IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of:	Takahiro Nakano, et al.	Attorney Docket No.:18768-0217IP5
U.S. Patent No.:	8,736,729	
Issue Date:	May 27, 2014	
Appl. Serial No.:	13/681,495	
Filing Date:	November 20, 2012	
Title:	ELECTRIC CAMERA	

DECLARATION OF W. LEO HOARTY

I currently hold the opinions set forth 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: January 9, 2025

By: W Leo Hoarty

W. Leo Hoarty

TABLE OF CONTENTS

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. 8,736,729 (the '729 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 '729 Patent.

2. I have been asked to provide my independent analysis of the '729 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 '729 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 '729 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. 8,736,729 (LG-1001), and its accompanying prosecution history (LG-1002);
b. U.S. Patent No. 5,444,482 (Misawa) (LG-1005);
c. U.S. Patent No. 6,292,218 (Parulski) (LG-1006);
d. U.S. Patent No. 6,963,361 (Kawahara) (LG-1007);
e. U.S. Patent No. 6,690,881 (Tomita) (LG-1008);

II. QUALIFICATIONS AND BACKGROUND INFORMATION

9. 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.

10. I am currently the Principal of WLH Consulting LLC. My curriculum vitae is provided (as Appendix A to LG-1003).

11. 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.

12. 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).

13. 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.

14. 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).

15. 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.

16. 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 widely used 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 make, Vizio, to produce 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 programing is returned to the smart TV for display of supplemental information and for targeted advertising.

17. 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.

18. 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.

19. Throughout my career I have received a variety of awards including, for example, the National Cable Television Association (NTSC)—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.

20. 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

21. 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 1-4 of the ’729 Patent are rendered obvious by Misawa 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 1-4 of the ’729 Patent are rendered obvious by Kawahara in view of Misawa and further 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 1-4 of the ’729 Patent are rendered obvious by Tomita in view of Kawahara and further in view of Parulski.

IV. BACKGROUND KNOWLEDGE ONE OF SKILL IN THE ART WOULD HAVE HAD PRIOR TO THE PRIORITY DATE OF THE ’729 PATENT

22. 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 ’729 Patent (POSITA). Based on instruction from Counsel, I have applied 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, Parulski, Kawahara, and Tomita.

23. 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.

24. Taking these factors into consideration, based on my knowledge and experience in the field and my review of the ’729 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.

25. 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, digital signal processing, and telecommunications. *See supra* Section II, LG-1003. 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

26. 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

27. 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

28. 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.

29. 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

30. 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.

31. 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.

32. 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.

33. 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.

34. 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.

35. 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.

36. 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

37. The technology in the ’729 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 ’729 Patent, there existed numerous products, publications, and patents that implemented or described the functionality claimed in the ’729 Patent.

A. Overview of Digital Cameras

38. 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-1005, 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-1006, 5:1-19; LG-1008, 3:37-50. These electrical signals could then be recorded or could be used to directly drive a display.

39. 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-1005, 5:9-16; LG-1006, 3:27-29; LG-1007, 11:1-8; LG-1008, 6:63-7:10.

40. 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-1005, 1:16-19; LG-1006, 1:16-24; LG-1007, 11:1-8; LG-1008, 1:11-17) and (2) movie capture modes (e.g., for recording moving images or movies) (LG-1005, 1:19-23; LG-1007, 11:1-8; LG-1008, 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-1005, 1:44-49; LG-1007, 11:1-8; LG-1008, 1:11-17.

B. Displays for Digital Cameras

41. 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-1006, 1:27-34. And some digital cameras had built-in LCDs for displaying such imagery. *Id.*, 1:27-28; LG-1008, 5:29-38, FIG. 1. 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-1006, 3:29-38; LG-1008, 8:54-65.

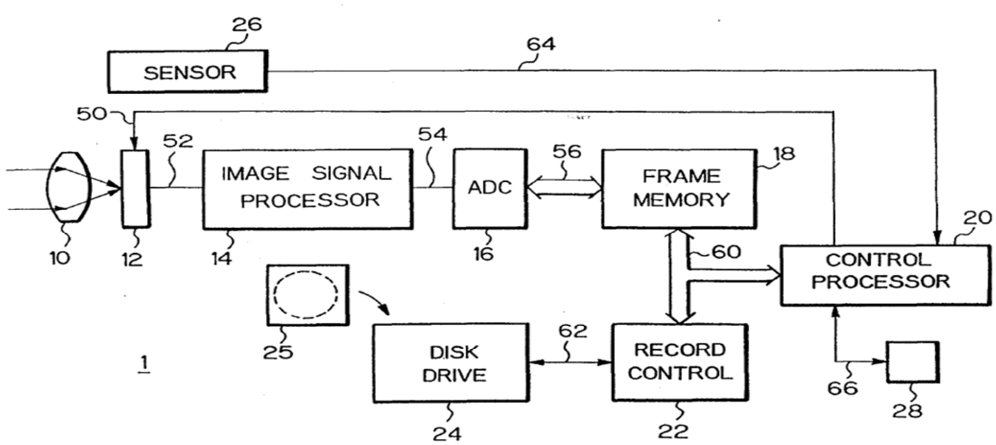
42. LCDs typically had a rectangular array of display pixels for presenting an image. *See* LG-1006, 1:39-52. LCDs would be specified based on their resolutions, which described a horizontal pixel dimension and a vertical pixel dimension of the rectangular array. *See, e.g.*, *id.*, 1:49-52; LG-1008, 4:43-44. 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

43. 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 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-1005, 2:55-61.

Fig. 1



Id., FIG.1 (annotated).

44. 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.*, 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.*, 3:30-38.

45. 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.

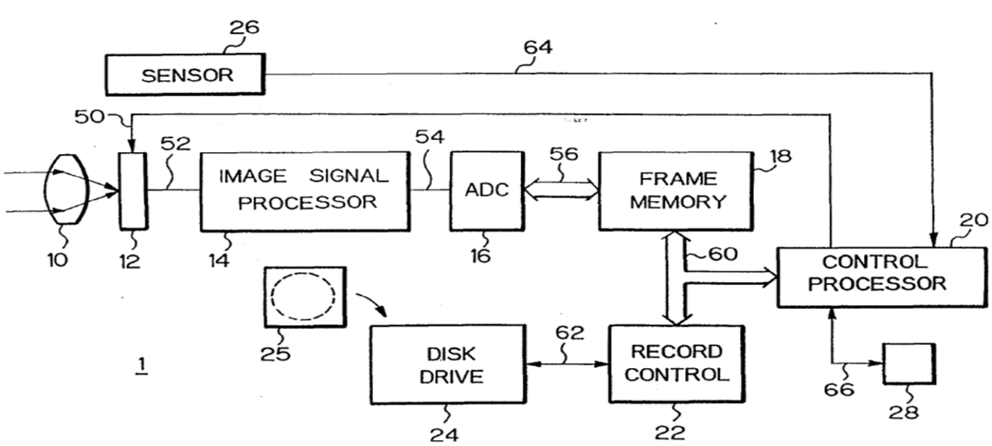
46. Like a typical arrangement for pixels of an LCD, a typical arrangement for the array of photoelectric elements of an image sensor was a rectangular array. And like the array of pixels for an LCD, this rectangular array was defined in the image sensor's specification by a resolution represented by 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).

47. 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.

48. 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 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-1005, 6:7-14, 6:38-65, 8:40-52; LG-1006, 3:48-57, 4:35-46.

Fig. 1



LG-1005, FIG. 1 (annotated).

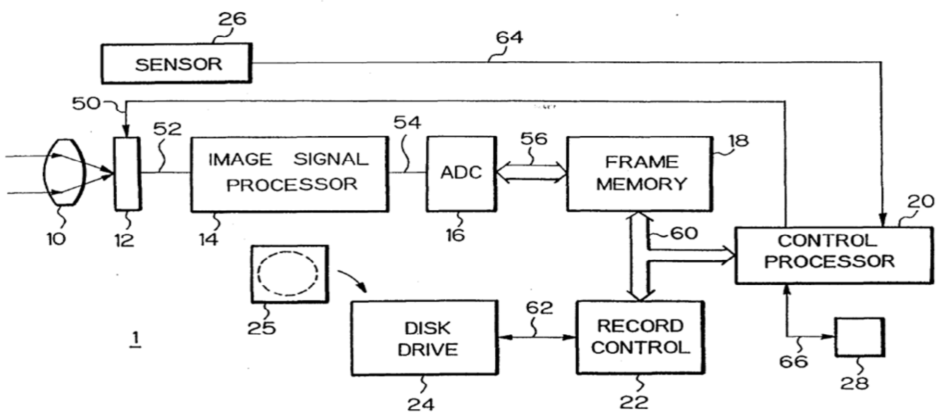
49. Pixel resolutions of LCDs were often different from pixel resolutions of CCD sensors of digital cameras. *See* LG-1006, 2:24-53; LG-1008, 7:11-32; *see also* LG-1001, 2:28-37 (admitting that there was a trend toward increasing number of pixels for image sensing devices and that the number of pixels 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-1006, 4:42-46, 7:8-11. As a result, digital cameras could convert the number of pixels to a resolution that matched that of the desired LCD. *See* LG-1006, 2:31-35, 4:42-54; LG-1008, 7:11-32.

2. Processing of Output of Image Sensing Devices

50. 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 below. *See* LG-1005, 2:61-65; LG-1006, 3:57-63. 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 below. *See* LG-1005, 3:30-48; LG-1006, 3:57-60.

Fig. 1



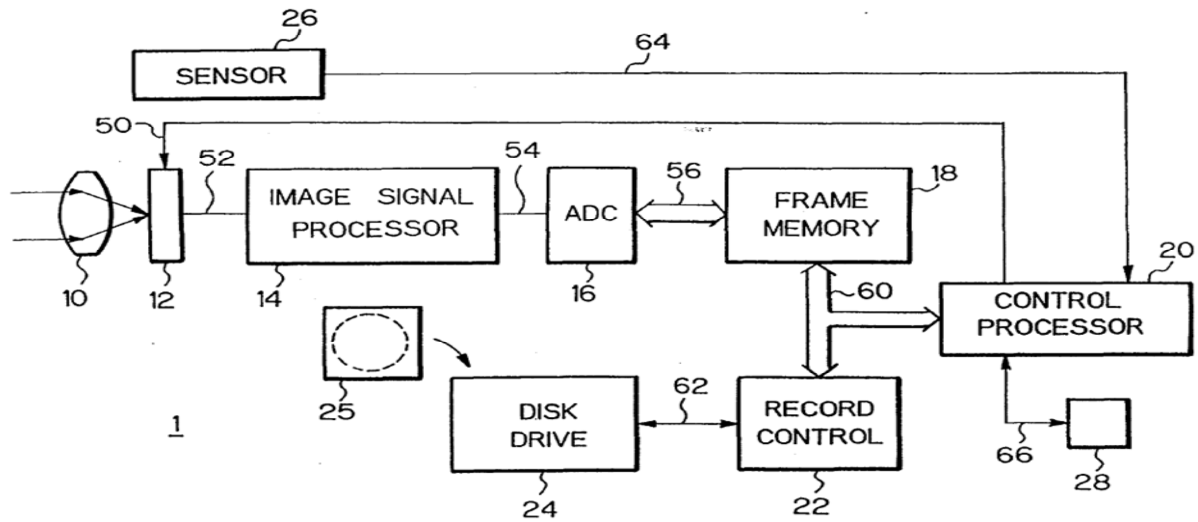
LG-1005, FIG. 1 (annotated).

51. 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-1007, 57-67; LG-1008, 5:18-28. 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-1005, 3:39-46; LG-1006, 3:57-60, 3:63-64, 4:21-31; LG-1007, 1:51-56; LG-1008, 5:18-28. And as discussed above,

digital cameras were known to use hardware, software, or both to process electrical signals. *See* LG-1006, 5:1-19; LG-1008, 3:37-50.

52. 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 below. *See* LG-1005, 2:64-66; LG-1006, 3:60-63; LG-1007, 13:56-61; LG-1008, 5:31-35, 7:21-32. 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 below. *See* LG-1005, 3:2-7; LG-1006, 3:45-47, 3:63-67; LG-1008, 8:4-21. 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-1005, 4:1-3, 6:66-7:18, 7:30-48, 8:60-9:8, 9:57-10:2; LG-1008, 7:11-32.

Fig. 1



LG-1005, FIG. 1 (annotated).

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

53. 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-1005, 6:66-7:18; LG-1006, 4:49-54, 6:15-45; LG-1007, 3:62-67; LG-1008, 4:37-42, 7:11-17, 8:22-29. 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-1005, 6:66-7:18; LG-1006, 6:15-45; LG-1007, 3:62-67; LG-1008, 4:37-42, 7:11-17, 8:22-29) or combining (e.g., mixing) information corresponding to multiple pixel lines of the image sensor (*see, e.g.*, LG-1006, 4:49-54, 8:12-27). A process for generating the reduced number of pixel lines could involve controlling the image sensor itself (*see, e.g.*, LG-1006, 6:15-45; LG-1008, 4:37-42, 7:11-17, 8:22-29), controlling the digital signals read from the temporary memory (*see, e.g.*, LG-1005, 6:66-7:18), 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-1006, 4:49-54).

VII. OVERVIEW OF THE ’729 PATENT

A. Technology Background and the Admitted Prior Art

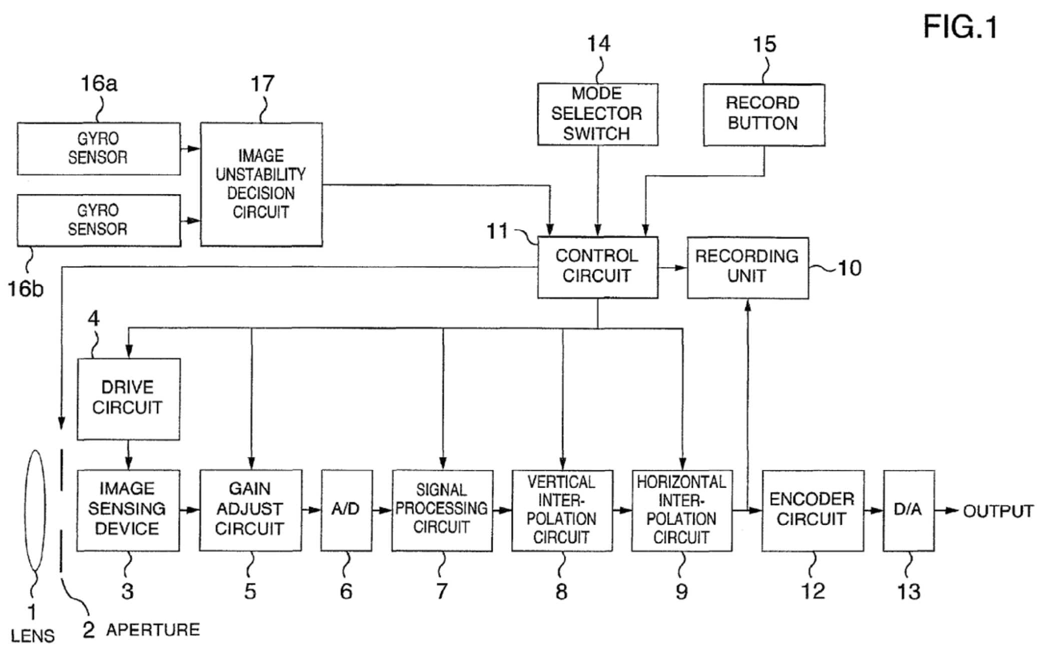
54. According to the ’729 Patent, at the time of the alleged invention, electric cameras that use solid-state image sensors, such as CCDs were available. *See* LG-1001, 1:25-31. Such cameras included both (1) video cameras for taking

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.*, 2:7-11; *see id.*, 2:28-34. In other words, the ’729 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.*, 2:28-34 (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 ’729 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.*, 1:32-36, 1:47-52, 2:46-55.

B. Description of the ’729 Patent

55. The ’729 Patent describes “[a]n electric camera includ[ing] an image sensing device.” LG-1001, Abstract. 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 '729 patent, an image sensing device 3 (e.g., a charged-coupled device) converts received light into an electric signal. *Id.*, 3:43-45, 4:36-39, 7:62-8:6. The image sensing device includes pixels arranged vertically and horizontally in a grid pattern to facilitate this conversion. *Id.*, 4:37-43. The electric camera also includes a signal processing circuit 7 to "generate image signals by using the output signals of the image sensing device." *Id.*, 3:32-33.

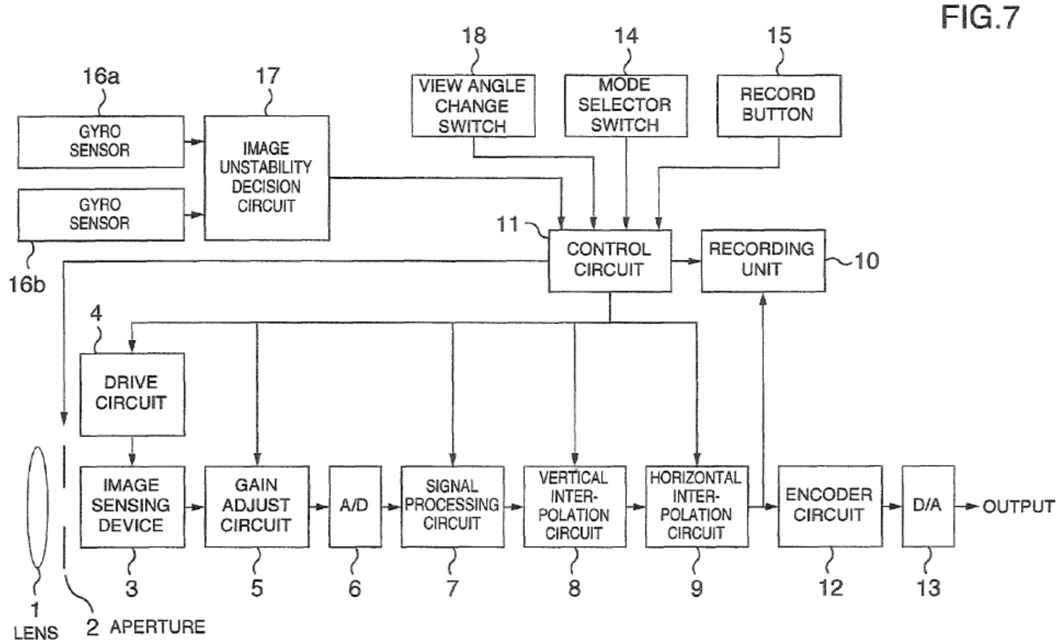


Id., FIG. 1.

56. The electric camera also includes gyro sensors 16a, 16b to "detect vertical image-unstability and lateral image-unstability." *Id.*, 4:31-33. And in another embodiment of the electric camera shown in FIG. 7 below, the electric

camera includes a view angle change switch 18, which provides a "zooming function." *Id.*, 10:56-58.

FIG.7



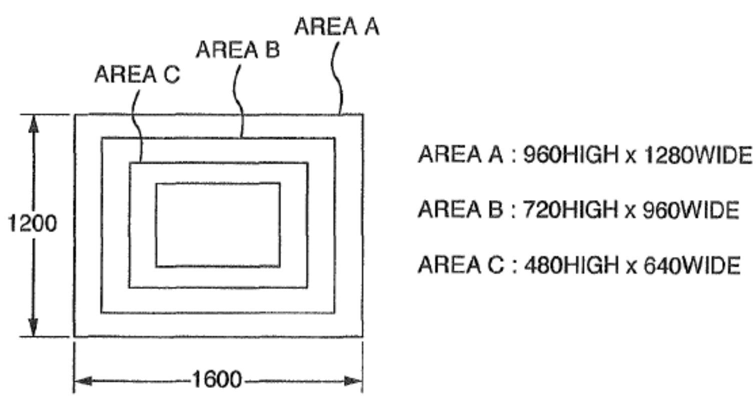
Id., FIG. 7.

57. In the embodiments shown in both FIGS. 1 and 7, the electric camera includes a mode selector switch 14 that selects between a static image mode and a moving video mode. *Id.*, 4:66-5:1, 7:30-32.

58. In the static image mode, a static image can be monitored or recorded. *Id.*, 8:53-60. The '729 patent describes that when recording a static image, "***all*** of the effective pixels on the image sensing device are used." *Id.*, 5:36-39 (emphasis added). Meanwhile, during monitoring in a static image mode, the '729 patent describes that image signals are formed with a "first view angle by using a first effective set of pixels of the image sensing device." *Id.*, 16:4-6. In some

embodiments, the first effective set of pixels used to generate television signals is described as corresponding to "the entire pixel area" of the image sensing device. *Id.*, 7:39-41. However, the '729 patent also describes embodiments in which the view angle is changed during monitoring the static image to extract only a portion of the total pixel area of the image sensing device (e.g., to perform a zooming function). *Id.*, 11:60-65, 12:12-15, FIG. 9 (reproduced below).

FIG.9



59. In the moving video mode, the '729 patent describes that when moving videos are recorded, image signals are formed with "a second view angle … by using a second effective set of pixels which is a portion of the array of pixels of the image sensing device." *Id.*, 16:10-14. In this way, recording the moving video mode is unlike the recording of static images because only a ***portion*** of the pixels of the image sensing device are used for image forming. *Id.*, 7:36-39; *see also id.*, 5:9-17 (describing an embodiment where only 960 pixels out of 1200

vertically arranged pixels are used for image forming). As the ’729 patent explains, the purpose of this feature is “to realize [an] image stabilizing function,” in which “the position of an extracted area (effective pixel area) on the light receiving surface [i.e., the image sensing device] is shifted in a direction that cancels the image-unstability” detected by the gyro sensors 16a, 16b. *Id.*, 5:9-10, 7:11-28. This shifting of effective pixel area to perform image instability correction is possible because the effective pixel area is smaller than the entire pixel area of the image sensing device. This is because the smaller size of the effective pixel area, effectively creates a “buffer” zone around the effective pixel area that allows the effective pixel area to be shifted while still staying within the bounds of the overall pixel area of the image sensing device.

60. The ’729 patent also describes that changing the angle of view (e.g., zooming in/out) in the moving video mode (*see* LG-1001, 10:46-12:12) involves a “similar operation” as during monitoring in the static image mode (*id.*, 12:12-15). However, as explained above, monitoring in the static image mode allows for generating television signals based on “signals coming from the entire pixel area” (*id.*, 7:39-41) while recording in the moving video is described as using only a ***portion*** of the pixels of the image sensing device for image forming. Therefore, it would be readily apparent to a POSITA that, in at least some implementations, the “first view angle” associated with monitoring in the static image mode is

necessarily different—and larger than—the "second view angle" associated with recording in the moving video mode. *Id.*, 16:11-12, 20-21, 52-53, 60-61.

C. Prosecution History

61. The initial application for the '729 Patent included claim 1, which in its original form, did not correspond to any of the issued claims. LG-1002, 289-298, 302-339.

62. In a non-final office action dated February 26, 2013, in addition to making several formal objections to the claims, the U.S. Patent and Trademark Office (Office) rejected claim 1 under the doctrine of obviousness-type double patenting as being unpatentable over certain claims of U.S. Patent No. 6,756,616 and U.S. Patent No. 8,059,177, and the Office further rejected claim 1 as being anticipated by U.S. Patent No. 6,661,451. *Id.*, 149-55. In response, the applicant amended claim 1 extensively and added claims 2-4. *Id.*, 115-22.

63. In a final office action dated August 28, 2013, in addition to making several formal objections to the claims, the Office rejected claims 1-4 as failing to comply with the written description requirement and as being indefinite. *Id.*, 106-12. In response, the applicant amended claims 1 and 3 to address the claim objections, written description rejections, and indefiniteness rejections. *Id.*, 85-93. On January 9, 2014, the applicant also submitted a terminal disclaimer with respect to U.S. Patent No. 8,339,493 and U.S. Patent No. 6,765,616. *Id.*, 76-77.

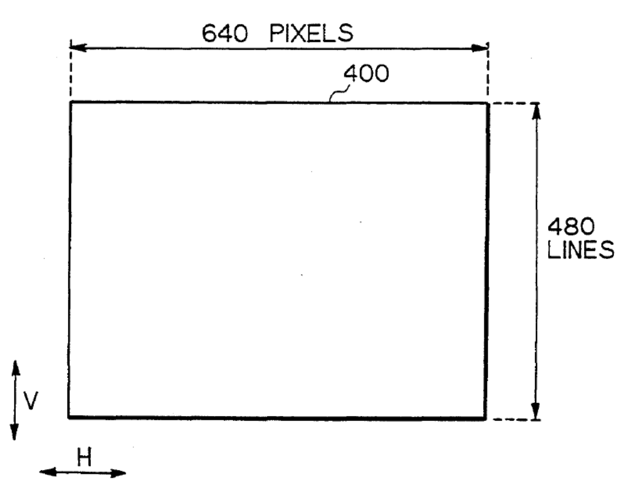
64. In a Notice of Allowance, the Office made several examiner's amendments to the claims, which issued as claims 1-4 of the '729 patent. *Id.*, 53-62.

VIII. SUMMARY OF THE PRIOR ART

A. Misawa

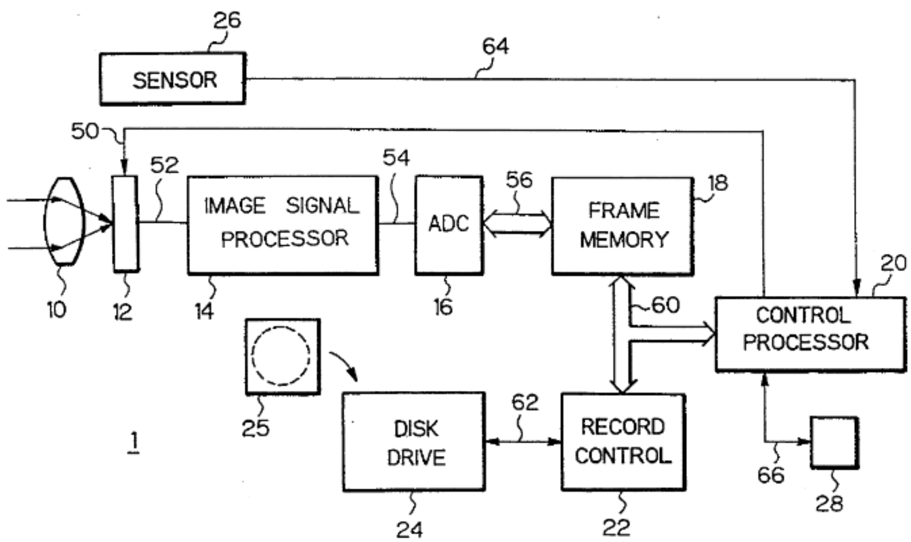
65. Misawa discloses a digital electronic camera including (1) an optical lens for forming the optical image of an object to be captured and (2) an image sensor for producing pixel signals associated with the optical image. LG-1005, 2:36-44, 2:55-61. As illustrated in Figure 4A below, the image sensor includes a photosensitive array with 640 pixels extending in a horizontal direction and 480 horizontal lines extending in a vertical direction. *Id.*, 3:30-34.

Fig. 4A



LG-1005, FIG.4A.

66. Misawa also discloses that the camera includes an image signal processor 14 "adapted for processing the pixel signals produced [by the image sensor 12] to develop image signals representative of the optical image captured." *Id.*, 2:55-61; FIG. 1 (reproduced below). Misawa explains that it was known to reproduce image data or signals using a playback device "to be visualized on an image monitor such as a TV monitor device in the form of pictures." *Id.*, 1:33-39.

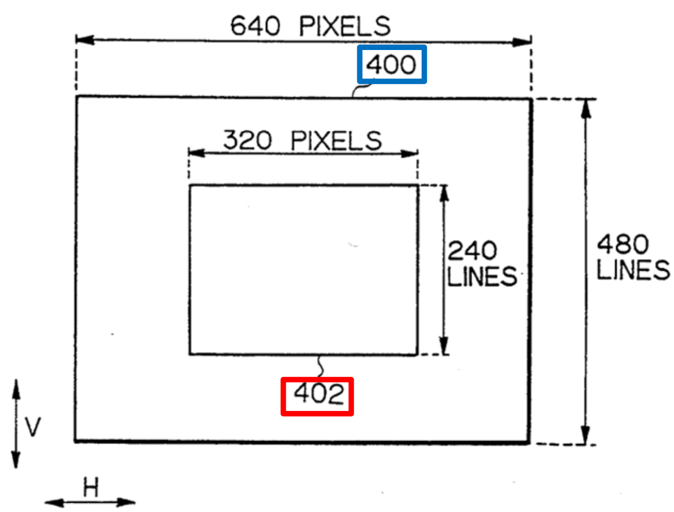


Id., FIG. 1.

67. Misawa's camera operates in a still picture mode and a movie picture mode. *Id.*, 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.*, 7:1-7, 8:60-9:8. In the movie picture mode, the read-out processor reads out part of the image data corresponding to part of an imaging field of the image sensor corresponding to a smaller **area 402** in an **image frame 400** shown

in Figure 4B below. LG-1005, 7:8-13. The image frame 400 (640-pixel by 480-pixel) and the area 402 (320-pixel by 240-pixel) have a 4:3 aspect ratio. LG-1005, 7:13-15.

Fig. 4B



LG-1005, FIG. 4B (annotated).

68. To provide image instability correction, Misawa discloses that the camera includes a sensor 26 such as a gyroscopic transducer that senses "unintentional movement or vibration of the camera body proper which would cause blur in a picture" and provides the sensed signals to a control processor 20. *Id.*, 4:60-5:8. As Misawa explains, the control processor 20 includes a movement detector 314 and a correction processor for forming "correction data used for compensating for blur due to the movement of camera 1 in movie pictures taken by camera 1." *Id.*, 6:7-14, 8:17-21.

69. Misawa explains that one of the major advantages of using an area 402 smaller than the entire frame of imaging field 400 to record moving videos is that "portions of the image data associated with a peripheral portion adjacent to and surrounding area 402 [can be utilized] for the purpose of compensating for blur which would [otherwise] be caused in a reproduced picture by unintentional movements of digital camera 1 proper." *Id.*, 10:45-51. More specifically, Misawa describes that, in the movie picture recording mode, instability correction can be achieved by shifting the position of the area 402 based on a "moving amount" and "directional data" included in the movement data provided by movement detector 314. *Id.*, 8:17-27.

B. Parulski

70. Parulski discloses a camera including (1) a liquid crystal display (LCD) that can have 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-1006, 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.*, 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 [(charge-coupled device)] 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." LG-1006, 5:49-52.

71. Parulski discloses a "still image mode" for capturing and storing a still image from the image sensor and a "motion preview mode" for producing a preview image prior to capturing the still image from the image sensor. *Id.*, 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.*, 6:29-31. In other words, all rows and all charges are read to produce the still image in the still image mode.

72. In the motion preview 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.*, 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.*, 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.*, 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.*, 4:61-63.

73. Parulski describes that after reading out lines from the image sensor using a line-skipping process, those lines are displayed on the LCD. *Id.*, 7:41-61. For example, after 512 lines are read out from the image sensor using a line-skipping process in which two or four lines are alternately skipped, 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.*, 7:41-48. Specifically, 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.*, 7:48-54.

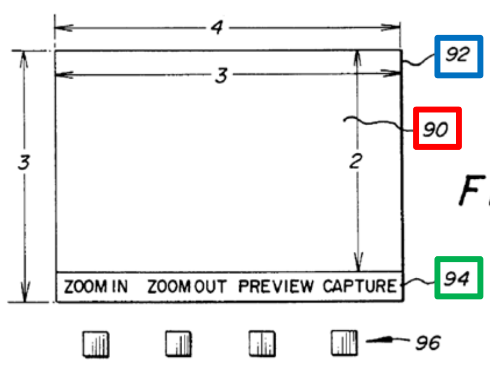


FIG. 11

Id., FIG. 11 (annotated).

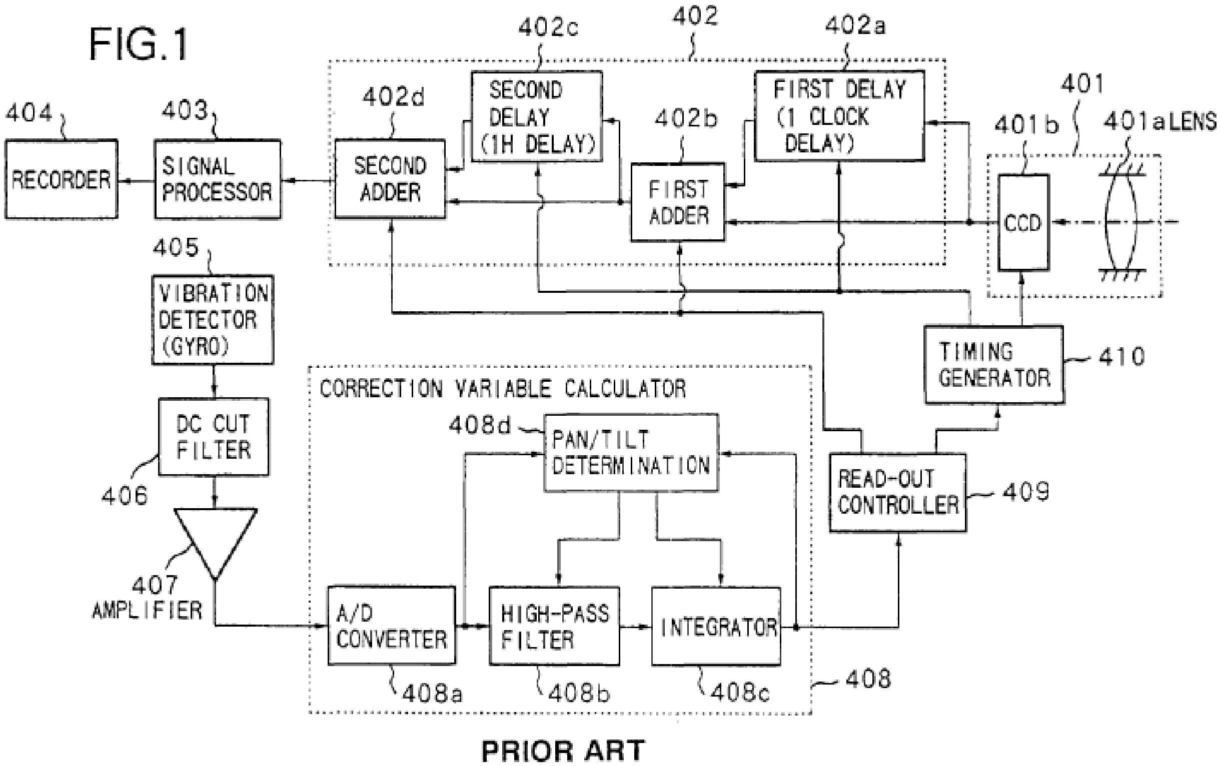
74. As shown in FIG. 11 of Parulski, the status area 94 includes a list of functions that a user can select including a "zoom in" function, a "zoom out" function a "preview" function, and a "capture" function. *Id.*, 7:51-54. For example, to make this selection, Parulski describes that the camera can include corresponding user control buttons for zooming in and out of the displayed image, monitoring the displayed image in the preview mode, and recording a still image once the user is satisfied with the composition shown on the LCD display. *Id.*, 3:23-38.

C. Kawahara

75. Kawahara discloses conventional and improved image sensing apparatuses such as video cameras, including those capable of sensing "both a moving image and a still image." LG-1007, 1:17-21, 7:58-59. For example, Kawahara discloses a conventional image sensing apparatus that includes "an imaging sensor 410b such as a CCD [charge-coupled device] or the like" and shows, in FIG. 4, an image sensing device 701 constructed with pixels arranged vertically and horizontally in a grid pattern. *Id.*, 1:40-41, 4:29-34, 6:22-26, 13:5-10, FIG. 4.

76. Kawahara also discloses that the image sensing apparatus includes (1) a vibration correction section 402 "to correct image signals … to reduce vibration components of a moving image influenced by unsteady hands or the like" (*id.*,

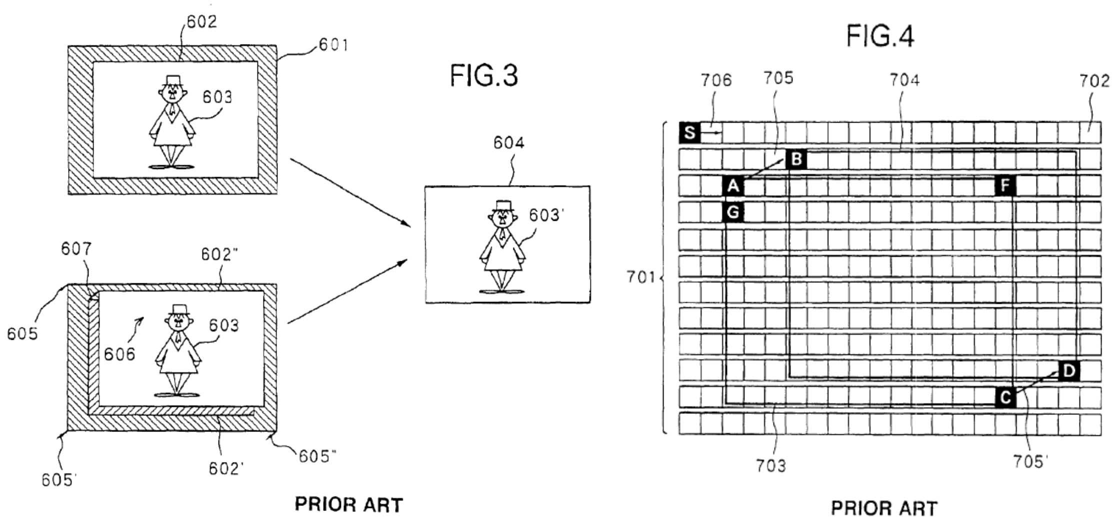
1:42-45), (2) a signal processor 403 to "convert electric signals … to standard video signals" (*id.*, 1:51-54), (3) a recording section 404 to "record[] the standard video signals … as image signals" (*id.*, 1:54-56), (4) a vibration detector 405 such as a "vibration gyro sensor or the like" (*id.*, 1:56-58), (5) a DC cut filter 406 to "cut off the DC components of the angular velocity signal, outputted by the vibration detector" (*id.*, 1:60-63), (6) an amplifier 407 to amplify the angular velocity signal outputted by the DC cut filter (*id.*, 1:66-67), (7) a correction variable calculator 408 to obtain an angle displacement signal that serves as a correction target value (*id.*, 2:1-26), (8) a read-out controller 409 to "shift[] a read-out start position of the image sensing device 401b in accordance with the vibration correction target value signal" (*id.*, 2:27-32), and (9) a [timing] generator 410 to "generate[] driving pulses … based on the control data of the read-out controller" (*id.*, 2:33-36). Kawahara explains that captured images could be reproduced on a monitor such as video monitor or a finder or the like. *Id.*, 4:1-5, 13:53-55.



Id., FIG. 1.

77. To provide vibration correction, Kawahara discloses shifting a position of an extraction frame (comprising only a portion of the pixels of the entire image sensing device) in order to remove "displacement caused by vibration on the image sensing apparatus." *Id.*, 4:11-5:27, FIGS. 3-4 (reproduced below). Using this technique, "a partial image from the entire image sensing area 601 of the image sensing device 401b" is selectively extracted. *Id.*, 5:6-9. Furthermore, Kawahara explains that since this image extraction technique "can only be performed in each unit pixel 702 of the image sensing device 401b," an additional

"fine pixel shifting" operation can be performed to achieve sub-pixel correction amounts. *Id.*, 5:43-50.

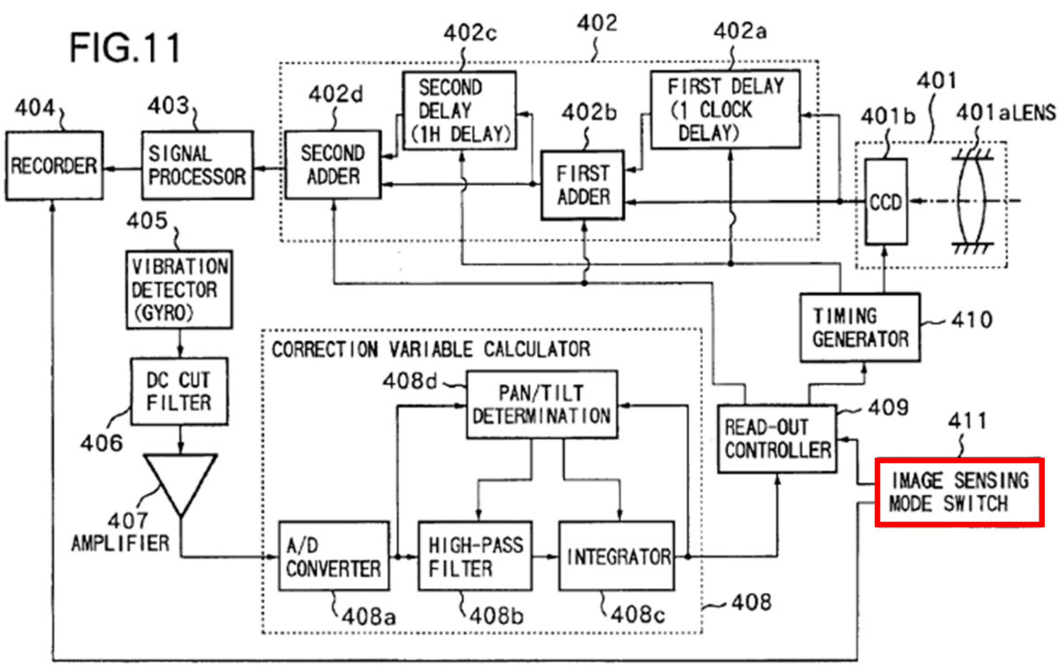


Id., FIGS. 3-4.

78. In another embodiment of an image sensing apparatus, Kawahara discloses that the apparatus further includes an **image sensing mode switch 411** that "allows users to switch the record mode of the recording section 404 between a moving image recording mode and a still image recording mode." *Id.*, 11:1-8, FIG. 11 (reproduced below). Kawahara explains that "in a case of sensing a still image wherein correction between frames by image extraction is not important, a problem of deteriorating resolution in images rather arises." *Id.*, 7:66-8:2. Therefore, in this embodiment, Kawahara explains that the camera is operated such that the fine pixel-shifting operation is performed ***only*** in the moving image sensing mode and ***not*** in the still image recording mode. *Id.*, 11:18-12:6, FIG. 12.

According to Kawahara, this selective use of the fine pixel-shifting operation has the advantage of making it possible "to obtain [a still] image where resolution is not greatly deteriorated." *Id.*, 12:7-13. In still other embodiments of the image sensing apparatus, Kawahara discloses that the anti-vibration signal can be deactivated entirely to prevent the performance of any pixel shifting operations. *Id.*, 18:48-53, FIGS. 14 and 17. A POSITA would understand that this could further prevent the deterioration of resolution in images captured by the camera.

FIG.11



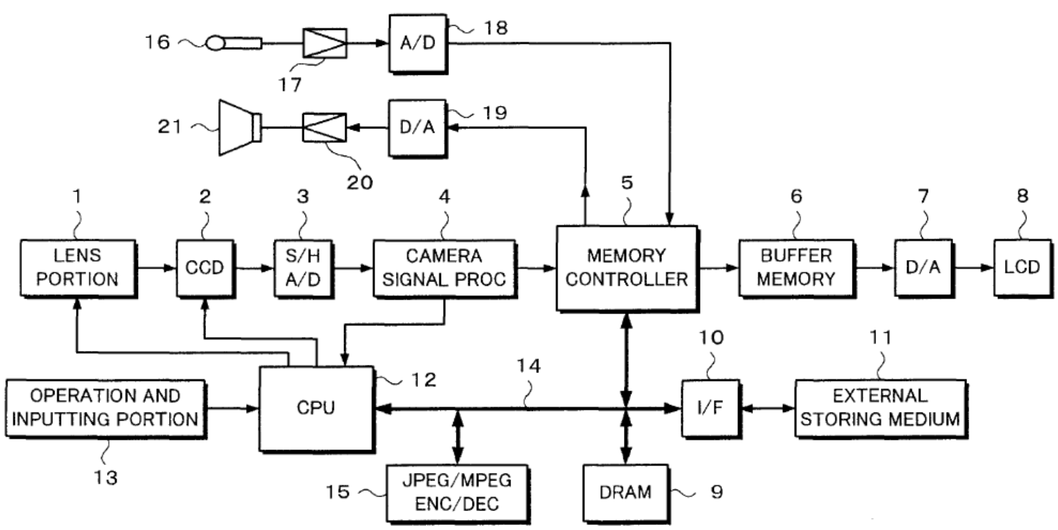
Id., FIG. 11 (annotated).

D. Tomita

79. Tomita discloses a digital camera capable of photographing and recording a still picture, an audio attached still picture, and an audio attached moving picture. LG-1008, 4:24-28, FIG. 1. The camera includes a CCD (Charge

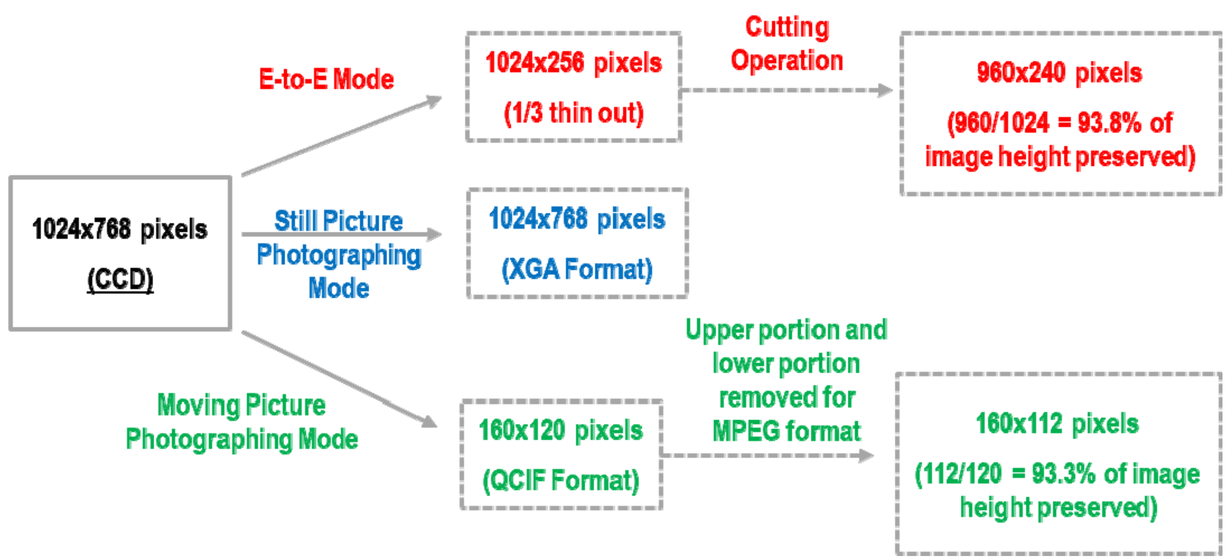
Coupled Device) having a 1024x768 pixel array as well as various signal processing components for forming image signals based on the output signals of the CCD including a "sample hold and A/D converting portion" 3, a "camera signal processing portion" 4, a "memory controller" 5, a "CPU" 12, and an "encoder/decoder" 15. *Id.*, 4:29-45, 5:11-6:3, FIG. 1. Tomita also discloses that the camera includes an LCD 8 configured to display photographed pictures in the E-to-E mode and that the E-to-E mode is "the state of which the user checks an object before pressing the shutter button." *Id.*, 4:65-67, 5:6-10; FIG. 1. Therefore, Tomita discloses displaying pictures not only after they have been recorded, but also while they are being monitored/previewed prior to recording.

Fig. 1



Id., FIG. 1.

80. Tomita describes that the camera includes various user-selectable modes including (1) a "line thin-out mode" or "E-to-E mode" in which a user can view and compose an image prior to pressing the shutter button, (2) a "still picture photographing mode," and (3) a "moving picture photographing mode." *Id.*, 4:45-56, 4:65-5:10, 5:43-46, 6:65-7:45, 8:22-52. The following diagram summarizes the various modes taught by Tomita including the pixel dimensions used to form images in each mode, which are relevant to my analysis of the '729 Patent below.



81. In the **E-to-E mode**, the number of pixel lines of the CCD are thinned out by 3 in the vertical direction (resulting in a 1024x256 pixel area), and a 960x240 pixel area is "cut" from the 1024x256 pixel area before being displayed on the camera's LCD. *Id.*, 4:40-41, 4:50-56, 7:11-32. This cutting operation necessarily changes (and decreases) the angle of view of the formed image relative to the image sensed by the CCD. As described by Tomita, the E-to-E mode allows

a camera user to monitor a preview image and then set an angle of view, a focus, and/or an exposure prior to pressing a shutter button to photograph a still image. *See id.*, 7:11-32.

82. When a user ultimately presses the shutter button, Tomita's camera is placed in a **still picture photographing mode**. *Id.*, 7:33-38. In this mode, the camera's CCD outputs a high-resolution picture in XGA format (1024x768 pixels) that is directly stored to the camera's DRAM. *Id.*, 7:38-45. As Tomita explains, "[i]n the photographing mode, all pixels are read." *Id.*, 4:38-39.

83. Additionally, Tomita describes that the camera can operate in a **moving picture photographing mode** in order to record moving pictures. *Id.*, 7:56-59, 8:22-53. In this mode, the user can set the picture size to a QCIF format, corresponding to a 160x120 pixel area. *Id.*, 8:39-40, 5:51. However, as Tomita explains, since the size of each macro block in the MPEG format is 16x16 pixels, "the upper portion and lower portion of a picture in the picture format QCIF are removed," resulting in a picture composed of 160x112 pixels that is stored to the camera's DRAM. *Id.*, 5:51-56, 8:39-42. This cropping of the picture to remove the upper portion and lower portions necessarily changes (and decreases) the angle of view of the formed image relative to the image sensed by the CCD.

IX. ANALYSIS OF MISAWA IN VIEW OF PARULSKI

A. Misawa-Parulski Combination

84. Both Misawa and Parulski pertain to electronic digital cameras for recording imagery such as still images and moving videos. LG-1005, 1:54-58; LG-1006, 1:9-13. Misawa describes "a digital electronic camera for capturing the image of an object and recording data representative of still and movie images," LG-1005, 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-1006, 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.*, 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.*, 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.

85. A POSITA would have been motivated to combine the teachings of Misawa and Parulski in several ways. First, a POSITA would have been motivated to add an LCD, as taught in Parulski, to Misawa's camera and use a motion preview mode, as taught in Parulski, for monitoring on the LCD an image to be captured in Misawa's still picture mode. Second, a POSITA would have been motivated to add user control buttons, as taught in Parulski, to Misawa's camera for selecting between a monitoring operation and an image recording operation in

the static image mode from a list displayed on the LCD. Third, a POSITA would have been motivated to add Parulski's zoom functionality to Misawa's camera for changing a view angle of images prior to recording.

86. First, with respect to the LCD, a POSITA would have been motivated to add an LCD, as taught in Parulski, into Misawa's electronic 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'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-1006, 1:27-34, 2:24-53, 3:33-38, 7:41-48; LG-1005, 1:9-58. Misawa acknowledges the known use case of monitoring captured images on an external device such as a "TV monitor device," while Parulski's LCD eliminates the need for an external device by including the LCD as part of the camera itself. LG-1005, 1:33-39; LG-1006, 1:27-34. In addition, Parulski describes how the LCD can be used, in a motion preview mode, to allow a user to compose an image to their liking before capturing the image. LG-1006, 3:33-38. It would have been an insignificant and predictable step to incorporate Parulski's LCD and motion preview mode into Misawa's camera to achieve similar advantages, and the combination would have had a reasonable expectation of

success since both Parulski's and Misawa's cameras are similarly configured to capture still images.

87. 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'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-1006, 2:24-53. Moreover, the display could be used for viewing previously recorded images. *Id.*, 7:43-43. A POSITA would have understood that such displays were used for showing previously recorded still images or previously recorded moving images.

88. The LCD could also be used for presenting information to a user regarding the operation of the camera. *Id.*, 7:43-54. For example, the display can present textual descriptions for the functions of physical buttons on the camera. *See id.*, 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.

89. 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.*, 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.*, 4:61-5:19.

90. 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.*, 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.*, 4:64-5:1. By comparison, a POSITA would understood 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.*, 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.*, 5:8-9.

91. 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.*, 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.*, 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.*, 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.*, 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.*, 4:42-46, 4:64-5:1 (describing that low-resolution imagery can be used to drive the low-resolution LCD).

92. Both Parulski and Misawa teach digital cameras that capture still imagery, thus supporting a finding that combining the teachings of Misawa 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.*, 3:29-33. And Misawa similarly teaches capturing still imagery with its digital camera. LG-1005, 1:9-14, 1:54-58. Thus, incorporating an LCD and a motion preview mode as taught in Parulski into Misawa's camera would have had a reasonable expectation of success.

93. Second, as for the user control buttons, a POSITA would have been motivated to add user control buttons, as taught in Parulski, to Misawa's electronic digital camera. A POSITA would have been motivated to do this so that, in the static image mode, a user could select a monitoring operation and/or a recording operation from a list displayed on the camera's LCD. As I have already described above, a POSITA would have been motivated to modify Misawa's camera to

include Parulski's motion preview mode to perform a monitoring operation in addition to Misawa's recording operation for still images. Additionally, upon making this modification, a POSITA would have recognized the need for a user interface to select between these multiple operations. Parulski provides a simple solution to this very problem by displaying a list of functions such as "Preview" and "Capture" on the status area 94 of the LCD display screen 92 as well as including control buttons 96 for selecting between the functions. LG-1006, 3:23-37, 7:51-54, FIG. 11. Displaying selectable camera settings and functions on LCD screens was well known and widely performed as of the Critical Date, and it was also common practice to include buttons on cameras to control camera operations. Therefore, a POSITA would have viewed the user interface taught by Parulski as a straightforward and obvious modification to Misawa's camera in order to provide the very same control benefits to Misawa's camera that the user interface provides in Parulski. At the Critical Date, there was simply nothing nonobvious about adding buttons to a camera to control the camera's operation. As such, incorporating user control buttons as taught in Parulski into Misawa's camera would have had a reasonable expectation of success.

94. Third, with respect to the zooming function, a POSITA would have been motivated to add a zooming function, as taught in Parulski, to Misawa's camera. As I described above, a POSITA would have been motivated to add an

LCD and motion preview mode to Misawa's camera in order to present a user a preview of an image to be captured in Misawa's still picture mode. Furthermore, consistent with this motivation, Parulski describes that a user can compose a picture by depressing "zoom in" or "zoom out" buttons "while observing the display image" and can then depress the capture button "[w]hen the user is satisfied with the composition on the color LCD display." LG-1006, 3:33-38. Therefore, a POSITA would have recognized that it would be desirable to add the zooming function taught by Parulski into Misawa's camera to give a user even more control over the composition of an image prior to capturing the image. Such an addition would merely be a natural and logical result of combining Misawa and Parulski. A POSITA, therefore, would have found it predictable to modify Misawa's camera in this way and would have had a reasonable expectation of success since the zooming function would operate in the resulting combination just as it does in Parulski's camera to achieve similar advantages of improved image composition.

B. Claim 1

[1.pre] "A camera comprising:"

95. To the extent the preamble is limiting, Misawa-Parulski renders obvious this element. Misawa discloses a "digital electronic camera 1." LG-1005, 1:9-14. Parulski likewise discloses an electronic camera. LG-1006, 1:9-13.

[1.1] "an image sensing device having an array of pixels arranged vertically and horizontally in a grid pattern;"

96. Misawa-Parulski renders obvious this element. Misawa discloses this feature. *Id.* Misawa's image sensor 12 is described as having "an array of photosensitive cells … adapted to transduce the optical image from on the photosensitive array into corresponding pixel signals." LG-1005, 2:35-44, 3:14-29. And in one example, Misawa describes that "the photosensitive array of image sensor 12 has an imaging field 400 including 640 photosensitive cells or pixels in its horizontal direction H to form a horizontal line and 480 lines in its vertical direction (V)" to create a 640x480 grid pattern of pixels. *Id.*, 3:30-38. Therefore, Misawa's image sensor 12 corresponds to *an image sensing device having an array of pixels arranged vertically and horizontally in a grid pattern*.

97. Parulski similarly discloses this feature. For example, Parulski discloses an image sensor including a two-dimensional array of pixels arranged in rows and columns of image pixels and specifically identifies 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—as a preferred sensor. LG-1006, 5:39-41, 5:49-52.

[1.2] "an image-instability detector, configured to detect an amount of image-instability of the camera;"

98. Misawa-Parulski renders obvious this element. Misawa discloses this feature. *Id.* Misawa's camera includes a sensor 26 such as a piezoelectric gyroscopic transducer that senses "unintentional movement or vibration of the camera body proper which would cause blur in a picture." LG-1005, 4:60-5:8. These sensed signals are provided to a control processor 20 that includes a movement detector 314. *Id.*, 6:7-14. Misawa further describes that the movement detector 314 "receives a movement signal from sensor 26 … and generates movement data" that includes "moving amount data." *Id.*, 8:7-16. Therefore, a POSITA would have understood that Misawa's sensor 26 and movement detector 314—either alone or in combination—correspond to *an image-instability detector, configured to detect an amount of image-instability of the camera*.

[1.3] "a signal processing unit configured to form image signals with a predetermined view angle by using effective pixels of the image sensing device, and:"

99. Misawa-Parulski renders obvious this element. Misawa discloses the digital electronic camera includes:

> an image signal processor 14 adapted for processing the pixel signals produced [by the image sensor 12] to develop image signals representative of the optical image captured … [,] an analog-to-digital [converter] (ADC) 16

> for [c]onverting the output from [the] image signal processor 14 into image data containing corresponding digital values, a frame memory 18 for temporarily storing therein the image data, and [a] control processor 20 adapted to compress the image data stored in frame memory 18 for the purpose of recording in [an] optical disk 25 and also to control the overall operations of digital camera 1.

LG-1005, 2:55-3:2; *see also id.* 3:39-4:15. The control processor includes, among other components, 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 an optical disk. *Id.*, 6:7-14, 66-67, 7:49-55, 7:66-8:1, 9:4-5. A POSITA would therefore have understood that Misawa has *a signal processing unit*—including the image signal processor, ADC, frame memory, and control processor—*configured to form image signals*.

100. Misawa also discloses that the image signals can be formed with various predetermined view angles by using effective pixels of the image sensing device. For example, Misawa discloses that when recording image data in the still

picture mode, "a full frame of image data is read out from frame memory 18 and processed." LG-1005, 10:39-41. However, when recording image data in the movie picture mode, only "part of image data corresponding to area 402 within imaging field 400 is read out from frame memory 18 to be processed." LG-1005, 10:42-45. In one example, Misawa describes that the entire frame of the imaging field 400 can be a 640x480 pixel array, while the area 402 can be a smaller 320x240 array. *Id.*, 3:30-35, 7:13-15, FIG. 4B. These different areas correspond to different predetermined view angles, and a POSITA would have recognized this. A POSITA would also have understood that the image signals formed with these view angles are formed by using effective pixels of the image sensing device.

[1.4] "during monitoring in a static image mode, to form image signals with a first view angle by using a first effective set of pixels of the image sensing device,"

101. Misawa-Parulski renders obvious this element. Misawa's camera includes a "still picture mode" for recording still images, and a POSITA would have recognized that this "still picture mode" corresponds to *a static image mode*. LG-1005, 2:7-9. To the extent that Misawa does not explicitly disclose a "monitoring" operation in the static image mode, Parulski discloses this feature.

102. Parulski discloses an electronic camera for capturing still images that includes a "motion preview mode" for producing a preview image of "acceptable quality" prior to capturing the still image from the image sensor. LG-1006, 1:9-13,

2:25-31, 6:27-34. This motion preview mode corresponds to performing a *monitoring in a static image mode*, and a POSITA would have understood this. Parulski describes that in the motion preview mode, a digital image processing technique is used to map an array of color image pixels from an image sensor into an array of color display pixels on an LCD display that has fewer pixels than the image sensor. LG-1006, 2: 24-39. For example, Parulski describes that after 512 lines of pixels are read out from an image sensor using a line-skipping process, 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.*, 7:41-48. Specifically, as shown in Figure 11 of Parulski, 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.*, 7:48-54. A POSITA would have understood this formation of an image with a 4:3 aspect ratio in the motion preview mode to correspond to *forming image signals with a first view angle by using a first effective set of pixels of the image sensing device*. Furthermore, Parulski discloses a "zoom in" and "zoom out" functionality in the motion preview mode. Therefore, Parulski discloses (and a POSITA would have understood Parulski as disclosing) **multiple** alternative view angles using **different** effective sets of pixels of the image sensing device. LG-1006, 3:29-36.

103. A POSITA would have been motivated to modify Misawa's still picture mode to include the monitoring operation of Parulski's motion preview mode since both references disclose electronic cameras used for capturing static images. LG-1005, 1:54-58; LG-1006, 1:9-13. The POSITA also would have been motivated to make this combination at least because it would predictably allow a user to improve the quality of captured images since Parulski's motion preview mode allows a user to compose an image to their liking before recording the image. LG-1006, 3:33-38. Indeed, this feature would have been simple to implement and desirable to many users by the Critical Date. Parulski's motion preview mode would operate in a very similar manner to achieve the same effect in Misawa's camera, and the POSITA would therefore have recognized that the combination would have a reasonable expectation of success.

[1.5] "during recording in the static image mode, to form image signals by using all effective pixels of the image sensing device, and"

104. Misawa-Parulski renders obvious this element. As described above, Misawa's camera includes a "still picture mode" for recording still images, and a POSITA would have recognized that this "still picture mode" corresponds to *a static image mode*. LG-1005, 2:7-9. Misawa also discloses that, "[i]n order to record image data in the still mode, a full frame of image data is read out from

frame memory 18 and processed" (LG-1005, 10:39-41) and that "the entire pixel data included in imaging field 400 [of the image sensor 12] is sequentially read out from frame memory 18" (LG-1005, 8:60-66). *See also id.*, 3:30-38; 7:1-7, FIG. 4A. Therefore, a POSITA would have understood Misawa's description of recording images in the static image mode to correspond to *during recording in the static image mode, to form signals by using all effective pixels of the image sensing device*.

105. Parulski also discloses this feature. For example, Parulski discloses that in a still imaging mode, "***all*** rows of image pixel charge corresponding to each line are progressively read out through the horizontal register 70 during a single scan" to form an image. LG-1006, 6:27-38 (emphasis added).

[1.6a] "during recording in a moving video mode, to form image signals with a second view angle, different from the first view angle, by using a second effective set of pixels which is a portion of the array of pixels of the image sensing device, and"

106. Misawa-Parulski renders obvious this element. Misawa describes a "movie picture mode" for "movie picture recording" that corresponds directly to *recording in a moving video mode*. LG-1005, 1:63-68. Furthermore, Miswa discloses that, in the movie picture mode, image data is recorded such that only "part of image data corresponding to area 402 within imaging field 400 is read out from frame memory 18 to be processed." *Id.*, 10:42-45. More specifically, Misawa describes an example in which the imaging field 400 can be a 640x480

pixel array, while the area 402 can be a smaller 320x240 array. *Id.*, 3:30-35, 7:13-15, FIG. 4B. A POSITA would have understood that forming an image based on the pixels in the smaller area 402 corresponds to *form[ing] image signals with a second view angle … by using a second effective set of pixels which is a portion of the array of pixels of the image sensing device*.

107. Misawa-Parulski also renders obvious that the second view angle (associated with the recording in the moving video mode) is *different from the first view angle* (associated with the monitoring in the static image mode). As described above, it would have been obvious to modify Misawa's still picture mode to include the monitoring operation of Parulski's motion preview mode. *See supra* Sections IX.A and IX.B.[1.4]. And since Parulski discloses a "zoom in" and "zoom out" functionality in the motion preview mode (i.e., during monitoring in the static image mode), the combination of Misawa and Parulski would enable **multiple** alternative view angles during monitoring in the static image mode. LG-1006, 3:29-36. In view of this disclosure, a POSITA would have understood that the obvious combination of Misawa and Parulski necessarily yields, in at least some instances, a second view angle that is different from the first view angle. LG-1006, 3:29-36.

[1.6b] "during recording in a moving video mode … to change a position of the second effective set of pixels according to the amount of image-instability detected by the image-instability detector, in order to correct the image-instability; and"

108. Misawa-Parulski renders obvious this element. Misawa discloses that one of the major advantages of using an area 402 smaller than the entire frame of imaging field 400 to record moving videos is that "portions of the image data associated with a peripheral portion adjacent to and surrounding area 402 [can be utilized] for the purpose of compensating for blur which would [otherwise] be caused in a reproduced picture by unintentional movements of digital camera 1 proper." LG-1005, 10:45-51. More specifically, Misawa describes that, in the movie picture recording mode, instability correction can be achieved by shifting the position of the area 402 based on a "moving amount" and "directional data" included in the movement data provided by movement detector 314. *Id.*, 8:17-27. A POSITA would have understood this disclosure in Misawa as corresponding to *during recording in a moving video mode ... to change a position of the second effective set of pixels according to the amount of image-instability detected by the image-instability detector, in order to correct the image-instability*.

[1.7] "a display unit configured to display an image corresponding to the image signals formed by the signal processing unit."

109. Misawa-Parulski renders obvious this element. Misawa discloses the capturing of an object and recording data representative of still and movie images

in a data recording medium and that such recorded data can be adapted to be visualized on an image monitor such as a TV monitor device. LG-1005, 1:9-39. To the extent Misawa does not explicitly disclose a display unit 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 that can directly drive a LCD that is part of Parulski's electronic camera. LG-1006, 3:23-26, 4:37-46. Based on these teachings in Parulski, a POSITA would have been motivated to modify Misawa to include an LCD as a monitor device and to include a preview mode processing circuit that generates image data to drive the LCD ("*a display unit configured to display an image corresponding to the image signals formed by the signal processing unit*"). *See* LG-1006, 2:24-53, 3:33-38; *supra* Section IX.A.

C. Claim 2

[2] "A camera according to the claim 1, wherein the first view angle is larger than the second view angle."

110. Misawa-Parulski renders obvious this element. As I described above, it would have been obvious to combine Misawa and Parulski to obtain a camera in which the first view angle (associated with the monitoring in the static image mode) is *different* than the second view angle (associated with the recording in the moving video mode). *See supra* Section IX.B.[1.6a]. It also would have been

obvious for the first view angle to be *larger* than the second view angle for at least the following reasons.

111. First, Parulski's line-skipping process in the motion preview mode is described as displaying "the ***entire*** 3:2 aspect ratio sensor image on the 4:3 aspect ratio LCD, without introducing geometric distortion." LG-1006, 6:45-40 (emphasis added); *see also id.*, 7:33-40 ("This special 'line skipping' readout mode, as shown in FIG. 7, allows the sensor 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. This 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.") In contrast, Misawa's movie picture mode uses only a 320x240 pixel area of a wider 640x480 pixel imaging field to form images. Therefore, a POSITA would have understood that adding Parulski's motion preview mode to Misawa's camera would result in a first view angle (during monitoring in a static image mode, as taught by Parulski) that is larger than a second view angle (during recording in a moving video mode, as taught by Misawa). Indeed, it would have been common sense for the view angle used during monitoring in the static image mode to match the view angle during recording in the static image mode (which Misawa describes as using the "full frame" of image data) so that a user could

more accurately preview images before capturing them. Otherwise, a user monitoring an image might unintentionally compose the image to include or exclude objects without appreciating how the preview differs from the composition of the ultimately recorded image.

112. Second, Parulski describes both a "zoom in" and "zoom out" functionality in the motion preview mode (i.e., during monitoring in the static image mode). Therefore, a POSITA would have had reason to configure the zooming out function in the motion preview mode to provide a first view angle larger than the second view angle of Misawa's movie picture mode. A POSITA would have been motivated to do this, for example, to provide a wider view angle for composing and recording still images. Additionally, since the image instability correction disclosed by Misawa (which requires using a smaller view angle) is not implemented in the still picture mode, there would be even more reason for a POSITA to modify Misawa's camera to allow a user to zoom out when previewing and recording still images to take advantage of the maximum view angle possible with the image sensor.

D. Claim 3

[3.pre] "A method for operating a camera, the camera including an image sensing device having an array of pixels arranged vertically and horizontally in a grid pattern, a signal processing unit configured to form image signals at a predetermined view angle by using effective pixels of the image sensing device, a display unit configured to display an image corresponding to the image signals formed by the signal processing unit, and an image-instability detector

configured to detect an amount of image-instability of the camera, the method for operating the camera comprising the steps of:"

113. To the extent the preamble is limiting, Misawa-Parulski renders obvious this element. Both Misawa and Parulski disclose electronic cameras and methods for operating them. *See* LG-1005, 54-58; LG-1006, 2:24-31; *supra* Section IX.B.[1.pre].

114. Misawa-Parulski also renders obvious that the camera includes "an image sensing device having an array of pixels arranged vertically and horizontally in a grid pattern." *See supra* Section IX.B.[1.1].

115. Misawa-Parulski also renders obvious that the camera includes "a signal processing unit configured to form image signals at a predetermined view angle by using effective pixels of the image sensing device." *See supra* Section IX.B.[1.3].

116. Misawa-Parulski also renders obvious that the camera includes "a display unit configured to display an image corresponding to the image signals formed by the signal processing unit." *See supra* Section IX.B.[1.7].

117. Misawa-Parulski also renders obvious that the camera includes "an image-instability detector configured to detect an amount of image-instability of the camera." *See supra* Section IX.B.[1.2].

[3.1] "selecting between a static image mode and a moving video mode; and"

118. Misawa-Parulski renders obvious this element. Misawa discloses a shutter release button mechanism 28 that can be depressed by a user to send signals to a control processor 20. LG-1005, 5:9-6:6. Misawa further describes that the control processor includes a mode selector 302 that selects between a still picture mode and a movie picture mode based on the input from the shutter release mechanism. *Id.*, 6:15-36. Therefore, Misawa discloses a method for operating a camera that includes *selecting between a static image mode and a moving video mode*.

[3.2] "selecting an operation from a list of operations, as follows:"

119. Misawa-Parulski renders obvious this element. Parulski describes a camera with an LCD 92 that includes a status area 94 for displaying a list of operations including a "zoom in" function, a "zoom out" function, a "preview" function, and a "capture" function. LG-1006., 7:51-54, FIG. 11. Parulski also describes that the camera includes corresponding user control buttons for selecting these operations to zoom in and out of a displayed image, monitor a displayed image in the preview mode, and record a still image once the user is satisfied with the composition shown on the LCD display. *Id.*, 3:23-38. Parulski, therefore, discloses *selecting an operation from a list of operations*. As described above, a POSITA would have been motivated to add Parulski's LCD and user control

buttons to Misawa to assist a user with composing an image to their liking before capturing the image, and would have had a reasonable expectation of success in doing so. *See supra* Section IX.A.

[3.3] "when in the static image mode, selecting an operation from a list of operations including: a monitoring of an image in the static image mode, and a recording of an image in the static image mode, and"

120. Misawa-Parulski renders obvious this element. As described above, Parulski discloses an LCD 92 that includes a status area 94 for displaying a list of operations including a "zoom in" function, a "zoom out" function, a "preview" function, and a "capture" function as well as corresponding user control buttons for selecting these operations. *See supra* Section IX.D.[3.2]. Parulski's "preview" function corresponds to operating the camera in a "motion preview mode" for producing a preview image prior to capturing a still image from the image sensor, and Parulski's "capture" function corresponds to operating the camera in a "still image mode" for capturing and storing the still image from the image sensor. LG-1006, 1:9-13, 2:25-31, 3:45-47, 6:27-31. Therefore, Parulski's user-selectable "preview" function corresponds to *selecting an operation from a list of operations including a monitoring of an image in the static image mode*, and Parulski's user-selectable "capture" function corresponds to *selecting an operation from a list of operations including ... a recording of an image in the static image mode*. As described above, a POSITA would have been motivated to add Parulski's LCD and

user control buttons to Misawa to assist a user with composing an image to their liking before capturing the image, and would have had a reasonable expectation of success in doing so. *See supra* Section IX.A.

[3.4] "when in the moving video mode, selecting an operation from a list of operations including: a recording of an image in the moving video mode;"

121. Misawa-Parulski renders obvious this element. Misawa discloses a camera with a movie picture mode, and further discloses that a "manipulation of the release button mechanism [of the camera] … will in turn select the movie picture mode effecting movie picture recording." LG-1005, 1:63-68. This disclosure corresponds to *when in the moving video mode, selecting an operation from a list of operations including: recording of an image in the moving video mode*.

122. To the extent element [3.4] requires a list of operations to be displayed, Misawa-Parulski renders this element obvious, at least because Parulski discloses an LCD 92 that includes a status area 94 for displaying a list of operations including a "capture" function. *See supra* Section IX.D.[3.2]. Although Parulski describes capturing still images, it would have been obvious to provide a similar display and user control button for capturing moving pictures in Misawa's moving video mode. A POSITA would have been motivated to do this in order to achieve a similar user experience across camera modes.

[3.5] "wherein when the selected operation is the monitoring of an image in the static image mode, the signal processing unit forms image signals with a first view angle, by using a first effective set of pixels of the image sensing device;"

123. *See supra* Section IX.B.[1.4].

[3.6] "wherein when the selected operation is the recording of an image in the static image mode, the signal processing unit forms image signals by using all effective pixels of the image sensing device; and"

124. *See supra* Section IX.B.[1.5].

[3.7a] "wherein when the selected operation is the recording of an image in the moving video mode, the signal processing unit forms image signals with a second view angle, different from the first view angle, by using a second effective set of pixels which is a portion of the array of pixels of the image sensing device,"

125. *See supra* Section IX.B.[1.6a].

[3.7b] "a position of the second effective set of pixels being changed according to the amount of im-age-instability detected by the image-instability detector, in order to correct the image-instability."

126. *See supra* Section IX.B.[1.6b].

E. Claim 4

[4] "A method for operating a camera of claim 3, wherein the first view angle is larger than the second view angle."

127. *See supra* Section IX.C.[2].

X. ANALYSIS OF KAWAHARA IN VIEW OF MISAWA AND FURTHER IN VIEW OF PARULSKI

A. Kawahara-Misawa-Parulski Combination

128. A POSITA would have been motivated to combine the teachings of Kawahara, Misawa, and Parulski because all three references pertain to electronic digital cameras for recording imagery such as still images and moving videos. LG-

1005, 1:54-58; LG-1006, 1:9-13; LG-1007, 1:17-21, 7:58-59. A POSITA would have, in particular, been motivated to (1) modify Kawahara's camera to implement vibration correction only when recording moving images, as taught in Misawa, to reduce processing burden when recording still images and to prevent the deteriorated resolution of still images caused by Kawahara's anti-vibration technique; (2) add an LCD, as taught in Parulski, to Kawahara's camera and use a motion preview mode, as taught in Parulski, for monitoring on the LCD an image to be captured in Kawahara's still image recording mode; (3) add user control buttons, as taught in Parulski, to Kawahara's camera for selecting between a monitoring operation and an image recording operation in a static image mode from a list displayed on the LCD; and (4) add a zoom functionality, as taught in Parulski, to Kawahara's camera for changing a view angle of images prior to recording.

129. First, a POSITA would have been motivated to modify Kawahara's camera based on the teachings of Misawa to implement vibration correction only when recording moving images. A POSITA would have been motivated to modify Kawahara's camera in this way to reduce processing requirements when recording still images and to prevent the deteriorated resolution of recorded still images while still providing stabilization to moving images, where vibration correction is more important. Kawahara acknowledges that compared to the recording of

moving images, "in a case of sensing a still image … a [vibration] correction between frames by image extraction is not important." LG-1007, 7:61-8:2. Moreover, Kawahara recognizes that the "fine pixel-shifting operation" that it discloses for sub-pixel vibration correction will result in "deteriorated resolution in images." *Id.*; *see also id.*, 12:10-13. Therefore, while Kawahara discloses shifting a partial image extraction frame by an integer number of pixels in both a moving image sensing mode ***and*** a still image recording mode for vibration correction, Kawahara addresses the issue of deteriorated resolution in still images by using its "fine pixel-shifting operation" for sub-pixel correction ***only*** in a moving image sensing mode and ***not*** in a still image recording mode. *Id.*, 11:18-12:13, 15:44-55, FIGS. 12-13. In this way, Kawahara prevents the deteriorated resolution of still images (compared to moving images) and achieves reduced processing burden for recording still images. Misawa achieves similar benefits by performing blur compensation (e.g., by shifting the read-out position of image data) ***only*** when recording moving images so that still pictures can be formed using "a full frame of image data" and with less processing burden compared to moving images. LG-1005, 7:30-48, 10:39-51. Misawa's disclosed solution is readily applicable to the problem of deteriorated resolution in still images caused by Kawahara's anti-vibration technique. Therefore, a POSITA would have found it predictable to modify Kawahara's camera, as taught in Misawa, to selectively implement

Kawahara's partial image extraction technique for vibration correction ***only*** when sensing moving images (just as Kawahara already discloses with respect to its "fine pixel-shifting operation"). The POSITA would have recognized that this combination would yield a reasonable expectation of success in reducing the processing requirements for recording still images and improving the resolution of recorded still images.

130. Second, a POSITA would have been motivated to add an LCD, as taught in Parulski, into Kawahara's camera so that the LCD could (1) present a user a preview of an image to be captured in Kawahara's still image recording 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-1006, 1:27-34, 2:24-53, 3:33-38, 7:41-48; LG-1007, 4:1-10, 13:53-55. Kawahara acknowledges the known use case of displaying captured images on a "video monitor or a finder or the like" while Parulski's LCD eliminates the need for an external display device by including the LCD as part of the camera itself. LG-1007, 13:53-55; LG-1006, 1:27-34. In addition, Parulski describes how the LCD can be used, in a motion preview mode, to allow a user to compose an image to their liking before capturing the image. LG-1006, 3:33-38. A POSITA would therefore have found it predictable to incorporate Parulski's LCD and motion preview mode into Kawahara's camera to

achieve similar advantages, and the combination would have had a reasonable expectation of success since both Parulski's and Kawahara's cameras are similarly configured to capture still images. Indeed, the combination of Kawahara and Parulski would be motivated by the same rationales as the combination of Misawa and Parulski described above with a similar expectation of success. *See supra* Section IX.A.

131. Third, a POSITA would have been motivated to add user control buttons, as taught in Parulski, to Kawahara's electronic digital camera so that, in the static image mode, a user could select a monitoring operation or a recording operation from a list displayed on the camera's LCD. As I have already described above, a POSITA would have been motivated to modify Kawahara's camera to include Parulski's motion preview mode to perform a monitoring operation in addition to Kawahara's recording operation for still images. Additionally, upon making this modification, a POSITA would have recognized the need for a user interface to select between these multiple operations. Parulski provides a simple solution to this very problem by displaying a list of functions such as "Preview" and "Capture" on the status area 94 of the LCD display screen 92 as well as including control buttons 96 for selecting between the functions. LG-1006, 3:23-37, 7:51-54, FIG. 11. Displaying selectable camera settings and functions on LCD screens was well known and widely performed as of the Critical Date, and it was

also common practice to include buttons on cameras to control camera operations. Therefore, a POSITA would have viewed the user interface taught by Parulski as a straightforward and obvious modification to Kawahara's camera in order to provide the very same control benefits to Kawahara's camera that the user interface provides in Parulski. At the Critical Date, there was simply nothing nonobvious about adding buttons to a camera to control the camera's operation. As such, incorporating user control buttons as taught in Parulski into Kawahara's camera would have had a reasonable expectation of success. Indeed, the combination of Kawahara and Parulski would be motivated by the same rationales as the combination of Misawa and Parulski described above with a similar expectation of success. *See supra* Section IX.A.

132. Fourth, with respect to the zooming function, a POSITA would have been motivated to add a zooming function, as taught in Parulski, to Kawahara's camera. As I described above, a POSITA would have been motivated to add an LCD and motion preview mode to Kawahara's camera in order to present a user a preview of an image to be captured in Kawahara's still picture mode. Furthermore, consistent with this motivation, Parulski describes that a user can compose a picture by depressing "zoom in" or "zoom out" buttons "while observing the display image" and can then depress the capture button "[w]hen the user is satisfied with the composition on the color LCD display." LG-1006, 3:33-38.

Therefore, a POSITA would have recognized that it would be desirable to add the zooming function taught by Parulski into Kawahara's camera to give a user even more control over the composition of an image prior to capturing the image. Such an addition would merely be a natural and logical result of combining Kawahara and Parulski. A POSITA, therefore, would have found it predictable to modify Kawahara's camera in this way and would have had a reasonable expectation of success since the zooming function would operate in the resulting combination just as it does in Parulski's camera to achieve similar advantages of improved image composition.

B. Claim 1

[1.pre] "A camera comprising:"

133. To the extent the preamble is limiting, Kawahara-Misawa-Parulski renders obvious this element. Kawahara discloses "an image sensing apparatus" such as a "video camera." LG-1007, 1:8-12, 1:17-20. Misawa and Parulski likewise disclose electronic cameras. LG-1005, 1:9-14; LG-1006, 1:9-13.

[1.1] "an image sensing device having an array of pixels arranged vertically and horizontally in a grid pattern;"

134. Kawahara-Misawa-Parulski renders obvious this element. Kawahara discloses a conventional image sensing apparatus that includes "an imaging sensor 410b such as a CCD [charge-coupled device] or the like" and shows, in FIG. 4, an

image sensing device 701 constructed with pixels arranged vertically and horizontally in a grid pattern. LG-1007, 1:40-41, 4:29-34, 6:22-26, 13:5-10, FIG. 4. Misawa and Parulski similarly disclose this feature. *See supra* Section IX.B.[1.1].

[1.2] "an image-instability detector, configured to detect an amount of image-instability of the camera;"

135. Kawahara-Misawa-Parulski renders obvious this element. Kawahara's camera includes a vibration detector 405 such as a "vibration gyro sensor or the like" (LG-1007, 1:56-58); a correction variable calculator 408 to obtain an angle displacement signal that serves as a correction target value (*id.*, 2:1-26); a read-out controller 409 to "shift[] a read-out start position of the image sensing device 401b in accordance with the vibration correction target value signal" (*id.*, 2:27-32); and a vibration correction section 402 "to correct image signals … to reduce vibration components of a moving image influenced by unsteady hands or the like" (*id.*, 1:42-45). These components—either alone or in combination—correspond to *an image-instability detector, configured to detect an amount of image-instability of the camera*.

[1.3] "a signal processing unit configured to form image signals with a predetermined view angle by using effective pixels of the image sensing device, and:"

136. Kawahara-Misawa-Parulski renders obvious this element. Kawahara discloses a "signal processor 403 … that converts electric signals … to standard

video signals such as NTSC signals or the like." LG-1007, 1:51-54. This signal processor corresponds to *a signal processing unit configured to form image signals.*

137. Moreover, Kawahara discloses that the signals operated on by the signal processor 403 can include an extracted "partial area 202 … of [an] effective pixel area," with only the partial area being displayed on a monitor. LG-1007, 13:46-55, FIGS. 15A-15B; *see also id.*, FIG. 3 (showing extraction frames 602, 602'), FIG. 4 (showing extraction frames 703, 704). A POSITA would have recognized that the partial area 202 and the various extraction frames shown and described by Kawahara correspond to different *predetermined view angles*, and that the image signals formed with these view angles are formed *by using effective pixels of the image sensing device*.

[1.4] "during monitoring in a static image mode, to form image signals with a first view angle by using a first effective set of pixels of the image sensing device,"

138. Kawahara-Misawa-Parulski renders obvious this element. Kawahara's camera includes a "still image recording mode" for recording still images, and a POSITA would have recognized that this "still image recording mode" corresponds to *a static image mode*. LG-1007, 11:1-8. To the extent that Kawahara does not explicitly disclose a "monitoring" operation in the static image mode, Parulski discloses this feature—including "*during monitoring … to form*

image signals with a first view angle by using a first effective set of pixels of the image sensing device." *See supra* Section IX.B.[1.4].

139. A POSITA would have been motivated to modify Kawahara's still picture mode to include the monitoring operation of Parulski's motion preview mode since both references disclose cameras used for capturing static images. LG-1007, 1:8-16; LG-1006, 1:9-13. The POSITA also would have been motivated to make this combination at least because it would predictably allow a user to improve the quality of captured images, as taught by Parulski. LG-1006, 3:33-38. Parulski's motion preview mode would operate in a very similar manner to achieve the same advantages in Kawahara's camera, for example, by using Parulski's "relatively … simple digital image processing technique to produce a preview image of acceptable quality prior to initiation of [Kawahara's] still image [recording] mode." LG-1006, 2:29-31, *see also id.*, 5:15-17. Just as in Parulski, this technique could be implemented with Kawahara's camera by using a "fast dump" structure to eliminate lines of pixel charges from Kawahara's CCD and drive a color LCD display with decreased sensor readout time. *Id.*, 8:44-48. A POSITA would therefore have recognized that the combination would have a reasonable expectation of success.

[1.5] "during recording in the static image mode, to form image signals by using all effective pixels of the image sensing device, and"

140. Kawahara-Misawa-Parulski renders obvious this element. As described above, Kawahara's camera includes a "still picture mode" for recording still images, and a POSITA would have recognized that this "still picture mode" corresponds to *a static image mode*. LG-1007, 11:1-8. To the extent that Kawahara does not explicitly disclose that image signals are formed using *all effective pixels of the image sensing device* in this mode, a POSITA would have understood this feature is rendered obvious in biew of Misawa and Parulski. Misawa discloses that, "[i]n order to record image data in the still mode, a full frame of image data is read out from frame memory 18 and processed" (LG-1005, 10:39-41) and that "the entire pixel data included in imaging field 400 [of the image sensor 12] is sequentially read out from frame memory 18" (*id.*, 8:60-66). *See also id.*, 3:30-38; 7:1-7, FIG. 4A. Similarly, Parulski discloses that in a still imaging mode, "all rows of image pixel charge corresponding to each line are progressively read out through the horizontal register 70 during a single scan" to form an image. LG-1006, 6:27-38.

141. A POSITA would have been motivated to combine the teachings of Misawa and/or Parulski with Kawahara in order to reduce the processing burden of recording still images and to solve the problem of deteriorated resolution in still images caused by Kawahara's anti-vibration technique. *See supra* Section X.A. In

addition, it would have been predictable to combine these teachings with a reasonable expectation of success since the solutions provided by Misawa and/or Parulski are very similar to those presented in Kawahara and are directed to the very same issue of image resolution identified by Kawahara. *See supra* Section X.A; LG-1007, 7:66-8:2, 9:13-29, 9:38-42, 12:10-13, 12:52-53 (describing that the issue of deteriorated resolution in still images can be solved by performing fine pixel shifting operations for vibration correction only when sensing moving images); LG-1005, 2:7-14, 8:60-66, 10:39-41, (describing that high resolution still images can be obtained from full frames of image data by compensating for camera movement with partial frames only when sensing moving images); LG-1006, 6:27-38 (describing that high resolution still images can be obtained from all rows of image pixel charge by performing "line skipping" only when in a motion mode).

[1.6a] "during recording in a moving video mode, to form image signals with a second view angle, different from the first view angle, by using a second effective set of pixels which is a portion of the array of pixels of the image sensing device, and"

142. Kawahara-Misawa-Parulski renders obvious this element. Kawahara discloses a "moving image recording mode" that corresponds to *recording in a moving video mode*. LG-1007, 11:1-8, FIG. 11. Furthermore, Kawahara discloses various extraction frames that are used to form images in the moving image recording mode, with the extraction frames corresponding to only a portion of the

overall pixel area of the image sensing device. LG-1007, 13:46-55, FIGS. 15A-15B; *see also id.*, FIG. 3 (showing extraction frame 602, 602'), FIG. 4 (showing extraction frames 703, 704). A POSITA would have understood that Kawahara's image formation using these extraction frames corresponds to *forming image signals with a second view angle … by using a second effective set of pixels which is a portion of the array of pixels of the image sensing device*.

143. Kawahara-Misawa-Parulski also renders obvious that the second view angle (associated with the recording in the moving video mode) is *different from the first view angle* (associated with the monitoring in the static image mode). As described above, it would have been obvious to modify Kawahara's still picture mode to include the monitoring operation of Parulski's motion preview mode as well as Parulski's zooming function. *See supra* Sections X.A and X.B.[1.4]. Since Parulski discloses a "zoom in" and "zoom out" functionality in the motion preview mode (i.e., during monitoring in the static image mode), the combination of Kawahara and Parulski would enable **multiple** alternative view angles during monitoring in the static image mode. LG-1006, 3:29-36. Therefore, a POSITA would have understood that the combination of Kawahara and Parulski (in addition to Misawa) necessarily yields, in at least some instances, a second view angle that is different from the first view angle. LG-1006, 3:29-36.

[1.6b] "during recording in a moving video mode … to change a position of the second effective set of pixels according to the amount of image-instability

detected by the image-instability detector, in order to correct the image-instability; and”

144. Kawahara-Misawa-Parulski renders obvious this element. Kawahara discloses moving a position of an extraction frame (comprising only a portion of the pixels of the entire image sensing device) in order to remove “displacement caused by vibration on the image sensing apparatus.” LG-1007, 4:11-5:27, FIGS. 3-4; *see also id.*, 2:27-29. Kawahara also discloses that this vibration correction can be performed while recording moving images. *Id.*, 9:31-35. A POSITA would have understood this disclosure in Kawahara as corresponding to *during recording in a moving video mode ... to change a position of the second effective set of pixels according to the amount of image-instability detected by the image-instability detector, in order to correct the image-instability*. A POSITA would also have recognized that Misawa also discloses this feature. *See supra* Section IX.B.[1.6b].

[1.7] “a display unit configured to display an image corresponding to the image signals formed by the signal processing unit.”

145. Kawahara-Misawa-Parulski renders obvious this element. Kawahara discloses a recorder 404 that records signals converted by the signal processor 403 as image signals and “employs a record format corresponding to the selected image sensing mode [e.g., a moving image recording mode or still image recording mode] depending on a recording medium.” LG-1007, 1:53-55, 11:1-8. Kawahara also

discloses that, when an image signal is converted and outputted, the signal can be reproduced or displayed "on a monitor." *Id.*, 3:62-4:10, 13:46-55.

146. To the extent Kawahara does not explicitly disclose a display unit as part of its camera, Parulski discloses this feature. *See supra* Section IX.B.[1.7]. Based on these teachings in Parulski, a POSITA would have been motivated to modify Kawahara to include an LCD as a monitor device and to include a preview mode processing circuit that generates image data to drive the LCD ("*a display unit configured to display an image corresponding to the image signals formed by the signal processing unit*"). *See* LG-1006, 2:24-53, 3:33-38; *supra* Section X.A.

C. Claim 2

[2] "A camera according to the claim 1, wherein the first view angle is larger than the second view angle."

147. Kawahara-Misawa-Parulski renders obvious this element. As described above, it would have been obvious to combine Kawahara and Parulski to obtain a camera in which the first view angle (associated with the monitoring in the static image mode) is *different* than the second view angle (associated with the recording in the moving video mode). *See supra* Section X.B.[1.6a]. It also would have been obvious for the first view angle to be *larger* than the second view angle for at least the following reasons.

148. First, Parulski's line-skipping process in the motion preview mode is described as displaying "the ***entire*** 3:2 aspect ratio sensor image on the 4:3 aspect

ratio LCD, without introducing geometric distortion." LG-1006, 6:45-40 (emphasis added); *see also id.*, 7:33-40 ("This special 'line skipping' readout mode, as shown in FIG. 7, allows the sensor 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. This 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.") This is in contrast to Kawahara's moving image recording mode, which uses only "a partial image from the entire image sensing area 601 of the image sensing device 401b." LG-1007, 5:6-9. Therefore, a POSITA would have recognized that adding Parulski's motion preview mode to Kawahara's camera would result in a first view angle (during monitoring in a static image mode, as taught by Parulski) that is larger than a second view angle (during recording in a moving video mode, as taught by Kawahara). Indeed, it would have been common sense for the view angle used during monitoring in the static image mode to match the view angle used during recording in the static image mode so that a user could more accurately preview images before capturing them. And, as described above, the obvious combination of Kawahara and Misawa would have resulted in a camera that uses the "full frame" of image data while recording in the static image mode. *See supra* Sections X.A and X.B.[1.5].

149. Second, Parulski describes both a "zoom in" and "zoom out" functionality in the motion preview mode (i.e., during monitoring in the static image mode). Therefore, it would have been obvious to a POSITA to configure the zooming out function in the motion preview mode to provide a first view angle larger than the second view angle of Kawahara's moving image recording mode. A POSITA would have been motivated to do this, for example, to provide a wider view angle for composing and recording still images. Furthermore, since the vibration correction technique disclosed by Kawahara (which requires using a smaller view angle) would not need to be implemented in the still picture mode, as taught by Misawa, the POSITA would recognize that there would be even ***more*** reason to allow a user to zoom out when previewing and recording still images to take advantage of the maximum view angle possible with the image sensor.

D. Claim 3

[3.pre] "A method for operating a camera, the camera including an image sensing device having an array of pixels arranged vertically and horizontally in a grid pattern, a signal processing unit configured to form image signals at a predetermined view angle by using effective pixels of the image sensing device, a display unit configured to display an image corresponding to the image signals formed by the signal processing unit, and an image-instability detector configured to detect an amount of image-instability of the camera, the method for operating the camera comprising the steps of:"

150. To the extent the preamble is limiting, Kawahara-Misawa-Parulski renders obvious this element. Kawahara, Misawa, and Parulski all disclose

electronic cameras and methods for operating them. *See* LG-1007, 1:8-20; LG-1005, 54-58; LG-1006, 2:24-31; *supra* Section X.B.[1.pre].

151. Kawahara-Misawa-Parulski also renders obvious that the camera includes "an image sensing device having an array of pixels arranged vertically and horizontally in a grid pattern." *See supra* Section X.B.[1.1].

152. Kawahara-Misawa-Parulski also renders obvious that the camera includes "a signal processing unit configured to form image signals at a predetermined view angle by using effective pixels of the image sensing device." *See supra* Section X.B.[1.3].

153. Kawahara-Misawa-Parulski also renders obvious that the camera includes "a display unit configured to display an image corresponding to the image signals formed by the signal processing unit." *See supra* Section X.B.[1.7].

154. Kawahara-Misawa-Parulski also renders obvious that the camera includes "an image-instability detector configured to detect an amount of image-instability of the camera." *See supra* Section X.B.[1.2].

[3.1] "selecting between a static image mode and a moving video mode; and"

155. Kawahara-Misawa-Parulski renders obvious this element. Kawahara discloses an image sensing mode switch 411 that "allows users to switch the record mode of the recording section 404 between a moving image recording mode and a still image recording mode." LG-1007, 11:1-8, FIG. 11. Therefore, Kawahara

discloses a method for operating a camera that includes *selecting between a static image mode and a moving video mode*.

[3.2] "selecting an operation from a list of operations, as follows:"

156. Kawahara-Misawa-Parulski renders obvious this element. To the extent this element requires a list of operations to be displayed, Parulski describes this element. *See supra* Section IX.D.[3.2]. And as described above, a POSITA would have been motivated to add Parulski's LCD and user control buttons to Kawahara to assist a user with composing an image to their liking before capturing the image, and would have had a reasonable expectation of success in doing so. *See supra* Section X.A.

[3.3] "when in the static image mode, selecting an operation from a list of operations including: a monitoring of an image in the static image mode, and a recording of an image in the static image mode, and"

157. Kawahara-Misawa-Parulski renders obvious this element. As described above, Parulski discloses an LCD 92 that includes a status area 94 for displaying a list of operations including a "zoom in" function, a "zoom out" function, a "preview" function, and a "capture" function as well as corresponding user control buttons for selecting these operations. *See supra* Sections IX.D.[3.2], X.D.[3.2]. Parulski's "preview" function corresponds to operating the camera in a "motion preview mode" for producing a preview image prior to capturing a still image from the image sensor, and Parulski's "capture" function corresponds to

operating the camera in a "still image mode" for capturing and storing the still image from the image sensor. LG-1006, 1:9-13, 2:25-31, 3:45-47, 6:27-31. Therefore, Parulski's user-selectable "preview" function corresponds to *selecting an operation from a list of operations including a monitoring of an image in the static image mode*, and Parulski's user-selectable "capture" function corresponds to *selecting an operation from a list of operations including … a recording of an image in the static image mode*. And as described above, a POSITA would have been motivated to add Parulski's LCD and user control buttons to Kawahara to assist a user with composing an image to their liking before capturing the image, and would have had a reasonable expectation of success in doing so. *See supra* Section X.A.

[3.4] "when in the moving video mode, selecting an operation from a list of operations including: a recording of an image in the moving video mode;"

158. Kawahara-Misawa-Parulski renders obvious this element. Kawahara discloses a camera with a selectable moving image recording mode capable of "sensing a moving image" and "employ[ing] a record format corresponding to the selected image sensing mode." LG-1007, 9:31-35, 11:1-8. This disclosure corresponds to *when in the moving video mode, selecting an operation from a list of operations including: recording of an image in the moving video mode*.

159. To the extent element [3.4] requires a list of operations to be displayed, this would have been obvious, at least because Parulski discloses an

LCD 92 that includes a status area 94 for displaying a list of operations including a "capture" function. *See supra* Section X.D.[3.2]. Although Parulski describes capturing still images, it would have been obvious to provide a similar display and user control button for capturing moving pictures in Kawahara's moving image mode. A POSITA would have been motivated to do this in order to achieve a similar user experience across camera modes.

[3.5] "wherein when the selected operation is the monitoring of an image in the static image mode, the signal processing unit forms image signals with a first view angle, by using a first effective set of pixels of the image sensing device;"

160. *See supra* Section X.B.[1.4].

[3.6] "wherein when the selected operation is the recording of an image in the static image mode, the signal processing unit forms image signals by using all effective pixels of the image sensing device; and"

161. *See supra* Section X.B.[1.5].

[3.7a] "wherein when the selected operation is the recording of an image in the moving video mode, the signal processing unit forms image signals with a second view angle, different from the first view angle, by using a second effective set of pixels which is a portion of the array of pixels of the image sensing device,"

162. *See supra* Section X.B.[1.6a].

[3.7b] "a position of the second effective set of pixels being changed according to the amount of im-age-instability detected by the image-instability detector, in order to correct the image-instability."

163. *See supra* Section X.B.[1.6b].

E. Claim 4

[4] "A method for operating a camera of claim 3, wherein the first view angle is larger than the second view angle."

164. *See supra* Section X.C.[2].

XI. ANALYSIS OF TOMITA IN VIEW OF KAWAHARA AND FURTHER IN VIEW OF PARULSKI

A. Tomita-Kawahara-Parulski Combination

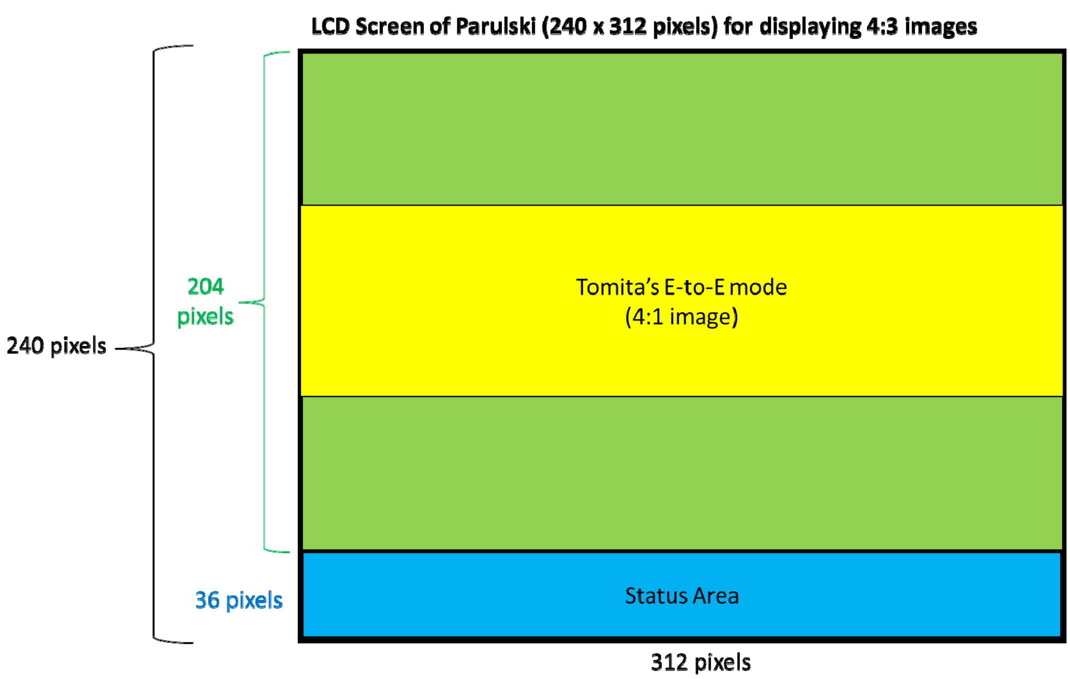
165. A POSITA would have been motivated to combine the teachings of Tomita, Kawahara, and Parulski because all three references pertain to digital cameras for recording imagery such as still images and moving videos. LG-1006, 1:9-13; LG-1007, 1:17-21, 7:58-59; LG-1008, 1:6-19. A POSITA would have, in particular, been motivated to (1) add an image-instability detector, as taught in Kawahara, to Tomita's camera to implement vibration correction in Tomita's moving picture photographing mode and (2) add user control buttons, as taught in Parulski, to Tomita's camera for selecting between a monitoring operation and an image recording operation in a static image mode from a list displayed on the LCD of Tomita's camera.

166. First, a POSITA would have been motivated to modify Tomita's camera, based on the teachings of Kawahara, to implement vibration correction while recording moving images in Tomita's "moving picture photographing mode." A POSITA would have been motivated to modify Tomita's camera in this way to increase the stability of moving pictures captured by Tomita's camera. Tomita discloses forming relatively low-resolution images in a moving picture

photographing mode by using only a portion of the CCD's total pixel area (*see supra* Section VIII.D), and Kawahara provides detailed description of how analogous partial extraction frames can be used in conjunction with a vibration detector to implement vibration correction (*see supra* Section VIII.C; LG-1007, 13:46-55). Moreover, Kawahara explains that its vibration correction technique is particularly important when recording moving images because, unlike still images, moving images require "correction between frames." LG-1007, 7:66-8:2. Therefore, a POSITA would have found it predictable to add an image instability detector to Tomita's camera and implement vibration control, as taught by Kawahara, while recording moving images in Tomita's moving picture photographing mode. Such a combination would amount to nothing more than using known techniques to improve similar devices in the same way to yield predictable results. *Id.*; *see* MPEP § 2143.

167. Second, a POSITA would have been motivated to add user control buttons, as taught in Parulski, to Tomita's digital camera. A POSITA would have been motivated to do this so that a user could select a monitoring operation in a static image mode (e.g., Tomita's "E-to-E mode"), a recording operation in a static image mode (e.g., Tomita's "still picture photographing mode"), or a recording operation in a moving video mode (e.g., Tomita's "moving picture photographing mode") from a list displayed on the camera's LCD. Tomita describes that its E-to-

E mode, still picture photographing mode, and moving picture photographing mode are selectable, for example, by a user pressing a shutter button or using a mode switch. LG-1008, 4:40-42, 6:65-7:12, 7:33-38, 8:22-26. A POSITA would have been motivated to use an alternative user interface, such as that of Parulski, to select between the multiple modes. Parulski provides a simple user interface for analogous selections by displaying a list of functions such as “Preview” and “Capture” on the status area 94 of the LCD display screen 92 as well as including control buttons 96 for selecting between the functions. LG-1006, 3:23-37, 7:51-54, FIG. 11. As I noted above, displaying selectable camera settings and functions on LCD screens was well known and widely performed as of the Critical Date, and it was also common practice to include buttons on cameras to control camera operations. Therefore, a POSITA would have viewed the user interface taught by Parulski as a straightforward and obvious modification to Tomita’s camera in order to provide the very same control benefits to Tomita’s camera that the user interface provides in Parulski. It would therefore have been predictable for a POSITA to modify Tomita’s camera (which already includes an LCD) to implement Parulski’s described user interface to obtain the same benefits with a reasonable expectation of success. In fact, a POSITA would have found it even ***simpler*** to implement Parulski’s user interface with Tomita’s camera than with Parulski’s. This is because, in Parulski, approximately 36 lines out of 240 LCD lines of pixels are used to make space for the status area 94, thus requiring Parulski's images to be downsized to fit (along with the status area 94) on Parulski's 4:3 aspect ratio LCD. *See* LG-1006, 7:33-61, 8:1-12. In contrast, Tomita does not specify an LCD with any particular pixel dimensions. But if Tomita's camera were to use a 4:3 aspect ratio LCD as suggested and encouraged in Parulski (*see* LG-1006, 8:1-12), then the 960x240 pixel images (i.e., a 4:1 aspect ratio image) formed in Tomita's E-to-E mode (*see* LG-1008, 7:11-32) would not need to be downsized in any way—unlike in Parulski—to make room for a status area. As shown in the diagram below, there would already be plenty of space on the screen for the status area, simply by virtue of displaying Tomita's 4:1 aspect ratio images on a 4:3 aspect ratio LCD.



A POSITA would therefore have found it even ***more straightforward*** to implement the user interface taught by Parulski with Tomita's camera compared to Parulski's, since Tomita's E-to-E mode would require no further image processing to make room for a status area on 4:3 aspect ratio LCDs that were commonly used as of the Critical Date. Moreover, to the extent that any image downsizing (e.g., by reducing pixel lines) ***was*** required to display Tomita's E-to-E mode images on an LCD, a POSITA would have been motivated to accomplish this with a reasonable expectation of success by using line-thinning processes that do not decrease the view angle of the images. Such techniques were well-known in the art, (*see, e.g.*, LG-1006, 7:33-40; LG-1008, 2:38-40), and a POSITA would have recognized them as desirable techniques to minimize image loss and any further reduction in view angle of Tomita's E-to-E mode images, which are already cropped once from a 1024x256 pixel area, (*see* LG-1008, 7:28-32).

B. Claim 1

[1.pre] "A camera comprising:"

168. To the extent the preamble is limiting, Tomita-Kawahara-Parulski renders obvious this element. Tomita discloses a digital camera. LG-1008, 4:24-25, FIG. 1. Kawahara and Parulski likewise disclose cameras. LG-1007, 1:8-12, 1:17-20; LG-1006, 1:9-13.

[1.1] "an image sensing device having an array of pixels arranged vertically and horizontally in a grid pattern;"

169. Tomita-Kawahara-Parulski renders obvious this element. Tomita discloses a CCD (Charge Coupled Device) having a 1024x768 pixel array. LG-

1008, 4:29-45. This CCD corresponds to *an image sensing device having an array of pixels arranged vertically and horizontally in a grid pattern*.

[1.2] "an image-instability detector, configured to detect an amount of image-instability of the camera;"

170. Tomita-Kawahara-Parulski renders obvious this element. To the extent Tomita does not explicitly disclose an image-instability detector, Kawahara discloses this feature. *See supra* Section X.B.[1.2]. Additionally, as described above, a POSITA would have been motivated to add Kawahara's image-stability detector to Tomita's camera to increase the stability of moving pictures captured by Tomita's camera. *See supra* Section XI.A.

[1.3] "a signal processing unit configured to form image signals with a predetermined view angle by using effective pixels of the image sensing device, and:"

171. Tomita-Kawahara-Parulski renders obvious this element. Tomita discloses various signal processing components for forming image signals based on the output signals of the CCD including a "sample hold and A/D converting portion" 3, a "camera signal processing portion" 4, a "memory controller" 5, a "CPU" 12, and an "encoder/decoder" 15. LG-1008, 5:11-6:3, FIG. 1. These components, either taken alone or in combination, correspond to *a signal processing unit configured to form image signals*.

172. Moreover, Tomita discloses that, depending on the mode of operation, the image signals are formed with various predetermined view angles including a

960x240 pixel image in the E-to-E mode, a 1024x768 pixel image in the still picture photographing mode, and a 160x112 pixel image in the moving picture photographing mode. *See supra* Section VIII.D. A POSITA would have recognized this disclosure as corresponding to *forming image signals with a predetermined view angle by using effective pixels of the image sensing device*.

[1.4] "during monitoring in a static image mode, to form image signals with a first view angle by using a first effective set of pixels of the image sensing device,"

173. Tomita-Kawahara-Parulski renders obvious this element. Tomita discloses an "E-to-E mode" that allows a camera user to monitor a preview image on an LCD of the camera and then set an angle of view, a focus, and/or an exposure prior to pressing a shutter button to photograph a still image. LG-1008, 7:11-32. This E-to-E mode corresponds to *monitoring in a static image mode*. Tomita also explains that, in the E-to-E mode, a 960x240 pixel area is "cut" from the area of 1024x256 pixels written to the buffer memory before displaying the image signals on the LCD. *Id.*; *see also supra* Section VIII.D. This disclosure corresponds to *during monitoring in a static image mode, to form image signals with a first view angle by using a first effective set of pixels of the image sensing device*.

[1.5] "during recording in the static image mode, to form image signals by using all effective pixels of the image sensing device, and"

174. Tomita-Kawahara-Parulski renders obvious this element. Tomita discloses a still picture photographing mode that corresponds to *recording in the static image mode*. LG-1008, 7:33-38. Tomita also discloses that, in this mode, the camera's 1024x256 pixel CCD outputs a high-resolution picture in XGA format (1024x768 pixels) that is directly stored to the camera's DRAM. *Id.*, 7:38-45. As Tomita explicitly states, "[i]n the [still picture] photographing mode, all pixels are read." *Id.*, 4:38-39. This disclosure corresponds to *during recording in the static image mode, to form image signals by using all effective pixels of the image sensing device*.

[1.6a] "during recording in a moving video mode, to form image signals with a second view angle, different from the first view angle, by using a second effective set of pixels which is a portion of the array of pixels of the image sensing device, and"

175. Tomita-Kawahara-Parulski renders obvious this element. Tomita discloses a moving picture photographing mode that corresponds to *recording in a moving video mode*. LG-1008, 7:56-59, 8:22-53. Tomita also discloses that, in this mode, a user can set the picture size to, for example, a QCIF format, corresponding to a 160x120 pixel area. *Id.*, 8:39-40, 5:51. However, as Tomita explains, since the size of each macro block in the MPEG format is 16x16 pixels, "the upper portion and lower portion of a picture in the picture format QCIF are

removed," resulting in a cropped picture composed of 160x112 pixels that is stored to the camera's DRAM. *Id.*, 5:51-56, 8:39-42l. The view angle of this 160x112 pixel image is different from the first view angle (i.e., associated with the 960x240 pixel image formed during monitoring a static image in the E-to-E mode), and the image is formed using only a portion of the 1024x768 pixel array of the CCD. *See supra* Section VIII.D. Therefore, the foregoing cited portions of Tomita's disclosure corresponds to *during recording in a moving video mode, to form image signals with a second view angle, different from the first view angle, by using a second effective set of pixels which is a portion of the array of pixels of the image sensing device*.

[1.6b] "during recording in a moving video mode … to change a position of the second effective set of pixels according to the amount of image-instability detected by the image-instability detector, in order to correct the image-instability; and"

176. Tomita-Kawahara-Parulski renders obvious this element. While Tomita discloses *recording in a moving video mode* (*see supra* Section XI.B.[1.6a]), it does not explicitly disclose a technique for correcting image-instability in this mode. However, Kawahara discloses *during recording in a moving video mode ... to change a position of the second effective set of pixels according to the amount of image-instability detected by the image-instability detector, in order to correct the image-instability*. *See supra* Section X.B.[1.6b]. Furthermore, as described above, it would have been obvious to a POSITA to

combine the teachings of Kawahara with Tomita's camera to increase the stability of moving pictures captured by Tomita's camera. *See supra* Section XI.A.

[1.7] "a display unit configured to display an image corresponding to the image signals formed by the signal processing unit."

177. Tomita-Kawahara-Parulski renders obvious this element. Tomita discloses that the camera includes a "displaying portion (LCD 8)" configured to display photographed pictures formed by the signal processing unit (including both still pictures and moving pictures). LGE-1008, 4:65-67; *see also id.*, FIG. 1, 7:24-32, 8:60-62, 9:4-10. This LCD corresponds to *a display unit configured to display an image corresponding to the image signals formed by the signal processing unit*.

C. Claim 2

[2] "A camera according to the claim 1, wherein the first view angle is larger than the second view angle."

178. Tomita-Kawahara-Parulski renders obvious this element. As described above, Tomita discloses a camera in which the first view angle (associated with the monitoring in the static image mode) is *different* than the second view angle (associated with the recording in the moving video mode). *See supra* Section XI.B.[1.6a].

179. And Tomita further discloses that the first view angle can be *larger* than the second view angle. The view angle of the 960x240 pixel image formed in the E-to-E mode (i.e., the first view angle) preserves ***93.8%*** of the image height prior to the cutting operation. *See supra* Section VIII.D. This is larger than the

view angle of the 160x112 pixel image (i.e., the second view angle) formed in the moving picture photographing mode, which preserves only ***93.3%*** of the image height prior to removing the upper and lower portions of the 160x120 pixel QCIF format image. *See supra* Section VIII.D. Therefore, a POSITA would understand that Tomita discloses that *the first view angle is larger than the second view angle*.

D. Claim 3

[3.pre] "A method for operating a camera, the camera including an image sensing device having an array of pixels arranged vertically and horizontally in a grid pattern, a signal processing unit configured to form image signals at a predetermined view angle by using effective pixels of the image sensing device, a display unit configured to display an image corresponding to the image signals formed by the signal processing unit, and an image-instability detector configured to detect an amount of image-instability of the camera, the method for operating the camera comprising the steps of:"

180. To the extent the preamble is limiting, Tomita-Kawahara-Parulski renders obvious this element. Tomita, Kawahara, and Parulski all disclose cameras and methods for operating them. *See* LG-1008, 4:24-28; LG-1007, 1:8-20; LG-1006, 2:24-31; *supra* Section XI.B.[1.pre].

181. Tomita-Kawahara-Parulski also renders obvious that the camera includes "an image sensing device having an array of pixels arranged vertically and horizontally in a grid pattern." *See supra* Section XI.B.[1.1].

182. Tomita-Kawahara-Parulski also renders obvious that the camera includes "a signal processing unit configured to form image signals at a

predetermined view angle by using effective pixels of the image sensing device." *See supra* Section XI.B.[1.3].

183. Tomita-Kawahara-Parulski also renders obvious that the camera includes "a display unit configured to display an image corresponding to the image signals formed by the signal processing unit." *See supra* Section XI.B.[1.7].

184. Tomita-Kawahara-Parulski also renders obvious that the camera includes "an image-instability detector configured to detect an amount of image-instability of the camera." *See supra* Section XI.B.[1.2].

[3.1] "selecting between a static image mode and a moving video mode; and"

185. Tomita-Kawahara-Parulski renders obvious this element. Tomita discloses that its E-to-E mode, still picture photographing mode, and moving picture photographing mode are selectable, for example, by a user pressing a shutter button or using a mode switch. LG-1008, 4:40-42, 6:65-7:12, 7:33-38, 8:22-26. Therefore, Tomita discloses a method for operating a camera that includes *selecting between a static image mode and a moving video mode*.

[3.2] "selecting an operation from a list of operations, as follows:"

186. Tomita-Kawahara-Parulski renders obvious this element. To the extent this element requires a list of operations to be displayed, Parulski describes this element. *See supra* Section IX.D.[3.2]. And as described above, it would have been obvious to a POSITA to add Parulski's display features and user control

buttons to Tomita's camera as an alternative user interface for selecting between Tomita's E-to-E mode, still picture photographing mode, and moving picture photographing mode. *See supra* Section XI.A.

[3.3] "when in the static image mode, selecting an operation from a list of operations including: a monitoring of an image in the static image mode, and a recording of an image in the static image mode, and"

187. Tomita-Kawahara-Parulski renders obvious this element. As described above, Parulski discloses an LCD 92 that includes a status area 94 for displaying a list of operations including a "zoom in" function, a "zoom out" function, a "preview" function, and a "capture" function as well as corresponding user control buttons for selecting these operations. *See supra* Sections IX.D.[3.2], X.D.[3.2], XI.D.[3.2]. Parulski's "preview" function corresponds to operating the camera in a "motion preview mode" for producing a preview image prior to capturing a still image from the image sensor, and Parulski's "capture" function corresponds to operating the camera in a "still image mode" for capturing and storing the still image from the image sensor. LG-1006, 1:9-13, 2:25-31, 3:45-47, 6:27-31. Therefore, Parulski's user-selectable "preview" function corresponds to *selecting an operation from a list of operations including a monitoring of an image in the static image mode*, and Parulski's user-selectable "capture" function corresponds to *selecting an operation from a list of operations including ... a recording of an image in the static image mode*. And as described above, it would

have been obvious to a POSITA to add Parulski's display features and user control buttons to Tomita's camera as an alternative user interface for selecting between Tomita's E-to-E mode, still picture photographing mode, and moving picture photographing mode. *See supra* Section XI.A.

[3.4] "when in the moving video mode, selecting an operation from a list of operations including: a recording of an image in the moving video mode;"

188. Tomita-Kawahara-Parulski renders obvious this element. Tomita discloses a camera with a selectable moving picture photographing mode, which can be selected, for example, when a user presses a shutter of the camera to photograph a moving picture. LG-1008, 8:22-26. This disclosure corresponds to *when in the moving video mode, selecting an operation from a list of operations including: recording of an image in the moving video mode*.

189. To the extent element [3.4] requires a list of operations to be displayed, this would have been obvious, at least because Parulski discloses an LCD 92 that includes a status area 94 for displaying a list of operations including a "capture" function. *See supra* Sections IX.D.[3.2], X.D.[3.2], XI.D.[3.2]. Although Parulski describes capturing still images, it would have been obvious to provide a similar display and user control button for capturing moving pictures in Tomita's moving picture photographing mode. A POSITA would have been motivated to do this in order to achieve a similar user experience across camera modes.

[3.5] "wherein when the selected operation is the monitoring of an image in the static image mode, the signal processing unit forms image signals with a first view angle, by using a first effective set of pixels of the image sensing device;"

190. *See supra* Section XI.B.[1.4].

[3.6] "wherein when the selected operation is the recording of an image in the static image mode, the signal processing unit forms image signals by using all effective pixels of the image sensing device; and"

191. *See supra* Section XI.B.[1.5].

[3.7a] "wherein when the selected operation is the recording of an image in the moving video mode, the signal processing unit forms image signals with a second view angle, different from the first view angle, by using a second effective set of pixels which is a portion of the array of pixels of the image sensing device,"

192. *See supra* Section XI.B.[1.6a].

[3.7b] "a position of the second effective set of pixels being changed according to the amount of im-age-instability detected by the image-instability detector, in order to correct the image-instability."

193. *See supra* Section XI.B.[1.6b].

E. Claim 4

[4] "A method for operating a camera of claim 3, wherein the first view angle is larger than the second view angle."

194. *See supra* Section XI.C.[2].

APPENDIX A

Expert Witness Consultant—Curriculum Vitae

W. Leo Hoarty leo@wlhconsulting.llc
Mountain View, CA 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 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 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, CO_2, 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