

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TESLA INC.,
Petitioner,

v.

INTELLECTUAL VENTURES II LLC,
Patent Owner.

IPR2025-00339
U.S. Patent No. 7,916,180

**DECLARATION OF R. MICHAEL GUIDASH,
UNDER 37 C.F.R. § 1.68 IN SUPPORT OF PETITION FOR
INTER PARTES REVIEW**

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I, R. Michael Guidash, do hereby declare as follows:

I. INTRODUCTION

1. I am making this declaration at the request of Tesla Inc. in the matter of the *Inter Partes* Review of U.S. Patent No. 7,916,180 (“the ’180 patent”) to Olsen *et al.*

2. I am also being reimbursed for reasonable and customary expenses associated with my work and testimony in this investigation. My compensation is not contingent on the outcome of this matter or the specifics of my testimony, and I have no other interest in this case or the parties thereto.

3. I have been asked to provide my opinions regarding whether Claims 1-3, 10-12, 22-25, 28, 30, and 32-33 (“Challenged Claims”) of the ’180 patent are unpatentable as they would have been obvious to a person having ordinary skill in the art (“POSITA”) at the time of the alleged invention, in light of the prior art. It is my opinion that all of the limitations of the Challenged Claims would have been obvious to a POSITA.

4. In forming the opinions set forth in this declaration, I have reviewed the documents in the following table:

Ex.1001	U.S. Pat. No. 7,916,180 to Olsen et al. (“the ’180 patent”)
Ex.1002	Prosecution History of U.S. Pat. No. 7,916,180 (U.S. Application No. 11/788,279)

Ex.1005	U.S. 6,611,289 to Yu et. al
Ex.1006	U.S. 7,365,780 to Miyazaki
Ex.1007	JP Application Publication No. JP2003-319231 to Matsushima (Certified English Translation + Declaration + Japanese)
Ex.1008	U.S. 2005/0128323 to Choi
Ex.1009	Eastman Kodak Company, Kodak CMOS Image Sensors White Paper (November 10, 2000) (retrieved from https://web.archive.org/web/20010611235410/http://www.kodak.com/US/plugins/acrobat/en/digital/ccd/cmos.pdf)
Ex.1010	U.S. 7,206,136 to Labaziewicz et al.
Ex.1011	U.S. 7,733,414 to Kobayashi
Ex.1012	Dave Litwiller, CCD vs. CMOS: Facts and Fiction, Photonics Spectra (January 2001)
Ex.1013	US Application Pub. No. 2004/0239771 to Habe
Ex.1014	EP Application Pub. No. EP0858208 to Weldy et al.
Ex.1016	Texas Instruments, TC255P 336- × 244-PIXEL CCD IMAGE SENSOR (March 2003)
Ex.1021	Eastman Kodak Company, Solid State Image Sensors Terminology, Application Note, DS 00-001, Revision 0 (December 8, 1994) (https://web.archive.org/web/20030413064955/http://www.kodak.com/global/plugins/acrobat/en/digital/ccd/applicationNotes/terminology.pdf)
Ex.1022	US 7,830,435 to Guidash
Ex.1023	Eastman Kodak Company, Charge Coupled Device (CCD) Image Sensors, CCD Primer, MTD/PS-0218, Revision No. 1 (May 29, 2001) (https://web.archive.org/web/20030422183725/http://www.kodak.com/global/plugins/acrobat/en/digital/ccd/applicationNotes/chargeCoupledDevice.pdf)

Ex.1024	Szeliski, Image Mosaicing for Tele-Reality Applications (May 1994)
Ex.1025	Mann et al., On Being ‘Undigital’ with Digital Cameras: Extending Dynamic Range By Combining Differently Exposed Pictures (May 1995)
Ex.1026	Debevec et al., Recovering High Dynamic Range Radiance Maps from Photographs (August 3, 1997)
Ex.1027	PCT Pub. No. WO2001/010110 to Stark
Ex.1028	Yang et al., A 640 x 512 CMOS Image Sensor with Ultrawide Dynamic Range Floating-Point Pixel-Level ADC, IEEE Journal of Solid-State Circuits, VOL. 34, NO. 12 (December 1999)
Ex.1029	CCD Electronic Shutters, Interactive Java Tutorial, October 22, 2002 (https://web.archive.org/web/20021028042044/https://micro.magnet.fsu.edu/primer/java/digitalimaging/ccd/shutter/index.html)
Ex.1030	The Panorama Factory -- What is 35mm equivalent focal length (http://www.panoramafactory.com/equiv35/equiv35.html)
Ex.1031	Camera & Imaging Products Association, Guideline for Noting Digital Camera Specifications in Catalogs, October 11, 2005
Ex.1032	London etc., Photography, Eighth Edition, January 1, 2004
Ex.1033	American National Standards Institute (ANSI), ANSI/I3AIT 10.7000-2004 American National Standard for Photography - Digital Still Cameras - Guidelines for Reporting Pixel-Related Specifications, June 24, 2004
Ex.1034	Eastman Kodak Company, Shutter Operations for CCD and CMOS Image Sensors, Application Note, MTD/PS-0259, Revision 1 (October 23, 2001) (retrieved from https://web.archive.org/web/20030419002619/http://www.kodak.com/global/plugins/acrobat/en/digital/ccd/applicationNotes/ShutterOperations.pdf)
Ex.1036	U.S. Pat. No. 4,831,403 to Ishida et al.

Ex.1037	U.S. Pat. No. 7,443,427 to Takayanagi
Ex.1039	e2v Technologies, CCD Sensors Technical Note: Glossary of Terms (2003)
Ex.1040	Ralph E. Jacobson et al., The Manual of Photography: photographic and digital imaging, 9th Edition (2000)
Ex.1041	U.S. Pat. No. 6,215,597 to Duncan et al.
Ex.1042	O'Donnell, The Practical Use of the Exposure Triangle (retrieved from https://creativetraw.com/practical-use-exposure-triangle-explained/)
Ex.1043	U.S. Pat. No. 2,953,983 to Larson
Ex.1046	Comparison of Provisional Application No. 60604854 and '180 Patent Specification
Ex.1047	Provisional Application No. 60/604,854, filed on August 25, 2004
Ex.1048	Provisional Application No. 60/695,946, filed on July 1, 2005
Ex.1049	Provisional Application No. 60/795,946 filed on April 28, 2006
Ex.1050	Prosecution History of U.S. Application No. 11/212,803 (abandoned)
Ex.1051	U.S. Application No. 11/212,803 (published as US 2006/0054782)

5. Additionally, I have utilized my own experience and expertise, including regarding the knowledge and capabilities of a person of ordinary skill in the relevant art in the timeframe of the claimed priority dates of the '180 patent.

6. Unless otherwise noted, all emphasis in any quoted material has been added.

II. QUALIFICATIONS AND PROFESSIONAL EXPERIENCE

7. My complete qualifications and professional experience are described

in my *Curriculum Vitae*, a copy of which can be found in Exhibit 1004. The following is a brief summary of my relevant qualifications and professional experience.

8. After graduating with a Bachelor of Science in Electrical Engineering from the University of Delaware in 1981, I started my career with Eastman Kodak as a product engineer for application specific integrated circuits (ASIC's) used to perform photometer functions, (e.g. auto-exposure, auto-focus and flash control), for Kodak film cameras. In this role, I was responsible for all aspects of IC test, packaging, delivery, customer interface and failure analysis, yield and cost of the photometer ASICs. This required detailed knowledge of camera designs, functions and operation. This role continued until 1987 and included responsibility for copier output driver ASICs and photometer ASICs for Kodak DISC cameras and Instant Film cameras.

9. In 1986-1988, I began transitioning to the Kodak Research Laboratories and CCD wafer fabrication facility. During my time with the Kodak Research Laboratories and CCD wafer fabrication facility, I developed 2 μm and 1 μm CMOS processes, and a 30 V 4 μm Bipolar complementary metal-oxide-semiconductor (BiCMOS) process. These processes were used for gate arrays for many Kodak products and output driver ASICs for all of Kodak's copiers. During this time, I was also awarded entrance into the Special Opportunity Graduate

Program that allowed me to obtain a Master's of Science in Electrical Engineering from the Rochester Institute of Technology. My Master's Thesis involved design and process integration of bipolar and CMOS transistors into an existing CCD (charge-coupled device) image sensor process.

10. In 1989, I initiated and began leading a Smart Sensor Group which developed BiCMOS-CCD processes to provide fully integrated CCD systems on a chip. I also served as product engineer and yield enhancement engineer for Kodak's high volume CCDs. During this time, I led product delivery and technology development of all ASIC and smart sensor products used in Kodak copiers and other electronic products, and CCD sensor yield improvement for sensors used in Nikon digital SLR cameras. I developed a number of products during this time to include an interline CCD integrated with 2 μm CMOS on the same chip, and linear CCD image sensor with on-chip timing and control. I also led and directed the CCD dark current and point defect reduction team.

11. In 1996, I formally started the CMOS Image Sensor group at Kodak. From 1996 to 2009, I managed the R&D and product development of CMOS Image Sensor (CIS) programs. As is further shown in my curriculum vitae, I was the inventor or co-inventor of many key patents in the field of CMOS image sensors including pinned photodiode pixels, camera-on-a-chip architecture, and shared amplifier pixel architectures. During this time, I led the development of the

world's 1st pinned photodiode CIS product, Shared amplifier CIS pixel product, and the world's first ½ inch optical format 1.3 megapixel CMOS image sensor into mass production, providing successful delivery to several compact digital camera products for Kodak and other camera manufacturers. I also led the development of one of the earliest 3D hybrid stacked backside illuminated (BSI) CIS architecture. This led to demonstration of very high performance, low dark current BSI prototype sensors with pixel sizes ranging from 0.9µm to 5.0µm. During development of these CIS devices, I worked closely with Kodak's and external companies' digital camera developers, and these CIS devices were commercialized in Kodak consumer digital cameras, as well as other companies' low-cost compact digital cameras.

12. In 2001, product development was transferred to other individuals and my role was focused on CIS R&D. During this time, I initiated and led a cross-functional camera R&D team directed at CIS and other Kodak technologies for novel co-optimized cameras and camera sub-systems, including cell phone camera modules with small form factors, improved low light response, and fast auto-focus. During this time, I interfaced with cell phone camera manufacturers regarding their requirements and presented our technological improvements and camera modules and CIS roadmaps.

13. In 2009, when Kodak closed its CMOS Image Sensor Business, I

transitioned into a role as an intellectual property technologist and coordinator.

This role included managing remaining image sensor patent applications and office actions, managing broad electronic components patent applications and office actions, and providing technical support for intellectual property sales and licensing teams.

14. In 2012 I left Kodak and started my consulting company, providing technical consulting services for CMOS image sensors. In this role I provide tutorials and consulting services for processes, pixels, circuits, sensor architectures, systems and intellectual property to companies and clients.

15. I am a named inventor on over 100 issued US patents. The majority of these patents are directed toward technologies relevant to cameras and image sensors.

III. LEVEL OF ORDINARY SKILL IN THE ART

16. I understand there are multiple factors relevant to determining the level of ordinary skill in the pertinent art, including (1) the levels of education and experience of persons working in the field at the time of the invention; (2) the sophistication of the technology; (3) the types of problems encountered in the field; and (4) the prior art solutions to those problems.

17. It is my understanding that the earliest priority date for the '180 patent is August 25, 2004, the filing date of the earliest Provisional Application No.

60/604,854 (the “’854 provisional,” Ex.1047). Furthermore, as discussed below at VI.C, it is my opinion that the effective filing date of each of the Challenged Claims of the ’180 patent is no earlier than July 1, 2005, the filing date of Provisional Application 60/695,946 (“the ’946 provisional,” Ex.1048).

18. A person of ordinary skill in the art at and before the earliest priority date (August 25, 2004) or earliest effective filing date of the ’180 patent (July 1, 2005) (“POSITA”) would have had a bachelor’s degree in electrical engineering, computer engineering, computer science, or a related field and 2-3 years of experience in digital imaging systems. Less experience may be necessary with additional education, and likewise, less education may be necessary with additional work experience.

19. For purposes of this Declaration, in general, and unless otherwise noted, my statements and opinions, such as those regarding my experience and the understanding of a POSITA generally (and specifically related to the references I consulted herein), reflect the knowledge that existed in the field as of the earliest priority date (August 25, 2004) for Grounds 1-2 analysis¹, and reflect the knowledge that existed in the field as of the earliest effective filing date of the ’180

¹ My analysis of Grounds 1-2 remains the same if the level of a POSITA as of the earliest effective filing date of the ’180 patent (July 1, 2005) is applied.

patent (July 1, 2005) for Ground 3 analysis. Unless otherwise stated, when I provide my understanding and analysis below, it is consistent with the level of a POSITA as of these dates.

IV. RELEVANT LEGAL STANDARDS

20. I am not an attorney. In preparing and expressing my opinions and considering the subject matter of the '180 patent, I am relying on certain basic legal principles that counsel have explained to me. These principles are discussed below.

21. I understand that prior art to the '180 patent includes patents and printed publications in the relevant art that predate the priority date of the alleged invention recited in the '180 patent.

22. I have been informed that a claimed invention is unpatentable under 35 U.S.C. § 103 if the differences between the invention and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. I have also been informed by counsel that the obviousness analysis takes into account factual inquiries including the level of ordinary skill in the art, the scope and content of the prior art, and the differences between the prior art and the claimed subject matter.

23. I have been informed by counsel that the Supreme Court has

recognized several rationales for combining references or modifying a reference to show obviousness of claimed subject matter. Some of these rationales include the following: (a) combining prior art elements according to known methods to yield predictable results; (b) simple substitution of one known element for another to obtain predictable results; (c) use of a known technique to improve a similar device (method, or product) in the same way; (d) applying a known technique to a known device (method, or product) ready for improvement to yield predictable results; (e) choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; and (f) some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

V. TECHNICAL BACKGROUND

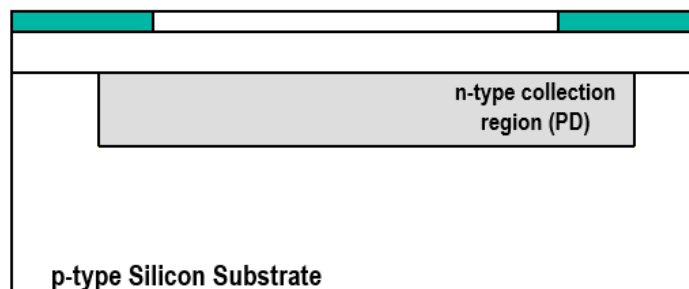
24. The '180 patent discusses various well-known components and techniques in digital imaging, including image sensors, controlling exposure times for image sensors, and expanding dynamic range for image sensors. All these techniques were both well-known and widely available in commercial products, such as those offered by Eastman Kodak Company ("Kodak"). *See e.g.*, Ex.1009 (Kodak Image Sensors White Paper describing Kodak's leading technology in image sensors); Ex.1034 (Kodak Shutter Operations Application Note describing

shutters in digital cameras to control photodiode integration times).

A. Image Sensors

25. Image sensors are devices “capable of converting an incident optical pattern (i.e. image) into an electronic signal which contains all spatial and intensity relationships of the original pattern,” and the term is “usually used to refer to solid state semiconductor image sensors.” Ex.1021, 24. There were two well-known types of image sensors: “CCD (Charge Coupled Device) image sensors,” and “CMOS (Complementary Metal Oxide Semiconductor) image sensors.” Ex.1009, 2.

26. Both CCD image sensors and CMOS image sensors (also referred to as CIS) include an array of photosensitive cells, also referred to as pixels, on the image sensor chip, that respond to light that is striking the chip. Each pixel includes a photodetector, usually a photodiode (PD) including a p-n junction. I have created a simplified cross-sectional diagram of a photodiode for illustration below.



27. While the CCD and CMOS image sensor pixels structures are

different, the basic imaging process using the pixels is the same, which includes: (1) converting incident light into an electrical charge, (2) collecting and spatially confining the charge in the pixel, and (3) transferring the collected charge from the photodetector to be converted into a voltage and readout.

Ex.1023, 5.

28. First, the photodiode converts light (photons) into charge (electrons), which are integrated at pixel sites of image sensors. Ex.1009, 4 (“The photodiode converts light (photons) into charge (electrons).” FIG. 7 of Ex.1023 below illustrates the photon interaction with silicon “converting light (photons) to electronic charge.” Ex.1023, FIG. 7, 5 (“An image is acquired when incident light, in the form of photons, falls on the array of pixels. The energy associated with each photon is absorbed by the silicon and causes a reaction to take place. This reaction yields the creation of an electron-hole charge pair (or simply an electron)”). “The number of electrons collected at each pixel is linearly dependent on light level and exposure time and non-linearly dependent on wavelength.” Ex.1023, 5.

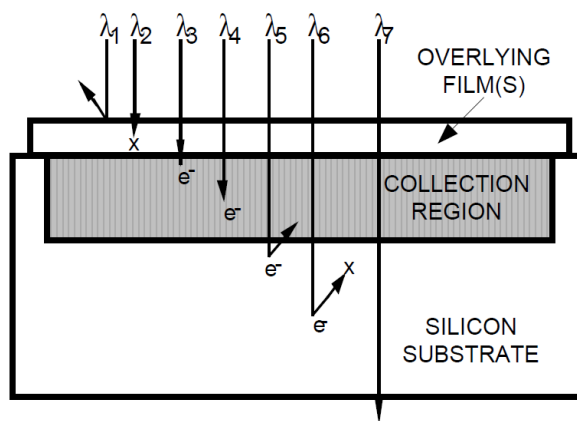


Figure 7 - Photon Interaction with Silicon

Ex.1023, FIG. 7.

29. Second, the photoelectrons are collected (integrated) and spatially confined within each photodiode. Fig. 8 of Ex.1023 below illustrates an example photodiode structure, which “consists of a vertically stacked conductive material (doped polysilicon) overlying a semiconductor (silicon) separated by a highly insulating material (silicon dioxide).” Ex.1023, 6.

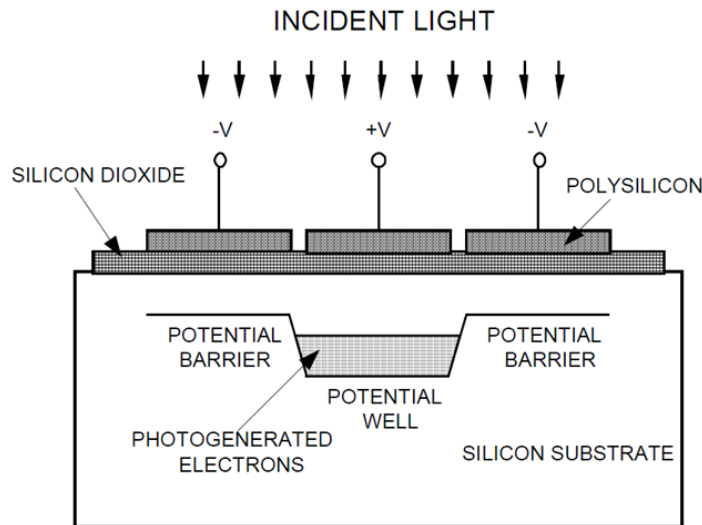


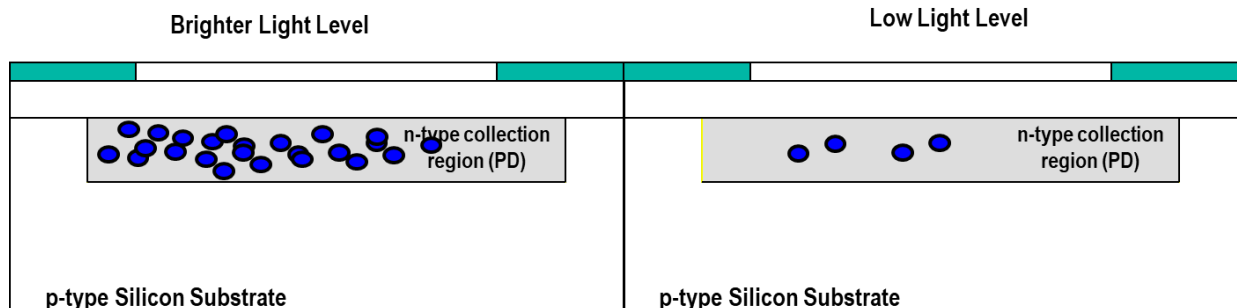
Figure 8 - Potential Well and Barriers

Ex.1023, FIG. 8.

30. As shown in FIG. 8 of Ex.1023 above, by applying a voltage potential to the polysilicon or “gate” electrode, a potential “well” can be formed “which has the capability of collecting the localized electrons that were created by the incident light.” Ex.1023, 6.

31. The electrical charge (number of electrons) collected in each PD is proportional to (1) amount of light incident on that PD; and (2) the time that the resulting photoelectrons are collected, which is also called “integration time.” The resulting amount of charge in the photodiode is a measure of brightness for a particular part of the scene that the incident light has arrived from. I have created a simplified diagram below showing the collected charge in two adjacent pixels, one with a lower light level and one with a brighter light level. The collection and

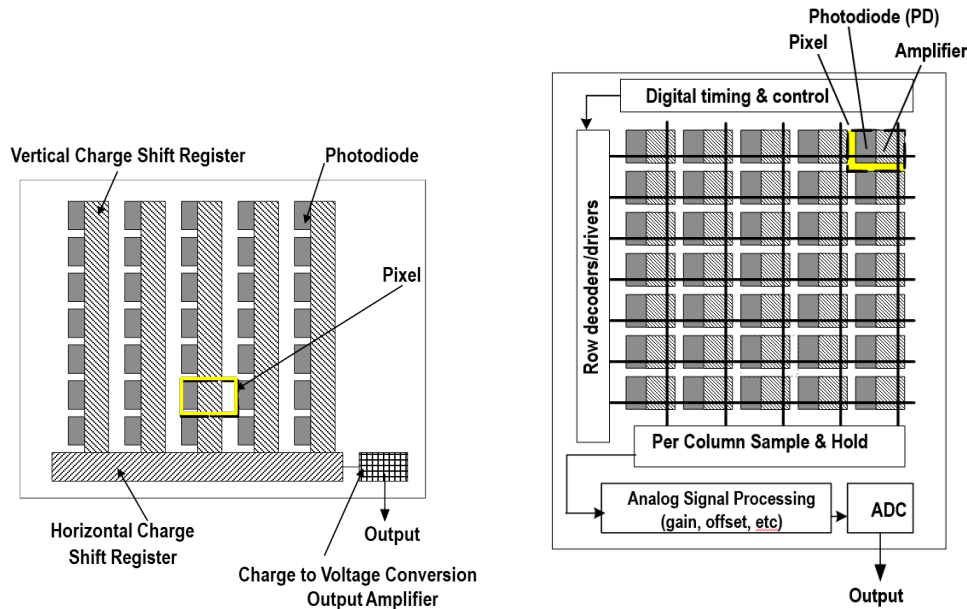
spatial confinement of charge (photoelectrons shown as blue dots) is a critical process of the image capture process.



32. Third, after “charge has been integrated and held locally by the bounds of the pixel architecture,” charge transfer techniques are applied to “move the packets of charge within the silicon substrate.” Ex.1023, 5-6. Readout techniques are then performed, “where the electrons (which represent a charge) are converted to a voltage.” Ex.1023, 10.

33. Specifically, some transistors associated with the pixel transfer the charge out of the PD and convert the collected charge to an electrical signal, typically a voltage. These electrical signals are used to produce a digital image. CCD and CIS devices are shown in the figures that I created below, CCD on the left, CIS on the right. There is a noise associated with reading charge out of the pixel and converting it to a voltage. This noise is determined by measuring the temporal and spatial variation of the image output signals when the image sensor is not exposed to light, i.e. in the dark. This “read noise” will limit the signal to noise ratio (SNR) in the dark regions of a scene or a low light imaging situation. Low

light image quality is dependent on the SNR of the readout. For example, if the read noise is 4 electrons, in order to get a SNR of 10, the pixel will need to collect 40 electrons. In very low light this will require a longer integration time to get a desired SNR.



34. The amount of charge (number of electrons) that the PD can hold is limited. This maximum level, called Full Well Capacity (FWC), is determined by photodetector size, and photodetector electrical capacitance. If a region in a scene is very bright, the resulting number of photoelectrons can exceed the FWC (become saturated), and the image information in that part of scene is lost (clipped to the FWC level).

35. As a result of this FWC limitation, one cannot simply increase the integration time of the sensor in order to collect more charge in the dark regions of

the scene in an attempt to increase the SNR of the dark regions, because this would cause the photodetectors capturing the bright regions of the scene to saturate. The dynamic range of the image sensor, discussed below, is related to this trade off with dark regions and bright regions.

B. Dynamic Range

1. True Dynamic Range vs. Intra-Scene Dynamic Range

36. There are two well-known types of dynamic range—true dynamic range and intra-scene dynamic range.

37. Specifically, one type of dynamic range is measured as the ratio of the maximum photo-charge that can be meaningfully integrated in a pixel of the imager to the pixel noise level, which is referred to as “true dynamic range” or “DR” in the art. Ex.1009, 9 (“True dynamic range is a measure of the sensor’s maximum number of signal electrons compared to its total dark temporal RMS noise level.”).

38. Another type of dynamic range is referred to in the art as “intra-scene dynamic range” or “IDR,” which refers to the range of illumination levels within a single scene. Ex.1009, 9 (“Intra-scene dynamic range (IDR) refers to the range of illumination levels within a single scene”).

2. Expanding Intra-Scene Dynamic Range Using Multiple Integration Times

39. Techniques for capturing pictures with different integration times

and combining the pictures to achieve expanded intra-scene dynamic range were well-known. *See, e.g.*, Ex.1009, 9; Ex.1024, 3 (Abstract discussing the “fundamental technique” of “image mosaicing, i.e., the automatic alignment of multiple images into larger aggregates); Ex.1025, 7, FIG. 8 (illustrating combining images of different exposures including “underexposed,” “properly exposed,” and “overexposed”); Ex.1026, 1 (providing high dynamic range by fusing multiple photographs with different amounts of exposure into a single high dynamic range radiance map); Ex.1014, FIGS.1a-1c, 3, 5:14-20 (describing producing a combined digital image having improved characteristics using two electronic images, where “scene exposure conditions” are selected “in a way that provides for improving various characteristics,” where “all the greater than two lens/sensor systems are used to simultaneously capture light information from the same scene”).

40. Specifically, Kodak Image Sensor White Paper explains in detail the technique for expanding intra-scene dynamic range. Ex.1009, 9. As an example, a sensor can take two pictures with “a long integration time” and “a short integration time” respectively. Ex.1009, 9. “The picture with the long integration time will provide good details in the dark regions of the scene but the bright regions may not show good details since too many electrons may have overpowered, or saturated the pixel.” Ex.1009, 9. On the other hand, “the picture with the short integration time will provide good details in the bright

areas (because the pixels did not saturate), but now, there are not enough photons captured to provide good details in the darker regions of the scene.” *Id.*

41. As such, an image with a high intra-scene dynamic range can be achieved by combining two images captured with different integration times, where “signal processing electronics can be used to blend these two images to provide both the dark and bright regions of the scene.” *Id.* In other words, a high IDR is achieved to capture details of both the bright and dark areas, without the requirement of a high true dynamic range, since the details of the darker parts of the scene are captured by the image that has a long integration time, and the details of the brighter part of the scene is captured with the other image that has a shorter integration time.

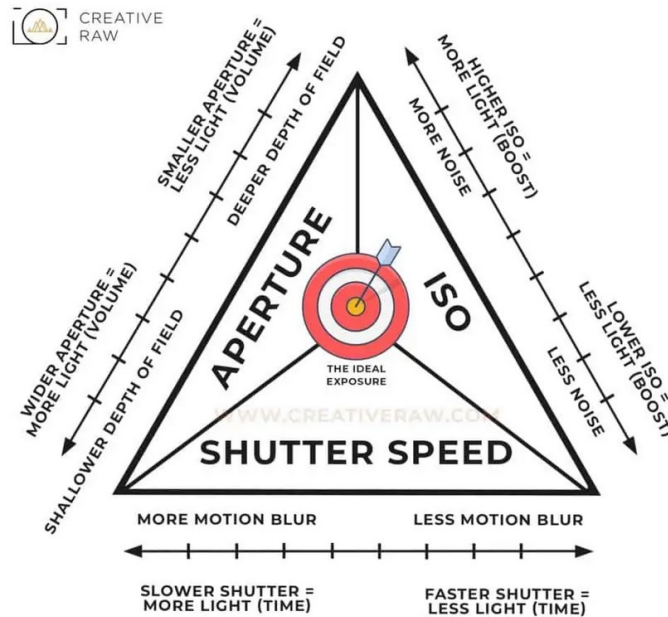
42. The ’180 patent also uses the term “effective single-frame dynamic exposure range.” *See e.g.*, Ex.1001, 20:7-10 (“The digital camera systems of an embodiment provide digital cameras with large effective single-frame dynamic exposure ranges through the use of multiple camera channels, including multiple optics and image sensors.”). A POSITA would have understood that this term refers to the intra-scene dynamic range, directed at an expanded dynamic range of a scene. Ex.1009, 9.

C. Exposure

43. Exposure “is important for any photographic situation in terms of

the resulting quality of the photographic image.” Ex.1040, 310 (describing that generally, “the photographic result of exposure (H) is the product of image illuminance (E) and exposure duration (t), so that $H = Et$.”).

44. “The four principal variables determining camera exposure are subject luminance, film speed, lens aperture and shutter speed.” Ex.1040, FIG. 19.1, 310. As shown in the figure below, in film cameras, to capture a scene having a given subject luminance, three parameters are available to control exposure: (1) film speed, which is measured on a scale published by the International Organization for Standardization (ISO), that measures the sensitivity of the film to the light; (2) lens aperture that controls how much light is incident on the film; and (3) shutter speed, also referred to exposure time, that controls the length of time that the film is sensing and responding to incident light. Ex.1040, FIG. 19.1, 310.

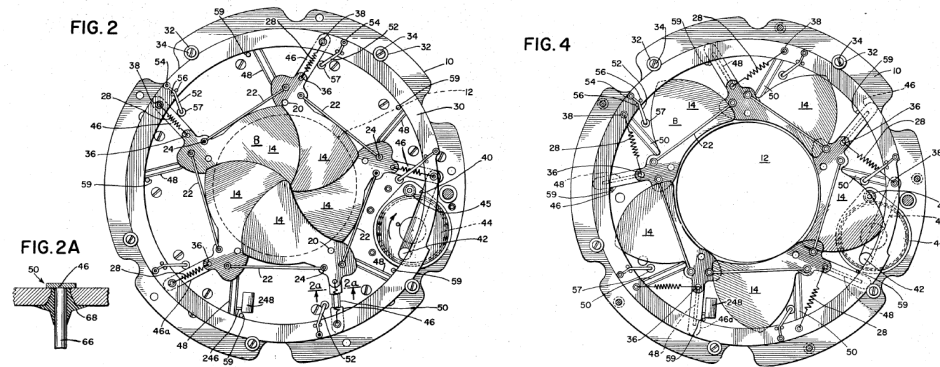


Ex.1042, 1.

45. In film cameras, exposure control generally can be done with one or a combination of these three parameters. The choice of which ones to use or prioritize is based on the attendant primary consideration of each. For example, shutter speed impacts motion blur, lens aperture impacts depth of field, and ISO speed impacts image noise.

46. Shutter speed for film cameras is controlled using a traditional mechanical shutter, which is a physical mechanism that opens and closes to allow light to reach the film. A mechanical shutter is located in front of the film, so that it can physically block incident light from reaching the film. The specific types of mechanical shutters have evolved over time. Older cameras used a leaf shutter located inside the photographic lens, where the exposure time is the

duration of the entire time period from fully closed to full open and then to fully closed again. An example leaf shutter is illustrated below, where the left figure illustrates the leaf shutter in closed position, and the right figure illustrate the left shutter in open position.



Ex.1043, FIGS. 2 and 4.

47. Another type of mechanical shutter is called a “focal plane shutter,” which is positioned immediately in front of the focal plane of the camera, that is, right in front of the photographic film. A focal plane shutter usually includes shutter blades (also referred to as shutter curtains) that move horizontally or vertically to open and close.

48. Exposure control in digital cameras is very similar to that used in film cameras. Since digital cameras use semiconductor image sensors in place of film, there are some differences for ISO and shutter speed.

49. ISO in digital cameras is controlled by electrical voltage gain (amplification), and increasing the voltage gain in the image sensor signal

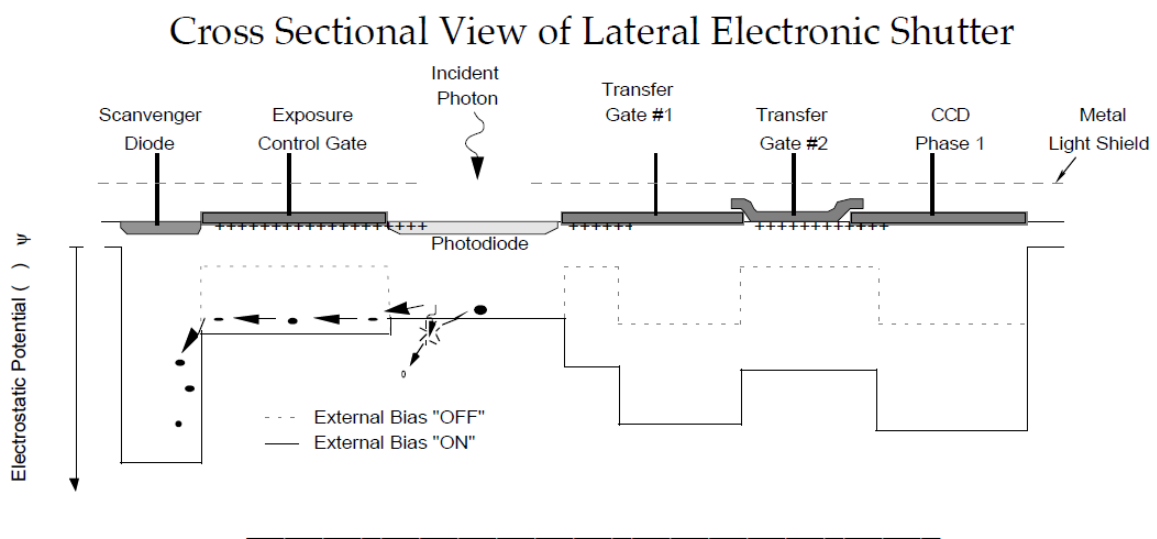
readout circuits may produce a larger voltage signal for the same amount of charge collected in the photodiode, such that the signal voltage is more sensitive to light. Ex.1013, [0022]. Further, increasing the voltage gain in the first stage of the signal readout circuits may reduce the readout noise which improves the SNR of low light images.

50. Shutter speed/exposure time in digital cameras is also referred to as integration time, which can be controlled “either by incorporating an external mechanical shutter in front of the image sensor or by incorporating an on-chip electronic shutter.” Ex.1034, 2; Ex.1013, [0024] (“It is to be noted that in a camera having a mechanical shutter used to control the length of time over which the light flux enters the image-capturing element 6, the length of time over which the shutter remains open is equivalent to the shutter speed. In a camera having an electronic shutter used to control the length of time over which charges are stored at the image-capturing element 6, the length of time over which the electrical charges are stored at the image-capturing element 6 is equivalent to the shutter speed.”).

51. Image sensors have the ability to perform electronic shuttering, which obviate the need for a mechanical shutter. Ex.1023, 11 (“Electronic exposure, which is much more accurate and reliable than mechanical shuttering, allows very versatile operation for systems or cameras.”); Ex.1034, 2-5 (describing

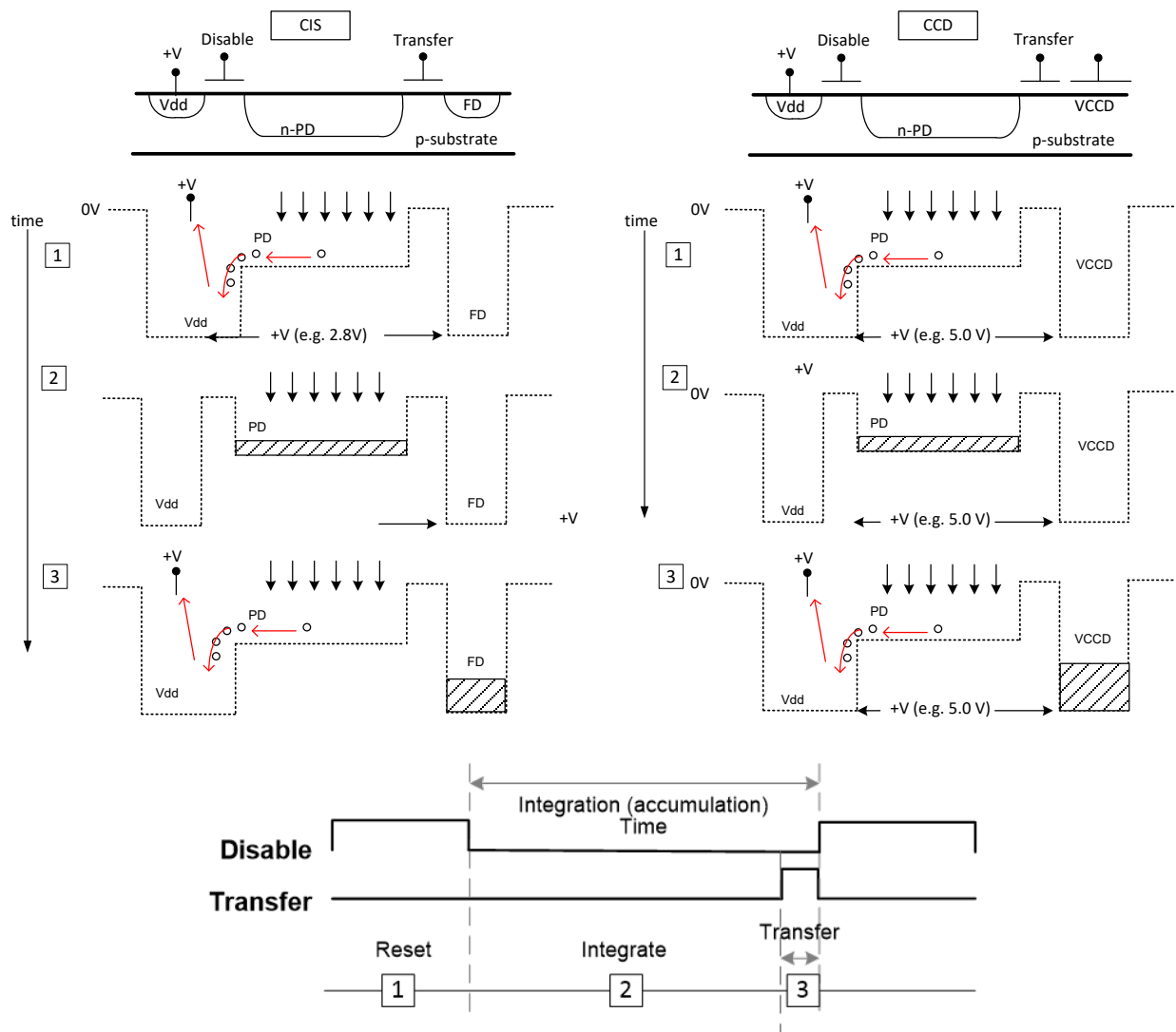
on-sensor electronic shutters for CCD and CMOS imagers); Ex.1012, 2 (describing electronic shuttering as “a standard feature of virtually all consumer and most industrial CCDs”); Ex.1016, 1 (an image sensor by Texas Instruments providing “electronic shutter function”); Ex.1011, FIG. 3, 8:45-50 (Fujifilm patent describing that a CPU controls the electronic shutter speed of CCD image sensor using the timing generator); EX.1006, FIGS. 2-3, 5:56-60 (“In addition, the system controller 38 feeds a control signal indicative of an electronic shutter speed to be assigned to the CCD image sensor 14 to the CCD driver 36. In this sense, the system controller 38 has an automatic exposure adjusting function.”).

52. An electronic shutter, as illustrated in the figure below, does not have any physical moving parts that open or close, and accomplishes the equivalent of a mechanical shutter by electrically enabling the photodiode to collect photoelectrons formed by incident light for a specified duration of time.



Ex.1021, 17.

53. When a photodiode is disabled from collecting light, photoelectrons are still created from incident light, but they are continuously drained from the photodiode to a power supply connection in the pixel. Such periods do not affect the imaging result, and are not considered to be part of the integration time/exposure time/shutter speed. This is shown in the figures that I created below.



54. Electronic shutter may allow the elimination of the mechanical shutter, thereby reducing the size and cost of the camera, and enabling much shorter (faster) integration times compared to a mechanical shutter. Ex.1034, 2 (Image sensors incorporating an on-chip electronic shutter “for controlling integration time...may allow the elimination of the mechanical shutter.”).

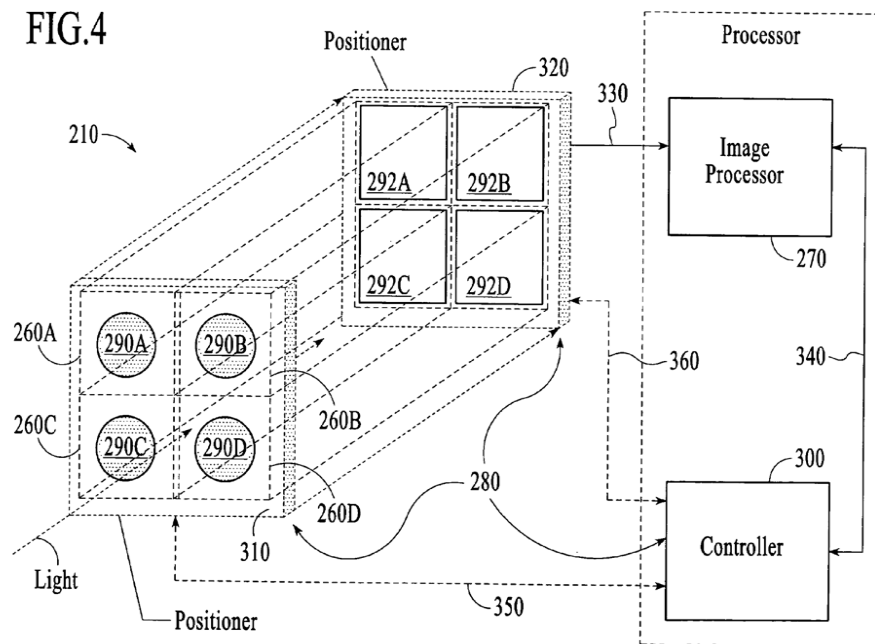
55. The terms “exposure time” and “integration time” are often used interchangeably in the context of an image sensor, and an image sensor with an on-chip electronic shutter controls its exposure time by controlling its integration time. Ex.1028, 1821n.1 (“we use *integration time and exposure time interchangeably*”); Ex.1022, 1:22-24 (“The *exposure or integration time* for the array of photodetectors can be controlled by well known mechanisms.”); Ex.1027, 3:10-12 (“Several images at different *exposures (charge-integration periods)* are acquired and then combined into a single image.”); Ex.1009, 9 (using “short integration time” and “long integration time” to describe images with different exposure times); Ex.1029, 1 (“Electronic shutters are employed in charge-coupled devices (CCDs) to control *integration time (exposure)* of the photodiode array”); Ex.1012, 2 (“*Shuttering*, the ability to *start and stop exposure* arbitrarily. It is a *standard feature* of virtually all consumer and most industrial CCDs”), 4 (“A ‘*rolling shutter*’ can *start and stop exposure* on a CMOS device”); *see also* Ex.1039, 3 (defining “integration time” as “The time or proportion of the operating

cycle of the CCD in which charge is accumulated”); Ex.1034, 2 (describing that in CCD image sensors providing an electronic shutter, “[t]he **exposure time** is the time between the reset of the imager and the transfer of charge from the photodiodes to the vertical CCDs,” which is the charge integration time.).

VI. THE ’180 PATENT

A. Overview

56. The ’180 patent is directed to “digital cameras configured to simultaneously acquire image data via multiple channels having different fields of view [FOV].” Ex.1001, Abstract. In the digital camera of FIG. 4 below, each channel 260A-260D respectively includes an optics component 290A-290D and a sensor 292A-292D in a one-to-one relationship, where “[e]ach camera channel...provides a different FOV.” ’180 patent, Abstract, FIG. 4, 6:31-33.

**Ex.1001, FIG. 4.**

57. The '180 patent states, "Exposure is the total amount of light allowed to fall on a sensor during the process of taking a photograph. Exposure control is control of the total amount of light incident on a sensor during the process of taking a photograph. In contrast to exposure control, which is used by conventional digital cameras to manage dynamic range, the digital camera systems of an embodiment use integration time control to control the time the electrical signal is integrated on a charge storage device (capacitance) within a sensor (pixel)."

Ex.1001, 20:25-33.

58. A POSITA would have understood here the '180 patent's description of "in contrast to exposure control" means "in contrast to exposure control by

mechanical shutters,” because it was well-known in that art that “integration time control” controls exposure time of the sensor and is also a technique for exposure control. Ex.1009, 9; Ex.1013, [0024] (“It is to be noted that in a camera having a mechanical shutter used to control the length of time over which the light flux enters the image-capturing element 6, the length of time over which the shutter remains open is equivalent to the shutter speed. In a camera having an electronic shutter used to control the length of time over which charges are stored at the image-capturing element 6, the length of time over which the electrical charges are stored at the image-capturing element 6 is equivalent to the shutter speed.”).

B. Prosecution History

59. The '180 patent claims priority to an abandoned parent application and three provisional applications. Ex.1001, 1; Exs.1047-1050 (prosecution histories of parent and provisional applications).

60. During prosecution of the earliest parent application (abandoned), the Examiner rejected claims (e.g., claim 12 reciting “the first array of photo detectors and the second array of photo detectors are disposed in the same image plane”) that are substantively different from the Challenged Claims based on prior art combinations that included Yu. Ex.1050, 1-2, 18, 21, 527.

61. During prosecution of the '180 patent, the claims were allowed after multiple office actions and amendments, where the applicant identified the

arrangement of the first and second channels having different FOVs comprising different angular widths as the distinguishing feature in the last response (see limitations [22.1]-[22.2] and [1.1.2] below). Ex.1002, 53, 90. Ex.1002, 57. Yu was never relied upon by the Office. Ex.1002, 199.

C. Effective Filing Date

62. It is my opinion that the effective filing date of each of the Challenged Claims of the '180 patent is no earlier than July 1, 2005, the filing date of Provisional Application 60/695,946 ("the '946 provisional," Ex.1048), because no written description exists in the '854 provisional for the Challenged Claims.

63. I was informed that for a claim in a later-filed application to be entitled to the filing date of an earlier application, the earlier application must provide written description support for the claimed subject matter.

64. Here, no written description exists in the '854 provisional for (1) providing multiple channels having different FOVs (a limitation of all Challenged Claims); and (2) configuring multiple optics components relative to multiple sensors respectively to form these multiple channels (limitations of claims 22-25, 28, 30, and 32-33). Ex.1046 (comparison of '180 patent specification and '854 provisional). As shown in FIG. 3 below, the '854 provisional simply describes "a different lens over each of the different array" of a **single** sensor 210, where the different lenses 230A-D are "tailored for **the respective wavelength** of the

respective array [210A-D].” Ex.1047, 5, 8 (’854 provisional specification, 2, 5).

There is no disclosure for multiple sensors—only a single “sensor 210.” *See also* Ex.1047, 16-19 (claims reciting a single sensor). Further, the ’854 provisional does not provide support for multiple channels having different FOVs, or configuring multiple optics components relative to multiple sensors respectively to form multiple channels with different FOVs, much less combining data captured with the channels with different FOVs.

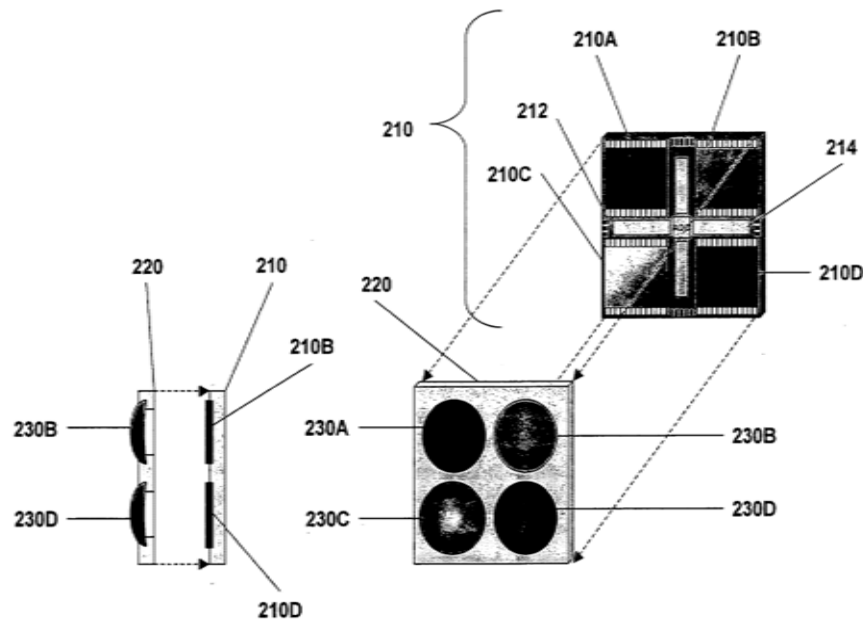


Figure 3

Ex.1047, FIG. 3.

65. Accordingly, the effective filing date of each of the claims of the ’180 patent is no earlier than July 1, 2005, the filing date of the ’946 provisional (Ex.1048).

66. For avoidance of doubt, only Ground 3 depends on this effective filing date analysis that the effective filing date of each of the claims of the '180 patent is no earlier than July 1, 2005. Grounds 1-2 do not depend on this effective filing date analysis, because the prior art in Grounds 1-2 predates the '854 provisional.

VII. CLAIM CONSTRUCTION

67. It is my understanding that in order to properly evaluate the '180 patent, the terms of the claims must first be interpreted. It is my understanding that for the purposes of this *inter partes* review, the claims are to be construed under the so-called *Phillips* standard, under which claim terms are given their ordinary and customary meaning as would be understood by one of ordinary skill in the art in light of the specification and prosecution history, unless the inventor has set forth a special meaning for a term.

68. For the purposes of my analysis below, I do not believe any claim terms require explicit construction other than the term(s) identified below.

A. “*simultaneous data acquisition with each of the first and second channels during a frame*” (claim 22)

69. A POSITA would have understood that “*simultaneous data acquisition with each of the first and second channels during a frame*” means “simultaneous data acquisition of an image frame with each of the first and second channels during a period of time.”

70. The '180 patent defines “frame” as a physical component of a camera.

Ex.1001, 22:8-9. A POSITA would have understood that this description does not apply to the claimed “...*during a frame*,” because a physical component does not have a time period for data acquisition.

71. This construction is supported by the specification. Application 11/212,803, incorporated by reference in the ’180 patent, provides that “if the instruction ‘**Single Frame Capture**’ is received, the camera interface may initiate capture of **a single frame**.” Ex.1051, [0836]; Ex.1001, 1:7-15. A POSITA would have understood that “*during a frame*” refers to during a period of time that data for an image frame is acquired.

72. Regarding data acquisition, the ’180 patent states, “[t]he electrical operation of each camera channel is independent of the other camera channels and **multiple fields of view can be acquired simultaneously**.” Ex.1001, 3:51-54. Thus, a POSITA would have understood that during the period of time, each of the first and second channels acquires data for an image frame simultaneously.

73. This construction is supported by the surrounding claim language. Claim 22 recites “*independently controlling **simultaneous data acquisition with each of the first and second channels during a frame***,” and “*combining data received during the frame from one or more of the first and second channels to provide an image*.” A POSITA would have understood that during a period of time when data for an image frame is acquired, simultaneous data acquisition of an

image frame with each of the first and second channels is performed, and the acquired data (*data received during the frame from one or more of the first and second channels*) is combined to provide an image.

B. “data of a frame” (claim 1)

74. A POSITA would have understood that “*data of a frame*” means “data of an image frame.”

75. A POSITA would have understood that the ’180 patent’s description of “frame” as a physical component (Ex.1001, 22:8-9) does not apply to the claimed “*data of a frame*,” because a physical component does not have data to be combined to provide an image as recited in the surrounding claim language.

Ex.1001, claim 1.

76. This construction is supported by the specification. The ’180 patent describes that “[t]he data from all sensors can be digitally combined to provide a much greater dynamic range **within one frame of digital camera data.**” Ex.1001, 20:19-21. A POSITA would have understood that one frame of digital camera data refers to data of an image frame. Ex.1001, 9:1-8 (image processor “generate[s] or composite[s] an image based on **data from one or more of the camera channels,**” particularly “**the images from the first and second camera channels**”).

VIII. IDENTIFICATION OF HOW THE CLAIMS ARE UNPATENTABLE

77. I have been asked to provide my opinion as to whether the Challenged Claims of the '180 patent would have been obvious in view of the prior art. The discussion below provides a detailed analysis of how the prior art references identified below teach the limitations of the Challenged Claims of the '180 patent.

78. As part of my analysis, I have considered the scope and content of the prior art and any differences between the alleged invention and the prior art. I describe in detail below the scope and content of the prior art, as well as any differences between the alleged invention and the prior art, on an element-by-element basis for each of the Challenged Claims of the '180 patent.

79. As described in detail below, the alleged invention of the Challenged Claims would have been obvious in view of the teachings of the identified prior art references as well as the knowledge of a POSITA. My obviousness analysis relies on the combined teachings of the references and not on a physical incorporation of elements. I apply the prior art as follows:

Ground	Claim	Pre-AIA § 103 Basis
#1	1-3, 10-12, 22, 24-25, 28, 30, 32-33	Matsushima and Yu
#2	28, 30	Matsushima, Yu, and Weldy
#3	22-23, 28, 30, 33	Choi, Labaziewicz, and Yu

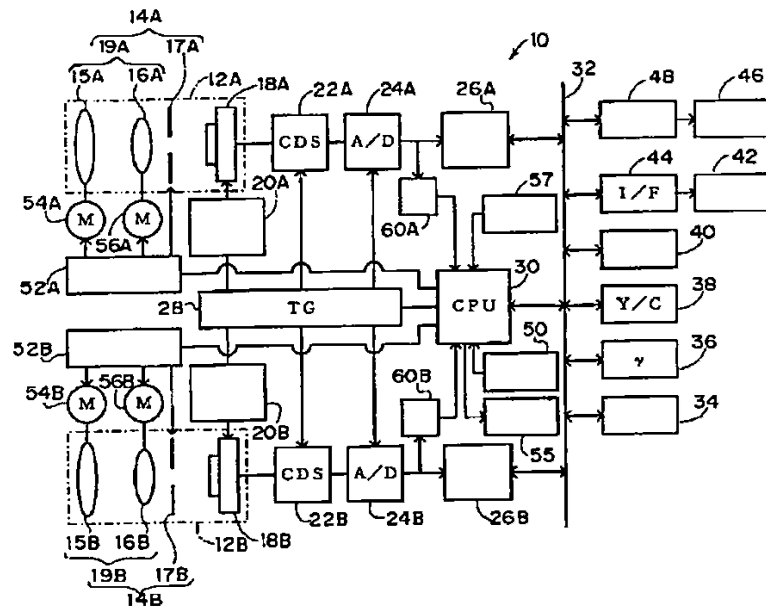
80. As stated above, I have used the earliest possible priority date, August 25, 2004, for my analysis of Grounds 1-2. I have used the earliest effective filing date, July 1, 2005, for my analysis of Ground 3.

A. Ground 1: Claims 1-3, 10-12, 22, 24-25, 28, 30, and 32-33 would have been obvious over Matsushima and Yu.

1. Overview of Matsushima

81. Matsushima discloses “a digital camera equipped with **multiple imaging systems**,” including two **independent** imaging systems,” with “a first image imaging system including **a first image sensor...and a first lens** for forming an image of the subject,” and “a second imaging system including **a second image sensor...and a second lens** with a focal length **longer than** the first lens for forming an image of the subject.” Ex.1007, [0001], [Claim 1], [0017]; *see also id.*, [0008], [0020]. Matsushima’s digital camera “prevent[s] unnatural boundary regions even when a telephoto captured image is **combined** in the center of a wide-angle captured image.” Ex.1007, [0007].

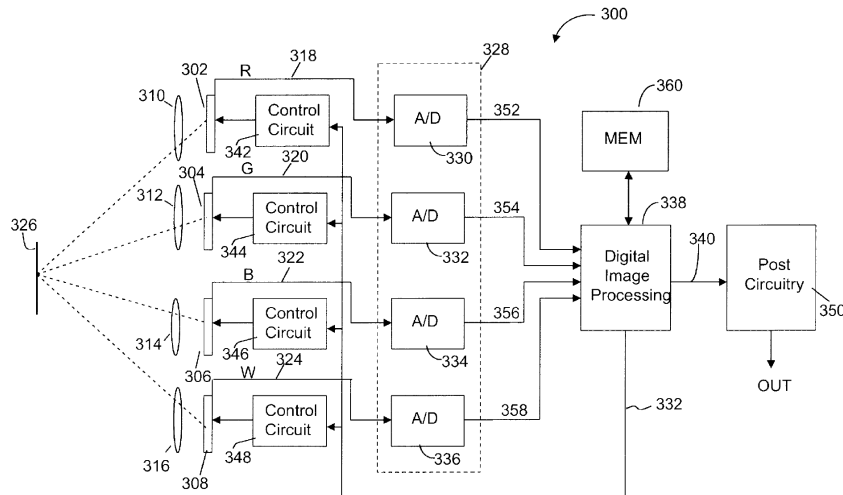
[FIG. 1]



Ex.1007, FIG. 1.

2. Overview of Yu

82. Yu is directed to a “digital camera that produces digital images of high qualities without using expensive image sensors and optics....The disclosed digital cameras use multiple image sensors with multiple lenses.” Ex.1005, Yu, Abstract. In FIG. 3, below, Yu’s “digital camera uses four image sensors, each having its own lens.” *Id.*, 2:40-44.

**Fig. 3****Ex.1005, FIG. 3**

83. Yu explains that “each of the image sensors is **respectively and independently controlled** to expose to the same imaging target.” Ex.1005, 9:66-10:2; *id.*, 6:52-58 (“control circuits...receive respectively the control signals ...[and] each...**independently and respectively control** image sensors”); 12:16-18, 9:50-52. Yu explains there are “**many other causes**” that may need to control image sensors independently, “such as **gain and offset controls.**” Ex.1005, 6:58-61.

3. Analysis**a) Claim 22**

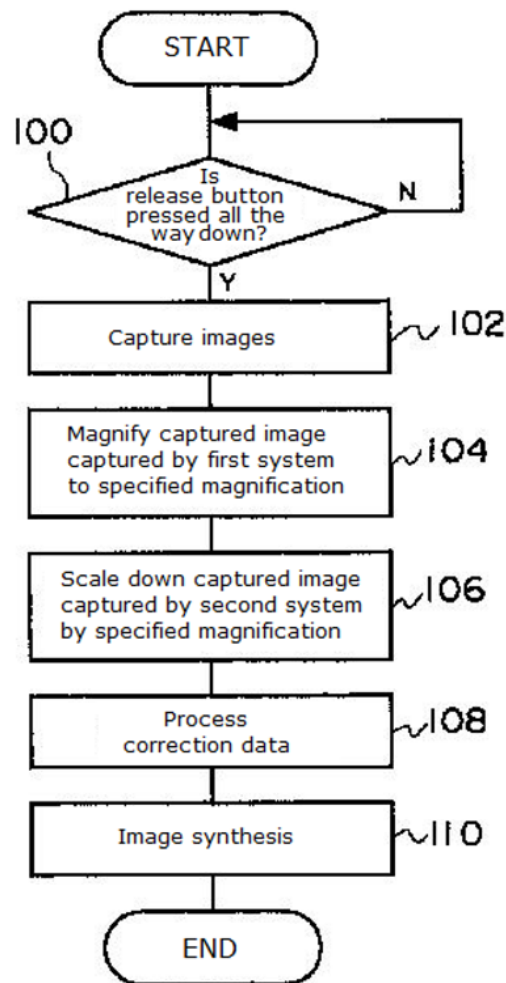
[22.0] A method comprising:

84. Matsushima discloses or renders obvious [22.0].

85. As shown in FIG. 7 below, Matsushima describes a *method* (control routine) for configuring two independent imaging systems, capturing images

therefrom, and performing image synthesis to generate an image with improved quality (e.g., improved resolution, expanded dynamic range). Ex.1007, FIG. 7, [0062]-[0069] (describing control routine in FIG. 7).

[FIG. 7]

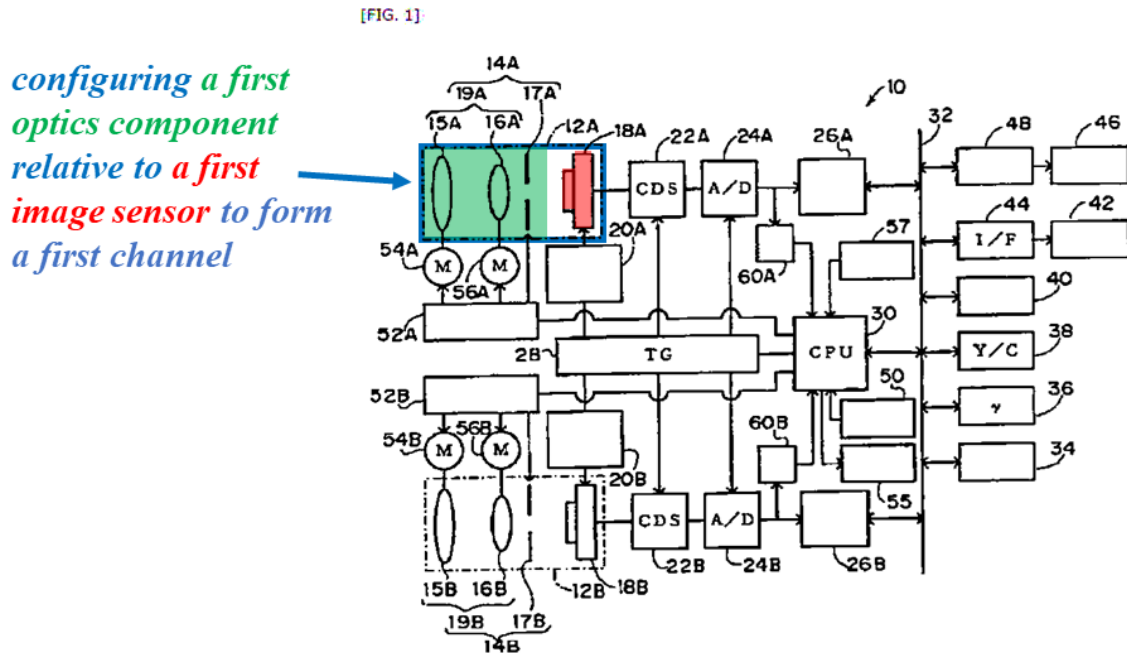
**Ex.1007, FIG. 7.**

86. Thus, Matsushima discloses or renders obvious [22.0].

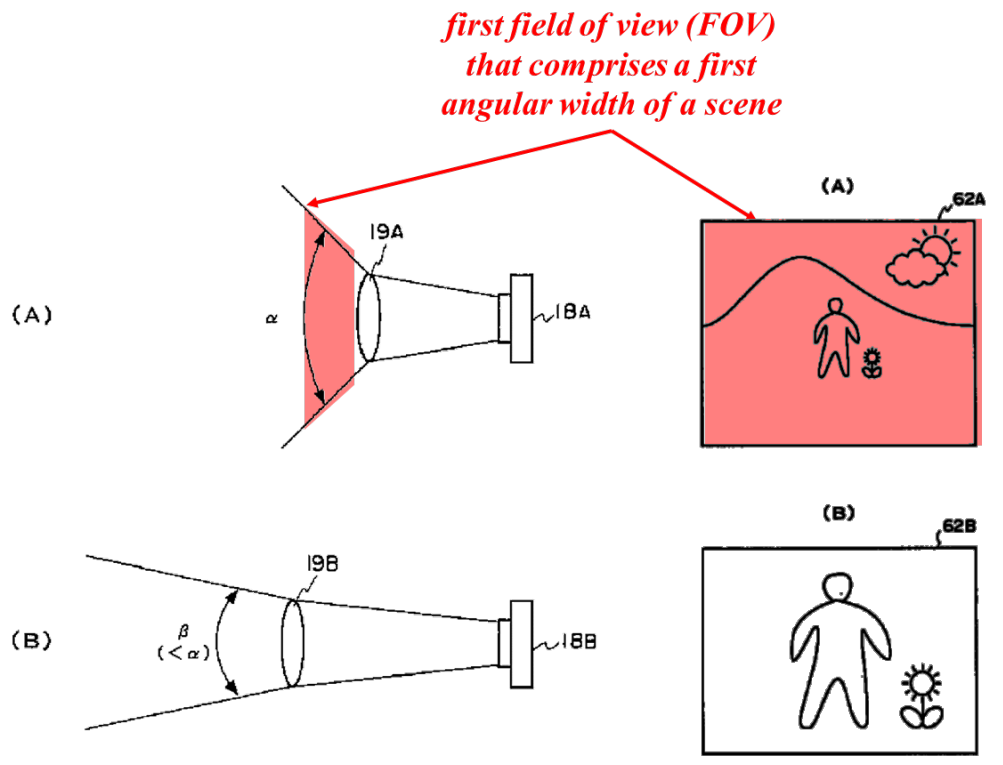
[22.1] *configuring a first optics component relative to a first image sensor to form a first channel having a first field of view (FOV) that comprises a first angular width of a scene;*

87. Matsushima discloses or renders obvious [22.1].

88. As shown in FIGS. 1, 2(A) and 3(A) below, Matsushima discloses *configuring a first optics component* (setting a first imaging optics 14A including first lens group 19A) *relative to a first image sensor* (first image sensor 18A) *to form a first channel* (first imaging system 12A) *having a first field of view (FOV)* (shown in annotation in FIGS. 2(A) and 3(A)) *that comprises a first angular width* (shooting angle α of lens group 19A) *of a scene* (e.g., scene of FIG. 3). Ex.1007, [Claim 1], [0017] (“configuration of a digital camera” of FIG. 1 including “a first imaging system 12A”), [0022], [0020] (“configuration of a digital camera” of FIG. 1 including lens group 19A with a “shooting angle α ”), [Claim 3] (“a means for **setting the shooting angle**”), [0014] (“the digital camera may be configured to further comprise a means for setting the shooting angle”).



Ex.1007, FIG. 1, annotated.



Ex.1007, FIGS. 2 and 3, annotated.

89. Matsushima describes *configuring a first optics component* (setting

the first imaging optics 14A including first lens group 19A) to operate with *a first image sensor* (first image sensor 18A) *to form a first channel having a first field of view (FOV)* according to the defined shooting angle α , with the following relationship:

$$\text{first FOV with shooting angle } \alpha = 2 \tan^{-1} \left(\frac{K_1}{2f_1} \right),$$

where K_1 is the diagonal of the sensor format of image sensor 18A, and f_1 is the focal length of the first optics 14A. Ex.1007, [0017], [Claim 3], [0014], [0020]. Such setting of a lens relative to the sensor to form a channel having a specific FOV was well-known in the art. Ex.1040, 48 (“The focal length of a lens also determines the angle of the field of view (FOV) **relative to a...sensor format**. The FOV is defined as the angle subtended at the (distortion-free) lens by the diagonal (K) of the format when the lens is focused on infinity.”), FIG. 4.13 (reproduced below, illustrating “Field (angle) of view (FOV) of a lens **related to** format dimension”).

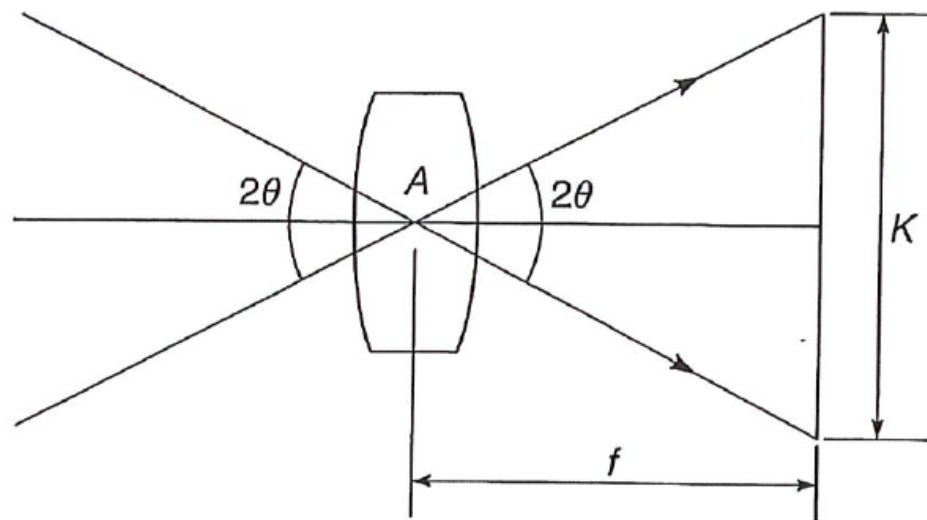


Figure 4.13 Field (angle) of view (FOV) of a lens related to format dimension

Ex.1040, FIG. 4.13

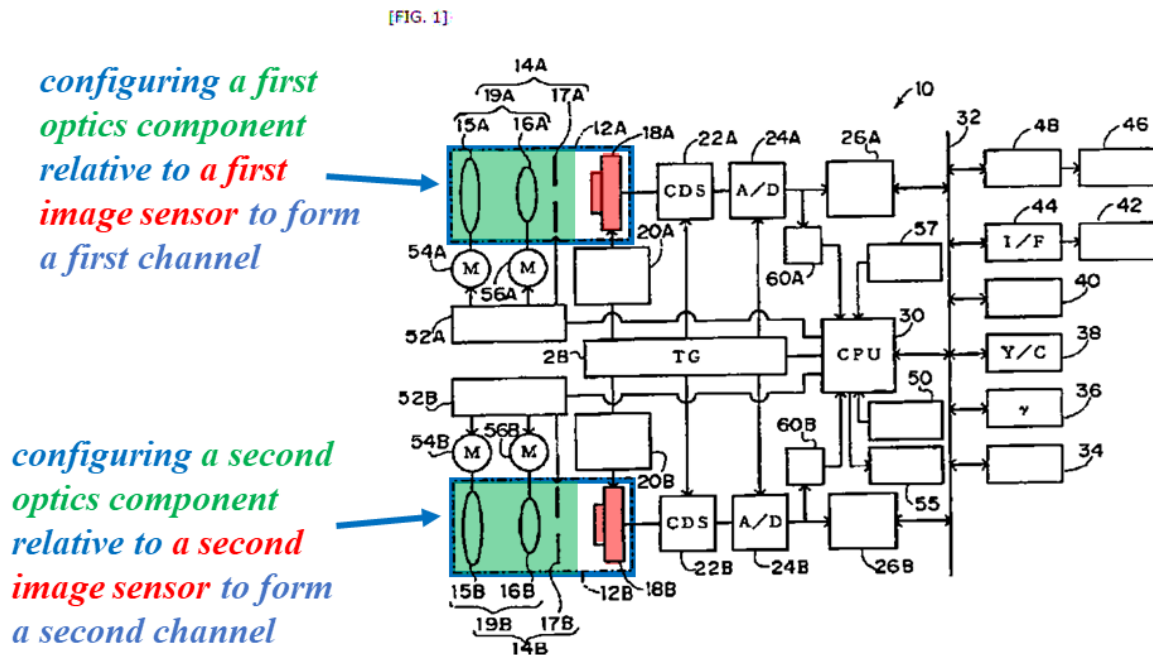
90. Thus, Matsushima discloses or renders obvious [22.1].

[22.2] *configuring a second optics component relative to a second image sensor to form a second channel having a second FOV that comprises a second angular width of the scene, wherein the first and second angular widths are different;*

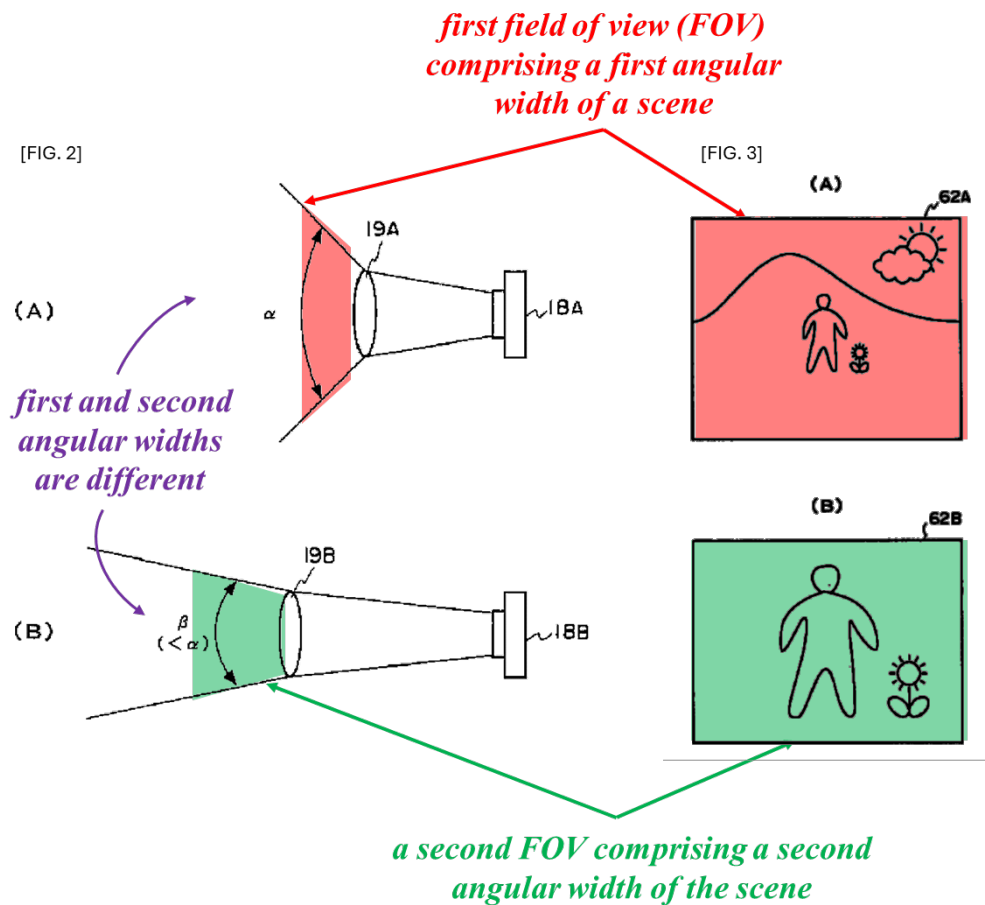
91. Matsushima discloses or renders obvious [22.2].

92. As shown in FIG. 1 and FIGS. 2(B) and 3(B) below, Matsushima discloses *configuring a second optics component* (setting a second imaging optics 14B including second lens group 19B) *relative to a second image sensor* (second image sensor 18B) *to form a second channel* (second imaging system 12B) *having a second FOV* (shown in annotation in FIGS. 2(B) and 3(B)) *that comprises a second angular width* (shooting angle β of lens group 19B) *of the scene* (e.g., scene of FIG. 3), where *the first and second angular widths are different* (shooting angle

β is narrower than shooting angle α). Ex.1007, [Claim 1], [0017] (“configuration of a digital camera” of FIG. 1 including “a second imaging system 12B”), [0022], [0020] (“configuration of a digital camera” of FIG. 1 including lens group 19B that “is a telephoto single focal length lens whose **shooting angle β is narrower than the shooting angle α of lens group 19A**”); [Claim 3] (“a means for **setting the shooting angle**”), [0014].



Ex.1007, FIG. 1, annotated.



Ex.1007, FIGS. 2 and 3, annotated.

93. Matsushima discloses setting a *second optics component* (second imaging optics 14B including second lens group 19B) to operate with a *second image sensor* (second image sensor 18B) to form a channel having a second FOV with shooting angle β to as follows:

$$\text{second FOV with shooting angle } \beta = 2 \tan^{-1} \left(\frac{K_2}{2f_2} \right),$$

where K_2 is the diagonal of the sensor format of image sensor 18B, and f_2 is the focal length of the second optics 14B. Ex.1007, [0020]. It was well-known knowledge to set a lens *relative to* an image sensor to provide an FOV. Ex.1040,

FIG. 4.13.

94. Thus, Matsushima discloses or renders obvious [22.2].

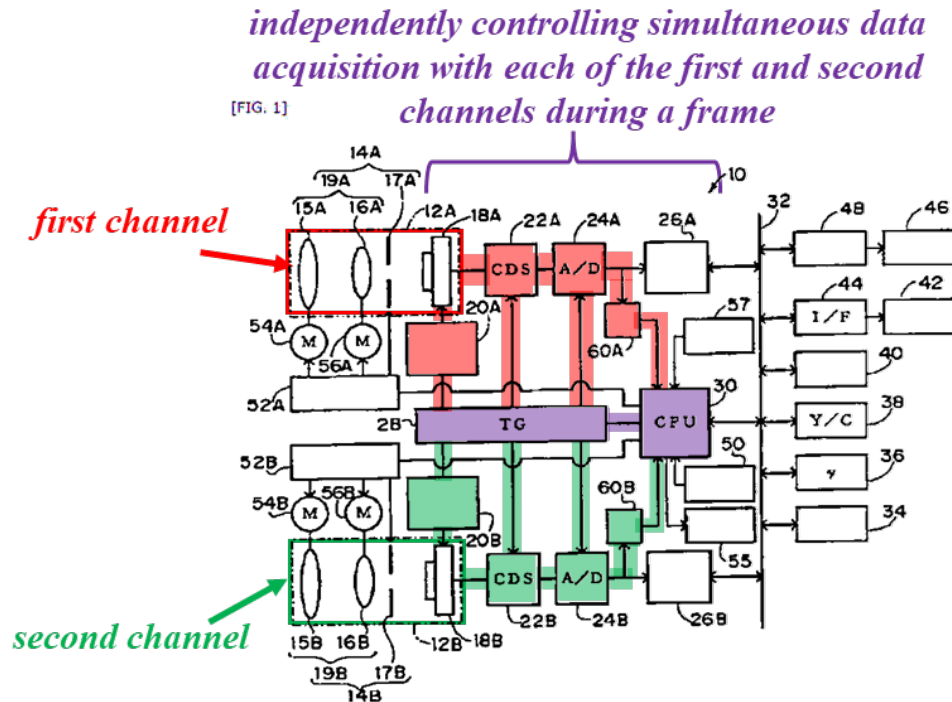
[22.3] *independently controlling simultaneous data acquisition with each of the first and second channels during a frame; and*

95. Matsushima alone discloses or renders obvious [22.3]. Alternatively, Matsushima in view of Yu renders obvious [22.3].

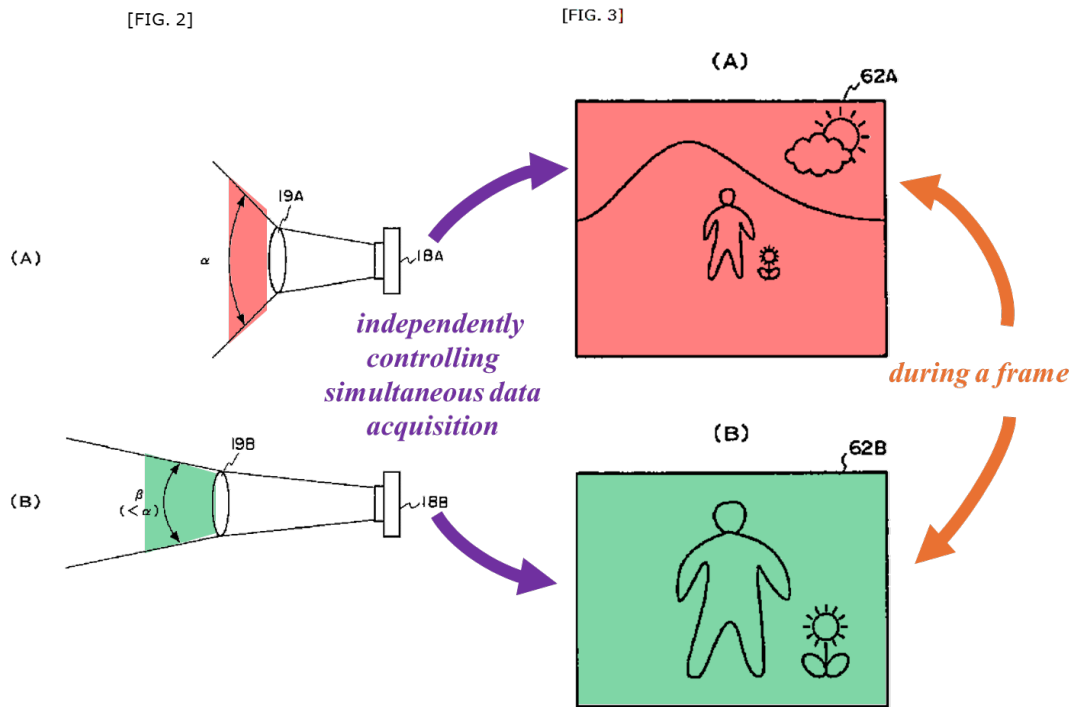
i. **Matsushima alone discloses or renders obvious [22.3].**

96. As shown in FIGS. 1-3 below, Matsushima discloses or renders obvious *independently controlling* (independent control of automatic exposure including independently controlling charge accumulation times of image sensors 18A and 18B) *simultaneous data acquisition with each of the plurality of channels during a frame* (during a period of time, simultaneous acquisition of data for image 62A with first imaging system 12A and data for image 62B with second imaging system 12B, “when the release button is ‘fully press[ed]’”). Ex.1007, [0031] (“**CPU 30 performs various calculations** such as focus evaluation calculations and AE [automatic exposure adjustment] calculations based on the **image signals** outputted from CCD 18A and CCD 18B, and the driving circuits 52A and 52B of the imaging lenses 15A and 15B, the focus lenses 16A and 16B, and the apertures 17A and 17B are **controlled** based on these calculations.”). A POSITA would have understood that Matsushima’s independent control of charge accumulation times is the independent control of integration times for image acquisition as described in

the '180 patent. Ex.1001, 20:34-36 ('180 patent equating integration time with charge accumulation time, stating that "[i]ntegration time control...controls the time the electrical signal is integrated or accumulated").



Ex.1007, FIG. 1, annotated.



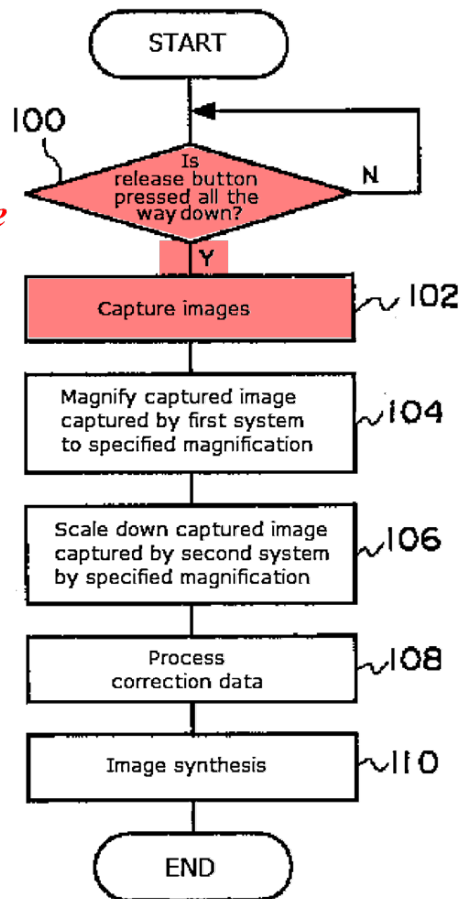
Ex.1007, FIGS. 2 and 3, annotated.

97. Specifically, Matsushima discloses or renders obvious that images 62A and 62B are acquired by *simultaneous data acquisition with each of the first and second channels during a frame*, because Matsushima describes that image 62B is a **scaled-up** image of the center of image 62A and therefore images 62A and 6B are captured at the same time to avoid image discrepancies due to motion or other artifacts. Ex.1007, [0021] (“the image captured by the second imaging system 12B is the **scaled-up captured image 62B at the center of FIG. 3(A)**, as shown in FIG.3(B)”). A POSITA would have understood that for image 62B to be a “**scaled-up** image” of the center of image 62A as described in Matsushima, images 62A and 62B are captured at the same time during a frame, because otherwise, an image frame 62B of a scene captured at a different time would

change (e.g., with moving objects, different lighting conditions) and therefore does not provide a “**scaled-up**” image of 62A. *See also* Ex.1007, [Claim 1] (“a first imaging system including a first image sensor for **imaging a subject**...; a second imaging system including a second image sensor for **imaging the subject**”). As shown in FIGS. 2-3 above, Matsushima describes performing *simultaneous data acquisition* of the same subject *during a frame* where control circuits are “**driven synchronously** by timing signals” for capturing image 62A (an image frame from the first channel) and image 62B (image frame from the second channel) of **the same scene**, albeit with different FOVs. Ex.1007, [0027]; *see also id.*, FIG. 7 below (“Capture images” after determining that “the release button has been fully pressed”), [0063]-[0064], [0035].

[FIG. 7]

*simultaneous data
acquisition...during a frame
after determining that the
release button is fully
pressed*



Ex.1007, FIG. 7, annotated.

98. **Second**, referring to FIG. 1 below, Matsushima describes *independently controlling* (using CPU 30 together with integration circuits 60A and 60B, Timing Generator (TG) 28, CCD drive circuits 20A and 20B, correlated double sampling (CDS) circuits 22A and 22B, and analog-to-digital (A/D) converters 24A and 24B) data acquisition of the independent first imaging system 12A, by using the circuits annotated in red to independently control the first imaging system 12A, and *independently controlling* data acquisition of the

independent second imaging system 12B using the circuits annotated in green to independently control the second imaging system 12B. Ex.1007, [0031] (“**CPU 30 performs various calculations** such as focus evaluation calculations and AE calculations based on the **image signals** outputted from CCD 18A and CCD 18B, and the driving circuits 52A and 52B of the imaging lenses 15A and 15B, the focus lenses 16A and 16B, and the apertures 17A and 17B are **controlled** based on these calculations.”), [0032], [0064], [0023] (“the CCDs 18 have a so-called electronic shutter function that **controls the accumulation time (shutter speed)** of the charge accumulated **by each sensor** via shutter gate pulses”) (citing Ex.1007, [0022], [0023], [0024], [0029], [0031]-[0034] describing independently controlling data acquisition using (1) automatic exposure adjustments (AE) performed independently for each channel, and (2) automatic focus (AF) performed independently for each channel).

and the second subject luminance of shooting angle β are determined independently (by circuit 60A for first channel, and 60B for second channel independently). Ex.1007, [0034] (AE control is based on the subject luminance (imaging EV value) according to the scene of the respective FOV). Similarly, the CPU independently controls the apertures 17A and 17B based on the calculated “appropriate aperture values” based on the first subject luminance and the second subject luminance for the respective imaging systems. Ex.1007, [0032] (“The motors 56A and 56B are driven to[] set the apertures 17A and 17B to the appropriate aperture values.”). The control paths for data acquisition (including for AE control) with the first and second channels (annotated in red and green respectively in FIG. 1 above, including CDS circuits 22A and 22B, A/D converters 24A and 24B, integration circuits 60A and 60B, and CCD drive circuits 20A and 20B) are independently controlled, because they are controlled by the CPU 30 based on the independently determined subject illuminance of each of the “independent imaging systems” 12A and 12B. Ex.1007, FIG. 1, [0017], [0025]-[0027], [0034]-[0035].

100. Matsushima’s teaching of independent control of the first and second channels, including the independent control of **charge accumulation times** of the first and second channels for AE control, is consistent with the ’180 patent’s description of independent control of data acquisition, which includes

“independent electrical control of features **such as integration time control.**”

Ex.1001, 5:63-67, 3:23-25, 3:51-63, 20:10-13.

101. A POSITA would have understood that Matsushima’s independent control of charge accumulation times is the independent control of integration times for image acquisition as described in the ’180 patent. Ex.1001, 20:34-36 (’180 patent equating integration time with charge accumulation time, stating that “[i]ntegration time control...controls the time the electrical signal is integrated or accumulated”). This is consistent with a POSITA’s understanding that integration time is used as synonymous with charge accumulation time. Ex.1036 (generally using “charge accumulation period” and “integration time” interchangeably throughout), 14:1-3 (“the charge accumulation (light integration) time period for accumulation of charges by the photosensor array”), 25:41-42 (“the charge accumulation (integration time) period”); Ex.1037, 3:35 (“a charge accumulation (integration) period”), 3:52 (“a charge accumulation (integration) period”), 4:16 (“integration (accumulation) time”).

102. In Matsushima, the charge accumulation time/integration times of the two channels would have independent values, because the first and second channels are controlled independently based on captured images of different subject luminance with different FOVs. Ex.1007, [0034]. For example, the first sensor imaging the larger FOV (see 62A including the sun, the sky and other

background objects) has a different subject illuminance (e.g., a higher subject illuminance) from the second sensor imaging the smaller FOV (see 62B including a person and a flower), thereby a different integration time (e.g., a shorter integration time) is determined for the first channel. It was well-known in the art, a broad dynamic range is achieved by combining images 62A and 62B having different integration times for different regions in a scene. Ex.1014, FIG. 1a-1c, 5:13-20 (illustrating a multi-lens camera where two or **greater than two lens/two sensor** “are used to **simultaneously** capture light information from **the same scene**” with different “scene exposure conditions...for improving various characteristics.”). Additionally, it was well-known knowledge that combining images with different exposures achieves improved image characteristics including expanded intra-scene dynamic range, which applies to images captured at the same time, as well as images captured at different times (with correction for any error caused by the timing difference). Ex.1009, 9; Ex.1024, 3; Ex.1025, 7, FIG. 8; Ex.1026, 3.

103. As discussed at Section VII.A, “*simultaneous data acquisition with each of the first and second channels during a frame*” means “simultaneous data acquisition of an image frame with each of the first and second channels during a period of time.” As shown in FIGS. 2-3 above, Matsushima discloses simultaneous data acquisition of an image frame with each of the first and second channels

during a period of time, by independently controlling the charge accumulation times/integration times during a period of time for acquiring data for an image frame (image frame 62A with the first channel, image frame 62B with the second channel). Ex.1007, [0017].

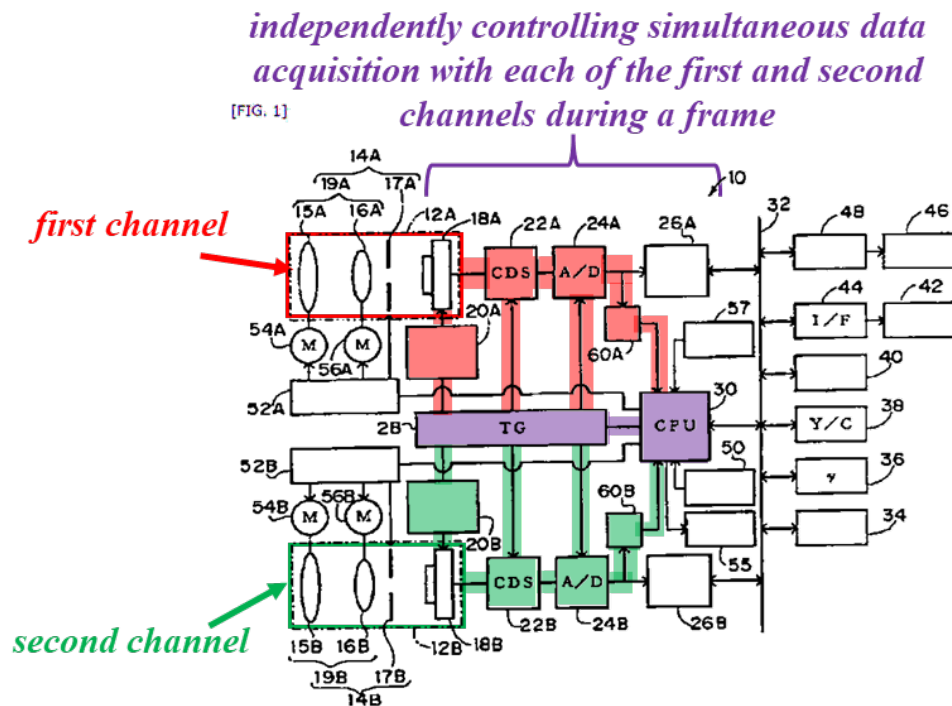
104. Thus, Matsushima discloses or renders obvious [22.3].

ii. Matsushima combined with Yu (Matsushima-Yu) renders obvious [22.3].

105. To the extent Patent Owner argues that Matsushima's simultaneous data acquisition does not explicitly disclose "*independently controlling*" as recited in [22.3], Matsushima-Yu renders obvious [22.3], because "*independently controlling*" as recited in [22.3] is a conventional implementation detail taught by Yu.

106. Yu describes that "each of the image sensors is **respectively and independently controlled** to expose to the same imaging target." Ex.1005, 9:66-10:2; *see also id.*, 6:52-58 ("control circuits[] receive respectively the control signals[], each... **independently and respectively control** image sensors").

107. As exemplified below, a POSITA would have been motivated to apply Yu's teaching of independently controlling data acquisition, for each channel of Matsushima's digital camera.



108. A POSITA would have been motivated to combine Matsushima and Yu for many reasons.

109. Matsushima and Yu are each analogous art to the '180 patent because they pertain to the same field of endeavor, namely, "[d]igital camera systems and methods." Ex.1001, Abstract; Ex.1005, Title ("Digital Cameras using Multiple Sensors with Multiple Lenses"); Ex.1007, Title ("Digital Camera"). Further, they are each pertinent to a particular problem of the '180 patent, such as the problem of achieving optimal exposure for each channel. Ex.1001, 11:37-40; Ex.1007, [0034]; Ex.1005, 12:16-19.

110. A POSITA would have been motivated to apply, in Matsushima's

multi-channel digital camera performing simultaneous data acquisition, Yu's teaching of independent control (e.g., of exposure time, gain control, and/or offset control) for each channel, because doing so would provide the benefits of an improved combined image from the independently captured images, with "increase[d] overall dynamic range" (Ex.1005, 9:19-27), and improved sharpness with "more scene objects are sharper than in any of the input images" (Ex.1014, 5:24-25). Ex.1005, 6:52-58 ("control circuits...each...**independently and respectively control** image sensors"); 9:66-10:2, 9:50-52 ("With images **independently** from multiple sensors with multiple lenses, the **complementary expansions of the respective dynamic ranges** become possible"), 6:58-61 (describing many causes for controlling image sensors "**independently**, such as **gain and offset controls.**"); Ex.1007, [0034]. While Yu describes examples of digital cameras with single-color-spectrum channels, a POSITA would have understood that Yu's independent control teaching does not require single-color-spectrum channels, and applies to channels with color sensors. Ex.1014, 5:18-20 ("As more than one representation of the scene is captured, it is possible to select scene exposure conditions in a way that provides for improving various characteristics").

111. A POSITA would have looked to Yu's explicit teaching, suggestion, and motivation that "each of the image sensors is **respectively and independently**

controlled to expose to the same imaging target” (Ex.1005, 9:66-10:2) as an implementation detail for Matsushima’s control function, because Matsushima has a need to control the channels to expose to the same imaging target. Ex.1007, [0034] (describing a need for optimal exposure for imaging the same target, albeit different FOVs having different subject luminance). Yu’s independent control of exposure is an implementation detail to provide optimal exposure for different subject luminance for different FOVs of the same scene having different lighting conditions.

112. Matsushima-Yu would have been a combination of prior art elements (Matsushima’s digital camera with independent control of the exposure time of each of the multiple image sensors, as taught by Yu) according to known methods (controlling each electronic shutter of each image sensor to control the exposure time of the sensor) to yield the predictable result of varying sensor integration time for exposure control.

113. In addition, modifying Matsushima’s multi-sensor multi-lens digital camera to implement, for each of the multiple sensors, independent control of exposure as taught by Yu would improve a similar device (Matsushima’s multi-sensor multi-lens digital camera) in the same way. I was informed that there is a motivation to combine when a known technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would

improve similar devices in the same way, using the prior art elements according to their established functions.”

114. A POSITA would have had a reasonable expectation of success in combining Matsushima and Yu, because Matsushima-Yu would have involved routine knowledge well within the skill of a POSITA. The digital cameras described in Matsushima and Yu perform similar functions (using control signals to control image sensors) to achieve similar goals (e.g., controlling exposure times of the image sensors and providing improved image quality) using similar technology. *See, e.g.,* Ex.1005, FIG. 3, 6:53-58; Ex.1007, [0034].

115. Accordingly, Matsushima-Yu renders obvious *independently controlling* (independent control of exposure, gain, offset including independently controlling charge accumulation times of image sensors 18A and 18B) *simultaneous data acquisition with each of the first and second channels during a frame* (during a period of time, simultaneous acquisition of data for images 62A and 62B).

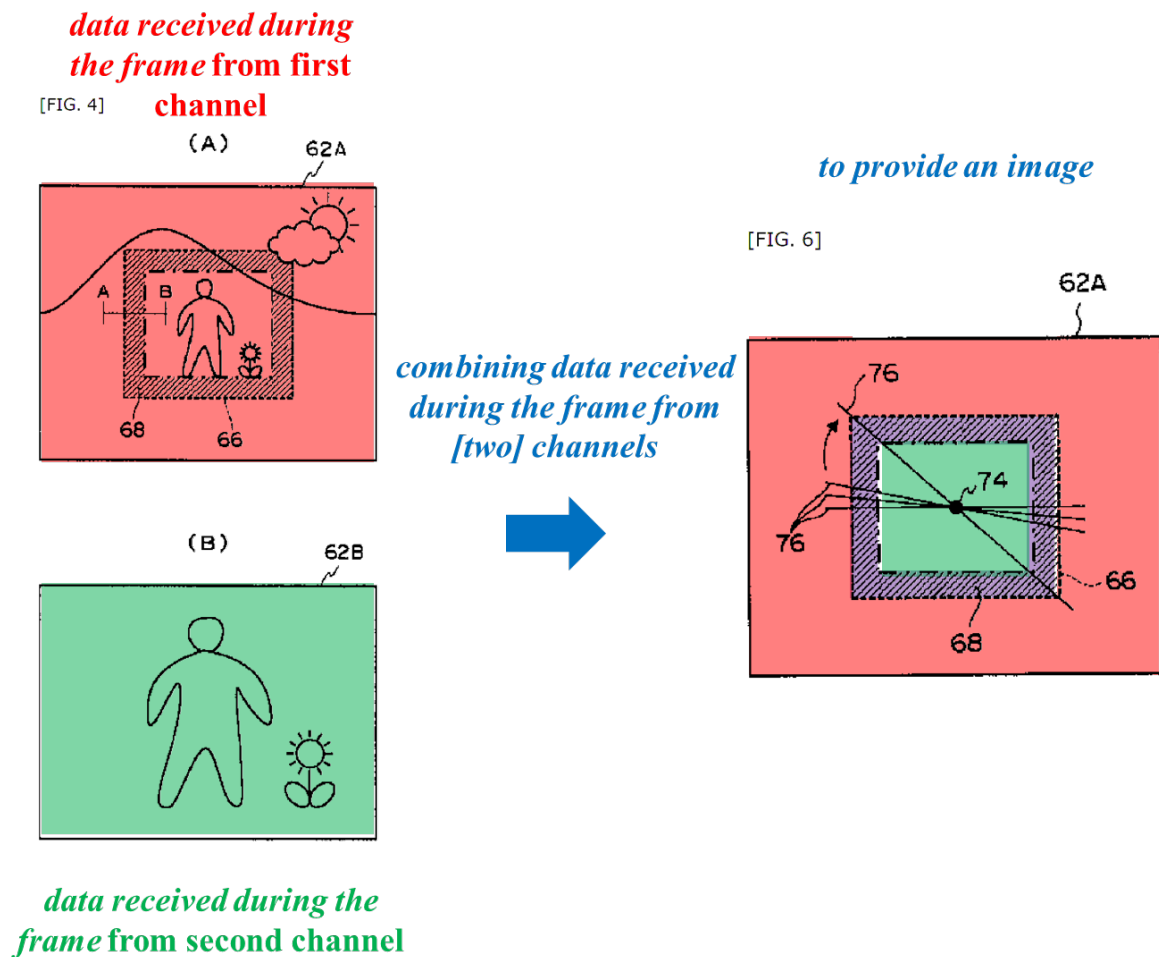
116. Thus, Matsushima-Yu renders obvious [22.3].
[22.4] *combining data received during the frame from one or more of the first and second channels to provide an image.*

117. Matsushima-Yu renders obvious [22.4].

118. As discussed at [22.3], Matsushima-Yu renders obvious simultaneous data acquisition with each of the first and second channels during a frame, where

data (image 62A and image 62B) is *received during the frame from one or more of the first and second channels* (two channels including first and second image systems 14A and 14B).

119. As illustrated in FIGS. 4 and 6 below, Matsushima describes *combining* (synthesis processing) *data received during the frame from at least one of the plurality of channels* (image 62A and image 62B from first imaging system 12A and second imaging system 12B respectively) *to provide an image* (an image of FIG. 6). Ex.1007, [0007] (describing “prevent[ing] unnatural boundary regions even when a telephoto captured image is **combined** in the center of a wide-angle captured image”), [0048]-[0051] (synthesis processing performed on captured images taken by the two imaging systems). Specifically, Matsushima’s CPU 30 generates a combined image (FIG. 6), when “a telephoto captured image [image 62B] is **combined** in the center of a wide-angle captured image [image 62A]”). Ex.1007, [0048]-[0049].



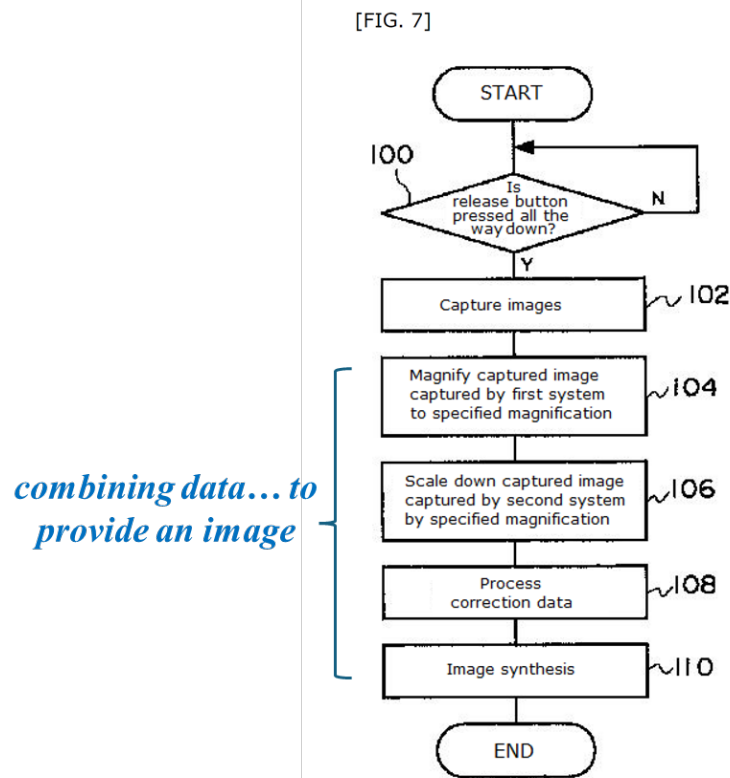
Ex.1007, FIGS. 4 and 6, annotated.

120. Matsushima's technique provides *an image having a relatively high resolution* because the combined image improves the resolution and image quality in the center of the image. Ex.1007, [0048]-[0049] (“[B]y synthesizing a captured image 62A taken with the first imaging system 12A with a captured image 62B taken with the second imaging system 12B, an image with improved image quality in the center of the captured image is generated”); Ex.1007, [0021] (stating that “CCDs of the same size, that is, the same number of pixels,” indicating that the

image 62B would have a larger number of pixels with a higher resolution compared to the corresponding region in the center of image 62A).

121. Additionally, Matsushima discloses *combining data received during the frame from one or more of the first and second channels to provide an image*, because Matsushima describes **combining data** of image 62A and image 62B from first and second channels to generate correction data for peripheral region 68, which achieves continuity of image data around the peripheral regions, to provide a natural boundary between the two images in the combined image of FIG. 6. Ex.1007, [0050]-[0051] (correction data generated to correct the image in the peripheral regions 68 based on the image data in the peripheral region 68 (shaded region) of the scaled down image 66 and the image data in the peripheral region 68 of the captured image 62A).

122. As illustrated in FIG. 7 below, Matsushima describes steps for *combining data received during the frame from one or more of the first and second channels to provide an image* (performing synthesis of the images captured at step 102). Ex.1007, FIG. 7, [0062], [0067]-[0068] (describing a control routine executed by CPU 30 to combine data from two channels to generate correction data, and generate a combined image by (1) replacing the image in the center of the wider FOV image with the narrower FOV image and (2) replacing the peripheral region with the correction data).



Ex.1007, FIG. 7, annotated.

123. Thus, Matsushima-Yu renders obvious [22.4].

b) Claim 24

[24.0] *The method of claim 22, wherein configuring the first optics component relative to the first image sensor comprises configuring the first optics component with a first focal length and configuring the first image sensor to include a first pixel count.*

124. Matsushima discloses or renders obvious [24.0].

125. As discussed at Ground 1:[22.1], Matsushima discloses setting the first channel with the following configuration:

First FOV with shooting angle $\alpha = 2 \tan^{-1} \left(\frac{K_1}{2f_1} \right)$,

where K_1 is the diagonal of the sensor format of image sensor 18A, and f_1 is the first focal length of the first optics 14A. Ex.1007, [Claim 1], [0017], [0020]. It was well-known knowledge to set a lens *relative to* an image sensor to provide an FOV. Ex.1040, 48, FIG. 4.13.

126. Thus, in Matsushima, the configuration of the first optics component relative to the first image sensor includes (1) setting the first optics component (first imaging optics 14A including first lens group 19A) with a first focal length (single focal length f_1); and (2) setting the first image sensor (image sensor 18A with K_1) to include a first pixel count. Ex.1007, [0021] (“CCDs of **the same size, that is, the same number of pixels.**”).

127. Thus, Matsushima discloses or renders obvious [24.0].

c) Claim 25

[25.0] *The method of claim 24, wherein configuring the second optics component relative to the second image sensor comprises configuring the second optics component with a second focal length that is different than the first focal length and configuring the second image sensor to include the first pixel count.*

128. Matsushima discloses or renders obvious [25.0].

129. As discussed at Ground 1:[22.2], Matsushima discloses setting the second channel with the following configuration:

$$\text{Second FOV shooting angle } \beta = 2\tan^{-1}\left(\frac{K_2}{2f_2}\right),$$

where K_2 is the diagonal of the sensor format of image sensor 18B, and f_2 is

the second longer focal length (a longer telephoto single focal length) of the second optics 14B. Ex.1007, [Claim 1], [0017], [0022], [0020] (“CCDs of **the same size**,” thus $K_2 = K_1$). It was well-known in the art to set a lens relative to an image sensor to provide an FOV. Ex.1040, 48, FIG. 4.13.

130. Thus, in Matsushima, the configuration of *the second optics component relative to the first image sensor* includes (1) setting *the second optics component* (second imaging optics 14B including second lens group 19B) *with a second focal length* (a longer telephoto focal length f_2) *that is different than the first focal length*; and (2) setting *the second image sensor* (image sensor 18B) *to include the first pixel count* (having a same size and same number of pixels as the first image sensor 18A). Ex.1007, [0021] (“CCDs of **the same size, that is, the same number of pixels.**”).

131. Thus, Matsushima discloses or renders obvious [25.0].

d) Claim 28

[28.0] *The method of claim 22, comprising configuring a third optics component relative to a third image sensor to form a third channel having a third FOV, wherein the third FOV is different from one or more of the first FOV and the second FOV.*

132. Matsushima-Yu renders obvious [28.0].

133. In FIG. 3 below, Yu describes a “digital camera us[ing] four image sensors, each having its own lens.” Ex.1005, 2:40-44. Three sensors are “respectively sensitive to three different regions of visible color spectrum,” e.g.,

red (“R”), green (“G”), and blue (“B”), and the fourth sensor (also referred to as black/white (“B/W” or “W”) sensor) is “sensitive to a full region of said visible color spectrum.” Ex.1005, 11:15-21.

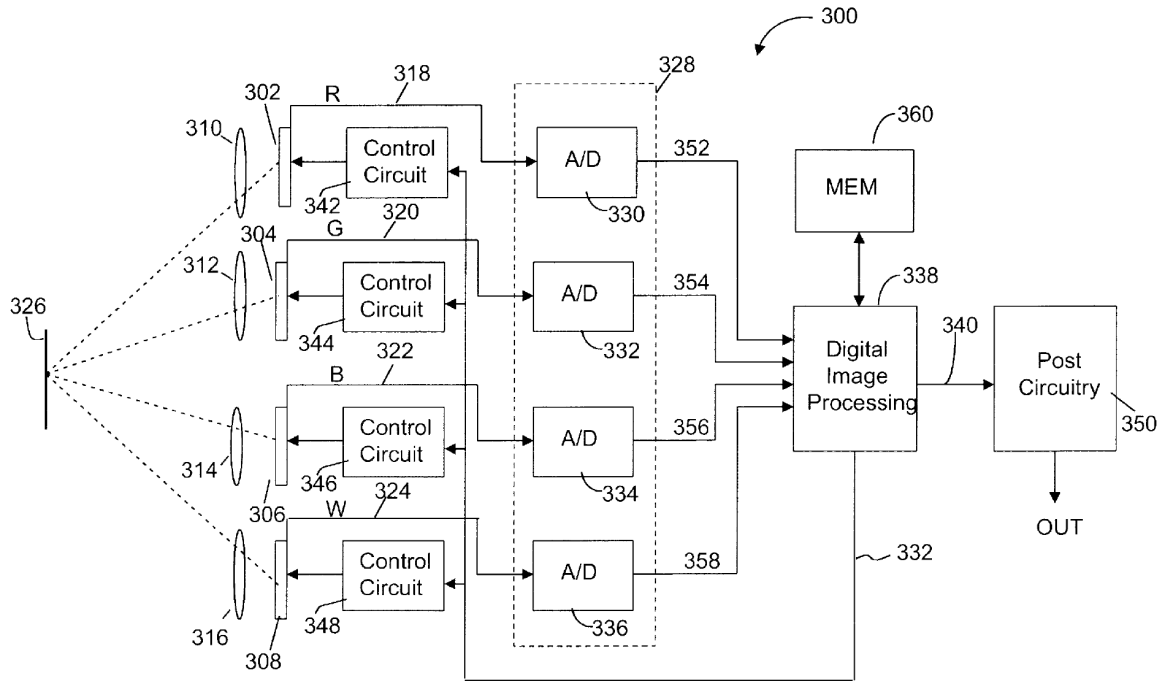
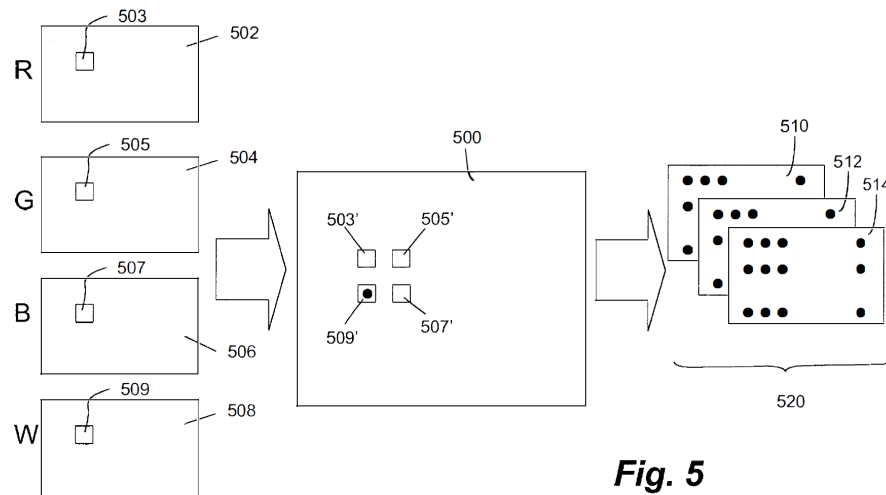


Fig. 3

Ex.1005, FIG. 3.

134. In Yu’s FIG. 5 below, an enhanced color image with increased “overall dynamic range” is generated by combining the four images (“R,” “G,” “B,” “W”) independently generated by the four sensors. Ex.1005, 9:19-27; FIG. 8; 9:50-52.

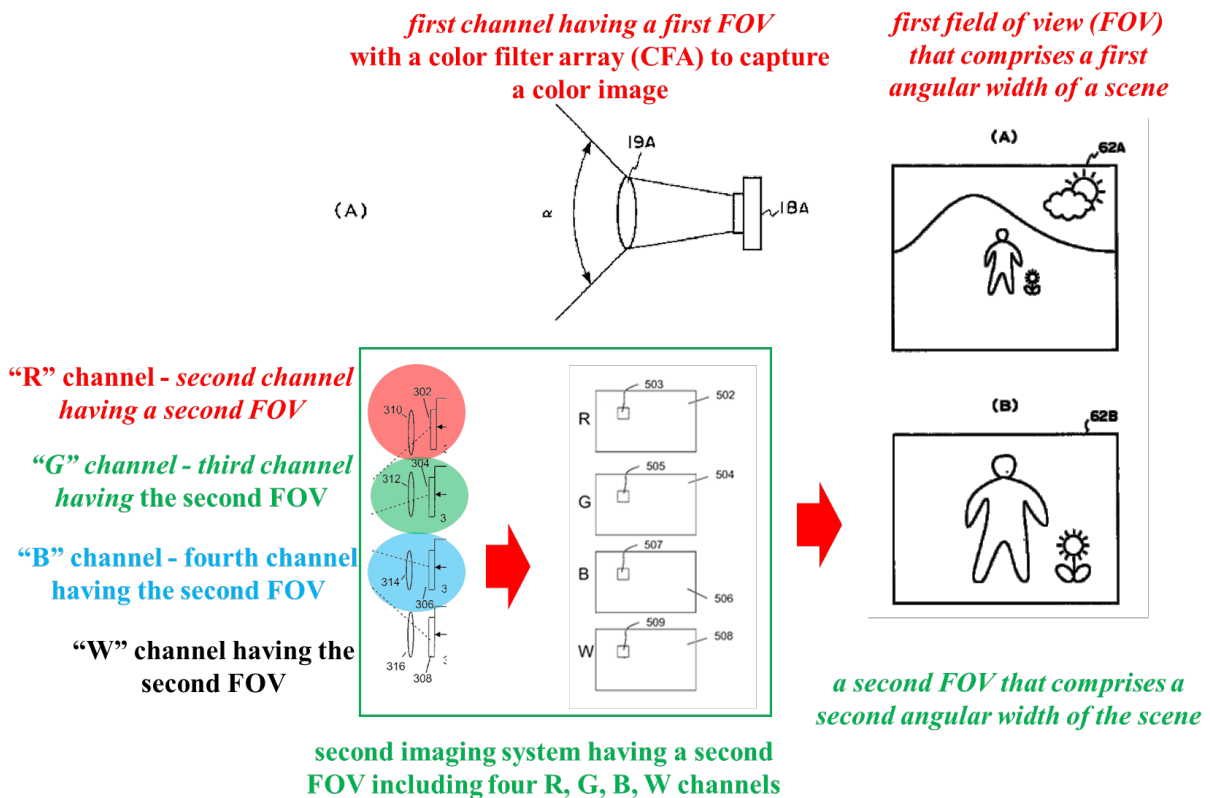
**Fig. 5****Ex.1005, FIG. 5.**

135. A POSITA would have been motivated to modify Matsushima's digital camera with Yu's teaching of an imaging system using four image sensors (e.g., sensitive to R, G, B, and B/W respectively), for the obvious and predictable benefits of (1) providing an enhanced color image with "increase[d] overall dynamic range," (Ex.1005, 9:19-27), and (2) using reduced sizes of image sensors and lenses for achieving the same resolution, as taught by Yu. Ex.1005, 2:50-65.

136. Matsushima-Yu would have been a combination of prior art elements (Matsushima's digital camera including multiple imaging systems, with an imaging system including four channels sensitive to R, G, B, and B/W, respectively, as taught by Yu) according to known methods (controlling the exposure time of the corresponding electronic shutter of each image sensor) to yield the predictable result of a digital camera including multiple imaging systems, where at least one of its multiple imaging systems is implemented using Yu's four-

channel imaging system.

137. A POSITA would have had a reasonable expectation of success in combining Matsushima and Yu, because Matsushima-Yu would have involved routine knowledge within the skill of a POSITA by combining Yu's known technique to improve Matsushima's similar device in the same way, using the prior art elements according to their established functions. An example (Example 1.1) of Matsushima's digital camera modified with a four-sensor imaging system, as taught by Yu, is illustrated below:



Example 1.1 of Matsushima-Yu.

138. As shown in Example 1.1, it would have been obvious to implement

the second imaging system 12B using Yu's imaging system having four identical channels each configured with the same first FOV, to provide color image 62B. It was well-known in multispectral (e.g., R, G, B, W) imaging system like Yu to implement each of the R, G, B, W channels with the same field of view, with the benefit of easy registration. Ex.1041, 2:12-16. While Example 1.1 illustrates that the second imaging system 12B of Matsushima-Yu is modified to implement Yu's teaching of a four-sensor system to provide color image 62B, with the first imaging system 12A using a color sensor (with a color filter array (CFA) e.g., having a "well-known Bayer color filter patten" Ex.1014, 2:14-15; Ex1010, 12:21-24; 20:66-6) to capture color image 62A, to achieve a combined output image with a more enhanced subject in the center, a POSITA would have configured Matsushima-Yu with other configurations, e.g., implementing the first imaging system 12A, or both the first and second imaging systems 12A and 12B, using Yu's four-channel imaging system, to achieve a combined output image with more enhanced background, or both enhanced background and subject in the center.

139. Accordingly, Matsushima-Yu renders obvious *configuring a third optics component* (a lens in the "G" channel of the second imaging system) *relative to a third image sensor* (a sensor in the "G" channel) *to form a third channel* (the "G" channel) *having a third FOV* (the same as the second FOV of the "R" channel corresponding to *the second channel having the second FOV*), *wherein the third*

FOV is different from one or more of the first FOV and the second FOV (e.g., narrower than the first FOV). Ex.1007, [0001], [0003]; Ex.1005, 11:15-21.

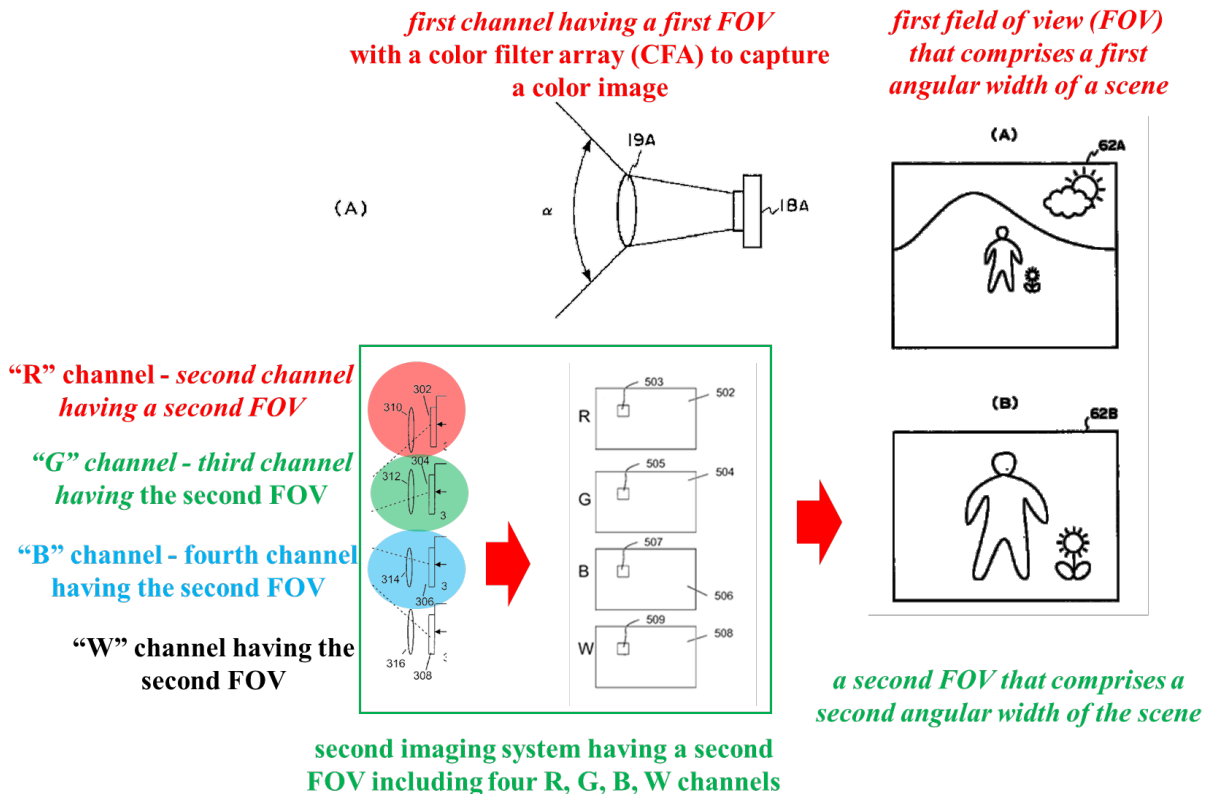
140. Thus, Matsushima-Yu renders obvious [28.0].

e) Claim 30

[30.0] *The method of claim 28, comprising configuring a fourth optics component relative to a fourth image sensor to form a fourth channel having a fourth FOV, wherein the fourth FOV is different from one or more of the first FOV, the second FOV and the third FOV.*

141. Matsushima-Yu renders obvious [30.0] for the reasons discussed at Ground 1:[28.0].

142. Specifically, as shown in Example 1.1 of Matsushima-Yu below, Matsushima-Yu renders obvious *configuring a fourth optics component (a lens in the “B” channel of the second imaging system) relative to a fourth image sensor (a sensor in the “B” channel) to form a fourth channel (the “B” channel) having a fourth FOV (the same as the second FOV of the “R” channel corresponding to the second channel having the second FOV), wherein the fourth FOV is different from one or more of the first FOV, the second FOV and the third FOV (e.g., narrower than the first FOV). Ex.1007, [0001], [0003]; Ex.1005, 11:15-21.*



143. Thus, Matsushima-Yu renders [30.0] obvious.

f) Claim 32

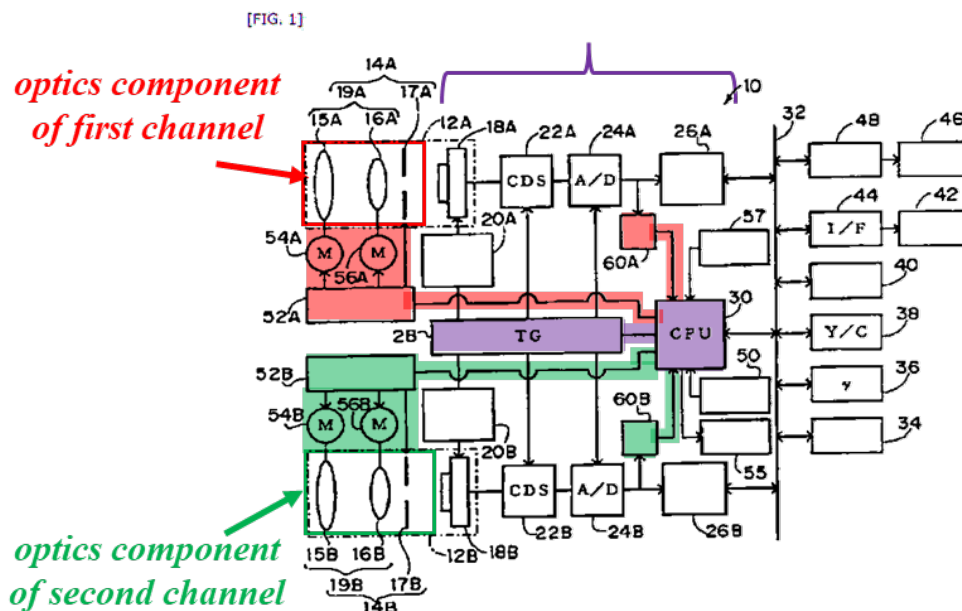
[32.0] *The method of claim 22, comprising separately and simultaneously controlling a parameter of one or more of the first and the second optics components.*

144. Matsushima discloses or renders obvious [32.0].

145. As shown in FIG. 1 below, Matsushima’s CPU 30 is configured to perform *separately and simultaneously* (lens focusing is performed simultaneously when the release button is “half-pressed,” and lens aperture values are adjusted simultaneously when the release button when the release button is “fully press”)

controlling a parameter (lens focusing positions or lens aperture values) of one or more of the first and second optics components (e.g., focusing position of focusing lens 16A or lens aperture value of aperture 17A in optics 14A, focusing position of focusing lens 16B or lens aperture value of aperture 17B in optics 14B). Ex.1007, [0033]-[0034].

separately and simultaneously controlling a parameter of the optics component



Ex.1007, FIG. 1, annotated.

146. As shown in FIG. 1 above, the controlling is performed by using the circuits annotated in red to separately and simultaneously control the first optics 14A, and by using the circuits annotated in green to separately and simultaneously the second optics 14B. See e.g., Ex.1007, [0022], [0023], [0024], [0029], [0031]-[0034] describing separately and simultaneously control including controlling **lens**

focusing positions in autofocus (AF) operations and **lens aperture values** in automatic exposure adjustments (AE) of optics 14A and 14B; Ex.1007, [0033] (describing automatic focus control where “the motors 56A and 56B are driven via the drive circuits 52A and 52B to move the focus lenses 16A and 16B”); [0034] (describing automatic exposure control where the “apertures 17A and 17B are driven via the drive circuits 52A and 52B” to control exposure).

147. Thus, Matsushima discloses or renders obvious [33.0].

g) Claim 33

[33.0] *The method of claim 22, wherein configuring the first optics component includes configuring the first optics component differently than the second optics component.*

148. Matsushima discloses or renders obvious [33.0].

149. Specifically, Matsushima discloses that configuring the first optics component (setting the imaging optics 14A including lens group 19A with a first focal length) differently than the second optics component (the imaging optics 14B including lens group 19B with a second focal length, where the first focal length is shorter than the second focal length). Ex.1007, [0017]; [0020].

150. Thus, Matsushima discloses or renders obvious [33.0].

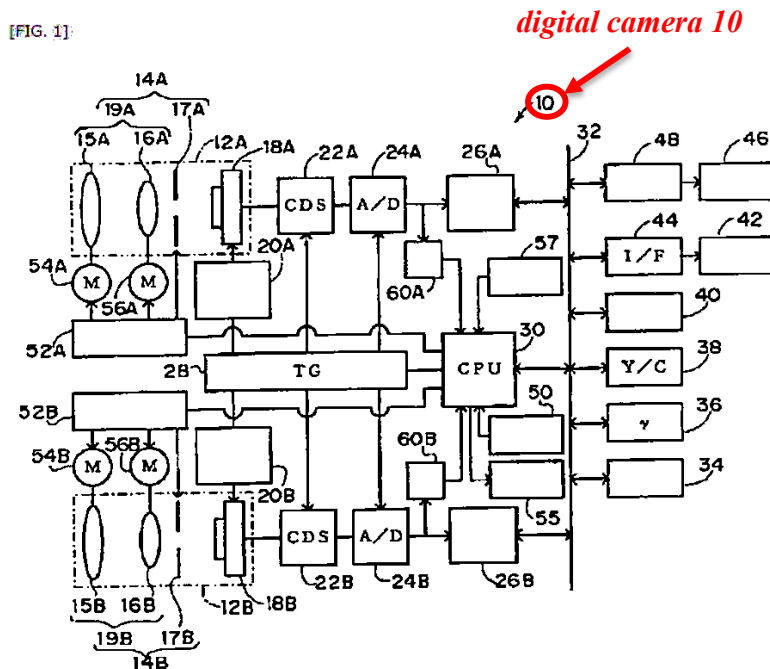
h) Claim 1

[1.0] *A digital camera comprising:*

151. To the extent the preamble is limiting, Matsushima discloses or

renders it obvious.

152. In FIG. 1 below, Matsushima discloses “a digital camera equipped with multiple imaging systems.” Ex.1007, [0001]; *see also id.*, FIG. 1, [0017] (“[D]igital camera 10 has two independent imaging systems (a first imaging system 12A and a second imaging system 12B), and subject images are formed on the light-receiving surfaces of CCD [charge-coupled device] 18A and 18B via imaging optics 14A and 14B, respectively.”).



Ex.1007, FIG. 1, annotated.

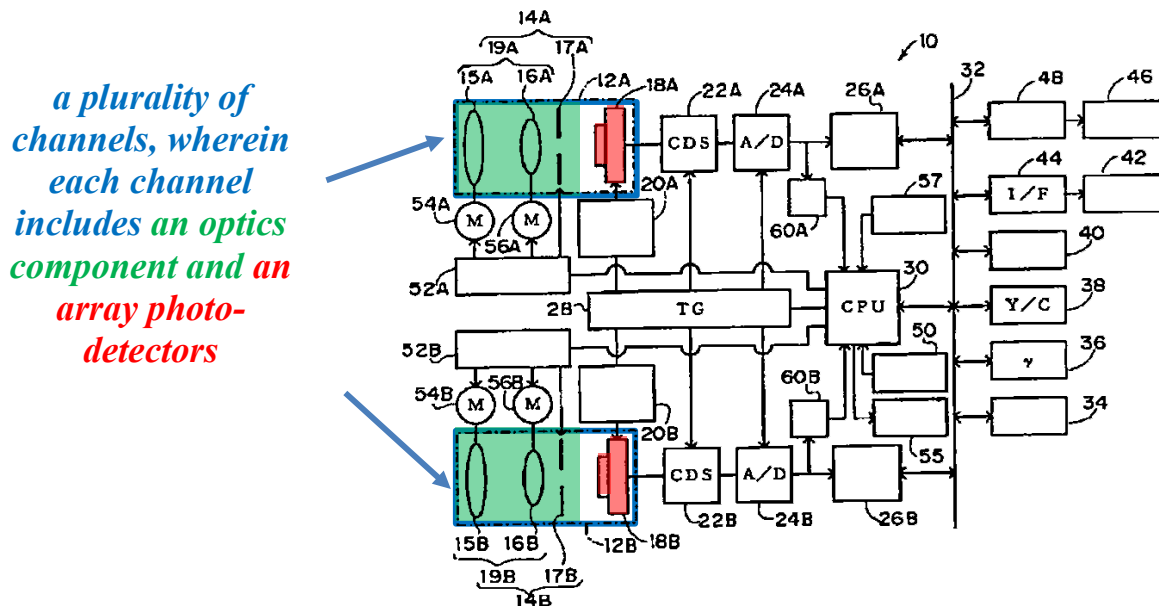
153. Thus, Matsushima discloses or renders obvious *a digital camera* (digital camera 10).

[1.1.1] a plurality of channels, wherein each channel includes an optics component and an array of photo-detectors integrated on a semiconductor substrate,

154. Matsushima discloses or renders obvious [1.1.1].

155. As discussed at Ground 1:[22.1]-[22.2], Matsushima discloses a plurality channels (two channels 12A, 12B), where each channel includes an optics component and an array of photo-detectors integrated on a semiconductor substrate (imaging system 12A including imaging optics 14A including lens group 19A and a first array of pixels of a first image sensor 18A, and imaging system 12B including imaging optics 14B including lens group 19B and a second array of pixels of a second image sensor 18B). Ex.1007, [Claim 1], [0017], [0019].

[FIG. 1]:



Ex.1007, FIG. 1, annotated.

156. Matsushima describes that each of the sensors 18A and 18B includes

“pixels,” which is *an array of photo-detectors*. Ex.1007, [0002], [0009], [0021], [Claim 1]. It was well-known that pixels are an array of *photo-detectors integrated on a semiconductor substrate*. Ex.1009, 4 (“A CCD is composed of pixels, or picture elements, which are arranged in an X-Y matrix consisting of rows and columns. Each pixel, in turn, is composed of a photodiode and an adjacent charge holding region, which is shielded from light. The photodiode converts light (photons) into charge (electrons)”).

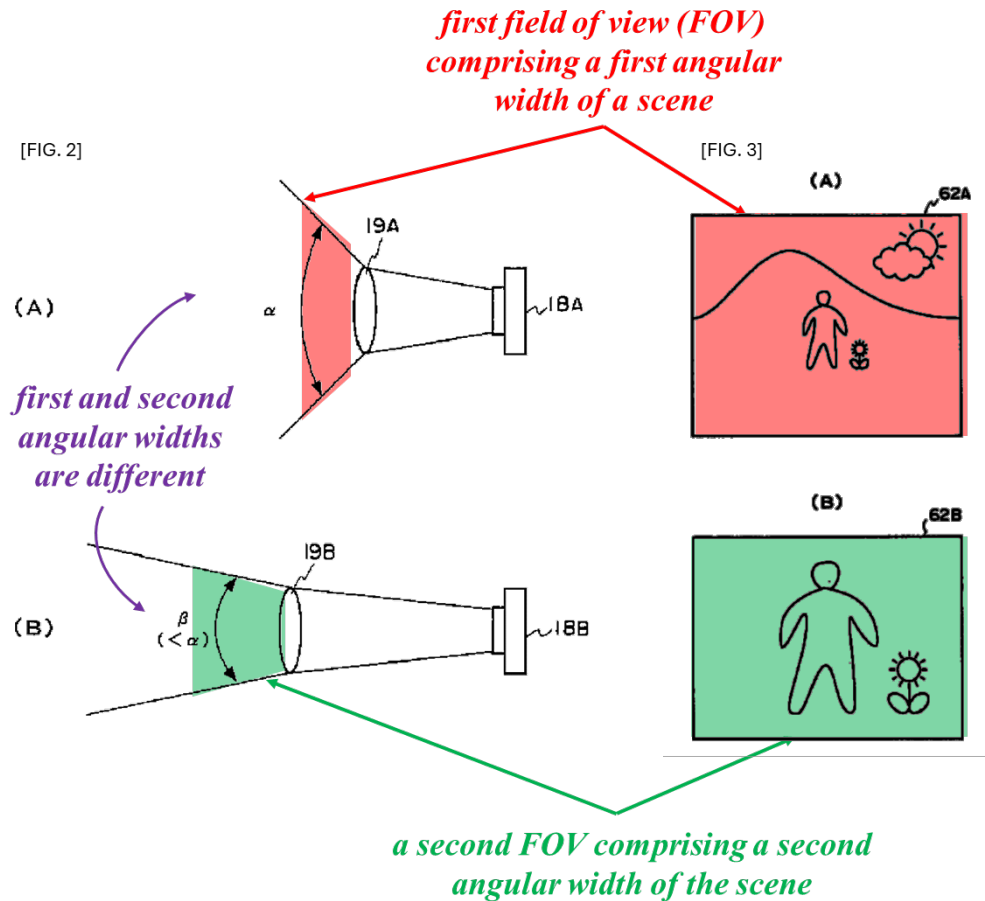
157. This is consistent with the '180 patent's description of photodetectors as pixels. Ex.1001, 22:23-25 (“‘Photo-detector’ and ‘pixels’ mean an electronic device that senses and captures photons and converts them to electronic signals.”). Thus, Matsushima discloses or renders obvious [1.1.1].

[1.1.2] *the plurality of channels including a first channel having a first field of view (FOV) comprising a first angular width of a scene imaged by the camera and a second channel having a second FOV comprising a second angular width of the scene imaged by the camera, wherein the first and second angular widths are different;*

158. Matsushima discloses or renders obvious [1.1.2].

159. As discussed at Ground 1:[22.1]-[22.2] and illustrated in FIGS. 2-3 below, Matsushima describes *a first channel* (first imaging system 12A) *having a first field of view (FOV) comprising a first angular width* (shooting angle α) *of a scene* (e.g., scene of FIG. 3) *imaged by the camera* (digital camera 10). Ex.1007, [0020]. Matsushima further describes *a second channel* (second imaging system

12B) having a second field of view (FOV) comprising a second angular width (shooting angle β) of the scene (e.g., scene of FIG. 3) imaged by the camera (digital camera 10). Ex.1007, [Claim 1], [0007], [0020], [0021]; [0072].



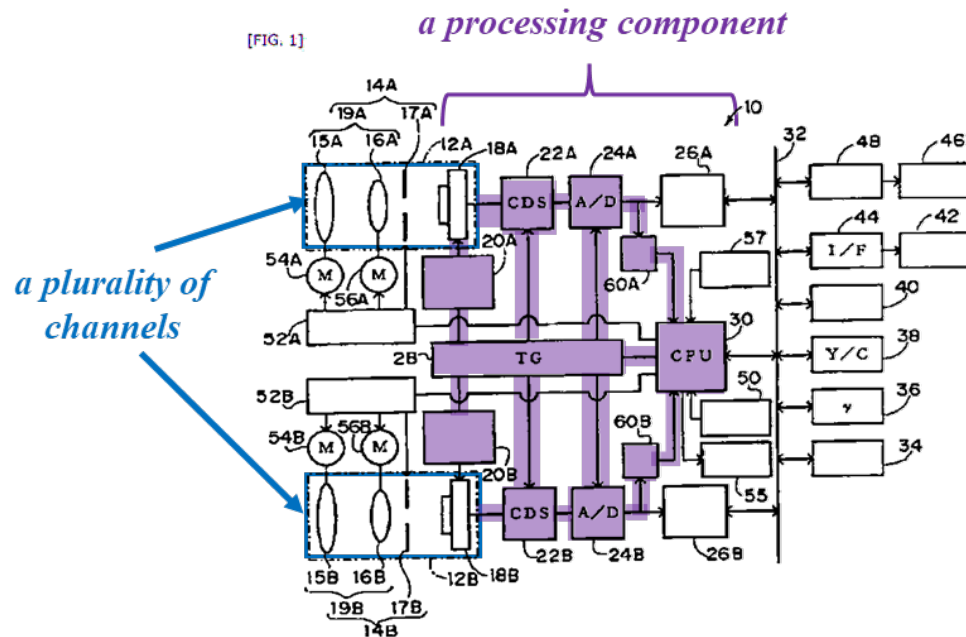
Ex.1007, FIGS. 2 and 3, annotated.

160. As discussed at Ground 1:[22.2], Matsushima discloses that *the first* (shooting angle α) *and second* (shooting angle β) *angular widths are different* (shooting angle α is wider than the shooting angle β). Ex.1007, [0020]. Thus, Matsushima discloses or renders obvious [1.1.2].

[1.2.1] a processing component coupled to the plurality of channels,

161. Matsushima discloses or renders obvious [1.2.1].

162. In FIG. 1 below, Matsushima discloses a processing component (CPU 30 together with integration circuits 60A and 60B, Timing Generator (TG) 28, CCD drive circuits 20A and 20B, CDS circuits 22A and 22B, and A/D converters 24A and 24B) *coupled to the plurality of channels* (with control signals to control imaging systems 12A and 12B). Ex.1007, [0027], [0034], [0035], [0036].



Ex.1007, FIG. 1, annotated.

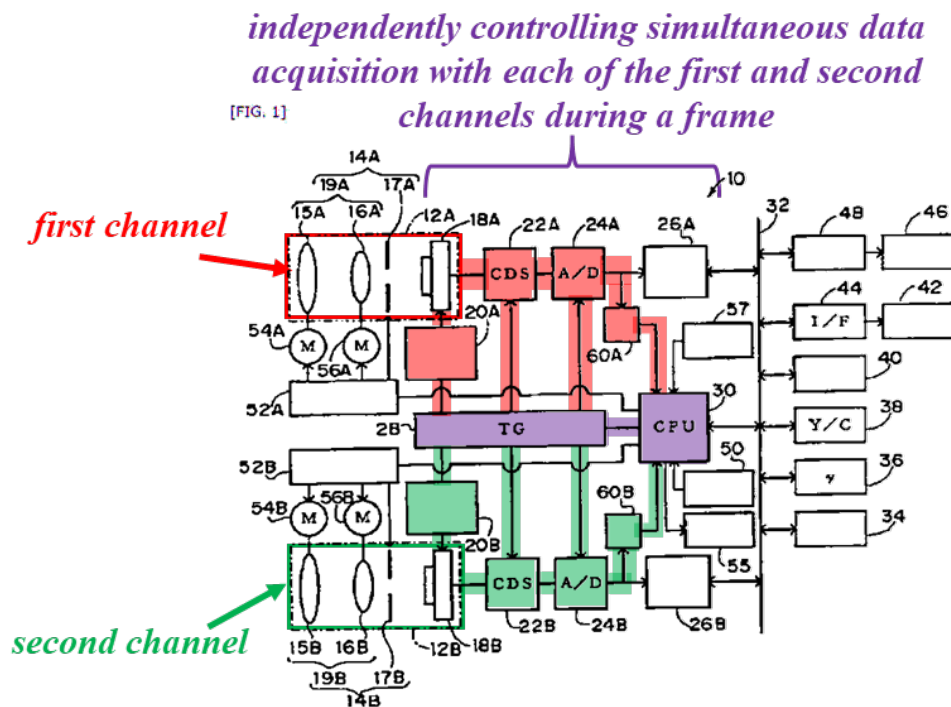
163. Thus, Matsushima discloses or renders obvious [1.2.1].

[1.2.2] the processing component configured to independently control simultaneous data acquisition with each of the plurality of channels,

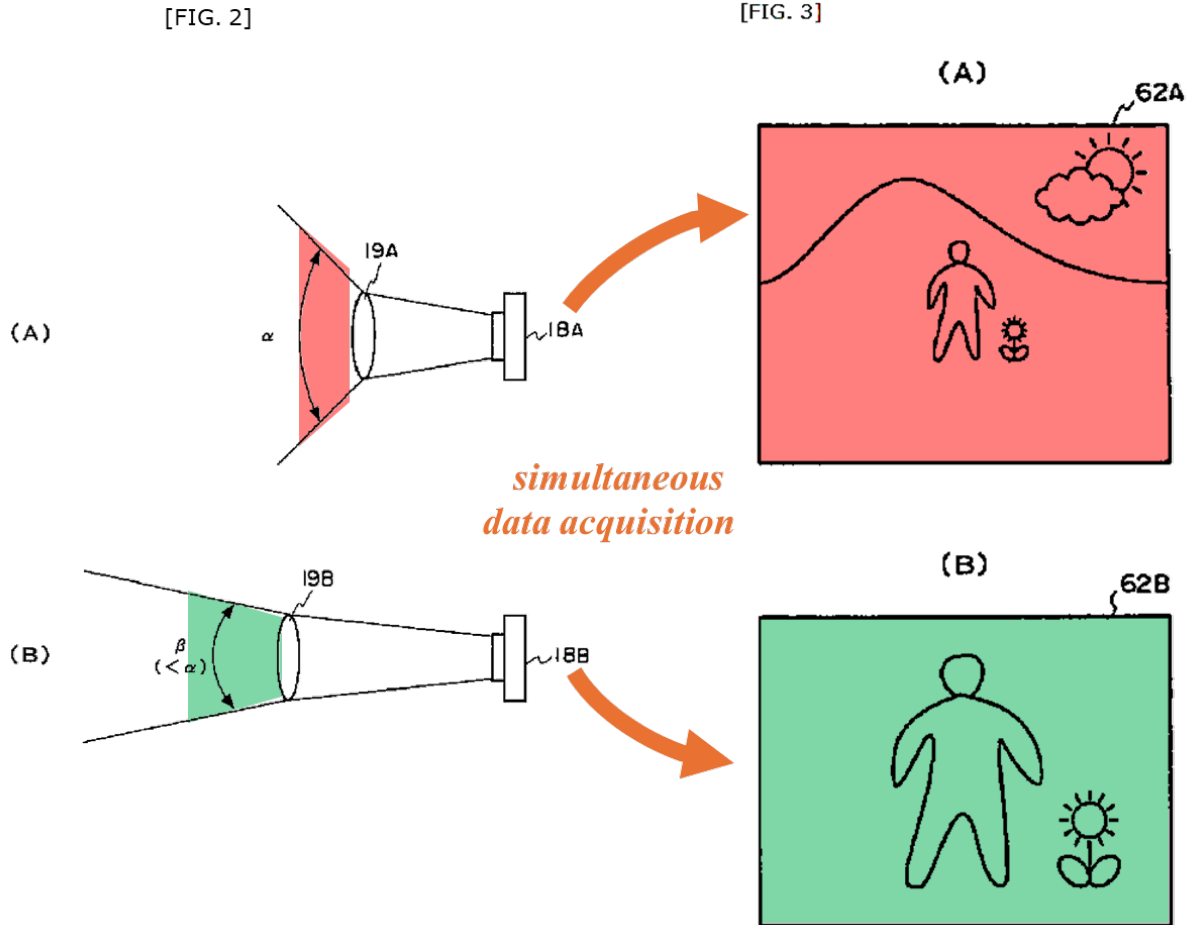
164. Matsushima alone discloses or renders obvious [1.2.1]. Alternatively, Matsushima-Yu renders obvious [1.2.1].

i. Matsushima alone discloses or renders obvious this limitation.

165. First, as discussed above at Ground 1:[22.3].i and as shown in FIGS. 1-3 below, Matsushima discloses that the *processing component* (CPU 30 together with integration circuits 60A and 60B, Timing Generator (TG) 28, CCD drive circuits 20A and 20B, CDS circuits 22A and 22B, and A/D converters 24A and 24B) is configured to *independently control* (independent control of exposure) *simultaneous data acquisition with each of the plurality of channels* (simultaneous acquisition of data of an image frame 62A and data of an image frame 62B “when the release button is ‘fully press[ed]’”). Ex.1007, [0027], [0034], [0035], [0036].



Ex.1007, FIG. 1, annotated.



Ex.1007, FIGS. 2 and 3, annotated.

166. Thus, Matsushima alone renders obvious [1.2.2].

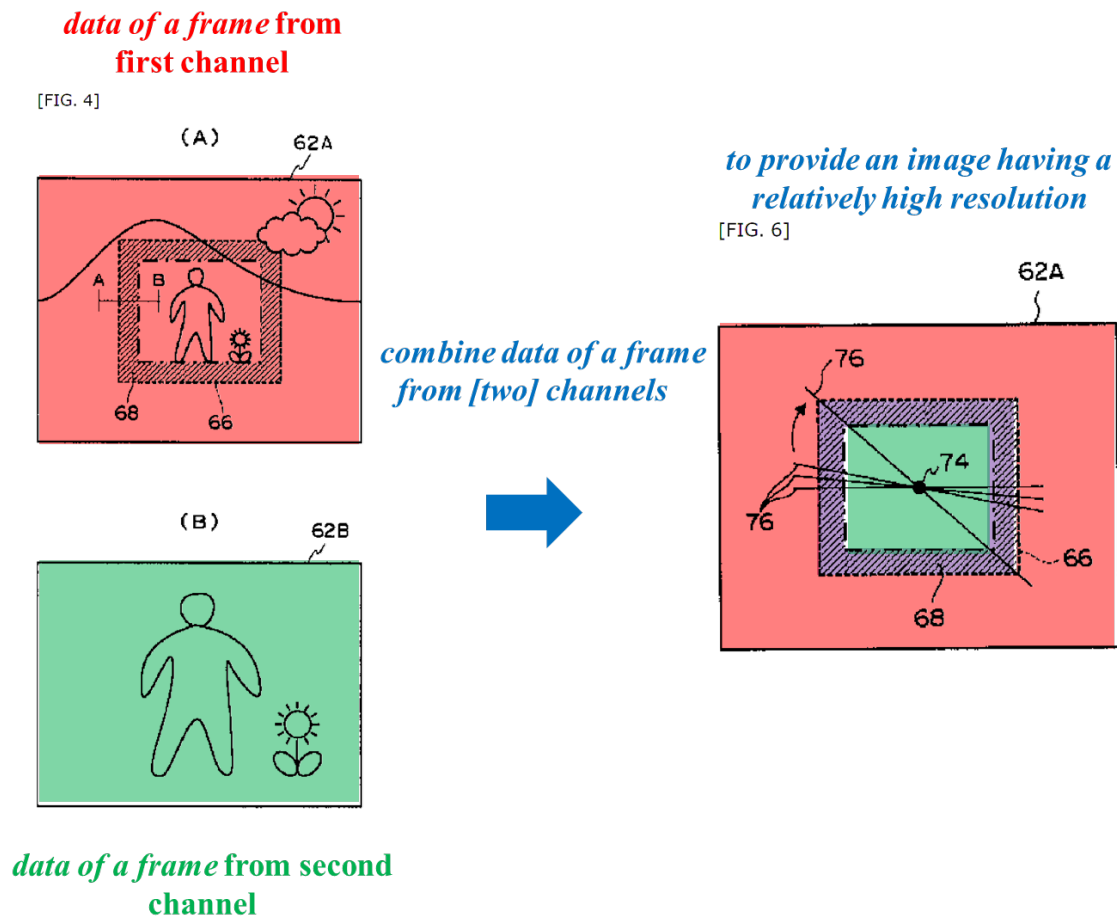
ii. Matsushima-Yu renders obvious this limitation.

167. To the extent Patent Owner argues that Matsushima does not explicitly disclose [1.2.2], Matsushima-Yu renders obvious this limitation for the reasons discussed at Ground 1:[22.3].ii.

[1.2.3] *the processing component configured to combine data of a frame from at least one of the plurality of channels to provide an image having a relatively high resolution.*

168. Matsushima discloses or renders obvious [1.2.3].

169. As discussed at Ground 1:[22.4] and as illustrated in FIGS. 4 and 6 below, Matsushima describes *the processing component* (CPU 30 together with integration circuits 60A and 60B, Timing Generator (TG) 28, CCD drive circuits 20A and 20B, CDS circuits 22A and 22B, and A/D converters 24A and 24B) *is configured to combine* (synthesis processing) *data of a frame* (data of an image frame 62A and data of an image frame 62B) *from at least one of the plurality of channels* (first and second imaging systems 12A and 12B) *to provide an image having a relatively high resolution* (an image frame of FIG. 6 with improved image quality). Ex.1007, [0007] (“a telephoto captured image is **combined** in the center of a wide-angle captured image”), [0048]-[0051]; V.B (“*data of a frame*” refers to “data of an image frame”).



Ex.1007, FIGS. 4 and 6, annotated.

170. Matsushima's technique provides *an image having a relatively high resolution* because the combined image improves the resolution and image quality in the center of the image. Ex.1007, [0048]-[0049] ("an image with **improved image quality** in the center of the captured image is generated") (explaining that Matsushima's technique uses a "scaled down" image 66 from image 62B thereby providing a relatively high resolution). Ex.1007, [0021] (stating that "CCDs of **the same size, that is, the same number of pixels,**" indicating the image 62B would have a larger number of pixels with a higher resolution compared to the

corresponding region in the center of image 62A).

171. Thus, Matsushima discloses or renders obvious [1.2.3].

i) **Claim 2**

[2.0] *The digital camera of claim 1, wherein the optics component of the first channel has a first focal length, and the array of photo-detectors of the first channel has a first dimension.*

172. Matsushima discloses or renders obvious [2.0].

173. Matsushima discloses *the optics component of the first channel* (imaging optics 14A including lens group 19A) *has a first focal length* (a wide-angle single focal length). Ex.1007, [0017]; [0020] (lens group 19A is “a **wide-angle single focal length lens**”).

174. Furthermore, Matsushima discloses that *the array of photo-detectors of the first channel* (array of pixels of a first image sensor 18A) has a first dimension (the dimension of a first image sensor 18A).

175. Thus, Matsushima discloses or renders obvious [2.0].

j) **Claim 3**

[3.0] *The digital camera of claim 2, wherein the optics component of the second channel has a second focal length that is different from the first focal length, and the array of photo detectors of the second channel has the first dimension.*

176. Matsushima discloses or renders obvious [3.0].

177. Matsushima discloses *the optics component of the second channel* (imaging optics 14B including lens group 19B) *has a second focal length* (“a

telephoto single focal length”) *different from* (longer than) *the first focal length*.

Ex.1007, [0017]; [0020].

178. Furthermore, Matsushima discloses that *the array of photo detectors of the second channel* (array of pixels of a second image sensor 18B) *has the first dimension* (the same dimension as the array of pixels of the first image sensor 18A). Ex.1007, [0021] (“CCDs of **the same size, that is, the same number of pixels.**”). A POSITA would have understood that image sensors having the same size refer to sensors have the **same sensor format** having the same dimensions, e.g., “if the image sensor uses a 1/2" type optical format, it has a focal plane of 6.4mm (width)x4.8mm (height), with a diagonal distance of 8.0 mm.” Ex.1010, 12:4-6.

179. Thus, Matsushima discloses or renders obvious [3.0].

k) Claim 10

[10.0] *The digital camera of claim 1, wherein the processing component is configured to separately and simultaneously control a parameter of the optics component of each channel.*

180. Matsushima discloses or renders obvious [10.0] for the reasons discussed at Ground 1:[32.0].

l) Claim 11

[11.0] *The digital camera of claim 1, wherein the optics component of the first channel includes a different configuration than the optics component of the second channel.*

181. Matsushima discloses or renders obvious [11.0] for reasons discussed at Ground 1:[33.0].

m) Claim 12

[12.0] *The digital camera of claim 1, wherein the optics component includes at least one lens.*

182. Matsushima discloses or renders obvious [12.0].

183. Matsushima discloses that *the optics component includes at least one lens* (“an imaging lens 15A or a focus lens 16A” for the first channel, and “an imaging lens 15B or a focus lens 16B” for the second channel). Ex.1007, [0019].

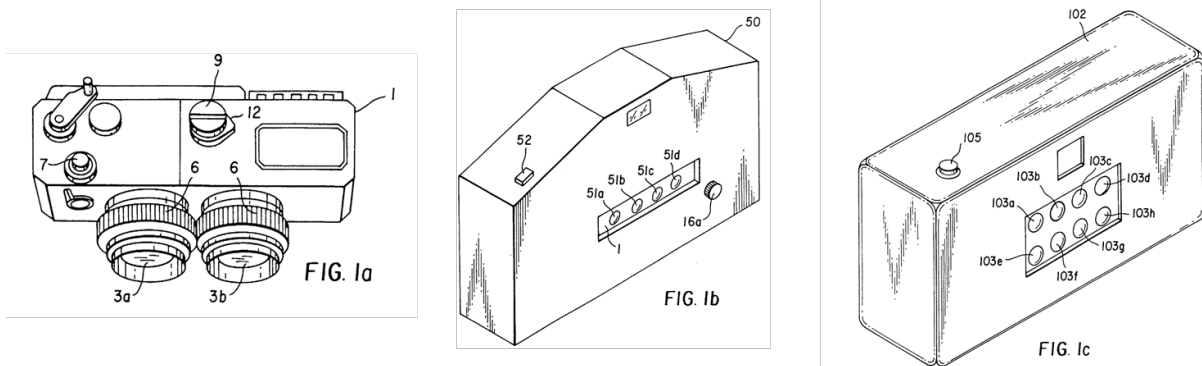
B. Ground 2: Claims 28 and 30 would have been obvious over Matsushima, Yu, and Weldy.

1. Overview of Weldy

184. Weldy discloses a “method of producing a digital image with improved performance characteristics,” including capturing and combining “**at least two** electronic images of a scene” to “produce a combined digital image of a scene with improved performance characteristics.” Ex.1014, 1 (57).

185. As shown in FIGS. 1a, 1b, and 1c below, Weldy discloses digital cameras with more than two channels for producing “at least two electronic

images” for producing the combined image. Ex.1014, 3:1-5 (“the use of the term dual lens camera, [] mean[s] that there are **at least two** separate images formed with **their own unique, non-optically linked lens systems...it will be evident...that greater than two images could be captured and combined...to** provide digital images with improved performance characteristics”), FIGS. 1b (illustrating a four-channel camera) and 1c (illustrating an eight-channel camera), 5 (describing a three-channel camera).



Ex.1014, FIG. 1a-1c.

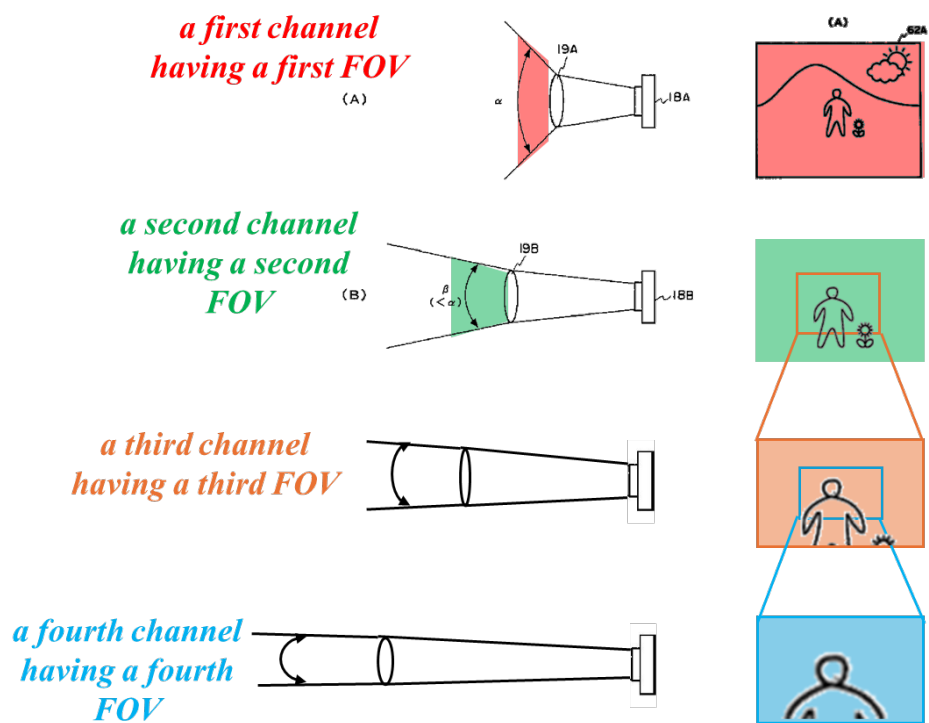
2. Reasons to Combine Matsushima, Yu, and Weldy

186. Weldy is analogous art to the '180 patent because it pertains to the same field of endeavor, namely, “[d]igital camera systems and methods.” Ex.1001, Abstract; Ex.1014, Title (“Method of producing digital images with improved performance characteristic”). Further, Weldy is pertinent to a particular problem addressed by the '180 patent, namely, configuring a digital camera to have multiple lenses with multiple sensors respectively and combining the images from the multiple channels. Ex.1001, FIG. 5; Ex.1014, FIG. 3, 2:49-50 (“improved

characteristics can be obtained by capturing so the at least two electronic images through a corresponding number of separate lenses (each pointing at the scene)").

187. A POSITA would have been motivated to apply, in Matsushima-Yu's digital camera (*see* Ground 1: [22.3].ii), Weldy's teaching of combining images from more than two channels for the benefits of (1) "improved performance characteristics" including e.g., "improved sharpness (spatial detail) and reduced noise," "more scene objects are sharper than in any of the input images," improved image quality "in cases of low scene illumination or when very short exposure times are required, e.g., for capturing fast moving action without image blur," (Ex.1014, 5:5-6, 23-25, 40-41); and (2) flexible design options of using different channel configurations, as taught in Weldy. Ex.1014, 1, 5:5-6 (describing a design option using "electronic sensors of different spatial resolutions"), 5:42-56 (describing using color sensors with color filter arrays (CFA), monochrome sensors (no color filter), or "single" color sensors (with a color filter allowing a single color)), 6:2-5 (describing a design option of using "a combination of high-resolution monochrome sensor and lower-resolution color sensors"), 6:13-15 (describing another design option of using "three or more non-optically linked lens systems and three or more electronic sensors, wherein each of the multiple lenses is spectrally filtered to one of at least three color types," e.g., "red, green and blue").

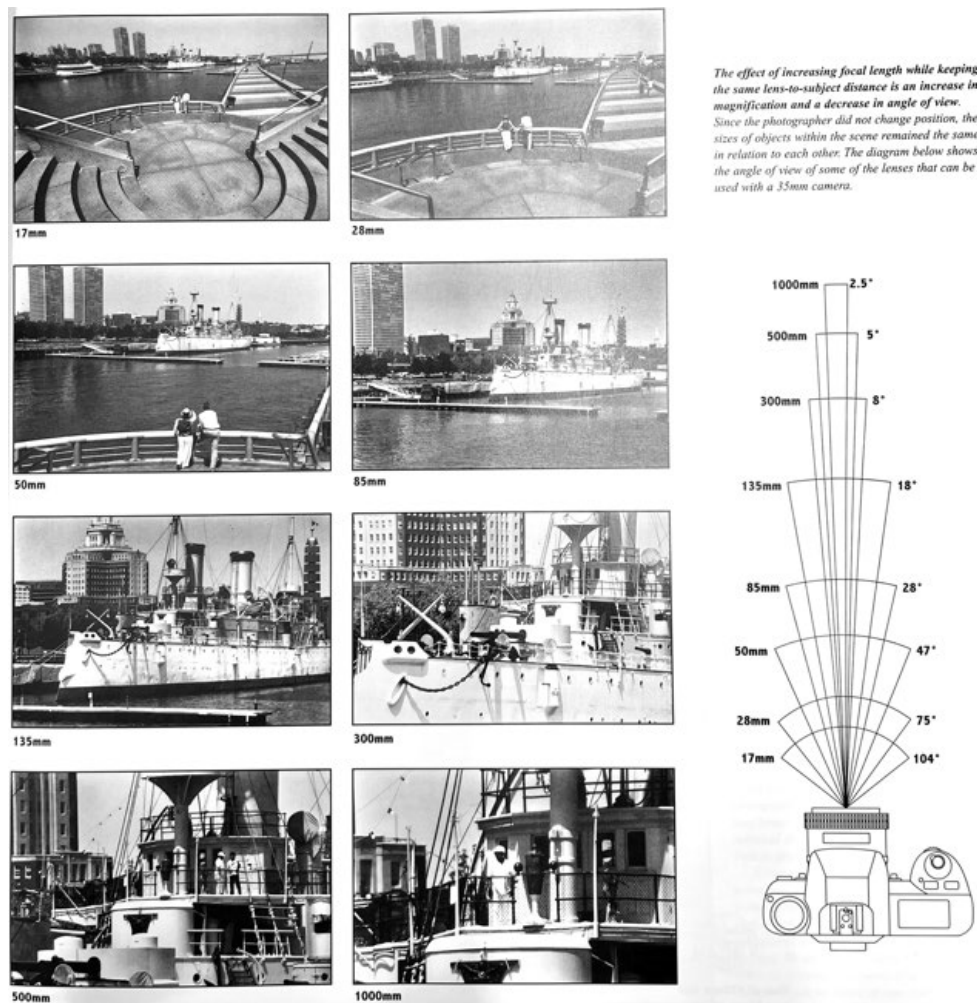
188. As shown in the following example (Example 2.1) of Matsushima-Yu-Weldy, a POSITA would have been motivated to modify the multi-imaging-system digital camera of Matsushima-Yu to implement Weldy's design option of using four independent channels each with a color sensor with a color filter array (CFA) (e.g., having a "well-known Bayer color filter patten") to capture color images. Ex.1014, 2:14-15; Ex1010, 12:21-24; 20:66-6. Below I provide Example 2.1 of Matsushima-Yu-Weldy, which includes four independent imaging systems, each with a color sensor:



Example 2.1: Matsushima-Yu-Weldy.

189. In this Example 2.1 of the combination, it would have been obvious to implement the four independent channels to have different FOVs for the benefits

of providing a combined image having (1) a wider scene coverage; (2) a more detailed subject in the center; and (3) improved performance characteristics, as taught by Weldy. Ex.1014, 1; Ex.1032, 43 (illustrating the well-known knowledge that a wider background scene is achieved using a wider FOV, and a more detailed subject view is achieved using a narrower FOV).



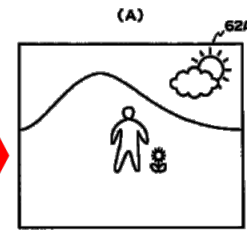
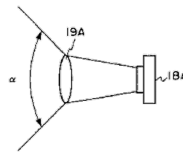
Ex.1032, 43.

190. I have provided another example (Example 2.2) of Matsushima-Yu-Weldy below. A POSITA would have been motivated to modify one or both of the

first and second channels of Matsushima-Yu's multi-imaging-system digital camera, by implementing that channel(s) (e.g., the second channel as shown in Example 2.2) to implement Weldy's alternative design option of "utilizing a high-resolution (small capture site) monochrome (no color filter) image sensor, in conjunction with either a single lower-resolution sensor with a color filter array attached and larger pixels, or a set of lower resolution (larger pixels) color arrays, each sensitive to bands of wavelengths corresponding to a 'single' color," e.g., "red, green and blue," for the benefit of improved performance characteristics when "the camera is operating at the limits of light sensitivity." Ex.1014, 6:2-5, 6:13-15.

a first channel having a first FOV with a color filter array (CFA) to capture a color image

(A)



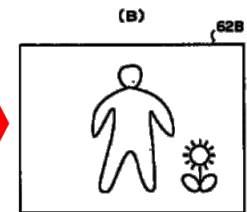
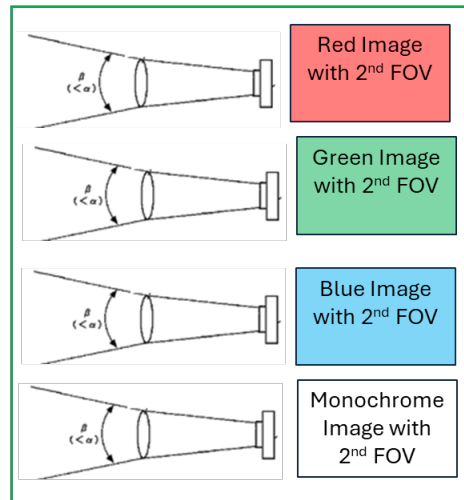
a second channel having a second FOV with a "red" filter

a third channel having a second FOV with a "green" filter

a fourth channel having a second FOV with a "blue" filter

a fifth channel having a second FOV with monochrome (no color filter) image sensor

second imaging system having a second FOV



Example 2.2: Matsushima-Yu-Weldy.

191. A POSITA would have had a reasonable expectation of success in combining Matsushima-Yu and Weldy, because the digital cameras use similar technology of generating multiple images formed with their own unique, non-optically linked lens systems and sensors. Further, modifying Matsushima-Yu to provide more than two imaging systems and combining the more than two images from the imaging systems as taught by Weldy, would improve a similar device (Matsushima's multi-sensor multi-lens digital camera) in the same way (providing more images of different characteristics for combination, thereby generating an improved image with improved characteristics).

3. Analysis

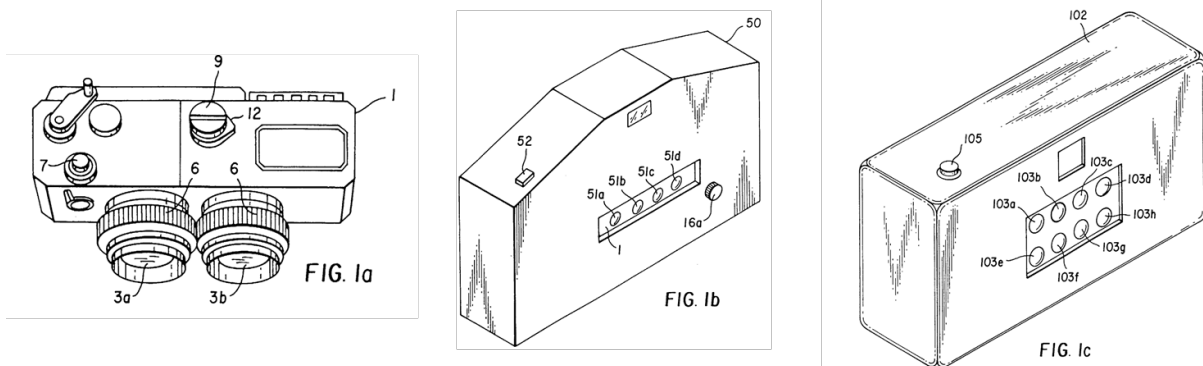
a) Claim 28

[28.0] *The method of claim 22, comprising configuring a third optics component relative to a third image sensor to form a third channel having a third FOV, wherein the third FOV is different from one or more of the first FOV and the second FOV.*

192. Matsushima-Yu-Weldy renders obvious [28.0].

193. First, Matsushima describes “a digital camera equipped with **multiple imaging systems.**” Ex.1007, [0001], [0003].

194. Second, as shown in FIGs. 1(a)-1(c) below, Weldy discloses a digital camera with two or more channels. Ex.1014, 3:1-5 (“**greater than two images** could be captured and combined...to provide digital images with improved performance characteristics”), 5-6 (describing a three-channel camera).



Ex.1014, FIGS. 1a-1c.

195. A POSITA would have been motivated to apply, in Matsushima-Yu’s digital camera, Weldy’s teaching of combining images from **more than two** (e.g., three, four, five, etc.) channels, because doing so would provide the benefits of

providing a combined image having the benefits of (1) improved performance characteristics; including “improved sharpness (spatial detail) and reduced noise” and improved image quality with “low scene illumination” or “for capturing fast moving action without image blur” (Ex.1014, 5:5-6, 23-25 40-41); (2) flexible design options of using different channel configurations based on design configurations, as taught in Weldy. Ex.1014, 1, 5:5-6, 6:2-5, 6:13-15. As illustrated in Ex.1032, 43, it was well-known that a wider background scene is achieved using a wider FOV, and a more detailed subject view is achieved using a narrower FOV; *see also* Section VIII.B.2.

196. A POSITA would have been motivated to modify Matsushima in view of Yu and Weldy for the reasons presented above in Section VIII.B.2.

197. Accordingly, Matsushima-Yu-Weldy renders obvious a digital camera with multiple independent imaging systems, which is configured to perform *configuring a third optics component relative to a third image sensor to form a third channel having a third FOV, wherein the third FOV is different from one or more of the first FOV and the second FOV* (e.g., the third FOV is different from **both** the first and second FOVs in Example 2.1, or the third FOV is different from the first FOV (and the same as the second FOV) in Example 2.2). Ex.1007, [0001], [0003].

198. Thus, Matsushima-Yu-Weldy renders obvious [28.0].

b) Claim 30

[30.0] *The method of claim 28, comprising configuring a fourth optics component relative to a fourth image sensor to form a fourth channel having a fourth FOV, wherein the fourth FOV is different from one or more of the first FOV, the second FOV and the third FOV.*

199. Matsushima-Yu-Weldy renders obvious [30.0] for the reasons discussed at Ground 2:[28.0], where Matsushima-Yu-Weldy renders obvious a digital camera with multiple independent imaging systems, which is configured to perform configuring a four optics component relative to a four image sensor to form a four channel having a four FOV, wherein the fourth FOV is different from one or more of the first FOV, the second FOV and the third FOV (e.g., the fourth FOV is different from all of the first, second, and third FOVs in Example 2.1, or the fourth FOV is different from the first FOV and the same as the second and third FOVs in Example 2.2).

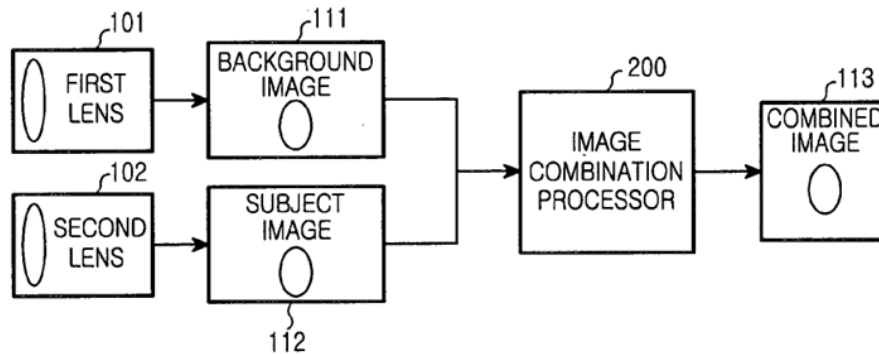
C. Ground 3: Claims 22-23, 28, and 30 would have been obvious over Choi, Labaziewicz, and Yu.

1. Overview of Choi

200. Choi provides an “image photographing device and method for combining images with different focal lengths to an in-focus image.” Ex.1008, Abstract.

201. Referring to FIG. 2 below, Choi’s “image photographing device...is provided with a first lens 101 for capturing an image with a remote background in

focus (hereinafter, referred to as a background image 111), a second lens 102 for capturing the image with a nearby subject in focus (hereinafter, referred to as a subject image 112), and an image combination processor 200 for combining the two images captured at different focal lengths.” Ex.1008, [0047].



Ex.1008, FIG. 2.

202. Choi describes that “[t]here is no time difference between the background and subject images 111 and 112 because they are captured simultaneously through a plurality of fixed lenses.” Ex.1008, [0069].

2. Overview of Labaziewicz

203. Labaziewicz discloses “a digital camera that produces digital image files and...uses multiple lenses and image sensors to provide an extended zoom range.” Ex.1010, 1:7-10.

204. Referring to an example in FIG. 19, Labaziewicz describes a digital camera having three channels, each channel having a fixed focal length lens with a corresponding sensor, with “a first fixed focal length lens with a first sensor, a

second fixed focal length lens with a second sensor, and a third fixed focal length lens with a third sensor.” Ex.1010, FIG. 19, 5:65-67.

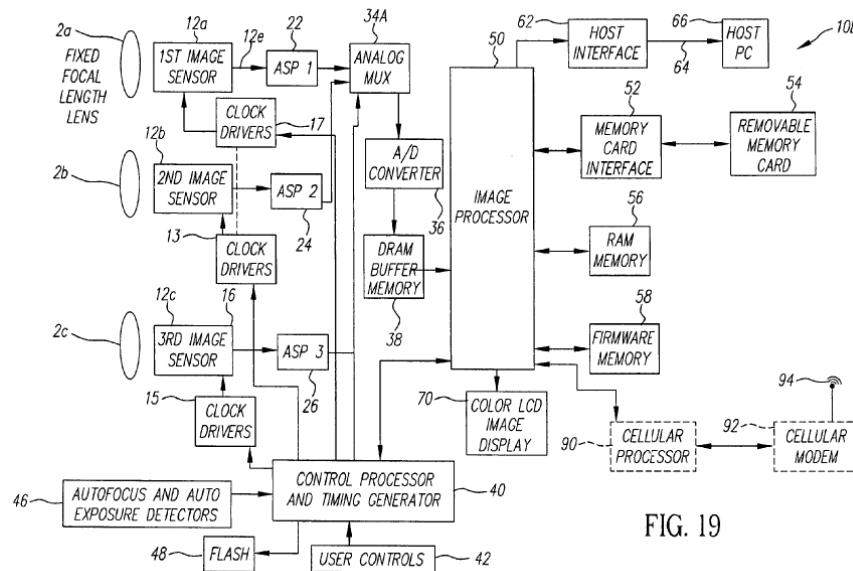


FIG. 19

Ex.1010, FIG. 19.

205. Labaziewicz describes that each channel has a different FOV.

Ex.1010, 6:41-45 (“the multiple lenses and sensors are generally aligned with respect to each other so as to be viewing substantially the same object, albeit **with different fields of view**”). Labaziewicz describes different FOVs measured with different values of “35 mm film equivalent focal length.” Ex.1010, 18:49-55 (“For example, the first focal length lens 2a may have a **focal length of 30 mm equiv. (35 mm equivalent)**, the second fixed focal length 2b lens may have a **focal length of 90 mm equiv.**, and the third fixed focal length lens 2c may have a **focal length of 135 mm equiv.**”); 12:1-9 (describing the calculation of “35 mm film

equivalent focal length” in relation to “an actual focal length” of the lens and “a diagonal distance” of the image sensor).

3. Reasons to Combine Choi, Labaziewicz, and Yu

206. Choi, Labaziewicz, and Yu are each analogous art to the '180 patent because they pertain to the same field of endeavor, namely, “[d]igital camera systems and methods.” Ex.1001, Abstract; Ex.1005, Title (“Digital Cameras using Multiple Sensors with Multiple Lenses”); Ex.1008, Title, Abstract; Ex.1010, Title (“Digital Camera Using Multiple Lenses and Images Sensors to Provide an Extended Zoom Range”).

207. Further, they are each pertinent to a particular problem addressed by the '180 patent. For example, each of Choi, Labaziewicz, and Yu is pertinent to the problem of providing a digital camera by configuring multiple lenses with multiple sensors respectively. Ex.1001, e.g., steps 502 and 504 in FIG. 5; Ex.1005, Title (“Digital Cameras Using Multiple Sensors with Multiple Lenses”); Ex.1008, FIG. 2 (“the image photographing device...is provided with a first lens...and...a second lens.”); Ex.1010, Title (“Digital Camera Using Multiple Lenses and Images Sensors to Provide an Extended Zoom Range”).

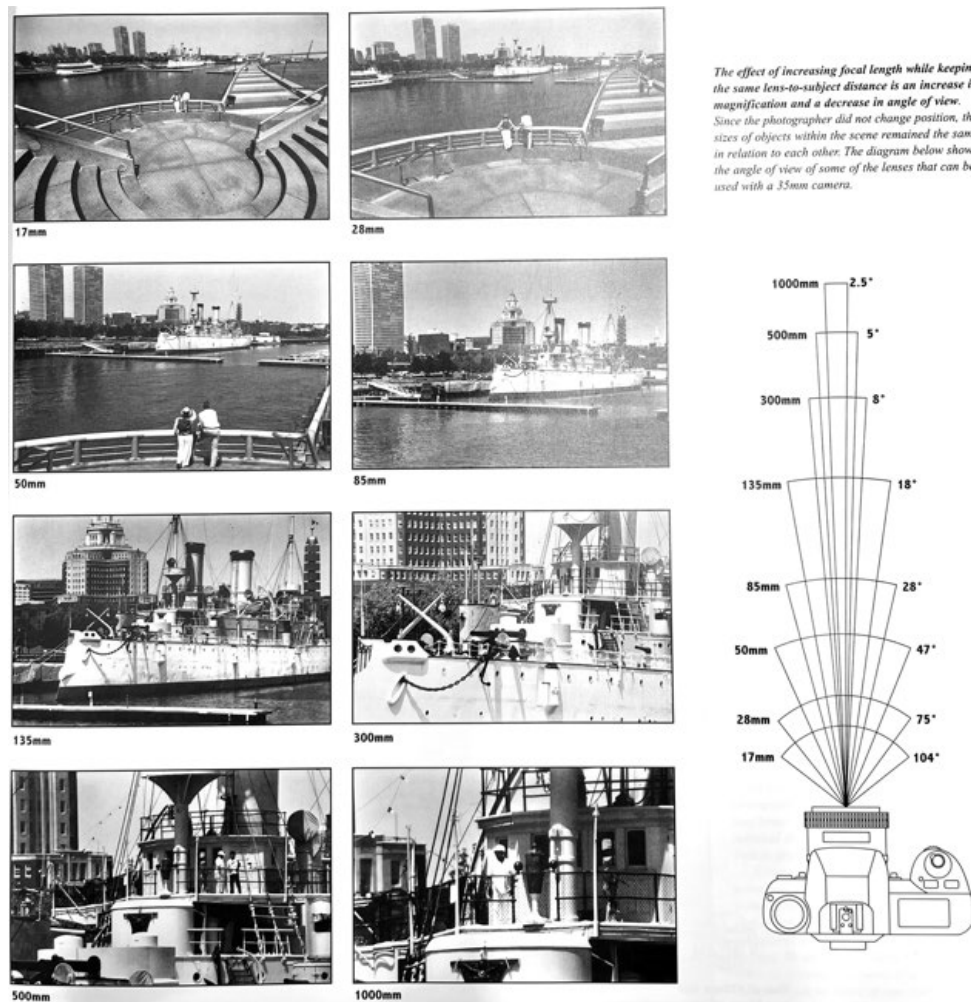
a) Choi combined with Labaziewicz (Choi-Labaziewicz)

208. A POSITA would have been motivated to apply, in Choi’s digital camera, Labaziewicz’s teaching of channels of different FOVs, because doing so

would provide the benefits of providing, in Choi-Labaziewicz, a combined image having (1) a wider scene coverage and (2) more in-focus background portions.

Ex.1032, 43; Ex.1008, [0011].

209. Specifically, a POSITA would have been motivated to implement in Choi the teaching of Labaziewicz, such that the background image has a wider FOV, and the subject image has a narrower FOV, thereby achieving the benefits of a combined image that has a wider coverage of the scene (e.g., more coverage of the background scene). As shown in Ex.1032, 43, it was well-known that a wider background scene is achieved using a wider FOV, and a more detailed subject view is achieved using a narrower FOV; *see also* Ex.1010, 6:41-45 (“the multiple lenses and sensors are generally aligned with respect to each other so as to be viewing substantially the same object, albeit with different fields of view,” where the wider FOV provides a wider background scene).

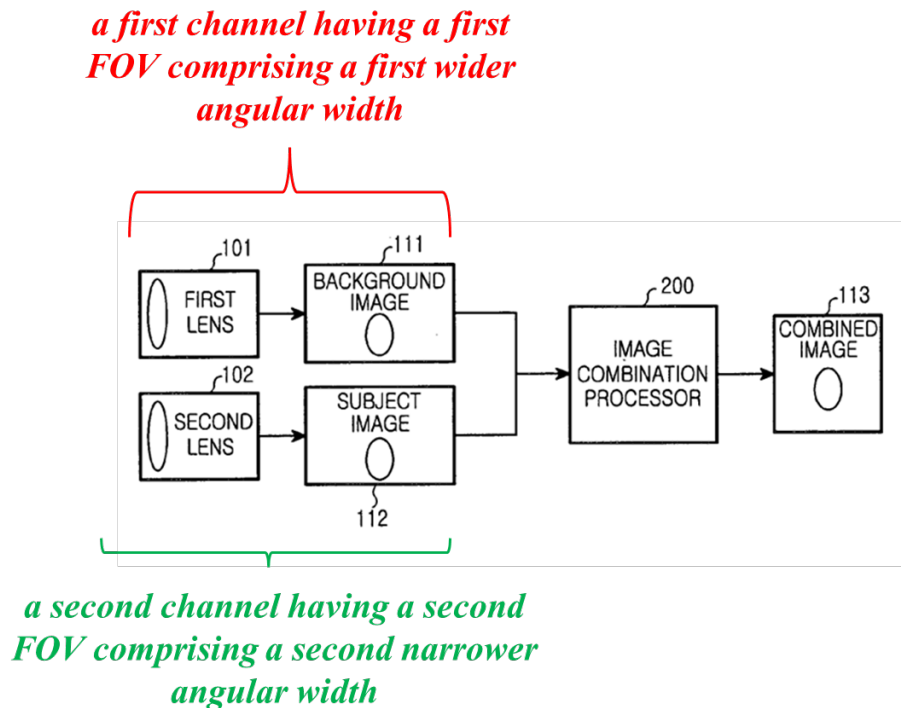


Ex.1032, 43.

210. Furthermore, a POSITA would have been motivated to combine Choi and Labaziewicz because Choi-Labaziewicz provides the benefits of a combined image with more in-focus background portions. A wider FOV provides a deeper depth of field (DOF) than the DOF of a narrower FOV, and therefore, the background image by the channel with the wider FOV would have more in-focus background portions (both inside and outside of the overlapping area with the narrower FOV for the subject image). Ex.1008, [0011] (“as the focal length is

shorter (e.g., wide-angle lens), the DOF is deep”). In other words, a wider FOV has a deeper DOF thereby providing an image with more background areas in focus.

Below I provide an example (Example 3.1) of Choi- Labaziewicz:



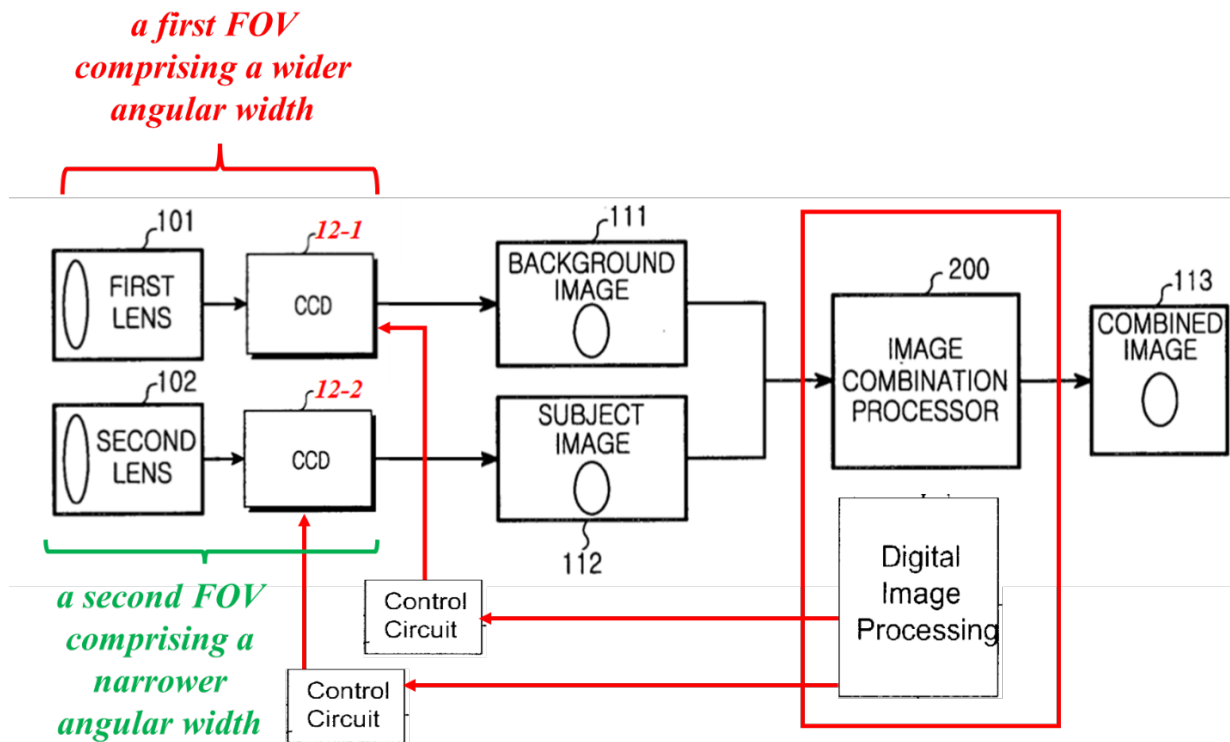
Example 3.1 of Choi-Labaziewicz.

211. In addition, a POSITA would have been motivated to implement in Choi the different FOVs as taught by Labaziewicz, because providing Choi’s with different FOVs is one of the two alternative predictable solutions for implementing the channels: (1) providing the channels of Choi with different FOVs, such that the background image and subject image have different FOVs (e.g., Example 3.1 of Choi-Labaziewicz); or (2) providing the channels of Choi with the same FOVs, such that the background image and subject image have the same FOVs.

b) Choi-Labaziewicz combined with Yu (Choi-Labaziewicz-Yu)

212. A POSITA would have been motivated to apply, in Choi's digital camera as modified with Labaziewicz, Yu's teaching of independent control of data acquisition with independent control of exposure time for each image sensor, because doing so would provide the benefits of a digital camera with improved image quality by providing for data acquisition with (1) independent control of exposure time; (2) independent control of gain control; and (3) independent control of offset control for data acquisition. Ex.1005, 9:66-10:2 ("each of the image sensors is respectively and independently controlled to expose to the same imaging target"), 9:50-52 ("With images **independently** from multiple sensors with multiple lenses, the **complementary expansions of the respective dynamic ranges** become possible"); Ex.1005, 6:58-61 ("there are many other causes that may need to control image sensors [] independently, such as **gain and offset controls.**"); Ex.1008, [0034] (recognizing the need for regulation exposure, stating that "[b]y utilizing the relationship between the opening of the iris and the shutter speed, exposure is regulated).

213. An example (Example 3.2) of Choi-Labaziewicz-Yu is illustrated below:



Example 3.2 of Choi-Labaziewicz-Yu.

214. Choi-Labaziewicz-Yu would have been a combination of prior art elements (Choi's digital camera with channels having different FOVs as taught by Labaziewicz, and with independent control of the exposure time of each of the multiple image sensors, as taught by Yu) according to known methods (configuring the lenses relative to the image sensors for different FOVs, and controlling each electronic shutter of each image sensor to control the exposure time of the sensor) to yield the predictable result of varying sensor integration time for exposure control.

215. In addition, modifying Choi's multi-sensor, multi-lens digital camera

to implement, for each channel, (1) a different FOV as taught by Labaziewicz, and (2) independent control of exposure as taught by Yu, would improve a similar device (Choi's multi-sensor multi-lens digital camera) in the same way. "There is a motivation to combine when a known technique 'has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way,' using the 'prior art elements according to their established functions.'"

216. A POSITA would have had a reasonable expectation of success in combining Choi, Labaziewicz, and Yu, because the digital cameras described in Choi and Labaziewicz use similar technology of providing two channels each with a fixed focal length lens and a corresponding image sensor. *E.g.*, Ex.1008, FIG. 2; Ex.1010, FIG. 19. Furthermore, digital cameras described in Choi and Yu perform similar functions (using control signals to control image sensors) to achieve similar goals (controlling exposure times of the image sensors and providing improved image quality) using similar technology. *See, e.g.*, Ex.1005, FIG. 3, 6:53-58 ("control circuits 342, 344, 346 and 348 receive respectively the control signals 332, each generated with respect to a corresponding histogram in digital image processing circuitry 338 and independently and respectively control image sensors 302, 304, 306 and 308).

4. Analysis

a) Claim 22

[22.0] *A method comprising:*

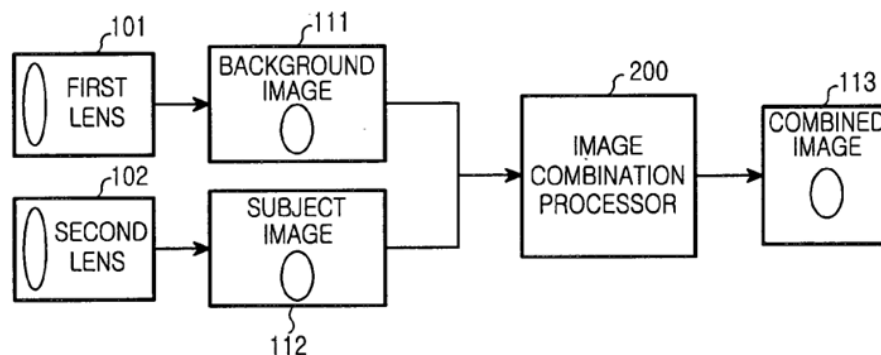
217. Choi renders obvious [22.0].

218. Choi describes “[a]n image photographing *method* for combining images with different focal lengths to an in-focus image.” Ex.1008, Claim 9. Thus, Choi renders obvious [22.0].

[22.1] *configuring a first optics component relative to a first image sensor to form a first channel having a first field of view (FOV) that comprises a first angular width of a scene;*

219. Choi-Labaziewicz-Yu renders obvious [22.1].

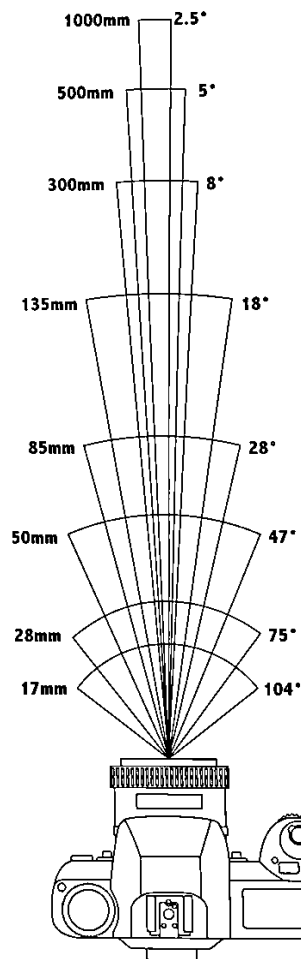
220. **First**, as shown in FIG. 2, Choi discloses *configuring a first optics component* (first lens 101) relative to *a first image sensor* (first image sensor) for providing background image 111. Ex.1008, [0047].



Ex.1008, FIG. 2.

221. **Second**, Labaziewicz describes configuring multiple channels such

that each channel has a different FOV, where FOVs are measured with different values of “35 mm film equivalent focal length.” Ex.1010, 18:49-55 (configuring the three lenses having “**a focal length of 30 mm equiv. (35 mm equivalent),**” “**a focal length of 90 mm equiv.,**” and “**a focal length of 135 mm equiv.**” respectively); Ex.1010, 11:59-63, 12:1-9 (describing the calculation of “35 mm film equivalent focal length” in relation to “an actual focal length” of the lens and “a diagonal distance” of the image sensor). As shown in the figure of London (Ex.1032) below, it was known that lenses with different “35 mm film equivalent focal length” have different FOVs (e.g., 17 mm equiv. has an FOV of 104 degrees, and 1000 mm equiv. has an FOV of 2.5 degrees).

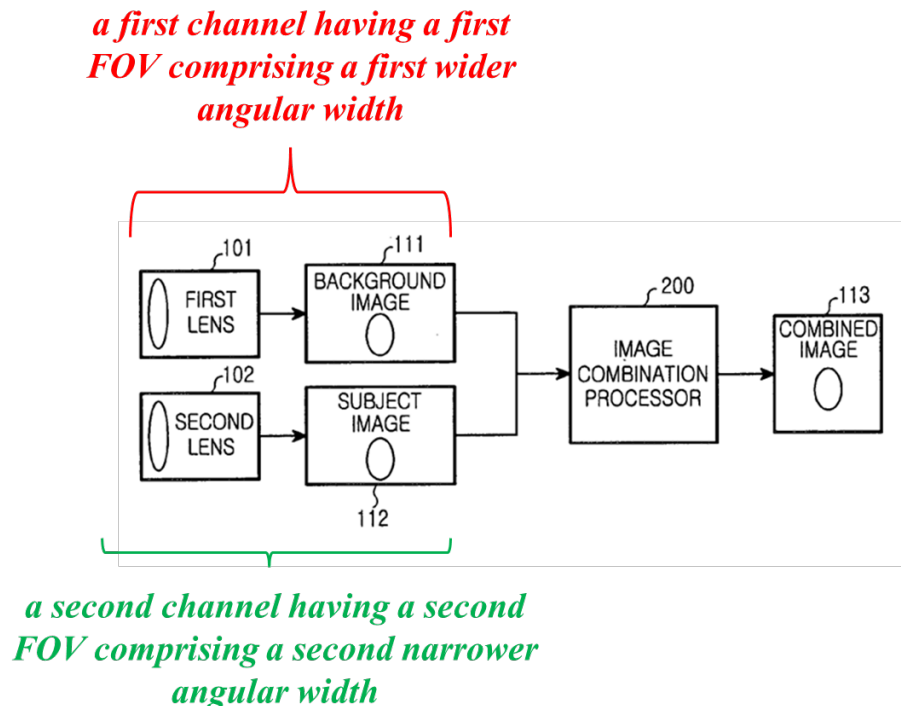
**Ex.1032, 43.**

222. Labaziewicz’s use of “35 mm film equivalent focal length” for measuring FOVs is consistent with well-known knowledge and digital camera catalog specification standards. Ex.1010, 11:60-66 (describing use of “35 mm film equivalent focal length” as defined “ANSI/I3AIT 10.7000-2004 Standard”); Ex.1033, 17 (ANSI/I3AIT 10.7000-2004 Standard defining the “35mm-equivalent focal length” as relative to “**same field of view** as the DSC camera lens”); Ex.1030, 2; Ex.1031, 12 (providing a catalog specification standard defining

“35mm camera equivalent” related to “**same input field angle** as the DSC lens”).

It was well-known that 30 mm equiv. 90 mm equiv. 135 mm equiv. correspond to FOVs with angular values of about 71.6 degrees, 27 degrees, and 18.2 degrees, respectively. See Ex.1032, 43.

223. As discussed at Section VIII.c.3.a, a POSITA would have been motivated to apply, in Choi, Labaziewicz’s teaching of configuring channels to have different FOVs, with the benefits providing a combined image having (1) a wider scene coverage and (2) more in-focus background portions, by implementing the background image with a wider FOV, and the subject image with a narrower FOV. Ex.1032, 43; Ex.1008, [0011]. Below I provide an example (Example 3.1) of Choi-Labaziewicz.



Example 3.1 of Choi-Labaziewicz.

224. As shown in Example 3.1, Choi-Labaziewicz renders obvious configuring a first optics component (setting the first lens 101) relative to a first image sensor (first image sensor for providing the background image 111) to form a first channel having a first field of view (FOV) that comprises a first angular width of a scene (a first wider angular width) as follows:

$$\text{First wider FOV for background image 111} = 2\tan^{-1}\left(\frac{K_1}{2f_1}\right),$$

where K_1 is the diagonal of the sensor format of image sensor, and f_1 is the focal length of the first lens. It was well-known in the art to set the lens relative to the sensor to have a specific FOV. Ex.1040, 48, FIG. 4.13.

225. Thus, Choi-Labaziewicz-Yu renders obvious [22.1].

[22.2] *configuring a second optics component relative to a second image sensor to form a second channel having a second FOV that comprises a second angular width of the scene, wherein the first and second angular widths are different;*

226. Choi-Labaziewicz-Yu renders obvious [22.2].

227. First, Choi discloses configuring a second optics component (setting the second lens 103) relative to a second image sensor (the second image sensor) to provide subject image 112). Ex.1008, FIG. 1.

228. Second, as shown in Example 3.1, Choi-Labaziewicz renders obvious configuring a second optics component (setting the second lens 103) relative to a second image sensor (second image sensor providing subject image 112) *to form a*

second channel having a second field of view (FOV) that comprises a second angular width of a scene (a second narrower angular width) as follows:

$$\text{second narrower FOV for subject image} = 2\tan^{-1}\left(\frac{K_2}{2f_2}\right),$$

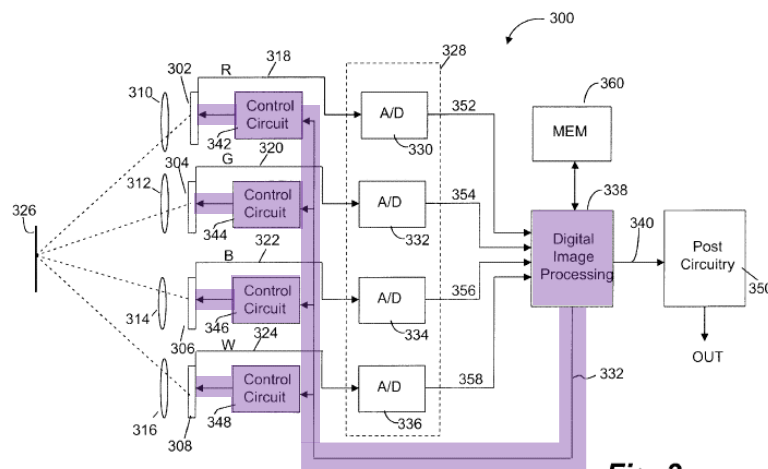
where K_2 is the diagonal of the sensor format of image sensor, and f_2 is the focal length of the second lens. It was well-known in the art to set the lens relative to the sensor to have a specific FOV. Ex.1040, 48; FIG. 4.13.

229. Thus, Choi-Labaziewicz-Yu renders obvious [22.2].

[22.3] *independently controlling simultaneous data acquisition with each of the first and second channels during a frame; and*

230. Choi-Labaziewicz-Yu renders obvious [22.3].

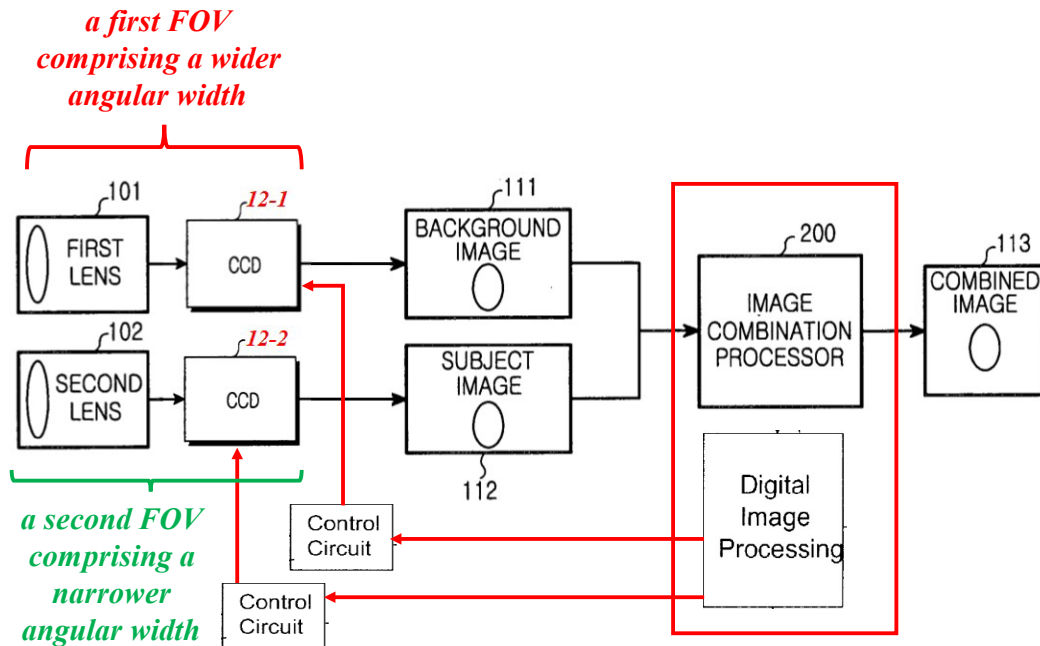
231. First, as shown in FIG. 3 below, Yu teaches a processing component (digital image processing circuitry 338, together with control circuits 342, 344, 346, and 348) coupled to a plurality of channels (multiple lenses 310, 312, 314, and 316 with respective sensors 302, 304, 306, and 308) and configured to perform *independently controlling simultaneous data acquisition with each of the first and second channels* (including independent control of an exposure time of each sensor, offset control, and gain control). Ex.1005, 6:52-58 (“control circuits...receive respectively the control signals...[and] each...**independently and respectively control** image sensors”), 9:66-10:2, 9:50-52, 6:59-65.

**Fig. 3**

a processing component configured to independently control simultaneous data acquisition

Ex.1005, FIG. 3, annotated.

232. Second, as discussed at VIII.c.3.b, a POSITA would have been motivated to apply Yu's teaching of independent control of image acquisition, for each channel of the digital camera of Choi-Labaziewicz. An example (Example 3.2) of Choi-Labaziewicz-Yu is illustrated below, where a processing component independently controls (as taught by Yu) simultaneous data acquisition (as taught by Choi) with each channel. Ex.1008, [0069] ("[t]here is **no time difference** between the background and subject images 111 and 112 because **they are captured simultaneously through a plurality of fixed lenses.**").



Example 3.2 of Choi-Labaziewicz-Yu.

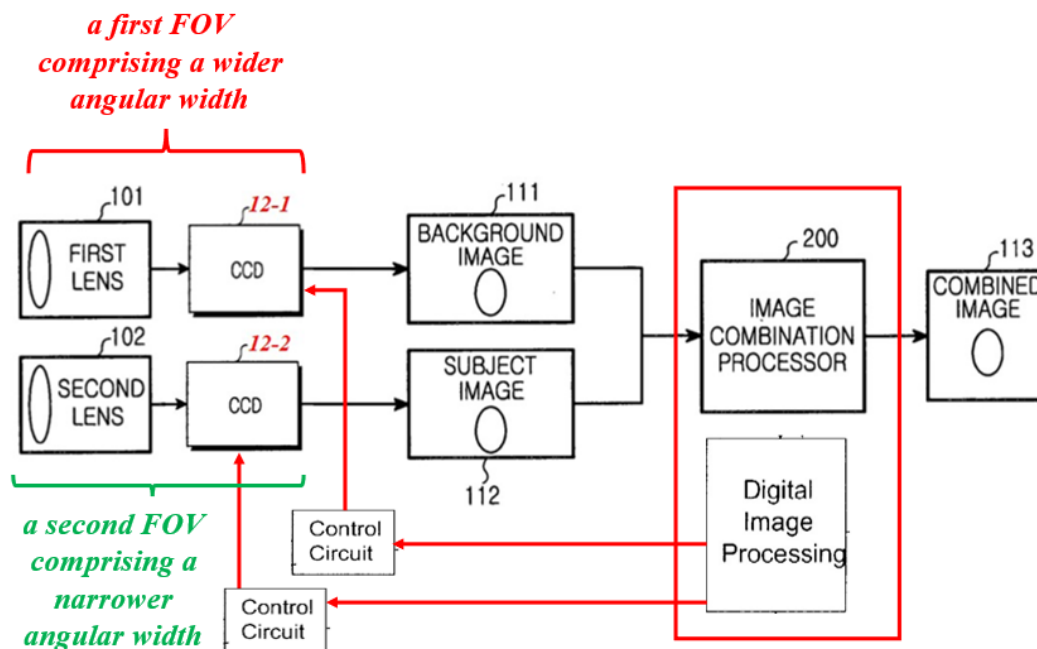
233. As shown in Example 3.2 of Choi-Labaziewicz-Yu above, Choi-Labaziewicz-Yu renders obvious *independently controlling* (independent control of exposure, gain, and/or offset) *simultaneous* (no time difference between the background and subject images 111 and 112) *data acquisition with each of the first and second channels during a frame* (acquisition at the same time, background image 111 with the first channel, subject image 112 with the second channel, during a period of a time). *See also* Section VII.A.

234. Thus, Choi-Labaziewicz-Yu renders obvious [22.3].

[22.4] *combining data received during the frame from one or more of the first and second channels to provide an image.*

235. Choi-Labaziewicz-Yu renders obvious [22.4].

236. As illustrated in Example 3.1 of Choi-Labaziewicz-Yu below, Choi-Labaziewicz-Yu renders obvious *combining data received during the frame* (background image 111 and subject image 112) *from one or more of the first and second channels to provide an image* (combined image 113). Ex.1008, [0047] (“an image combination processor 200 for **combining** the two images captured at different focal lengths”); [0048].



Example 3.2 of Choi-Labaziewicz-Yu.

237. Thus, Choi-Labaziewicz-Yu renders obvious [22.4].

b) Claim 23

[23.0] *The method of claim 22, comprising forming the first image sensor and the second image sensor in a semiconductor substrate.*

238. Choi-Labaziewicz-Yu renders [23.0] obvious.

239. Labaziewicz discloses that *forming the first image sensor and the*

second image sensor in a semiconductor substrate (“part of the same CCD or CMOS integrated circuit”). Ex.1010, 10:42-45 (“In some preferred embodiments, the **separate imaging arrays are part of the same** CCD or CMOS integrated circuit”). A POSITA would have been motivated to implement, in Choi-Labaziewicz-Yu, Labaziewicz’s teaching of forming imaging arrays in the same substrate, with the well-known benefits of a reduced size and simplified design with few components (e.g., replacing two separate sensor chips with one). Thus, Choi-Labaziewicz-Yu renders [23.0] obvious.

c) Claim 28

[28.0] *The method of claim 22, comprising configuring a third optics component relative to a third image sensor to form a third channel having a third FOV, wherein the third FOV is different from one or more of the first FOV and the second FOV.*

240. Choi-Labaziewicz-Yu renders [28.0] obvious.

241. First, Choi discloses using “**a plurality of** fixed lenses.” Ex.1008, [0064], claim 9.

242. Second, as shown in FIGs. 10E and 19 below, Labaziewicz discloses a digital camera including three channels, each having a different FOV (e.g., “30 mm equiv. (35 mm equivalent,” “90 mm equiv.,” “135 mm equiv.”). Ex.1010, 18:28-37 (“a digital camera 10E includes **three**...fixed focal length lenses, each providing an image to a corresponding imaging array.”); 18:49-53. It was well-

known that 35 mm equivalent focal length is a measure of FOV for a particular combination of a camera lens and image sensor size, and 30 mm equiv., 90 mm equiv., and 135 mm equiv. correspond to different angular values of 71.6 degrees, 27 degrees, and 18.2 degrees respectively. Ex.1032, 43.

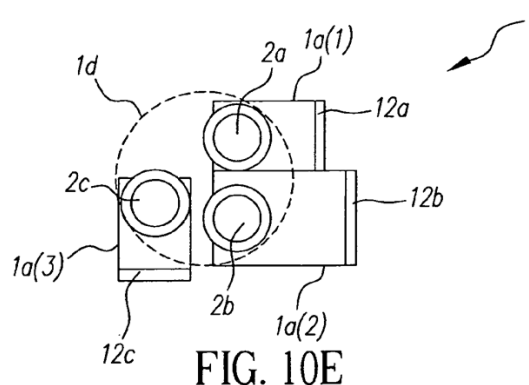


FIG. 10E

Ex.1010, FIG. 10E.

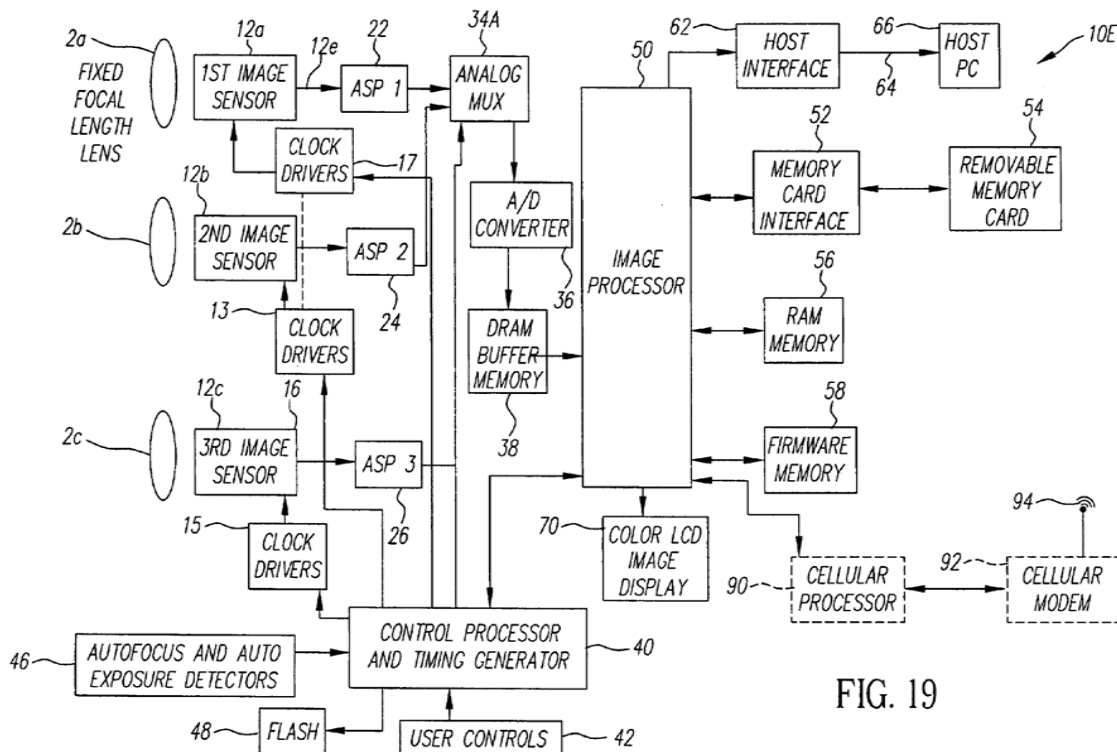
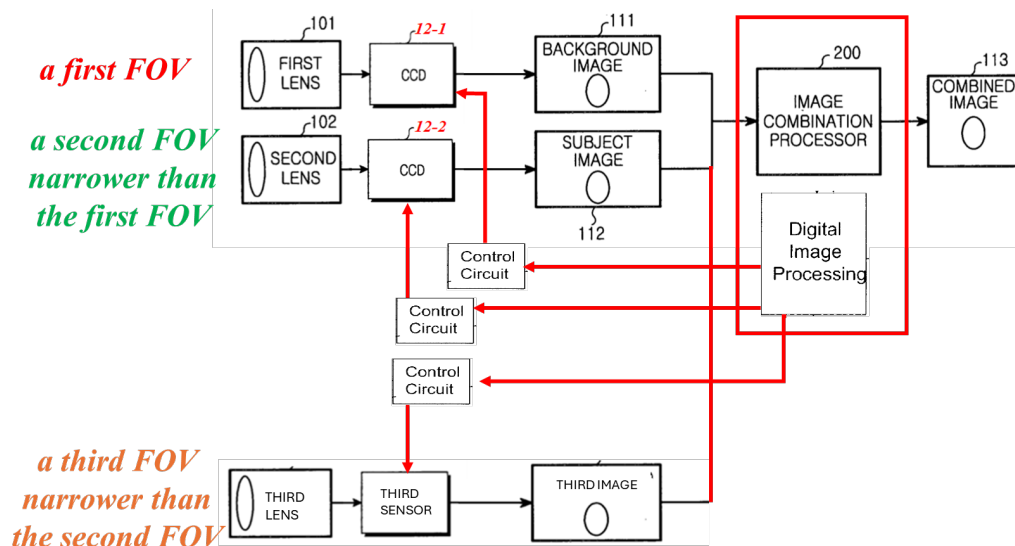


FIG. 19

Ex.1010, FIG. 19.

243. A POSITA would have been motivated to implement in Choi-Labaziewicz-Yu, three channels having different FOVs as taught by Labaziewicz, because of the benefits that the combined image (1) has a broad view of the scene; and (2) has improved performance characteristics by combining images of different FOVs with different exposures. *See, e.g.,* Ex.1014, 5:16-20 (with multiple lens/sensor systems like four and eight, “it is possible select scene exposure conditions in a way that provides 20 **for improving various characteristics.**”). Below I provide an example (Example 3.3) of the combination Choi-Labaziewicz-Yu:



Example 3.3 of Choi-Labaziewicz-Yu.

244. Thus, Choi-Labaziewicz-Yu renders obvious a third optics component (a third lens) relative to a third image sensor (a third image sensor) to form a third

channel having a third FOV, wherein the third FOV is different (e.g., narrower than both the first and second FOVs) from one or more of the first FOV and the second FOV. A POSITA would have understood that the scope of limitation [28.0] includes a third FOV that is different from **both** the first FOV and the second FOV.

d) Claim 30

[30.0] *The method of claim 28, comprising configuring a fourth optics component relative to a fourth image sensor to form a fourth channel having a fourth FOV, wherein the fourth FOV is different from one or more of the first FOV, the second FOV and the third FOV.*

245. Choi-Labaziewicz-Yu renders obvious [30.0].

246. As shown in FIG. 10F below, Labaziewicz describes a digital camera with four channels having different FOVs (e.g., 30 mm equiv., 60 mm equiv., 120 mm equiv., and 270 mm equiv.). Ex.1010, 21:30-36. A POSITA would have understood that 30 mm equiv., 60 mm equiv., 120 mm equiv., and 270 mm equiv. correspond to FOVs of about 71.6 degrees, 39.7 degrees, 20.4, and 9 degrees respectively. *See, e.g.,* Ex.1032, 43.

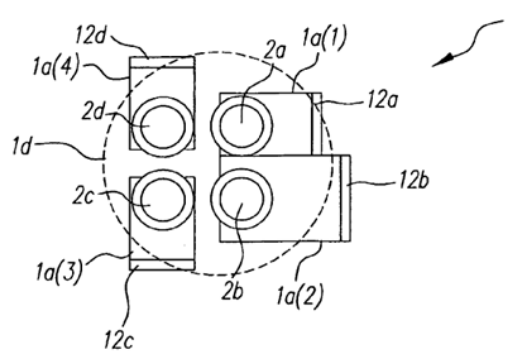
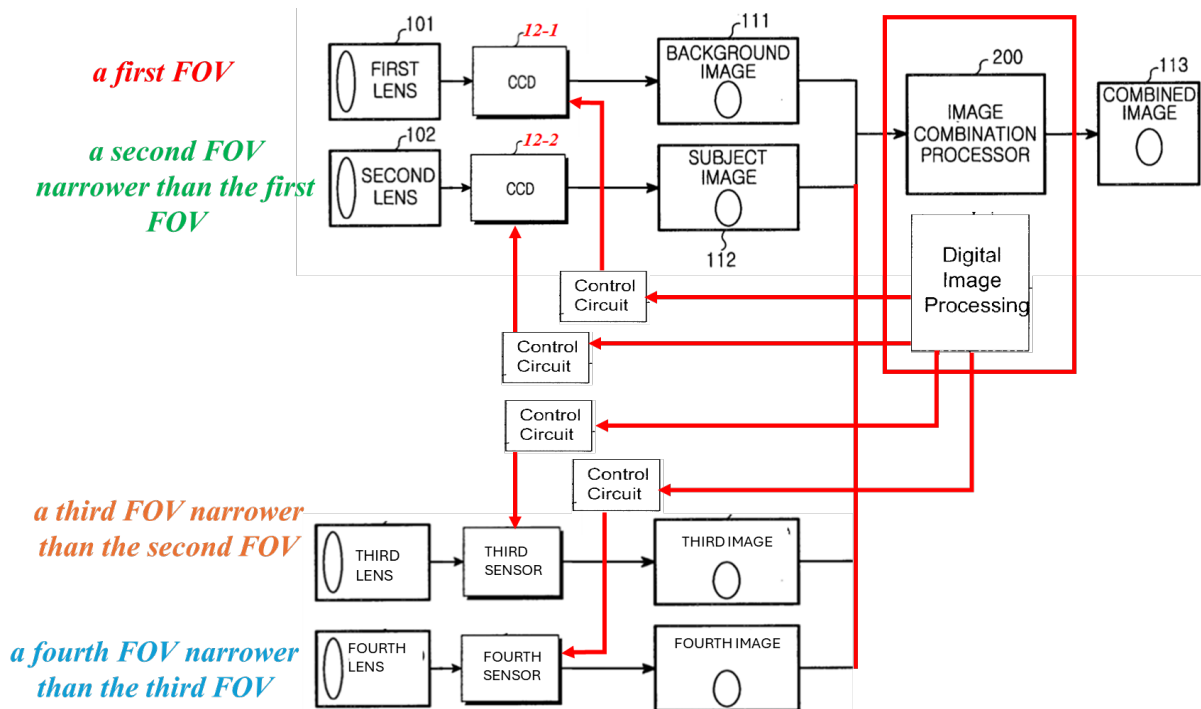


FIG. 10F

Ex.1010, FIG. 10F.

247. For similar reasons discussed at Ground 3:[28.0], a POSITA would have been motivated to implement in Choi-Labaziewicz-Yu, four channels having different FOVs as taught by Labaziewicz. *See, e.g.*, Ex.1014, 5:16-20. An example (Example 3.4) of Choi-Labaziewicz-Yu is illustrated below:



Example 3.4 of Choi-Labaziewicz-Yu.

248. Thus, as shown in Example 3.4 above, Choi-Labaziewicz-Yu renders obvious a fourth optics component (a fourth lens) relative to a fourth image sensor (a fourth image sensor) to form a fourth channel having a fourth FOV, wherein the fourth FOV is different from (narrower than) one or more of the first FOV, the second FOV and the third FOV. A POSITA would have understood that the scope of limitation [30.0] includes a fourth FOV that is different from **all** the first, second, and third FOVs.

IX. CONCLUSION

249. This declaration and my opinions herein are made to the best of my knowledge and understanding, and based on the material available to me, at the time of signing this declaration. I declare that all statements made herein on my own knowledge are true and that all statements made on information and belief are believed to be true, and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 or Title 18 of the United States Code.

Date: 12/29/2024

R. Michael Guidash