Vilsack.
- The group is further working with the United Nations CNTC, a peer group of the Inter-governmental Panel on Climate Change (IPCC). At COP28 in Dubai, the UN CNTC announce engaging Enterprise Neurosystem for multiple environmental monitoring projects in East Africa.

Professional Associations, Standards Bodies Participation and Awards:

- Delivered papers to and presented at numerous technical conferences in U.S., Asia and Europe including the National Association of Broadcasters (NAB), National Cable Television Association (NCTA), Society of Cable Telecommunication Engineers (SCTE), International Broadcast Conference (IBC) and the Montreux International Television Symposium, as well as many IEEE conferences and other industry related trade shows. (Papers available upon request.) Published two technical articles in trade magazines on graphics systems and networking.
- Member of IEEE, SMPTE, SCTE and Association of Computing Machinery (ACM).
- Served on many standards bodies over several decades including: ISO MPEG2, ATSC (HDTV standards), IEEE (802.14), CableLabs for plant and set-top standards efforts, EIA for cable TV compatibility (IR pass-through) and, in conjunction with CableLabs, cable TV interfaces such as CableCard.
- Awards: Society of Cable Television Engineers (SCTE)—Best New Technology at National Cable Television Association (NCTA) 1996 for ICTV’s interactive TV and VOD service; Best of Show at CES 2004 and 2005, MovieBeam set-top and service; 2003 Emmy Award went to Vizio, Inc for their precision audience measurement service which utilizes my patented audio automated content recognition (ACR) technology.

Education:

To: 1972 **Ohio State University**
From: 1970 Electrical Engineering