

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TESLA, INC.,
Petitioner

v.

INTELLECTUAL VENTURES II LLC.,
Patent Owner

IPR2025-00222
U.S. Patent No. 9,232,158

**PETITION FOR *INTER PARTES* REVIEW OF
U.S. PATENT 9,232,158**

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PETITIONER’S EXHIBIT LIST

Ex.1001	U.S. Pat. No. 9,232,158 to Olsen et al. (“the ’158 patent”)
Ex.1002	Prosecution History of U.S. Application No. 14/063,236 (issued as the ’158 patent)
Ex.1003	Declaration of R. Michael Guidash under 37 C.F.R. § 1.68
Ex.1004	<i>Curriculum Vitae</i> of R. Michael Guidash
Ex.1005	U.S. Pat. No. 6,611,289 to Yu et. al
Ex.1006	U.S. Pat. No. 7,365,780 to Miyazaki
Ex.1007	JP Application Publication No. JP2003-319231 to Matsushima (Certified English Translation + Declaration + Japanese)
Ex.1008	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.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	Eastman Kodak Company, Kodak Digital Science KAC-0311 Image Sensor (August 5, 2002) (retrieved from https://web.archive.org/web/20030411152500/http://www.kodak.com/global/plugins/acrobat/en/digital/ccd/products/cmos/KAC-0311LongSpec.pdf)
Ex.1011	U.S. Pat. No. 7,733,414 to Kobayashi
Ex.1012	Dave Litwiler, “CCD vs. CMOS: Facts and Fiction, Photonics Spectra,” (January 2001)

Ex.1013	U.S. Application Pub. No. 2004/0239771 to Habe
Ex.1014	EP Application Pub. No. EP0858208 to Weldy et al.
Ex.1015	Memorandum in Support of Claim Construction Order, <i>Intellectual Ventures I LLC et al. v. General Motors Company et al.</i> , 6:21-CV-1088 (WDTX), December 1 st , 2022
Ex.1016	Texas Instruments, TC255P 336- × 244-PIXEL CCD IMAGE SENSOR (March 2003)
Ex.1017	IV's Complaint, <i>Intellectual Ventures II, LLC v. Tesla, Inc.</i> , No. 6:24-cv-188-ADA (WDTX)
Ex.1018	Proposed Scheduling Order, <i>Intellectual Ventures II, LLC v. Tesla, Inc.</i> , No. 6:24-cv-188-ADA (WDTX)
Ex.1019	Statistics on District Court Timing
Ex.1020	Interim Procedure for Discretionary Denials in AIA Parallel District Court Litigation, June 21, 2022
Ex.1021	Eastman Kodak Company, Solid State Image Sensors Terminology, Application Note, DS 00-001, Revision 0 (December 8, 1994) (retrieved from https://web.archive.org/web/20030413064955/http://www.kodak.com/global/plugins/acrobat/en/digital/ccd/applicationNotes/terminology.pdf)
Ex.1022	U.S. Pat. No. 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) (retrieved from 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,” SIGGRAPH ’97: Proceedings of the 24th annual conference on Computer graphics and interactive techniques, 369-378 (August 1997)
Ex.1027	PCT Pub. No. WO2001/010110 to Stark
Ex.1028	Yang et al., “A 640 512 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 (retrieved from https://web.archive.org/web/20021028042044/https://micro.magnet.fsu.edu/primer/java/digitalimaging/ccd/shutter/index.html)
Ex.1030	Prosecution History of U.S. Application No. 11/212,803 (abandoned)
Ex.1031	Prosecution History of U.S. Application No. 11/788,122 (issued as U.S. Pat. No. 7,564,019)
Ex.1032	Prosecution History of U.S. Application No. 12/496,854 (issued as U.S. Pat. No. 8,198,574)
Ex.1033	Prosecution History of U.S. Application No. 13/465,229 (issued as U.S. Pat. No. 8,334,494)
Ex.1034	Prosecution History of U.S. Application No. 13/681,603 (issued as U.S. Pat. No. 8,598,504)
Ex.1035	Holst, CCD arrays, Cameras, and Displays, 2nd edition (1998)
Ex.1036	U.S. Pat. No. 4,831,403 to Ishida et al.
Ex.1037	U.S. Pat. No. 7443,427 to Takayanagi
Ex.1038	U.S. Pat. No. 4,642,679 to Nagano
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

I. INTRODUCTION

U.S. Patent No. 9,232,158 (the “’158 patent,” Ex.1001) is directed to a digital camera with basic components well-known in digital imaging—a plurality of sensors, optics components for passing light to those sensors in a one-to-one arrangement, and a processing unit for controlling an integration time of each sensor. Claims 1-2, 4-5, 8-11, 13-16, and 19 (“Challenged Claims”) recite well-known configurations of these components.

Pursuant to 35 U.S.C. §§ 311, 314(a), and 37 C.F.R. § 42.100, Tesla, Inc. (“Petitioner”) respectfully requests that the Board institute review and find unpatentable the Challenged Claims.

II. CERTIFICATION OF GROUNDS FOR STANDING

Petitioner certifies that the ’158 patent is available for *inter partes* review (IPR) and that Petitioner is not barred or estopped from requesting IPR of the patent’s claims.

III. NOTE

Petitioner cites to exhibits’ original page numbers, unless noted otherwise. Emphasis in quoted material has been added. Claim terms are presented in *italics*.

IV. TECHNOLOGY OVERVIEW

In its background, the ’158 patent discusses various well-known components and techniques in digital imaging, including image sensors, controlling integration

times for image sensors, and expanding dynamic range for image sensors. Ex.1001, 1:32-2:42.

Mr. Guidash confirms that these techniques were well-known and widely available in commercial products, such as those offered by Eastman Kodak Company (“Kodak”). *See e.g.*, Ex.1009, 9 (Kodak Image Sensors White Paper describing Kodak’s leading technology in image sensors); Ex.1008, 2 (Kodak Shutter Operations Application Note describing shutters in digital cameras to control integration times); Ex.1003, ¶¶23-53 (technology overview) (citing Ex.1021, 17, 24; Ex.1009, 2, 4, 9; Ex.1023, 5-6, 10, FIGS. 7-8; Ex.1024, 3, 11; Ex.1024, 3; Ex.1025, 7, FIG. 8; Ex.1026, 1; Ex.1014, FIGS.1a-1c, 3, 5:14-20; Ex.1001, 1:26-87, 2:31-34, 2:40-43, 5:33-54; Ex.1040, 310, FIG. 19.1; Ex.1042, 1; Ex.1043, FIGS. 2-4; Ex.1013, [0022], [0024]; Ex.1028, 1821n.1; Ex.1022, 1:22-24; Ex.1027, 3:10-12; Ex.1029, 1; Ex.1012, 2, 4).

V. THE ’158 PATENT

A. Overview

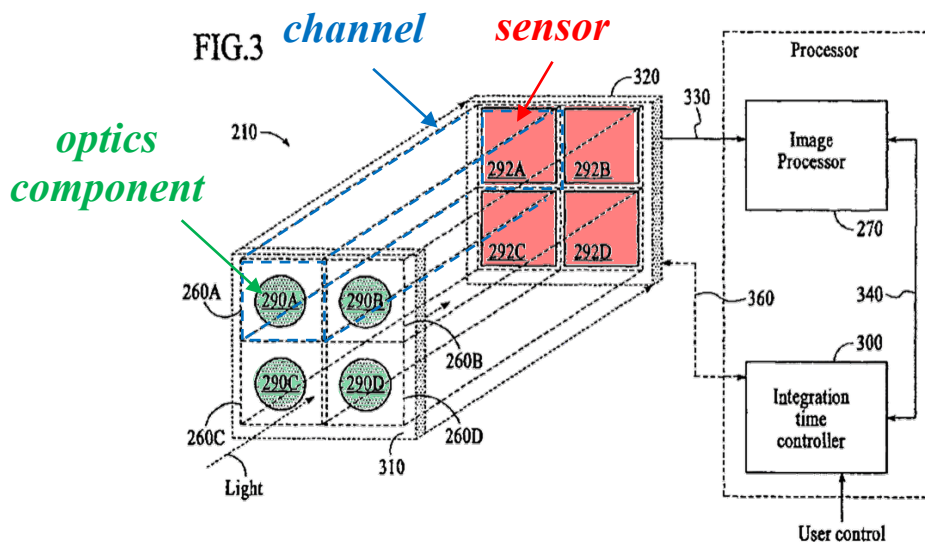
The ’158 patent is directed to “expanding the dynamic exposure range in digital cameras.” Ex.1001, 1:26-28; Ex.1003, ¶¶54-59. The ’158 patent acknowledges it was known that the “[intra-scene] dynamic range of an image sensor can be increased by using multiple...integration times.” Ex.1001, 1:57-58. “Integration time” refers to “the time the image sensor collects and integrates [the]

signal from the scene.” Ex.1001, 4:3-6. Integration time refers to the charge accumulation time of the sensor, and “upon completion of the integration period...the accumulated charge [is transferred] as a photo-signal to a processing component.” Ex.1001, 4:50-56. Integration time affects the exposure of a scene, e.g., darker objects are better captured with a longer integration time, and brighter objects are better captured with a shorter integration time. Ex.1001, 5:40-54; Ex.1003, ¶54. The ’158 patent asserts that known techniques of increasing the intra-scene dynamic range by using multiple integration times may “exhibit undesirable temporal aliasing” e.g., causing artifacts like ghosting or blurring due to inconsistent capturing of a fast-moving object, because the images are “captured using the same image sensor and thus are not captured concurrently.” Ex.1001, 1:57-2:5; Ex.1003, ¶¶54, 59 (citing Ex.1009, 9; Ex.1013, [0024]; Ex. 1001, 5:46-49, 5:50-54).

The ’158 patent attempts to solve this issue by using a digital camera system including “two or more camera channels,” where “[e]ach channel includes an optics component and an image sensor.” Ex.1001, 3:41-45. By having “two or more camera channels,” “[t]he images obtained in each channel under the different integration times are obtained simultaneously or nearly simultaneously, so undesirable temporal aliasing from moving scenes or camera motion is minimized.” Ex.1001, 3:53-57; Ex.1003, ¶55.

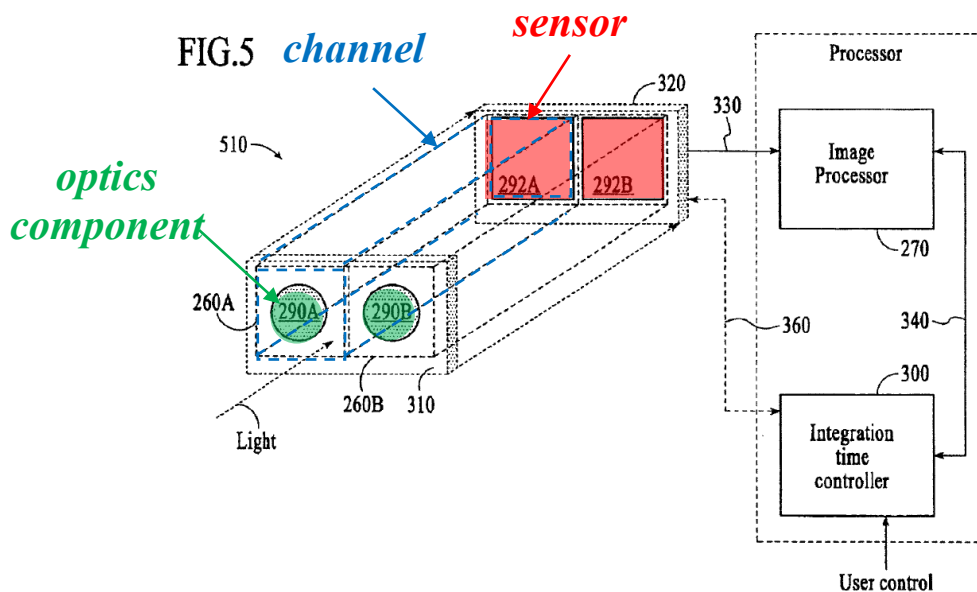
FIG. 3 below illustrates an embodiment of a digital camera subsystem 210

having “four camera channels 260A-260D,” each respectively including an optics component (290A-290D) and a corresponding sensor component (292A-292D), such that there is a one-to-one relationship between the optics component (e.g., optics component 290A) and the sensor (e.g., sensor 292A) that form a channel (e.g., channel 260A). Ex.1001, 7:17-39. In this embodiment, “each camera channel may be used to detect a different color (or band of colors) and/or band of light than that detected by the other camera channels.” Ex.1001, 8:49-52; Ex.1003, ¶¶56-57.



Ex.1001, FIG. 3, annotated; Ex.1003, ¶56.

FIG. 5 below illustrates another embodiment with two camera channels 260A and 260B, each “configured for RGB [red, green and blue] light.” Ex.1001, 10:37-40; Ex.1003, ¶58.



Ex.1001, FIG. 5, annotated; Ex.1003, ¶¶58.

B. Prosecution History

The '158 patent claims priority to five parent applications and three provisional applications. Ex.1002, 168-169; Exs.1030-1034 (prosecution histories of five parent applications); Ex.1003, ¶¶60-61.

During prosecution of the earliest parent application (abandoned), the Examiner rejected claims substantively different from the Challenged Claims based on combinations including Yu (Ex.1005).¹ Ex.1030, 1-2, 18, 21, 527. In the following four parent applications, Yu was cited along with many other references,

¹ The different claims of the earliest parent application are summarized in Section IX.A n.4.

but was never relied upon by the Office. Ex.1031, 1032, 1033, and 1034.

During prosecution of the '158 patent, all claims were allowed on a first action. Ex.1002, 89-96. In the Notice of Allowance, the Examiner identified all the limitations of application (issued) claim 1 as the allowable features. Ex.1002, 95. Yu was cited along with many other references, but was never relied upon by the Office. Ex.1002, 130.

C. Previous IPRs Involving the '158 Patent

1. IPR2022-00710 (“Toyota IPR”)

The Board denied institution after excluding from the scope of the claims “devices that rely on a **common** optics component to pass light to multiple camera channels.” IPR2022-00710, Paper 13, 11-16 (Oct. 26, 2022); *see also* Ex.1002, 14-18. None of the prior art cited in Toyota’s IPR petition is relied on in this Petition. This Petition asserts grounds based on prior art that discloses the one-to-one configuration the Board found was missing from Toyota’s petition.

2. IPR2022-01338 (“Honda IPR”)

In IPR2022-01338, the parties settled prior to institution of trial. None of the prior art cited in Honda’s IPR petition is relied on in this Petition.

VI. LEVEL OF ORDINARY SKILL IN THE ART

A person of ordinary skill in the art at, and before, the earliest claimed priority date of the '158 patent (August 25, 2004) (“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 sufficient with additional education, and likewise, less education may be sufficient with additional work experience. Ex.1003, ¶¶16-18.

VII. CLAIM CONSTRUCTION

Terms in the Challenged Claims were construed by the Board in the Toyota IPR and by the Court in *Intellectual Ventures I LLC et al. v. General Motors Company et al.*, WDTX 6:21-CV-1088 (“GM Litigation”). Ex.1002, 14-18; Ex.1015, 46-54. Petitioner has summarized these constructions for completeness and applies the prior art in this Petition in accordance with those constructions. However, neither the prior constructions nor the Board’s previous exclusions from the scope thereof are necessary in view of this Petition’s grounds. No claim term other than the terms identified below requires construction. Ex.1003, ¶¶62-71.

A. Terms Construed in Toyota IPR

The Board preliminarily construed the following terms in the Toyota IPR. *See* Ex.1002, 19-20.

Term	Board’s Construction
“wherein each optics component of the plurality of optics components is configured to pass light to a sensor of the plurality of sensors” (claim 1)	“each of the plurality of optics components is configured to pass light separately to a distinct sensor of the plurality of sensors.” Ex.1002, 19. “this claim element excludes from the scope of claim 1 devices that rely on a common optics

Term	Board's Construction
	component to pass light to multiple camera channels.” Ex.1002, 19.
“ <i>plurality of channels</i> ” (claims 9, 15)	“multiple independent structures that separately pass light to a different respective sensor” Ex.1002, 20. “the plain meaning of this claim element excludes from the scope of claims 9 and 15 devices that rely on a common optics component to pass light to multiple camera channels.” Ex.1002, 20.

The Petition's Grounds do not rely on a common optics component to pass light to multiple camera channels, which the Board excluded from the scope of the corresponding claims in the Toyota IPR. Ex.1003, ¶¶63-65.

B. Terms Construed in GM Litigation

The Court construed the following terms in the GM Litigation.

Term	Court's Construction
“ <i>integration time</i> ” (claims 1-3, 8-9, 11, 13-16)	“the time the image sensor collects and integrates signal from the scene” Ex.1015, 49.
“ <i>an image capture device</i> ” (claim 1)	“a device including a plurality of sensors, where two or more of the plurality of sensors each capture an overlapping portion of the same scene” Ex.1015, 52.

The prior art identified in the Grounds below render the Challenged Claims obvious in accordance with the prior constructions. Ex.1003, ¶¶66-68.

C. “during a frame”² (claim 2)

A POSITA would have understood that “*during a frame*” means “during a period of time in which data for a single frame of an image is captured” by a sensor. This period of time includes a period that the sensor is exposed to light and integrates the electronic charges to create that single frame of an image. Ex.1003, ¶69.

This construction is supported by the specification. The ’158 patent states that “[i]mage capture by the camera is performed using the multiple camera channels, and *each camera channel is controlled during a frame* under an independent integration time.” Ex.1001, 3:47-50; *see also id.*, 11:28-29 (“The photo-signal *from each camera channel is integrated...within a single frame of data*”); Ex.1003, ¶70.

This construction is supported by the surrounding claim language. Claim 2 recites “*the processing component is further configured to control the integration time of each sensor during a frame.*” A POSITA would have understood that for each particular sensor, the processing component controls the integration time of that sensor such that the particular sensor captures data for a single frame of an image.

² The ’158 patent also provides a definition of “frame” related to a physical component of a camera. Ex.1001, 23:44-45. A POSITA would have understood that this definition does not apply to the term “*during a frame*,” because a physical component is not a time period. Ex.1003, n.2.

Accordingly, the integration time of the particular sensor is controlled during a period of time in which data for a single frame of an image is captured by that sensor.

Ex.1003, ¶71.

VIII. CHALLENGED CLAIMS ARE UNPATENTABLE

A. Challenged Claims

Petitioner challenges claims 1-2, 4-5, 8-11, 13-16, and 19.³ Each reference below predates August 25, 2004, the earliest priority date of the '158 patent.

B. Prior Art Patents and Printed Publications

1. JP2003-319231 to Matsushima (“Matsushima”) (Ex.1007 including certified English translation, translator’s certification, and original Japanese publication); published November 7, 2003; prior art under §102(a).
2. U.S. 6,611,289 (“Yu”) (Ex.1005); filed January 15, 1999; issued August 26, 2003; prior art under §§102(a), 102(e).
3. U.S. 7,365,780 (“Miyazaki”) (Ex.1006); filed September 7, 2000; issued April 29, 2008; prior art under §§102(a), 102(e).

C. Statutory Grounds for Challenges

This Petition, supported by the declaration of Mr. Guidash (Ex.1003),

³ The pre-AIA statutory framework applies to the Challenged Claims.

demonstrates unpatentability of the Challenged Claims on the following Grounds:

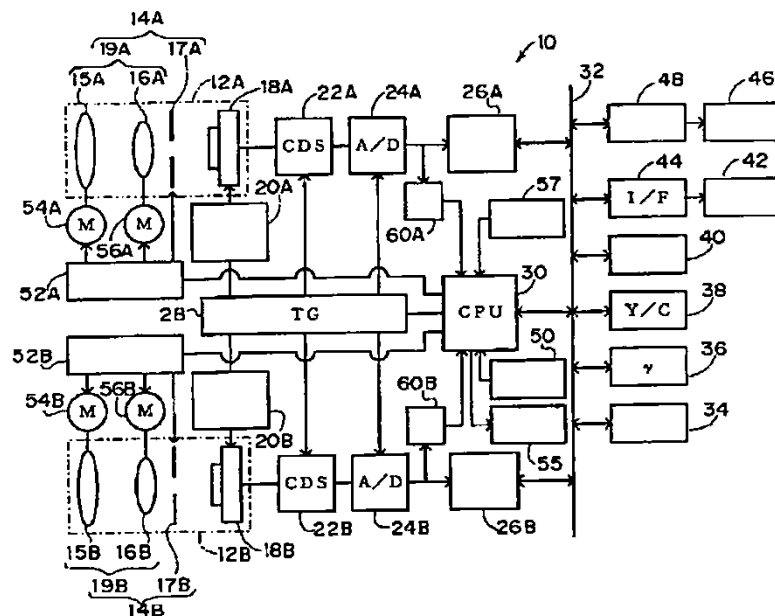
Ground	Claim	Basis (Pre-AIA)
#1	1-2, 5, 8-9, 11, 13-16, and 19	§ 103 over Matsushima
#2	1-2, 4-5, 8-11, 13-14	§ 103 over Yu in view of Miyazaki

D. Ground 1: Claims 1-2, 5, 8-9, 11, 13-16, and 19 Would Have Been Obvious Over Matsushima.

1. Overview of Matsushima

Matsushima “relates to a digital camera and, more specifically, to a digital camera equipped with multiple imaging systems.” Ex.1007, [0001]. As shown in FIG. 1 below, Matsushima describes a “digital camera 10 [that] has **two independent imaging systems** (a first imaging system 12A and a second imaging system 12B).” Ex.1007, [0017]. “[I]mages are formed on the light-receiving surfaces of CCD 18A and 18B via imaging optics 14A and 14B, **respectively.**” *Id.*; Ex.1003, ¶76.

[FIG. 1]



Ex.1007, FIG. 1.

2. Analysis

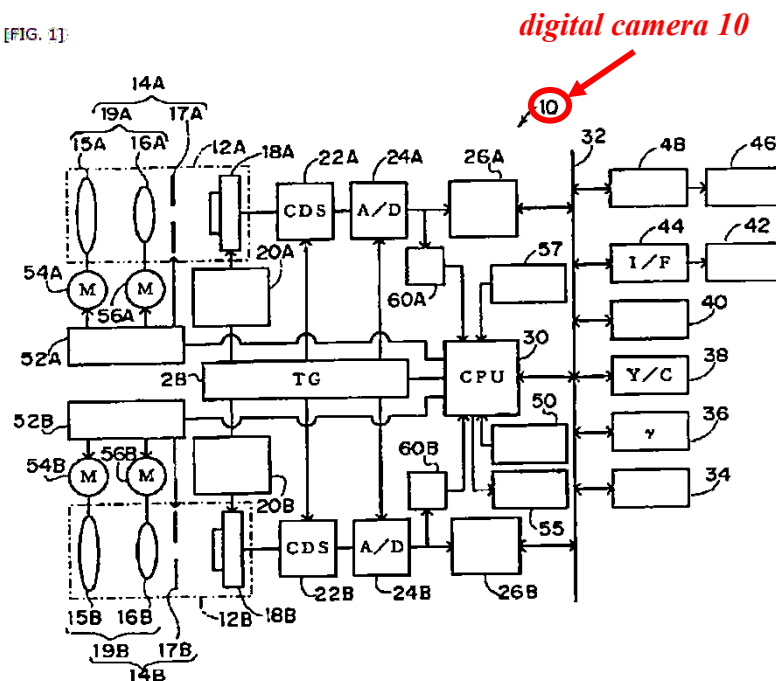
a. Claim 1

[1.0] An image capture device comprising:

To the extent the preamble is limiting, Matsushima discloses or at least renders it obvious. Ex.1003, ¶¶77-80.

Matsushima discloses “a digital camera equipped with multiple imaging systems.” Ex.1007, [0001]; FIG. 1, [0017] (“This digital camera 10 [in FIG. 1] 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 18A and 18B via imaging optics 14A and 14B, respectively.”); Ex.1003, ¶78.

[FIG. 1]

**Ex.1007, FIG. 1, annotated; Ex.1003, ¶78.**

Matsushima teaches *an imaging capture device* under the construction in the GM Litigation (VII.B), because Matsushima’s digital camera 10 is a device including a plurality of sensors (CCD 18A and 18B), where two or more of the sensors each capture an overlapping portion of the same scene. Ex.1007, [0048] (“a captured image 62A taken with the first imaging system 12A [using sensor 18A]” and “a captured image 62B taken with the second imaging system 12B [using sensor 18B]”); FIGS. 2, 3, 4, and 6 illustrating captured images 62A and 62B with an overlapping portion of the same scene; Ex.1003, ¶79.

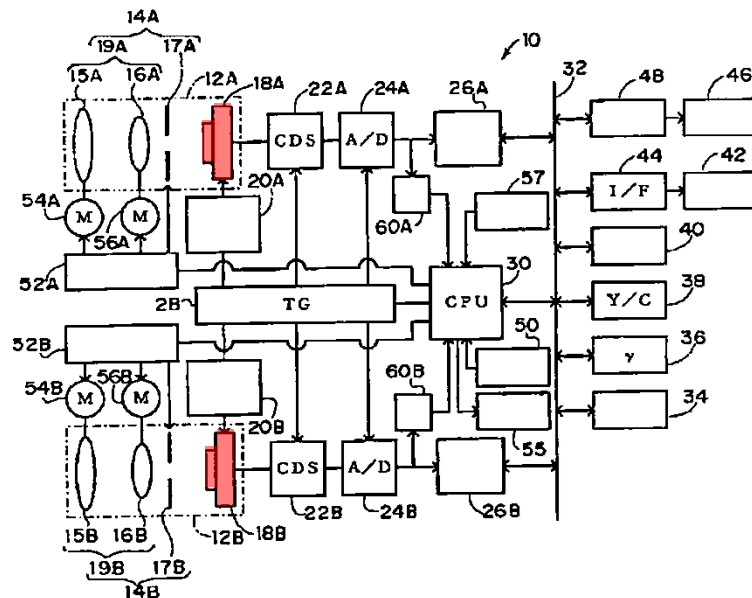
Thus, Matsushima discloses or at least renders obvious *an imaging capture device* (a digital camera). Ex.1003, ¶80.

[1.1] a plurality of sensors;

Matsushima discloses or at least renders obvious [1.1]. Ex.1003, ¶¶81-84.

As shown in FIG. 1 below, Matsushima discloses *a plurality of sensors* (CCD 18A and 18B). Ex.1007, [0017]; Ex.1003, ¶82. CCD image sensors were a well-known type of image sensor. Ex.1009, 2 (describing “CCD (Charge Coupled Device) image sensors”); Ex.1003, ¶82.

[FIG. 1] *a plurality of sensors*



Ex.1007, FIG. 1, annotated; Ex.1003, ¶82.

Matsushima discloses “[a] digital camera comprising: a first imaging system including *a first image sensor*...; a second imaging system including *a second image sensor*.” Ex.1007, [Claim 1]; [0022] (“CCD 18A corresponds to the first image sensor[, and] CCD 18B corresponds to the second image sensor.”); *id.*, [0017]

(“subject images are formed on the light-receiving surfaces of *CCD 18A and 18B* via imaging optics 14A and 14B, respectively.”); [0021] (“CCD 18A and CCD 18B can be...CCDs of the same size, that is, the same number of pixels”); Ex.1003, ¶83.

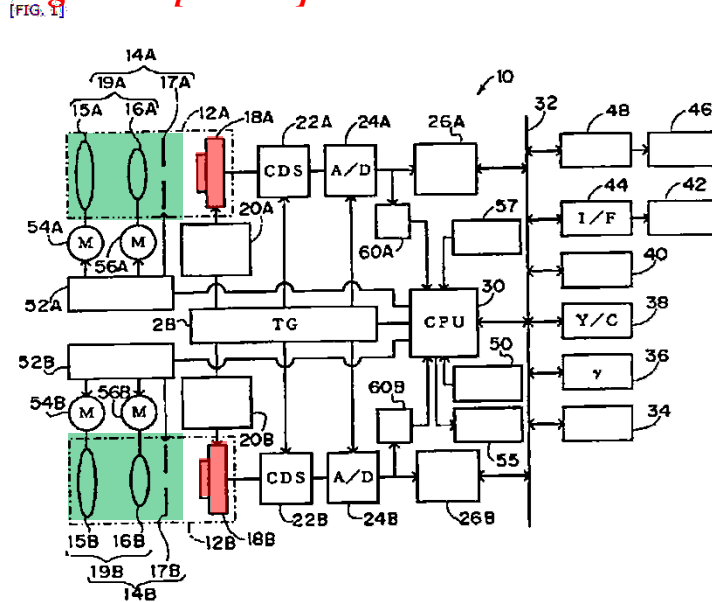
Thus, Matsushima discloses [1.1]. Ex.1003, ¶84.

[1.2] a plurality of optics components, wherein each optics component of the plurality of optics components is configured to pass light to a sensor of the plurality of sensors; and

Matsushima discloses or at least renders obvious [1.2]. Ex.1003, ¶¶85-89.

As shown in FIG. 1 below, Matsushima discloses *a plurality of optics components* (imaging optics 14A (and/or each optics component thereof including a first lens group 19A with an imaging lens 15A and a focus lens 16A, and an aperture 17A)) and imaging optics 14B (and/or each optics component thereof including a second lens group 19B with an imaging lens 15B and a focus lens 16B, and an aperture 17B)). Ex.1007, [0017], [0019]; Ex.1003, ¶86. In Matsushima, *each optics component of the plurality of optics components is configured to pass light to a sensor* (imaging optics 14A configured to separately pass light to a distinct image sensor 18A, imaging optics 14B configured to separately pass light to a distinct image sensor 18B) *of the plurality of sensors* (image sensors 18A, 18B). Ex.1007, [0017], [0019]; Ex.1003, ¶86.

each optics component
... configured to [separately]
pass light to a [distinct] sensor



Ex.1007, FIG. 1, annotated; Ex.1003, ¶86.

In Matsushima, each imaging optics 14A (and the optics components thereof including a first lens group 19A with an imaging lens 15A and a focus lens 16A, and an aperture 17A) and imaging optics 14B (and the optics components thereof including a second lens group 19B with an imaging lens 15B and a focus lens 16B, and an aperture 17B) teaches an *optics component*. Ex.1007, [0019]; Ex.1003, ¶87.

In Matsushima, *each optics component of the plurality of optics components* (imaging optics 14A and the optics components thereof, and imaging optics 14B and the optics components thereof) *is configured to pass light separately to a distinct sensor of the plurality of sensors*, because “subject images are formed on the light-receiving surfaces of CCD 18A and 18B via imaging optics 14A and 14B,

respectively.” Ex.1007, [0017]; [0023]; Ex.1003, ¶88. Imaging optics 14A and imaging optics 14B are in “two **independent** imaging systems...12A and 12B,” and are configured to separately pass light to respective and distinct image sensors 18A and 18B of their corresponding independent imaging systems 12A and 12B. Ex.1007, [0017]; Ex.1003, ¶88.

Thus, Matsushima discloses or at least renders obvious [1.2]. Ex.1003, ¶89.

[1.3] a processing component configured to control an integration time of each sensor.

Matsushima discloses or at least renders obvious [1.3]. Ex.1003, ¶¶90-100.

The ’158 patent makes clear that *integration time* is charge accumulation time. Ex.1001, 4:46-50 (“[i]ntegration time control...controls the time the electrical signal is integrated or accumulated”), 4:50-56 (“the charge integration switch is placed in a state to allow charge to accumulate within the sensor for a period of time... upon completion of the integration period...the accumulated charge [is transferred] as a photo-signal to a processing component”); Ex.1003, ¶91.

This is consistent with the construction in the GM litigation. VII.B; Ex.1003, ¶92. The ’158 patent also acknowledges that “integration time” is controlled with an “electronic shutter,” as is described in Matsushima. Ex.1001, 2:31-34; Ex.1003, ¶92.

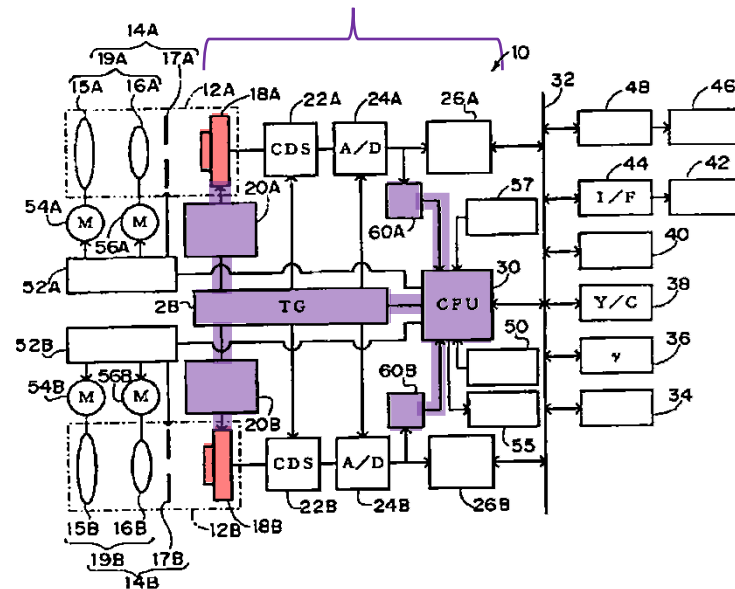
This description of integration time as synonymous with charge accumulation time is consistent with a POSITA’s understanding. Ex.1003, ¶93 (citing Ex.1036,

using “charge accumulation period” and “integration time” interchangeably), 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”), 52 (“a charge accumulation (integration) period”), 4:16 (“integration (accumulation time”)).

As shown in FIG. 1 below, Matsushima discloses *a processing component* (CPU 30 together with integration circuits 60A and 60B, Timing Generator (TG) 28 and CCD drive circuits 20A and 20B) *configured to control an integration time* (charge “accumulation time (shutter speed)”) *of each sensor* (sensors 18A, 18B) using an electronic shutter. Ex.1007, [0027], [0034]; Ex.1003, ¶94.

*a processing component configured to
control an integration time of each sensor*

[FIG. 1]



Ex.1007, FIG. 1, annotated; Ex.1003, ¶94.

Matsushima explains that the CPU 30 controls charge accumulation time (i.e., *integration time*) with an electronic shutter on each sensor:

CCD 18A and CCD 18B each have a shutter drain via a shutter gate, and the accumulated signal charges can be swept to the shutter drain by driving the shutter gates with shutter gate pulses. In other words, 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.

Ex.1007, [0024]; *id.*, [0034] (“The apertures 17A and 17B are driven via the drive circuits 52A and 52B, and the CCD 18A and CCD 18B **charge accumulation time**

is controlled using an electronic shutter to reach the determined shutter speed.”); [0035], [0027] (describing the CPU 30 controlling the “timing signal generating circuit (TG) 28 [that] provides appropriate timing signals to the CCD drive circuits 20A and 20B”). Matsushima’s description of the sensors collecting and accumulating charge is consistent with the construction of “*integration time*” in the GM Litigation. Ex.1015, 49 (“the time the image sensor collects and integrates signal from the scene”); Ex.1003, ¶95.

Matsushima explains that the CPU 30 performs automatic exposure adjustments (AE) by controlling the shutter speed (charge accumulation time) of the electronic shutter. Ex.1007, [0028] (“CPU 30 is the control unit that performs overall control of each circuit in the digital camera 10.”); Ex.1007, [0029] (“CPU 30...performs automatic exposure adjustments (AE).”); Ex.1007, [0034] (for automatic exposure (AE) adjustment, the integration circuits 60A and 60B determine the subject luminance (imaging EV value) for sensors (CCD) 18A and 18B respectively, and CPU 30 determines “aperture value and **shutter speed**...based on this imaging EV value.”); Ex.1003, ¶96.

Accordingly, in Matsushima, *a processing component* (CPU 30 together with integration circuits 60A and 60B, Timing Generator (TG) 28 and CCD drive circuits 20A and 20B) is *configured to control* (using an electronic shutter of each sensor) *an integration time* (charge accumulation time) *of each sensor* (sensors 18A and

18B) by controlling the sensor's electronic shutter, which achieves optimal exposure adjustment for each of the sensor. Ex.1007, [0024]; Ex.1003, ¶97.

As explained by Mr. Guidash and below at [5.0] and [11.0], Matsushima provides improved image quality with a broad dynamic range, by combining images 62A and 62B having different integration times for different regions in a scene. Ex.1003, ¶¶98, 106-112, 132-135; Ex.1007, [0048]-[0049], [0034].

Matsushima's teaching is consistent with well-known knowledge in the art, supported by numerous contemporaneous documents including many from Fujifilm (Matsushima's assignee), that in an image capture device like Matsushima, *a processing component* (a CPU together with integration circuits, timing Generator (TG), and CCD drive circuits) controls *the integration time* (charge accumulation time) *of each sensor* (CCD image sensor), e.g., using the respective CCD driver and/or timing generator. Ex.1003, ¶99 (citing 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 (using a control signal indicative of an electronic shutter speed to control the CCD image sensor with its corresponding CCD driver)).

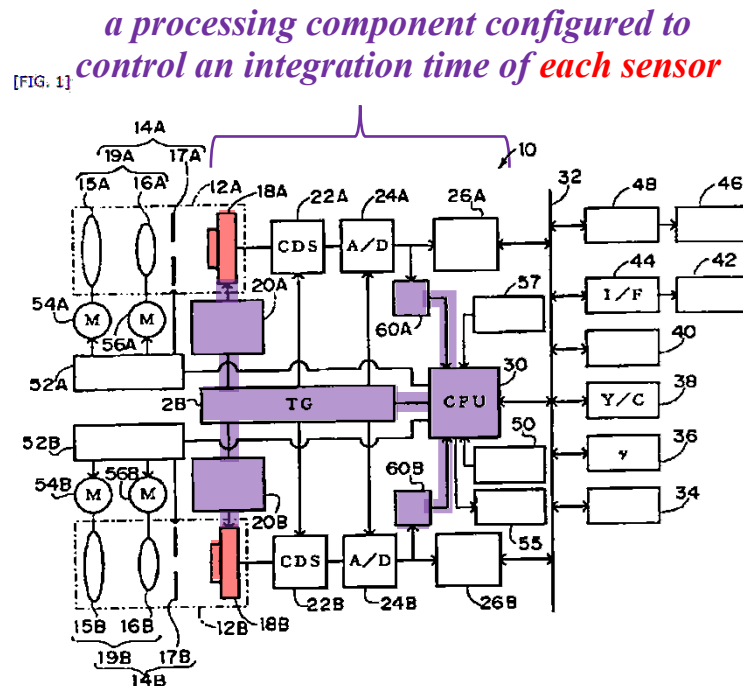
Thus, Matsushima discloses or at least renders obvious [1.3]. Ex.1003, ¶100.

b. Claim 2

[2.0] The device of claim 1, wherein the processing component is further configured to control the integration time of each sensor during a frame.

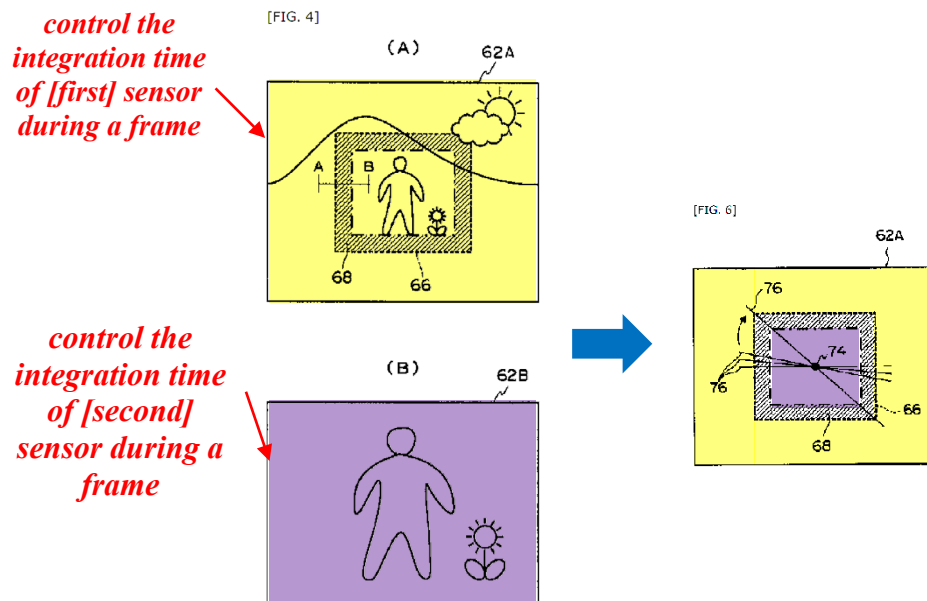
Matsushima discloses or renders obvious [2.0]. Ex.1003, ¶¶101-105.

First, as discussed at Ground 1:[1.3] and shown in FIG. 1 below, Matsushima discloses *a processing component* (CPU 30 together with integration circuits 60A and 60B, Timing Generator (TG) 28 and CCD drive circuits 20A and 20B) *configured to control an integration time* (charge “accumulation time (shutter speed)”) *of each sensor* (sensors 18A and 18B). Ex.1007, [0027], [0034]; Ex.1003, ¶102.



Ex.1007, FIG. 1, annotated; Ex.1003, ¶102.

Second, as discussed at VII.C, “*during a frame*” means “during a period of time in which data for a single frame of an image is captured” by a sensor. As shown in FIGS. 4 and 6 below, Matsushima discloses or at least renders obvious that control of each sensor as claimed in [1.3] is performed during a period of time in which data for a single frame of an image is captured by that sensor (a single frame of image 62A captured by sensor 18A, and a single frame of image 62B captured by sensor 18B). Ex.1003, ¶103.



Ex.1007, FIGS. 4 and 6, annotated; Ex.1003, ¶103.

Matsushima teaches using sensors 18A and 18B to capture images 62A and 62B of the same scene. Ex.1007, [0048] (“a captured image 62A taken with the first imaging system 12A [using sensor 18A]” and “a captured image 62B taken with the

second imaging system 12B [using sensor 18B]”). Ex.1003, ¶104. As discussed at Ground 1:[1.3], an integration time of each sensor is controlled to capture data for its corresponding single frame of an image. Ex.1007, [0034] (controlling an electronic shutter of each sensor for capturing the corresponding single frame of an image). Accordingly, Matsushima discloses that controlling an integration time of sensor 18A during a period of time in which data for a single frame of image 62A is captured by that sensor 18A, and controlling an integration time of sensor 18B during a period of time in which data for a single frame of image 62B is captured by that sensor 18B. Ex.1003, ¶104.

Thus, Matsushima discloses or at least renders obvious [2.0]. Ex.1003, ¶105.

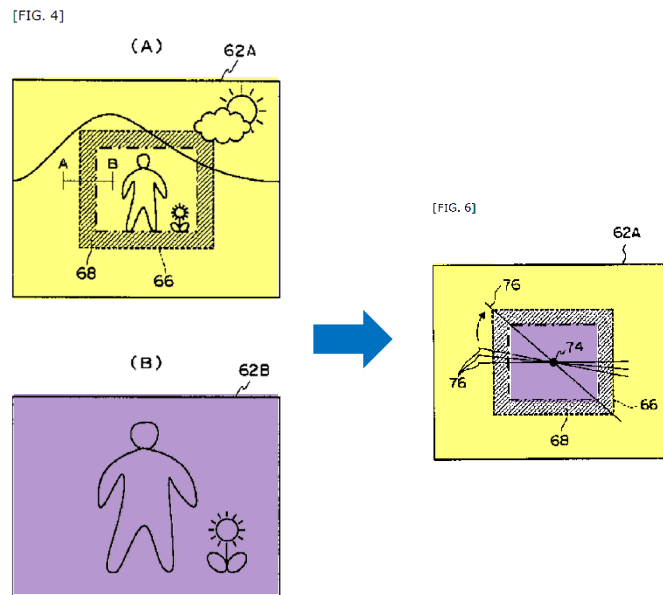
c. Claim 5

[5.0] The device of claim 1, wherein the processing component is further configured to combine data from the plurality of sensors received to provide an image.

Matsushima discloses or renders obvious [5.0]. Ex.1003, ¶¶106-112.

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 and CCD drive circuits 20A and 20B) *is configured to combine data* (synthesis processing) *from the plurality of sensors* (sensors 18A and 18B) *received* during the frame (image 62A taken with first imaging system 12A and image 62B taken with second imaging system 1B) *to provide an image* of FIG. 6.

Ex.1007, [0048]-[0051] (synthesis processing performed on captured images taken by the two imaging systems); Ex.1003, ¶107.



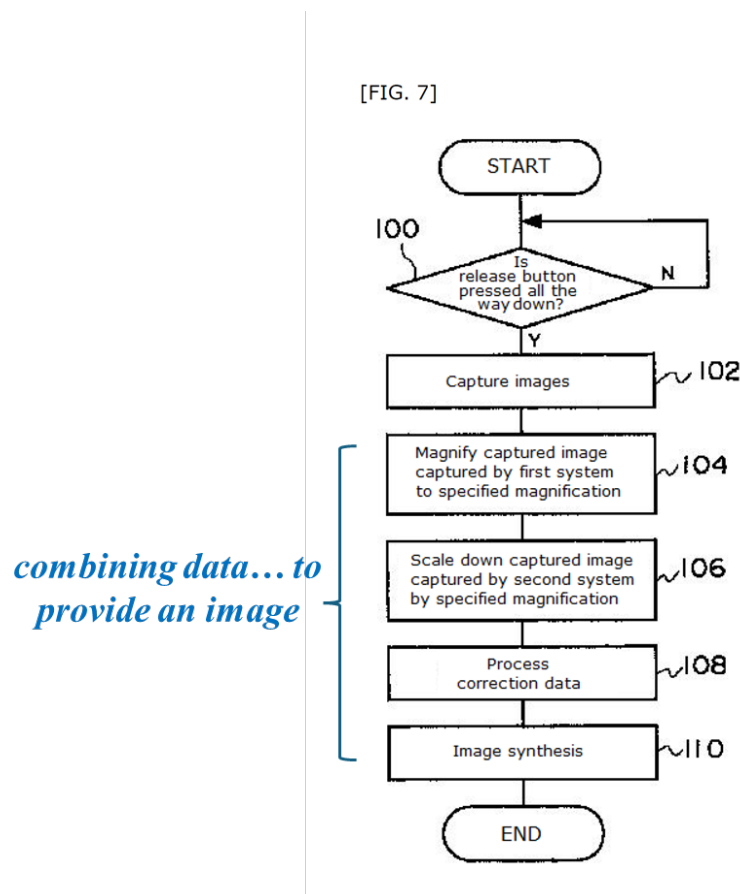
Ex.1007, FIGS. 4 and 6, annotated; Ex.1003, ¶107.

Matsushima describes *the processing component* (CPU 30 together with integration circuits 60A and 60B, Timing Generator (TG) 28 and CCD drive circuits 20A and 20B) *configured to combine data from the plurality of sensors* (image sensors 18A and 18B) *received during the frame*, because Matsushima's CPU 30 generates a combined image (FIG. 6) by replacing the image in the center of the captured image 62A corresponding to the scaled down image 66, with the scaled down image 66. Ex.1007, [0048], Ex.1003, ¶108.

Matsushima's technique improves image quality in the center of the image, and provides a large dynamic range because images 62A and 62B are captured with different exposures (different integration times). 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.1003, ¶109.

Furthermore, Matsushima describes *the processing component* (CPU 30 together with integration circuits 60A and 60B, Timing Generator (TG) 28 and CCD drive circuits 20A and 20B) *configured to combine data from the plurality of sensors received* during the frame, because Matsushima's CPU 30 combines data from first and second sensors (image sensors 18A, 18B) 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. Ex.1007, [0050]-[0051] (“**Correction data** is 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.** This correction data is then used as the image data for the peripheral regions 68. This prevents unnaturalness from occurring at the boundary between the captured image 62A and the scaled down image 66.”); Ex.1003, ¶110.

As illustrated in FIG. 7 below, Matsushima describes steps for *combin[ing]* *data from the plurality of sensors received* during the frame (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.1003, ¶111.



Ex.1007, FIG. 7, annotated; Ex.1003, ¶111.

Thus, Matsushima discloses or renders obvious [5.0]. Ex.1003, ¶112.

d. Claim 8

[8.0] The device of claim 1, wherein the integration time is controlled based on incident light level.

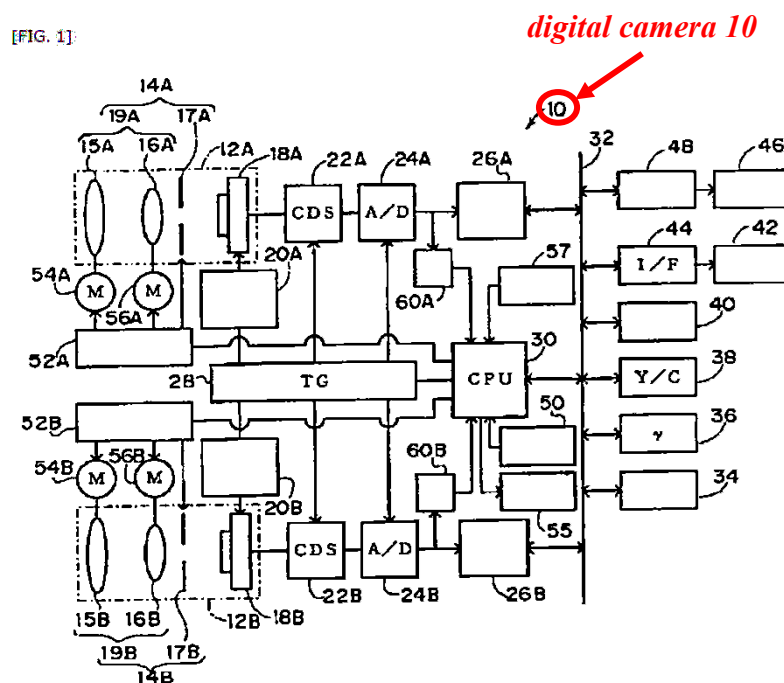
Matsushima discloses or renders obvious [8.0]. Ex.1003, ¶¶113-115.

As discussed at Ground 1:[1.3], in Matsushima, *the integration time* (charge accumulation time/shutter speed) *is controlled based on incident light level* (subject luminance/imaging EV value for each sensor). Ex.1007, [0034] (“For AE control, *the subject luminance (imaging EV value)* is determined based on integration of the R, G, and B signals in a single frame by the integration circuits 60A and 60B, and the aperture value and *shutter speed are determined based on this imaging EV value.*”), [0035] (“During imaging and recording, the AF operation is performed when the release button is ‘half-pressed,’ and *the metering operation is repeated several times to obtain the exact imaging EV.* The final aperture value and *shutter speed for imaging is then determined based on the imaging EV.*”); Ex.1003, ¶114.

Thus, Matsushima discloses or renders obvious [8.0]. Ex.1003, ¶115.

e. *Claim 9***[9.0] A system comprising:**

Matsushima discloses or at least renders obvious [9.0], because Matsushima discloses *a system* (digital camera system 10) as discussed above at Ground 1:[1.0], and shown in FIG. 1 below. Ex.1003, ¶¶116-117.



Ex.1007, FIG. 1, annotated; Ex.1003, ¶116.

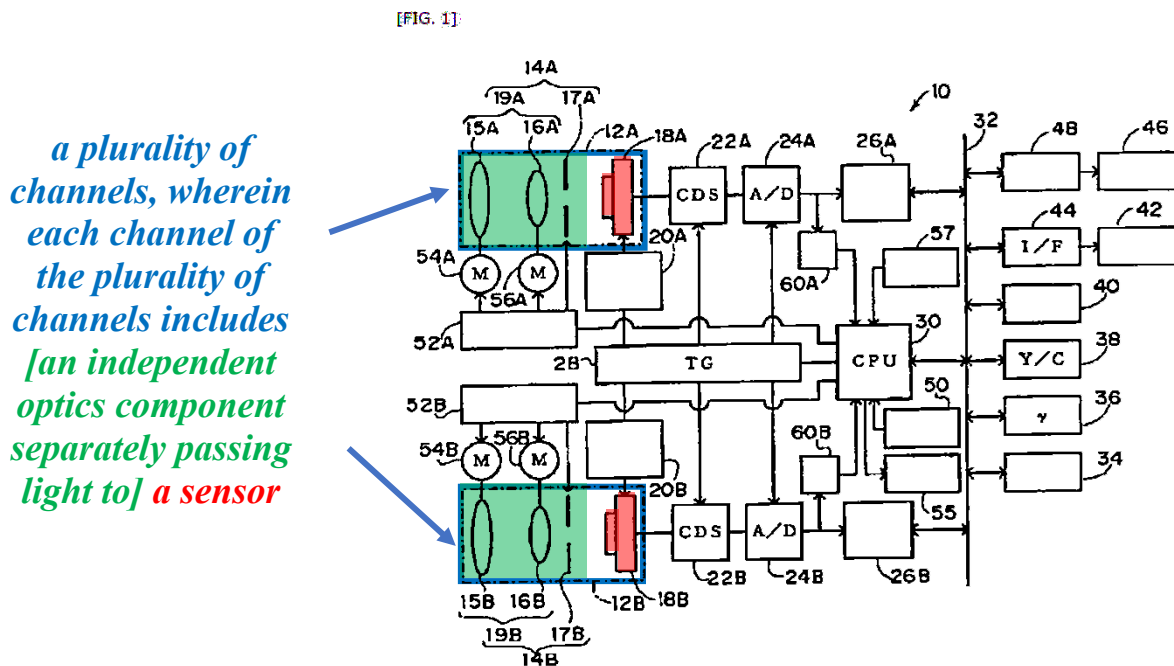
Thus, Matsushima discloses or at least renders obvious [9.0]. Ex.1003, ¶117.

[9.1] a plurality of channels, wherein each channel of the plurality of channels includes a sensor; and

Matsushima discloses or at least renders obvious [9.1]. Ex.1003, ¶¶118-121.

Matsushima discloses *a plurality channels* (two channels 12A and 12B), where a first channel (imaging system 12A) includes optics 14A passing light to

sensor 18A, and a second channel includes (imaging system 12B) includes optics 14B passing light to sensor 18B. Ex.1007, [0017]; Ex.1003, ¶119.



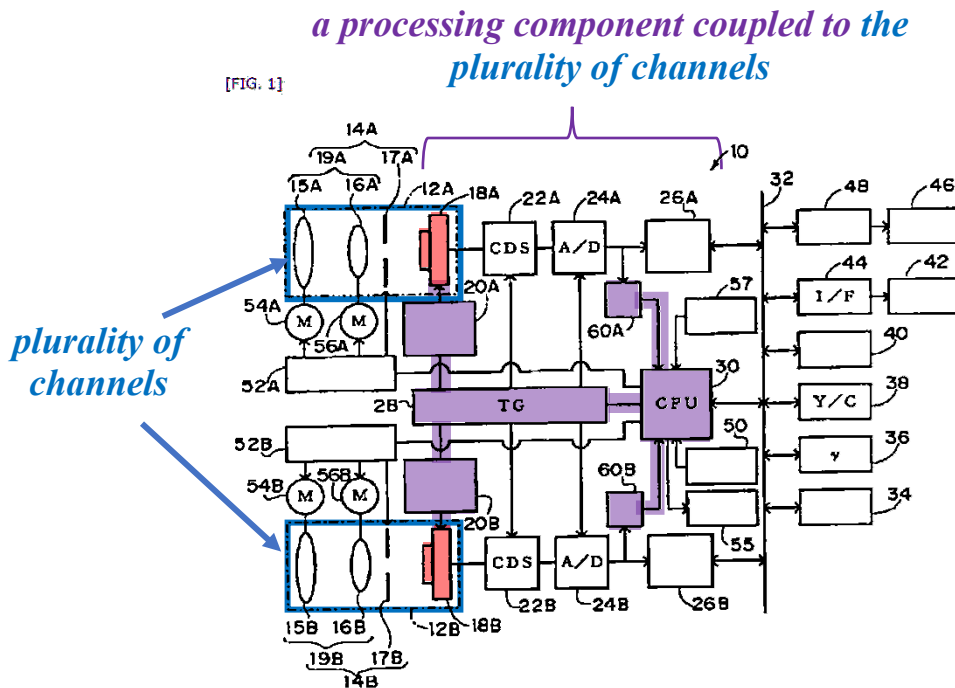
Ex.1007, FIG. 1, annotated; Ex.1003, ¶119.

Further, Matsushima teaches a plurality of channels under the construction in Toyota IPR (VII.A), because Matsushima's plurality of channels separately pass light to a different respective sensor (independent imaging system 12A passing light to sensor 18A, and independent imaging system 12B passing light to sensor 18B). Ex.1003, ¶120.

Thus, Matsushima discloses or at least renders obvious [9.1]. Ex.1003, ¶121.

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

Matsushima discloses or at least renders obvious [9.2.1]. Ex.1003, ¶¶122-124.



Ex.1007, FIG. 1, annotated; Ex.1003, ¶122.

As shown in annotated FIG. 2 above, Matsushima discloses *a processing component* (CPU 30 together with integration circuits 60A and 60B, Timing Generator (TG) 28 and CCD drive circuits 20A and 20B) *coupled to the plurality of channels* (image systems 12A and 12B, respectively). Ex.1007, [0027], [0034]; Ex.1003, ¶123.

Thus, Matsushima discloses or at least renders obvious [9.2.1]. Ex.1003, ¶124.

[9.2.2] wherein the processing component is configured to determine an integration time of each channel of the plurality of channels,

Matsushima discloses or at least renders obvious [9.2.2]. Ex.1003, ¶¶125-127.

As discussed above at Ground 1:[1.3], [8.0], and [9.1], Matsushima describes that *processing component* (CPU 30 together with integration circuits 60A and 60B, Timing Generator (TG) 28 and CCD drive circuits 20A and 20B) *is configured to determine an integration time* (charge accumulation time) *of each channel* (each of image systems 12A and 12B). Ex.1007, [0027], [0034]; Ex.1003, ¶126. As discussed in Ground 1:[8.0], the integration time is determined based on the incident light level/subject luminance. Ex.1003, ¶126.

Thus, Matsushima discloses or at least renders obvious [9.2.2]. Ex.1003, ¶127.

[9.2.3] wherein the processing component is configured to combine data from the plurality of channels received to provide an image.

Matsushima discloses or at least renders obvious [9.2.3]. Ex.1003, ¶¶128-131.

First, as discussed at Ground 1:[9.1] and [9.2.1], Matsushima discloses or at least renders obvious the plurality of channels, wherein each channel of the plurality of channels includes a sensor, and the processing component coupled to the plurality of channels. Ex.1007, [0017], [0027], [0034], Fig. 1; Ex.1003, ¶129.

Second, as discussed at Ground 1:[5.0], Matsushima discloses or at least renders obvious that the processing component is configured to combine data from the plurality of sensors received to provide an image. Ex.1007, [0048]-[0051], Figs. 4 and 6; Ex.1003, ¶130.

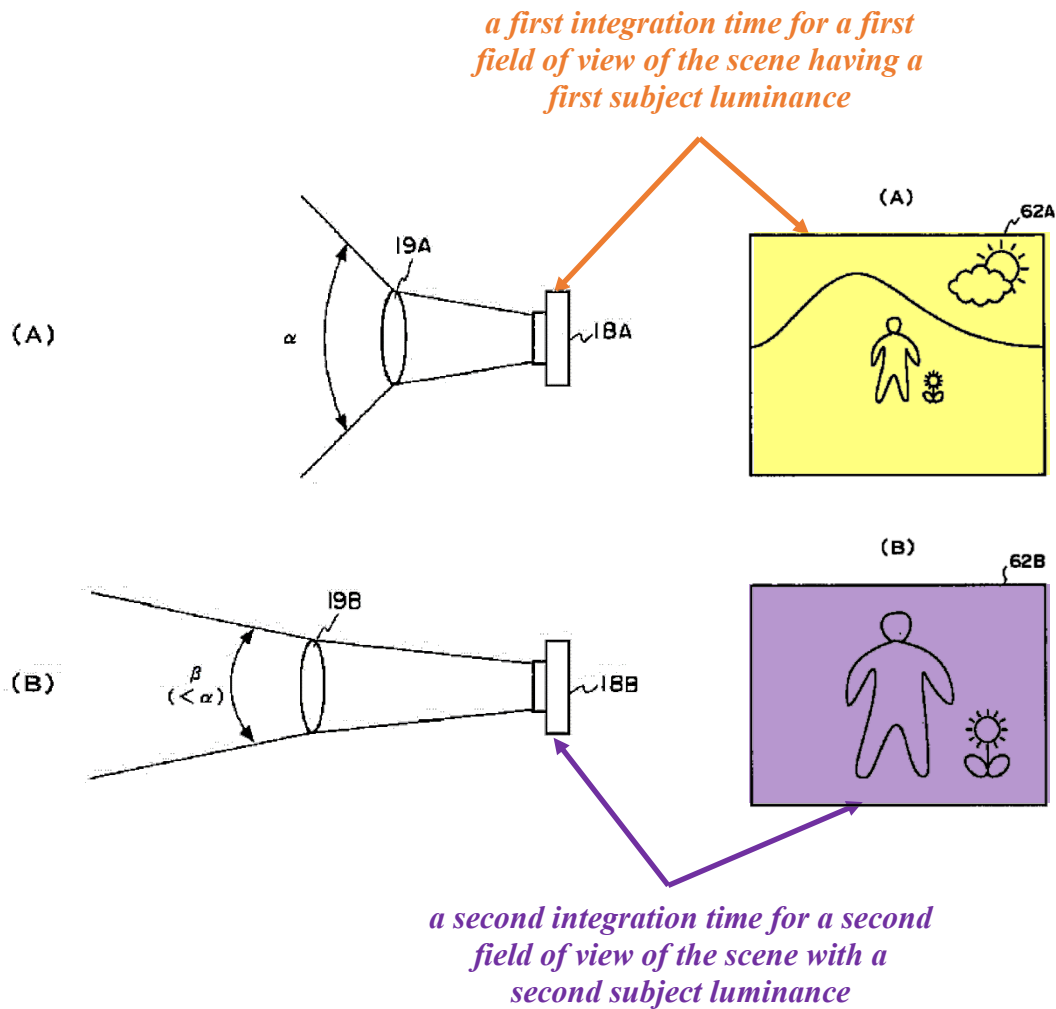
Accordingly, Matsushima discloses or at least renders obvious [9.2.3], because Matsushima's processing component combines data from the respective sensors in the plurality of channels to provide an image. Ex.1007, [0017], [0027], [0034], [0048]-[0051], Figs. 4 and 6; Ex.1003, ¶131.

f. Claim 11

[11.0] The system of claim 9, wherein the integration time of at least one channel is relatively shorter than the integration time of at least one other channel.

Matsushima renders obvious [11.0]. Ex.1003, ¶¶132-135.

As discussed above at Ground 1:[1.3] and [9.1] and shown in FIGS. 2 and 3 below, Matsushima in view of a POSITA's knowledge renders obvious that *the integration time of at least one channel* (e.g., imaging system 12A with wider FOV with a higher subject luminance) *is relatively shorter than the integration time of at least one other channel* (e.g., imaging system 12B with narrower FOV with a lower subject luminance). Ex.1007, [0020]; Ex.1003, ¶133.



Ex.1007, FIGS. 2-3, annotated; Ex.1003, ¶133.

Matsushima describes capturing images with different field of views (different shooting angles α and β) using two channels (independent imaging systems 12A and 12B), respectively. Ex.1007, [0017]. A POSITA would have understood that in Matsushima, the integration times of the image sensors would have different values for different subject luminance of different FOVs. Ex.1003, ¶134. This is because the first subject luminance of the shooting angle α and the second subject luminance of the shooting angle β are determined independently (by

integration circuits 60A and 60B). 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 sensor. Ex.1003, ¶134. A broad dynamic range is achieved by combining images 62A and 62B having different integration times for different regions in a scene. Ex.1003, ¶134 (expanding intra-scene dynamic range using images with different integration times were well-known, citing Ex.1009, 9; Ex.1024, 3; Ex.1025, 7, FIG. 8; Ex.1026, 1).

Thus, Matsushima renders obvious [11.0]. Ex.1003, ¶135.

g. Claim 13

[13.0] The system of claim 9, wherein the processing component is configured to automatically control the integration time of each sensor.

Matsushima discloses or renders obvious [13.0]. Ex.1003, ¶¶136-138.

As discussed above at Ground 1:[1.3] and [8.1], in Matsushima, *the processing component* (CPU 30 together with integration circuits 60A and 60B, Timing Generator (TG) 28 and CCD drive circuits 20A and 20B) *is configured to automatically control* (using automatic exposure control to control an electronic shutter of each sensor) *the integration time* (charge accumulation time/shutter speed)

of each sensor based on incident light level (subject luminance/imaging EV value for each sensor). Ex.1005, [0029] (“The CPU 30 controls the corresponding circuit blocks based on signals inputted from a control panel 50, controls the zooming operations of the imaging lenses 15A and 15B and the autofocusing (AF) operations of the focus lenses 16A and 16B, and *performs automatic exposure adjustments (AE).*”), [0034] (“For AE control, the subject luminance (imaging EV value) is determined based on integration of the R, G, and B signals in a single frame by the integration circuits 60A and 60B, and the aperture value and shutter speed are determined based on this imaging EV value.”); [0035] (“During imaging and recording, the AF operation is performed when the release button is ‘half-pressed,’ and the metering operation is repeated several times to obtain the exact imaging EV. The final aperture value and shutter speed for imaging is then determined based on the imaging EV.”); Ex.1003, ¶137.

Thus, Matsushima discloses or renders obvious [13.0]. Ex.1003, ¶138.

h. Claim 14

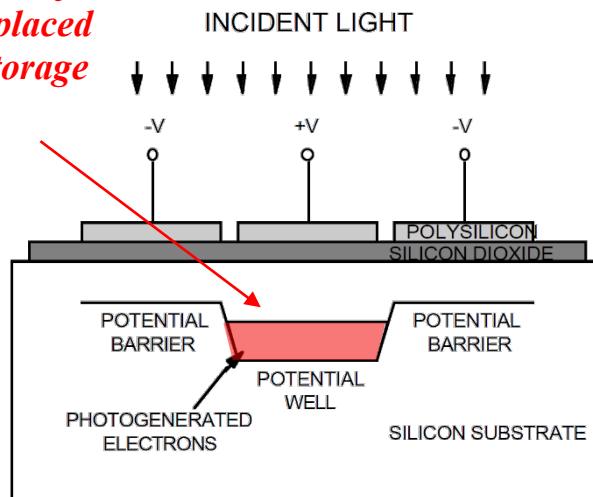
[14.0] The system of claim 9, wherein the integration time is used to control an amount of electrical charge placed on one or more storage devices associated with a sensor.

Matsushima discloses or renders obvious [14.0]. Ex.1003, ¶¶139-141.

As discussed at Ground 1:[1.3], in Matsushima:[1.3], *the integration time (charge accumulation time) is used to control an amount of electrical charge*

(accumulation of charge/electrons) *placed on one or more storage devices associated with a sensor* (photosensitive devices/photodiode array/pixels of the sensor). Ex.1007, [0035]; [0024] (“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”); [0002] (“The signal charges accumulated by the CCD are **retrieved pixel by pixel**”); Ex.1008, 2 (“In a *CCD imager* with a built in electronic shutter, the entire imager is reset before integration to remove any residual signal in the photodiodes. **The photodiodes then accumulate charge for some period of time.**”); Ex.1003, ¶140.

control an amount of electrical charge placed on one or more storage devices



Ex.1023, 5, annotated; Ex.1003, ¶140.

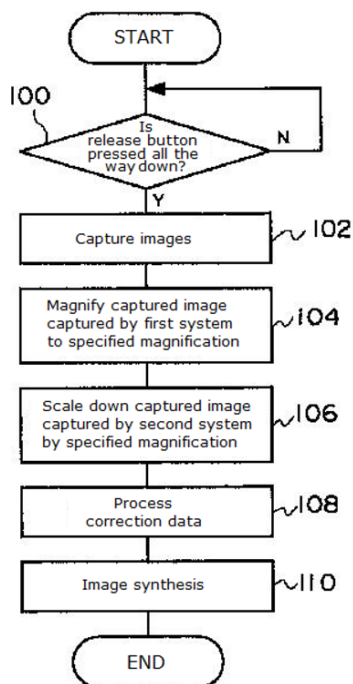
Thus, Matsushima discloses or renders obvious [14.0]. Ex.1003, ¶141.

i. Claim 15**[15.0] A method comprising:**

Matsushima discloses or renders [15.0] obvious. Ex.1003, ¶¶142-144.

As shown in FIG. 7 below, Matsushima describes a *method* for capturing images from two independent imaging systems 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 “the control routine executed by CPU 30 to perform the actions...described with reference to the flowchart in FIG. 7”); Ex.1003, ¶143.

[FIG. 7]

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

Thus, Matsushima discloses or renders obvious [15.0]. Ex.1003, ¶144.

[15.1] identifying an integration time for each of a plurality of channels of an image capture device, wherein the plurality of channels includes a plurality of sensors;

Matsushima discloses or at least renders obvious [15.1]. Ex.1003, ¶¶145-148.

First, as discussed at Ground 1:[9.1], Matsushima discloses *a plurality channels* (independent imaging systems 12A and 12B) of an image capture device (digital camera 10), where *the plurality of channels* (two channels 12A and 12B) *includes a plurality of sensors* (sensors 18A and 18B). Ex.1007, [0017]; Ex.1003, ¶146.

Second, as discussed at Ground 1:[1.3] and [8.0], Matsushima controls *the integration time* (charge accumulation time/shutter speed), which includes *identifying* (determining) *the integration time* (based on incident light level, i.e., subject luminance/imaging EV value) for each of sensors 18A and 18B, respectively. Ex.1007, [0034]-[0035]; Ex.1003, ¶147.

Accordingly, Matsushima describes *identifying an integration time* (determining charge accumulation time for automatic exposure control) *for each of a plurality of channels* (independent imaging systems 12A and 12B) *of an image capture device* (digital camera 10), wherein *the plurality of channels includes a plurality of sensors* (sensors 18A and 18B). Ex.1007, [0034]-[0035], [0017]. Thus, Matsushima discloses or at least renders obvious [15.1]. Ex.1003, ¶148.

[15.2] capturing data with each of the plurality of sensors, wherein the data captured by each sensor is based at least in part on the integration time of the sensor; and

Matsushima discloses or at least renders obvious [15.2]. Ex.1003, ¶¶149-151.

As discussed at Ground 1:[1.3], [2.0] and [5.0], in Matsushima, the processing component (CPU 30) performs *capturing data* (images 62A and 62B) *with each of the plurality of sensors* (sensors 18A and 18B), *wherein the data captured by each sensor is based at least in part on the integration time of the sensor* (charge accumulation time determined based on subject illuminance with automatic exposure control). Ex.1007, [0034], [0037]; Ex.1003, ¶150.

Thus, Matsushima discloses or at least renders obvious [15.2]. Ex.1003, ¶151.

[15.3] generating an image by combining the data captured by each of the plurality of sensors.

Matsushima discloses or at least renders obvious [15.3] for the same reasons presented above for Ground 1:[5.0]. Ex.1003, ¶152.

j. Claim 16

[16.0] The method of claim 15, wherein a first integration time of a first sensor is less than a second integration time of a second sensor.

Matsushima renders obvious [16.0] for the same reasons presented above for Ground 1:[11.0]. Ex.1003, ¶153.

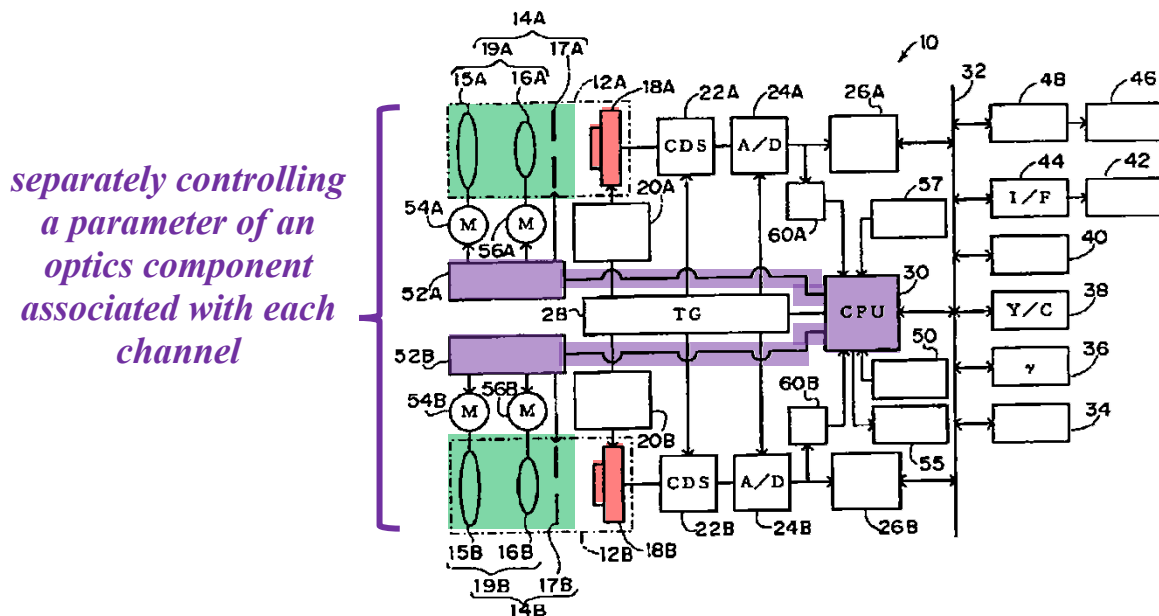
k. Claim 19

[19.0] The method of claim 15, further comprising separately controlling a parameter of an optics component associated with each channel of a plurality of channels.

Matsushima discloses or at least renders obvious [19.0]. Ex.1003, ¶¶154-156.

As shown in FIG. 1 below, Matsushima describes *separately controlling* (CPU 30 separately controlling first channel 12A with integration circuit 60A and driving circuit 52A with motors 54A and 56A, and separately controlling second channel 12B with integration circuit 60B and driving circuit 52B with motors 54B and 56B) *a parameter of an optics component* (focus position, aperture value, zoom position/FOV) of the digital imaging system. Ex.1007, [0031]-[0034] (describing CPU 30 separately controlling zoom motors 54A and 54B for controlling zoom position/FOV, and motors 56A and 56B for controlling focus positions and aperture values); Ex.1003, ¶155.

[FIG. 1]



Ex.1007, FIG. 1, annotated; Ex.1003, ¶155.

Thus, Matsushima discloses or at least renders obvious [19.0]. Ex.1003, ¶156.

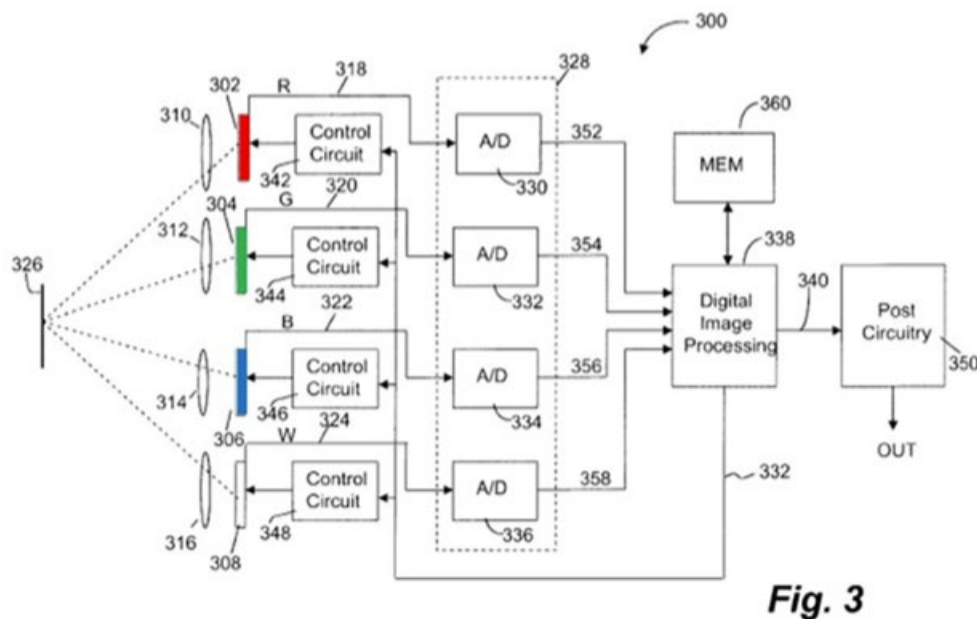
E. Ground 2: Claims 1-2, 4-5, 8-11, 13, and 14 Would Have Been Obvious Over Yu and Miyazaki.

As discussed in Section V, the '158 patent describes an embodiment, relative to FIG. 3, that includes a digital camera with integration times configured for four channels for different bands/spectra of light and thereby provide a large dynamic range imaging capability. Such a digital camera and related methods were well-known in the art, as shown below. Ex.1003, ¶¶157-250.

1. Overview of Yu

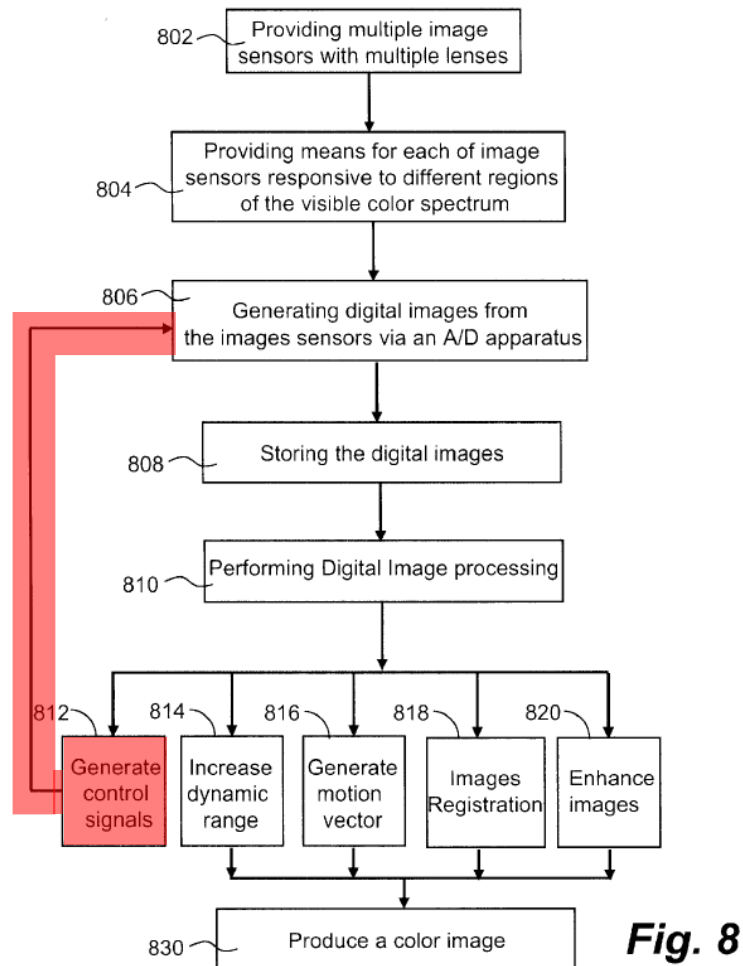
Yu is directed to “digital cameras [that] use multiple image sensors with multiple lenses.” Ex.1005, Abstract. As shown in FIG. 3, below, Yu’s “digital

camera uses **four image sensors, each having its own lens**, of which three image sensors are made responsive to the three primary colors [red, green, blue] and the fourth one [is] made responsive to all intensity information.” *Id.*, 2:40-44. Yu’s Figure 3, below, is annotated to depict the three image sensors integrated with red, green, and blue color filters (302, 304, and 306, respectively), and the fourth image sensor (308) not integrated with a color filter. Ex.1003, ¶158.



Ex.1005, FIG. 3, annotated; Ex.1003, ¶158.

Referring to FIG. 8, below, Yu describes that “each of the image sensors is **respectively and independently controlled** to expose to the same imaging target.” Ex.1005, 9:66-10:1; Ex.1003, ¶159 (citing Ex.1005, 10:6-16).

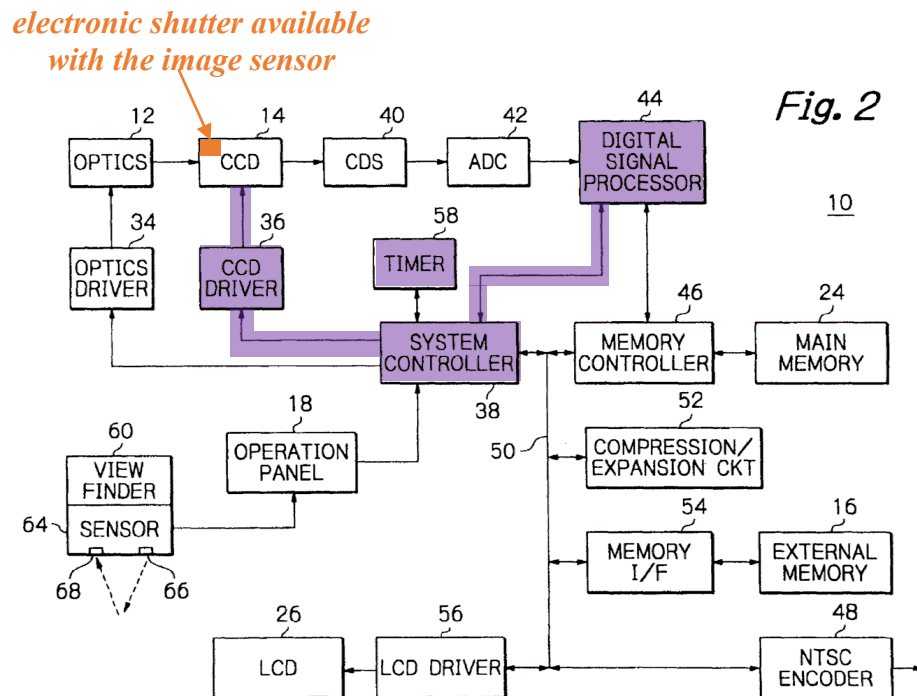


Ex.1005, Fig. 8, annotated; Ex.1003, ¶159.

While the analysis herein focuses on Yu's embodiment including three color sensors with a B/W sensor, the analysis similarly applies to other embodiments of Yu (e.g., embodiment including three color sensors without a B/W sensor). Ex.1003, ¶160.

2. Overview of Miyazaki

As illustrated in FIG. 2 below, Miyazaki describes a digital camera 10, which “includes a CCD image sensor 14 to which an optical image representative of a scene...is incident via optics 12.” Ex.1006, 3:15-17; Ex.1003, ¶161.



Ex.1006, FIG. 2, annotated; Ex.1003, ¶161.

Miyazaki describes that a “digital signal processor 44 and system controller 38 control **the electronic shutter available with the image sensor 14.**” Ex.1006, 9:48-49. An electronic shutter as described in Miyazaki is an on-sensor electronic shutter “available with the image sensor” itself, and is configured “for **controlling the duration of charge storage**” by that sensor—*i.e., integration time*. *Id.*, 9:11-14, 47-51; Ex.1003, ¶162 (citing Ex.1008, 2; Ex.1001, 2:31-34, 4:46-56).

3. Analysis

a. Claim 1

[1.0] An image capture device comprising:

To the extent the preamble is limiting, Yu discloses or renders it obvious. Ex.1003, ¶¶163-166.

Specifically, Yu describes an *image capture device* (a digital camera 300) that “uses four identical image sensors 302, [3]04, 306, and 308” that each image the same scene (target 326), as shown in FIG. 3 below. Ex.1005, 4:66-67. “[S]ensed images of target 326 from image sensors 302, 304, 306, and 308 can be digitized in parallel....” Ex.1005, 5:47-49. 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; Ex.1003, ¶164.

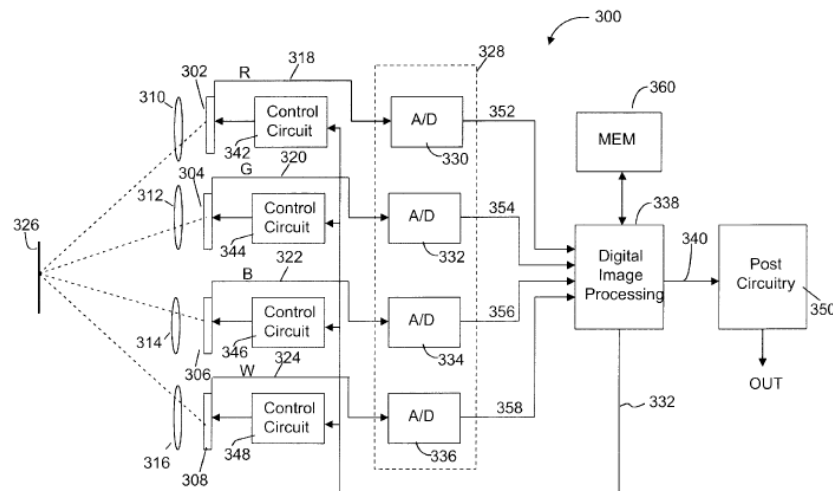


Fig. 3

Ex.1005, FIG. 3

Further, Yu teaches *an imaging capture device* under the construction in GM Litigation (VII.B), because the digital camera 300 illustrated in FIG. 3 is *an image capture device* that includes a plurality of sensors (image sensors 302, 304, 306, and 308) each capturing an overlapping portion of the same scene (including target 326). Ex.1003, ¶165.

Thus, Yu discloses or at least renders obvious [1.0]. Ex.1003, ¶166.

[1.1] a plurality of sensors;

Yu discloses or at least renders obvious [1.1]. Ex.1003, ¶¶167-169.

As shown in FIG. 3, below, Yu's imaging system (digital camera 300) includes *a plurality of sensors* ("four identical image sensors 302, [3]04, 306, and 308"). Ex.1005, 4:62-67; Ex.1003, ¶168.

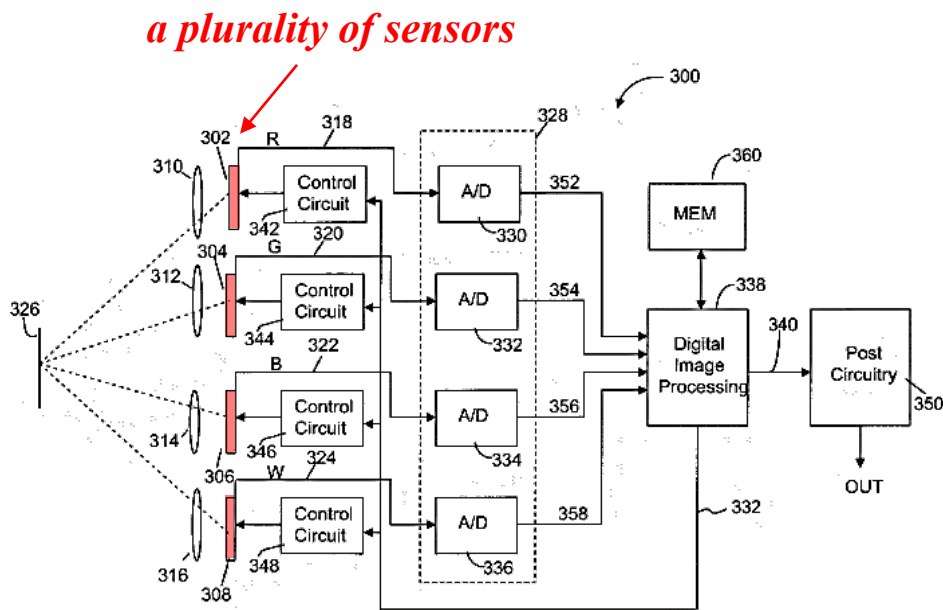


Fig. 3

Ex.1005, FIG. 3, annotated; Ex.1003, ¶168.

Thus, Yu teaches *a plurality of sensors* (image sensors 302, 304, 306, and 308). Ex.1003, ¶169.

[1.2] a plurality of optics components, wherein each optics component of the plurality of optics components is configured to pass light to a sensor of the plurality of sensors; and

Yu discloses or at least renders obvious [1.2]. Ex.1003, ¶¶170-174.

First, Yu describes “optical lenses,” which are *optics components*. Ex.1005, 2:64-65 (“the size of the image sensors could be smaller, resulting in smaller *optical lenses*”). A POSITA would have understood that lenses 310, 312, 314, and 316 in FIG. 3 are optical lenses, and therefore that Yu teaches *a plurality of optics components*. Ex.1003, ¶171.

The ’158 patent confirms that optical lenses are examples of “*optics components*.” Ex.1001, 7:23-31, 15:50-53 (“*Each of the optics portions 1504A-1504D may include a lens, and may be associated with a respective one of the sensor arrays 1504A-1504D*”). Similarly, Yu’s optical lenses 310, 312, 314, and 316, which are associated with respective image sensors 302, 304, 306, and 308, disclose *optics components*, as described and claimed. Ex.1003, ¶172.

each optics component...is configured to pass light [separately] to a [distinct] sensor

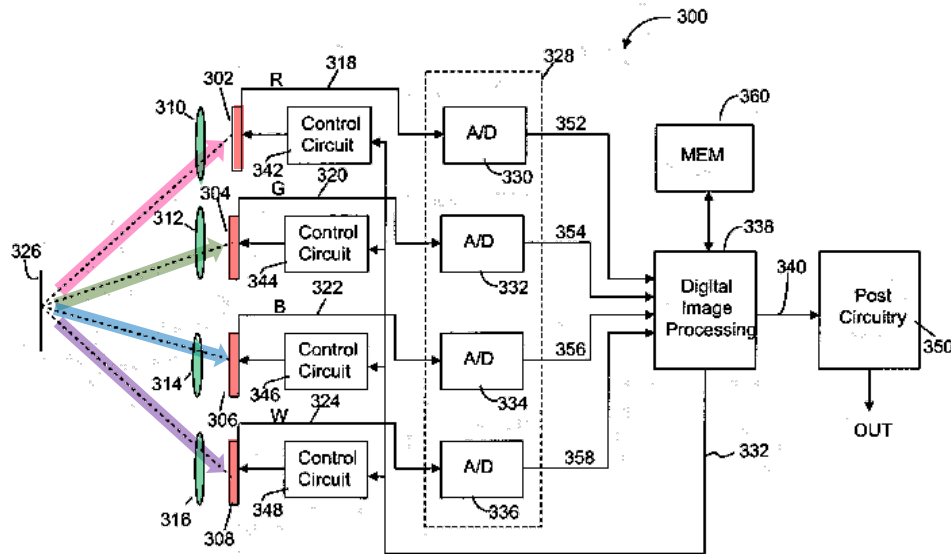


Fig. 3

Ex.1005, FIG. 3, annotated; Ex.1003, ¶172.

Second, as shown in Yu's FIG. 3 above, each of Yu's optical lenses 310, 312, 314, and 316 (*each of the plurality of optics components*) is *configured to pass light* (e.g., from target 326) *separately to a distinct sensor of the plurality of sensors* (sensors 302, 304, 306, and 308). Ex.1005, 2:40-44 ("an improved digital camera uses four image sensors, *each having its own lens*"); *see also* Ex.1005, 11:12-13; 11:21-23. Specifically, in FIG. 3, lens 310 passes light separately to a distinct sensor 302, lens 312 passes light separately to a distinct sensor 304, lens 314 passes light separately to a distinct sensor 306, and lens 316 passes light separately to a distinct sensor 308. Yu's system does *not* rely on a common optics component to pass light to multiple camera channels. Ex.1003, ¶173.

Thus, Yu teaches *a plurality of optics components* (lenses 310, 312, 314, 316), *wherein each optics component of the plurality of optics components is configured to pass light* (from target 326 whose image is being captured) *to a sensor of the plurality sensors* (e.g., lens 310 passing light separately to a distinct sensor 302, lens 312 passing light separately to a distinct sensor 304, lens 314 passing light separately to a distinct sensor 306, and lens 316 passing light separately to a distinct sensor 308). Ex.1003, ¶174.

[1.3] a processing component configured to control an integration time of each sensor.

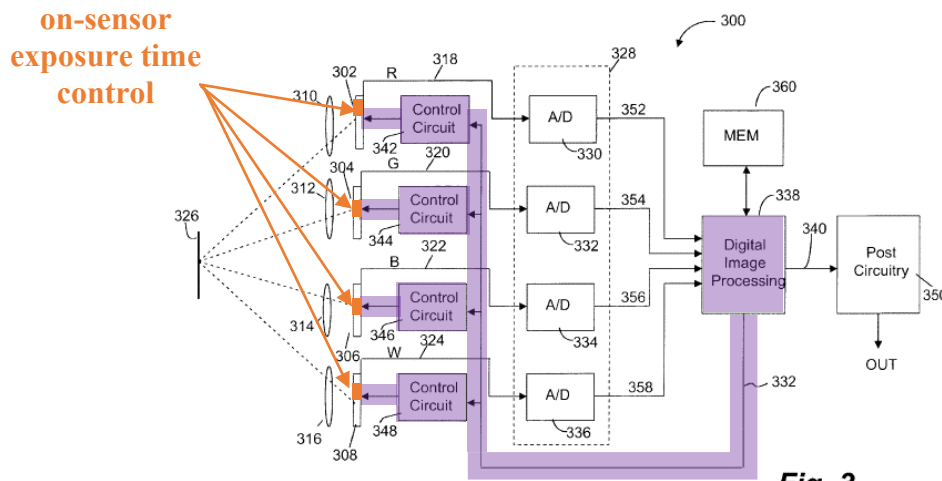
Yu alone or in view of Miyazaki (Yu-Miyazaki) renders obvious [1.3]. Ex.1003, ¶¶175-201.

i. Yu alone renders obvious this limitation.

As discussed at Ground 1:[1.3], “integration time” refers to “the time the image sensor collects and integrates signal from the scene,” and is synonymous with charge accumulation time. Ex.1001, 4:5-6; VII.B (previous construction in GM Litigation); Ex.1003, ¶176. The ’158 patent also acknowledges that “integration time” is controlled with an electronic shutter provided on the sensor. Ex.1001, 2:31-34; Ex.1008, 2 (discussing an on-sensor electronic shutter and an external mechanical shutter in front of a sensor as alternative techniques for controlling exposure time of a sensor); Ex.1003, ¶176.

In prior art literature describing digital cameras, “exposure time” and “integration time” are often used interchangeably in the context of an image sensor with an on-sensor exposure control (e.g., an electronic shutter). Ex.1028, 1821n.1 (“we use *integration time and exposure time interchangeably*”); Ex.1022, 1:22-24; Ex.1027, 3:10-12 (“Several images at different *exposures (charge-integration periods)* are acquired and then combined into a single image.”); Ex.1029, 1; Ex.1012, 2, 4; Ex.1003, ¶177. In a digital camera, an on-sensor electronic shutter does not physically open or close; instead, it controls the exposure time by controlling the sensor’s integration time, which controls how long the image sensor collects and integrates signal from the scene. Ex.1008, 2; Ex.1003, ¶177.

As shown in FIG. 3 below, Yu discloses *a processing component* (digital image processing circuitry 338, together with control circuits 342, 344, 346, and 348) configured to control each sensor, including controlling an *integration time* (exposure time) *of each sensor* with its respective on-sensor exposure control. Ex.1003, ¶178.

**Fig. 3**

a processing component configured to control an integration time of each sensor

Ex.1005, FIG. 3, annotated; Ex.1003, ¶178.

Yu describes its digital image processing circuitry 338 for providing “[a]ll necessary control signals” to control each sensor, including producing control signals “each controlling the exposure time” of each sensor. Ex.1005, 6:59-65 (“All necessary controls signals may be obtained from **digital image processing circuitry 338** that operates on four digital image 352, 354, 356 and 358 respectively and independently resulting from image sensors 302,304, 306 and 308”); Ex.1005, 11:39-42, 12:10-14, 12:16-18 (“digital image processing circuitry produces four control signals, **each controlling the exposure time of one of said four image sensors** by analyzing respectively said four digital images”), 12:21-23; 9:50-52 (“With images independently from multiple sensors with multiple lenses, the complementary expansions of the respective dynamic ranges become possible”);

Ex.1003, ¶179. Yu describes that “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.” Ex.1005, 6:52-58; Ex.1003, ¶179.

Accordingly, Yu discloses *a processing component* (digital image processing circuitry 338, together with control circuits 342, 344, 346, and 348) *configured to control each sensor*, where control circuit 342 controls image sensor 302, control circuit 344 controls image sensor 304, where control circuit 346 controls image sensor 306, and control circuit 348 controls image sensor 308. In each case, control of the respective sensor includes independent control of its exposure time. Ex.1003, ¶180.

Yu’s “controlling exposure time” of each sensor means “*controlling an integration time*” based on how Yu describes its control system. Ex.1003, ¶181. Specifically, Yu describes controlling exposure time by sending signals **to the sensors themselves**, rather than controlling a mechanical shutter separate from the sensors. Ex.1005,12:15-19 (“digital image processing circuitry produces four control signals, each controlling the exposure time of one of said four image sensors”); FIG. 3 (each control circuit 342, 344, 346, and 348 providing an exposure time control signal to sensors 302, 304, 306, and 308, respectively); Ex.1003, ¶181.

Thus, Yu does not control exposure by controlling the amount of time light is allowed to fall upon the sensors using mechanical shutters external to the sensors, but rather controls exposure time by controlling the duration a sensor collects and integrates the electronic signal from the scene, which is also referred to as integration time or charge accumulation period. Ex.1003, ¶182 (citing Ex.1039, 3; Ex.1008, 2 and Ex.1009, 4; Ex.1036, 14:1-3, 25:41-42, Ex.1037, 3:35, 4:16; Ex.1012, 2, 4 using “integration time” and “exposure time” interchangeably in the context of image sensors using on-sensor exposure control).

Yu’s disclosure of controlling exposure time at the sensor itself is consistent with the description in the ’158 patent of controlling integration time at the sensor. Ex.1001, 4:46-56 (“Integration time control...controls the time the electrical signal is integrated or accumulated by controlling a switch (e.g., charge integration switch) coupled or connected to the sensor or a photo-detection mechanism of a sensor.”), 5:33-54 (describing “sensor camera channel output values” with different integration times as “**with different exposure times**”); *see also* Ex.1003, ¶183 (citing Ex.1008, 2 and explaining that in digital cameras, the exposure time of an image sensor may be controlled “either by incorporating an external mechanical shutter in front of the image sensor or by incorporating an on-sensor electronic shutter,” and the on-sensor electronic shutter controls the sensor’s exposure time by controlling its integration time); Ex.1028, 1821 n.1, Ex.1022, 1:22-24; Ex.1027, 3:10-12; Ex.1029, 1).

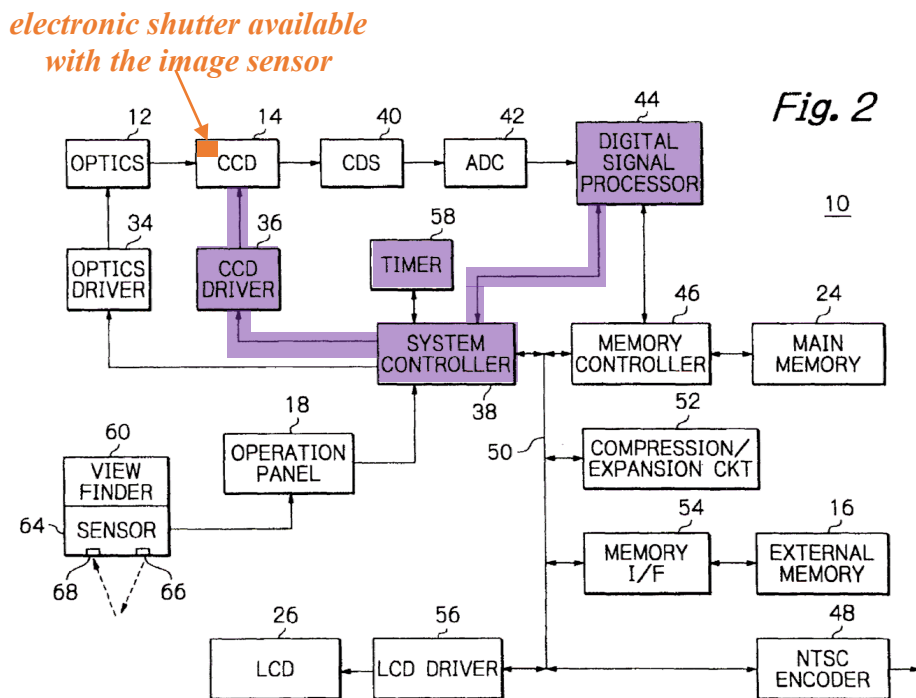
ii. Combination of Yu and Miyazaki (Yu-Miyazaki) renders obvious this limitation.

To the extent it is argued that Yu’s description of using sensor-level exposure time control to control the exposure time of that sensor does not explicitly teach controlling *an integration time of each sensor*, Yu in view of Miyazaki renders this limitation obvious. Ex.1003, ¶¶184-201.

As illustrated in FIG. 2 below, Miyazaki describes a digital camera 10, in which “the digital signal processor 33 and system controller 38 **control the electronic shutter available with the image sensor 14.**” Ex.1006, 9:48-39. The electronic shutter as described in Miyazaki was a well-known element in digital cameras, which POSITAs referred to as “an on-chip electronic shutter” located on the image sensor and understood is “for controlling integration time” of that sensor. Ex.1003, ¶185 (quoting Ex.1008, 2). The ’158 patent acknowledges that “integration time” is controlled with an “electronic shutter,” as described in Miyazaki. Ex.1001, 2:31-34; Ex.1003, ¶185.

Consistent with this common understanding, Miyazaki describes that “the [system] controller 38 feeds an electronic shutter control signal to the CCD driver 36 for **controlling the duration of charge storage** in the CCD image sensor 14.” Ex.1006, 9:11-14. Consistent with the ’158 patent’s disclosure, it was well-known that controlling the duration of charge storage using an electronic shutter is

controlling the integration time during which the sensor collects and integrates/accumulates the electronic charges from photon conversion to generate a signal. Ex.1001, 4:46-56 (describing charge accumulation time as synonymous with integration time); Ex.1007, [0035] (describing that “charge accumulation time is controlled using an electronic shutter”); Ex.1003, ¶186 (citing Ex.1036, 14:1-3, 25:41-42, Ex.1037, 3:35, 4:16 using “charge accumulation period” and “integration time” interchangeably). Miyazaki’s description of the sensors collecting and accumulating charge is consistent with the construction of “*integration time*” in the GM Litigation. VII.B; Ex.1015, 49 (“the time the image sensor collects and integrates signal from the scene”); Ex.1003, ¶187.



Ex.1006, FIG. 2, annotated; Ex.1003, ¶187.

As exemplified below, a POSITA would have been motivated to apply Miyazaki's teaching of using an on-sensor electronic shutter on a sensor to control the integration time of that sensor, for each sensor of Yu's multi-sensor multi-lens digital camera. Ex.1003, ¶188.

*controlling an electronic shutter
on each sensor to control an
integration time of that sensor*

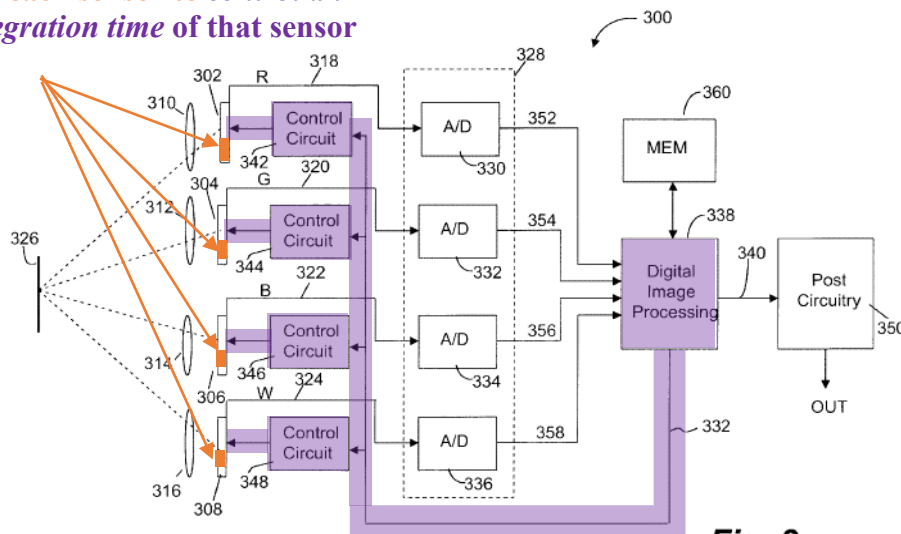


Fig. 3

*a processing component configured to control an
integration time of each sensor by controlling an
electronic shutter on that sensor*

Example Combination of Yu-Miyazaki (Ex.1005, FIG. 3, annotated);

Ex.1003, ¶188.

Yu and Miyazaki are each analogous prior art to the '158 patent because they pertain to the same field of endeavor, namely, "[d]igital camera systems and methods." Ex.1001, 3:39-40; Ex.1005, Title ("Digital Cameras using Multiple Sensors with Multiple Lenses"); Ex.1006, Title ("Image Pickup Apparatus for Producing a Desired Frame of Image Signals"). Ex.1003, ¶189.

Yu and Miyazaki are also analogous art to the '158 patent because they are each pertinent to a particular problem of the '158 patent, such as the problem of controlling an exposure time/integration time of a sensor. Ex.1001, 1:32-34 (“The dynamic range of an image sensor can be increased by using multiple exposure times and/or integration times”); Ex.1005, 12:16-19 (“digital image processing circuitry produces four control signals, each controlling the exposure time of one of said four image sensors by analyzing respectively said four digital images”); Ex.1006, 4:16-19 (“the camera 10 controls a shutter speed, i.e., an exposure time at the time of a shot by controlling the mechanical shutter and an electronic shutter available with the CCD image sensor 14.”). Ex.1003, ¶190.

A POSITA would have been motivated to apply, in Yu’s digital camera, Miyazaki’s teaching of an on-sensor electronic shutter to provide the independent on-sensor control of exposure time for each image sensor (as described in Yu) and, accordingly, the integration time of each sensor in Yu’s digital camera, because doing so would provide the benefit of a fast, reliable, and small digital camera. Ex.1023, 11 (“Electronic exposure, which is much more accurate and reliable than mechanical shuttering, allows very versatile operation for systems or cameras.”); Ex.1003, ¶191. First, by using an on-sensor electronic shutter as taught by Miyazaki which allows a fast shutter speed, Yu-Miyazaki would capture fast-moving subjects with reduced blur. Ex.1010, 8 (“Electronic shuttering, also known as electronic

exposure timing in photographic terms, is a standard feature [of an image sensor]....This feature can be especially useful in situations such as imaging of fast moving objects where normal integration times [e.g., when using a mechanical shutter] cause smear, blurring, or image tear.”). Using on-sensor electronic shutters as taught by Miyazaki allows for the elimination of any mechanical shutter in Yu-Miyazaki, which would allow for a more compact and lightweight camera due to the elimination of mechanical moving parts and the associated manufacturing and maintenance costs. Ex.1008, 2; Ex.1003, ¶191.

A POSITA would have been motivated to use an on-sensor electronic shutter to control an integration time of that sensor, as taught by Miyazaki, in Yu’s multi-sensor multi-lens digital camera. Ex.1003, ¶192. Yu describes a need to use an on-sensor exposure control to control an exposure time of each of its plurality of sensors. Ex.1005, FIG. 3, 12:16-19 (“digital image processing circuitry produces four control signals, **each controlling the exposure time of one of said four image sensors.**”). It was well-known that an electronic shutter is an on-sensor exposure control to control the exposure time (by controlling the integration time) of an image sensor. Ex.1003, ¶192 (citing Ex.1008, 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).

Yu does not describe the implementation details of its on-sensor exposure

time control. Accordingly, a POSITA would have used, for each sensor in Yu's multi-sensor multi-lens digital camera system, an on-sensor electronic shutter to control the exposure time by controlling the integration time of that sensor as taught by Miyazaki, (Ex.1006, 9:11-14), because electronic shutters were a standard feature in image sensors and provide the required function of Yu's on-sensor exposure time control. Ex.1003, ¶193 (citing Ex.1010, 8; Ex.1008, 2).

Yu-Miyazaki would have been a combination of prior art elements (Yu's digital camera with independent control of the exposure time of each of the multiple image sensors with an electronic shutter of an image sensor configured to control the integration time, as taught by Miyazaki) according to known methods (controlling each electronic shutter of each image sensor to control the integration time of the sensor) to yield the predictable result of varying sensor integration time for exposure control. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007); Ex.1003, ¶194.

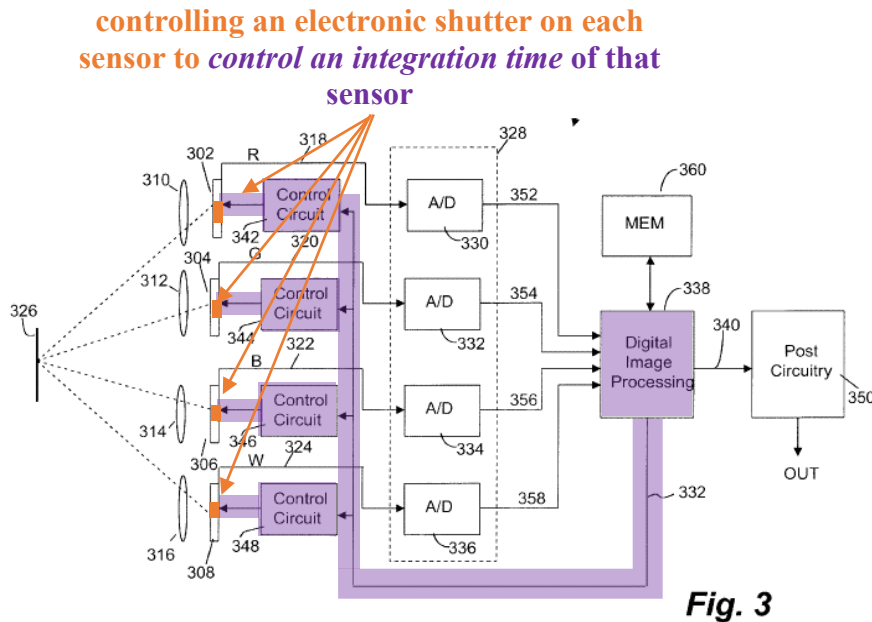
In addition, modifying Yu's multi-sensor multi-lens digital camera to implement, for each of the multiple sensors, controlling an on-sensor electronic shutter to control the integration time of that sensor as taught by Miyazaki would improve a similar device (Yu's multi-sensor multi-lens digital camera) in the same way. Ex.1003, ¶195. "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.’” *Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1380–81 (Fed. Cir. 2023).

A POSITA would have had a reasonable expectation of success in combining Yu with Miyazaki as presented above, because Yu-Miyazaki would have involved routine knowledge well within the skill of a POSITA prior to the earliest priority date of the ’158 patent. Ex.1003, ¶196. The digital cameras described in Yu and Miyazaki perform similar functions (using a control signal to control an image sensor) to achieve similar goals (controlling an exposure time of the image sensor) 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); Ex.1006, 9:11-14 (“the controller 38 feeds an electronic shutter control signal to the CCD driver 36 for controlling the duration of charge storage in the CCD image sensor 14”). Ex.1003, ¶196.

A POSITA would have had a reasonable expectation of success in combining Yu with Miyazaki, because as illustrated in the example Yu-Miyazaki combination below, it would have been within the ordinary skill of a POSITA to implement each

of Yu's image sensors with an on-sensor electronic shutter for integration time control, as taught by Miyazaki. Ex.1003, ¶¶197-199.



a processing component configured to control an integration time of each sensor by controlling an electronic shutter on that sensor

Example Yu-Miyazaki Combination (Ex.1005, FIG. 3, annotated);

Ex.1003, ¶197.

Therefore, Yu-Miyazaki renders obvious *a processing component* (Yu's digital image processor 338, together with Yu's control circuits 342, 344, 346, 348) *configured to control* (using four independent feedback signals 332 and respective control circuits 342, 344, 346, 348, as taught by Yu) *an integration time* (integration time by controlling an electronic shutter of a sensor as taught by Miyazaki and

applied in Yu) of *each sensor* (Yu's image sensors 302, 304, 306, 308). Ex.1003, ¶200.

Accordingly, Yu-Miyazaki renders obvious [1.3]. Ex.1003, ¶201.

b. Claim 2

[2.0] The device of claim 1, wherein the processing component is further configured to control the integration time of each sensor during a frame.

Yu-Miyazaki renders obvious [2.0]. Ex.1003, ¶¶202-207.

First, as discussed at Ground 2:[1.3], Yu-Miyazaki renders obvious *wherein the processing component is configured to control the integration time of each sensor*. Specifically, Yu-Miyazaki renders obvious *a processing component* (Yu's digital image processor 338, together with Yu's control circuits 342, 344, 346, 348) *configured to control* (using four independent feedback signals 332 and respective control circuits 342, 344, 346, 348, as taught by Yu) an *integration time* (integration time by controlling an electronic shutter of a sensor as taught by Miyazaki and applied in Yu) of *each sensor* (Yu's image sensors 302, 304, 306, 308). Ex.1003, ¶203.

Second, as shown in Yu's FIG. 5 below, in Yu-Miyazaki, *the processing component is configured to control the integration time of each sensor during a frame* (during a period of time in which data for a single image is captured by that

sensor). VII.C (“*during a frame*” means “during a period of time in which data for a single frame of an image is captured” by a sensor); Ex.1003, ¶204.

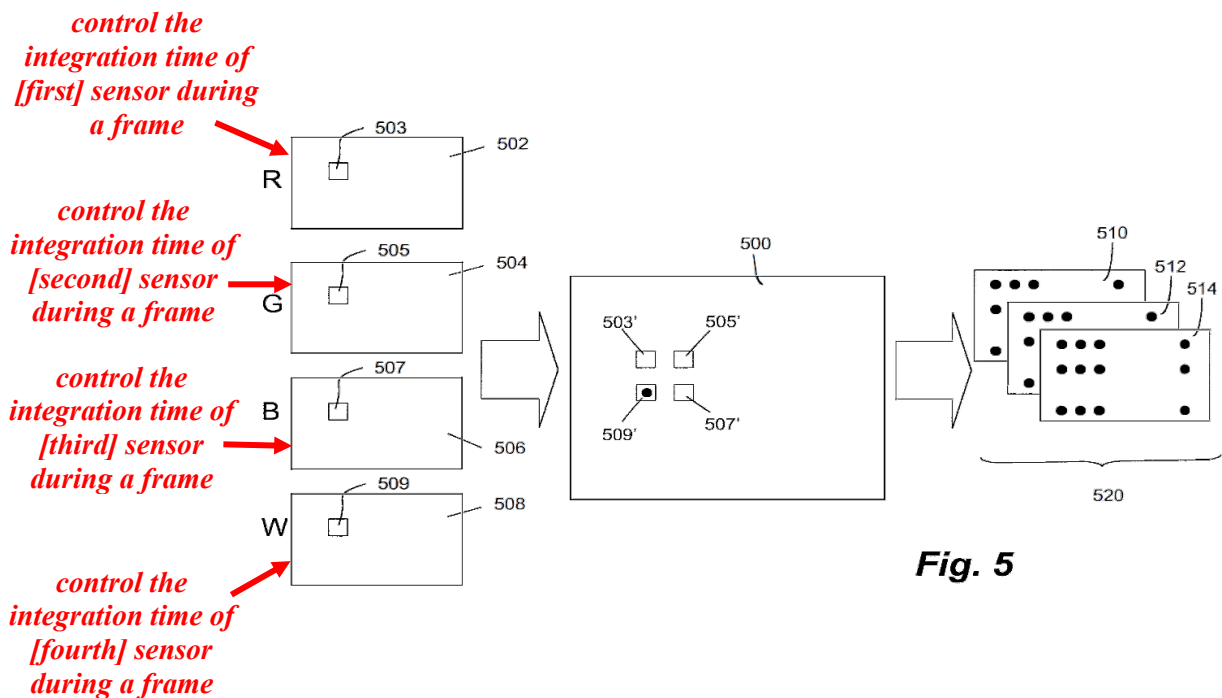


Fig. 5

Ex.1005, FIG. 5, annotated; Ex.1003, ¶204.

Relative to FIG. 5, Yu illustrates “[f]our intensity images 502, 504, 506 and 508 [that] correspond respectively to four intensity images from four image sensors 302, 304, 306 and 308 of FIG. 3.” Ex.1005, 7:50-53. In Yu-Miyazaki, *a processing component* (Yu’s digital image processor 338, together with control circuits 342, 344, 346, 348) is *configured to control* (using four independent feedback signals 332 and respective control circuits 342, 344, 346, 348, as taught by Yu) *an integration time* (integration time by controlling an electronic shutter of a sensor as taught by Miyazaki and applied in Yu) of *each sensor* (Yu’s image sensors 302, 304,

306, 308) *during a frame* (i.e., during a period of time in which data for a single frame of an image) is captured by that sensor. Ex.1003, ¶205; *see* VII.C (“*during a frame*” means “during a period of time in which data for a single frame of an image is captured” by a sensor); Ex.1006, FIG. 3, 8:4-20 (intervals between successive shots are determined such that exposure time ST (charge accumulation time) for each shot is completed within a frame); Ex.1003, ¶205.

In Yu-Miyazaki, the processing component is configured to control an integration time of image sensor 302 during a period of time in which data for a single frame of image 502 is captured by sensor 302, control an integration time of image sensor 304 during a period of time in which data for a single frame of image 504 is captured by sensor 304, control an integration time of image sensor 306 during a period of time in which data for a single frame of image 506 is captured by sensor 306, and control an integration time of image sensor 308 during a period of time in which data for a single frame of image 508 is captured by sensor 308. Ex.1003, ¶206.

Thus, Yu-Miyazaki renders obvious [2.0]. Ex.1003, ¶207.

c. Claim 4

[4.0] The device of claim 1, wherein each sensor is configured to image the same field of view.

Yu-Miyazaki, in view of a POSITA’s knowledge of optics design, renders obvious [4.0]. Ex.1003, ¶¶208-210.

Specifically, Yu itself teaches that the respective sensor and lens pairings image “the **same imaging target**.” Ex.1005, FIG. 3, 9:66-10:1, 10:12-15. As such, it was obvious that Yu, which is a multispectral imaging device, is configured to *image the same field view* (imaging the same imaging target), which was well-known in the art to be desirable in multispectral imaging, with the benefit of easy registration. Ex.1041, 2:12-16 (“Multispectral imaging is best accomplished when the images acquired by each channel’s image sensing device are identical in size. It is desirable that the image sensing pixels in each image channel see exactly the same geometric region in the field-of-view so that the images are exactly registered.”); Ex.1003, ¶209 (citing Ex.1005, 4:66-67 describing that its digital camera 300 “uses four **identical** image sensors,” and explaining that it would have been obvious to use identical lenses with the identical sensors to achieve the same field of view).

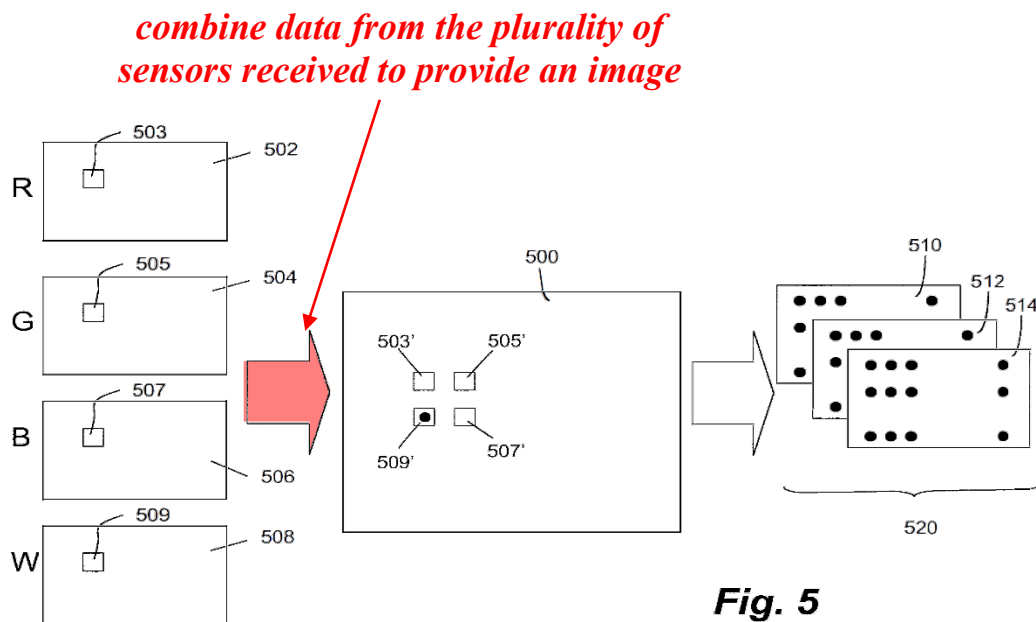
Accordingly, Yu-Miyazaki in view of a POSITA’s knowledge of optics design renders obvious use of four *identical* image sensors 302, 304, 306, and 308, and four corresponding *identical* lenses 310, 312, 314, and 316 oriented to image the *same* target or scene, and as such, providing the same FOV. Ex.1003, ¶210.

d. Claim 5

[5.0] The device of claim 1, wherein the processing component is further configured to combine data from the plurality of sensors received to provide an image.

Yu-Miyazaki renders obvious [5.0]. Ex.1003, ¶¶211-213.

As shown in FIG. 5, Yu teaches that *the processing component* (Yu's digital image processing circuitry 338, together with control circuits 342, 344, 346, and 348) is *configured to combine data* (combining four intensity images 502, 504, 506 and 508) *from the plurality of sensors received* (four image sensors 302, 304, 306 and 308) *to provide an image* (virtual color image 500 and/or color image 520). Ex.1005, 7:46-59 (“a virtual color image 500 formed by *combining four intensity images* 502, 504, 506 and 508”); *id.*, 10:54-58; 11:7-9; 11:39-41. Ex.1003, ¶212.



Ex.1005, FIG. 5, annotated; Ex.1003, ¶212.

Thus, Yu-Miyazaki renders obvious [5.0]. Ex.1003, ¶213.

e. Claim 8

[8.0] The device of claim 1, wherein the integration time is controlled based on incident light level.

Yu-Miyazaki renders obvious [8.0]. Ex.1003, ¶¶214-218.

First, as discussed at Ground 2:[1.3], Yu-Miyazaki renders obvious *a processing component configured to control an integration time of each sensor*. Ex.1003, ¶215.

Second, Yu describes that the exposure time of each sensor is controlled *based on incident light level* (by analyzing a histogram presenting the pixel intensity distribution associated with incident light level). Ex.1003, ¶216; Ex.1005, 6:44-52 (describing determining the control signal from a histogram of the given image). Yu describes using a histogram to analyze incident light level and over-saturation/under-saturation of the sensor in response to the incident light level of that sensor. Ex.1005, 6:44-52 (“Given an intensity image, there are many ways to determine if the given image is saturated due to an overexposure [to the incident light level on the sensor]....**Thus a control signal to reduce a predefined exposure time can be generated.**”); 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.”); Ex.1006, 4:20-35 (“The photosensitive devices each generate a signal charge corresponding to **a quantity of light incident thereto via the color filter.**”). Ex.1003, ¶216.

Accordingly, a POSITA would have been motivated to apply Yu’s teaching that the exposure time is controlled based on incident light in Yu-Miyazaki, such

that in Yu-Miyazaki, the *processing component* (digital image processor 338, together with control circuits 342, 344, 346, 348) is *configured to control* (using four independent feedback signals 332 and respective control circuits 342, 344, 346, 348) an *integration time* (integration time by controlling an electronic shutter of a sensor as taught by Miyazaki and applied in Yu) of *each sensor* (image sensors 302, 304, 306, 308) *based on incident light level* (e.g., using the histogram technique). Ex.1003, ¶217.

Thus, Yu-Miyazaki renders obvious [8.0]. Ex.1003, ¶218.

f. Claim 9

[9.0] A system comprising:

Yu discloses or at least renders obvious [9.0], because Yu discloses *a system* (a digital camera system) as discussed above at Ground 2:[1.0]. Ex.1003, ¶219.

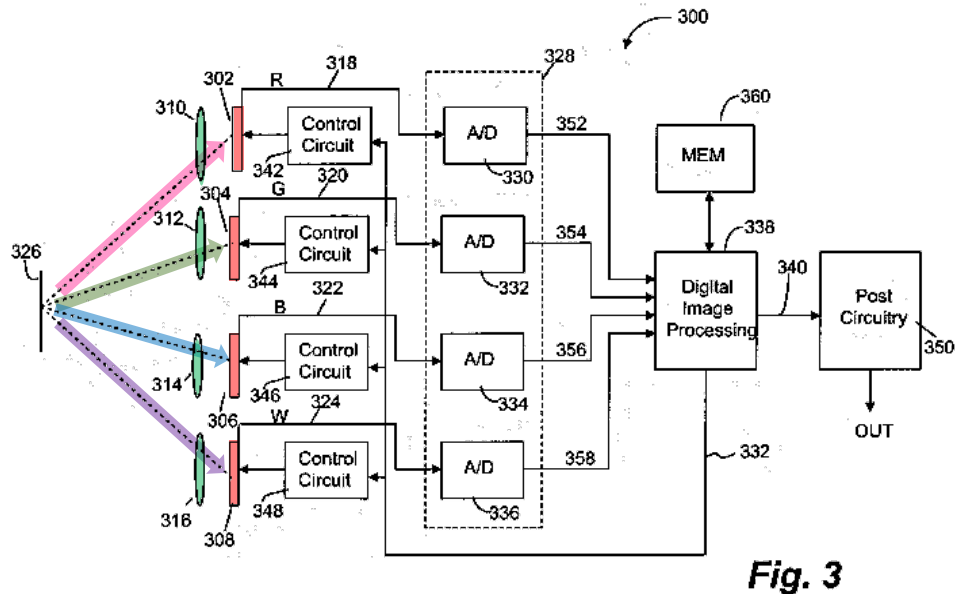
[9.1] a plurality of channels, wherein each channel of the plurality of channels includes a sensor; and

Yu discloses or at least renders obvious [9.1]. Ex.1003, ¶¶220-222.

Consistent with Ground 2:[1.1] and [1.2] above, and as further illustrated in FIG. 3 below, Yu discloses *a plurality channels* (e.g., four channels), where a first channel includes lens 310 passing light to sensor 302, a second channel includes lens 312 passing light to sensor 304, a third channel includes lens 314 passing light to sensor 306, and a fourth channel includes lens 316 passing light to sensor 308.

Ex.1005, 10:63-66; Ex.1003, ¶221. Further, Yu teaches *a plurality of channels* under the construction in the Toyota IPR (VII.A), because Yu's plurality of channels each include an independent optics component (lenses 310, 312, 314, and 316, respectively) that separately passes light to a different respective sensor. Ex.1003, ¶221.

a plurality of channels, wherein each channel of the plurality of channels includes [an independent optics component separately passing light to/ a sensor



Ex.1005, FIG. 3, annotated; Ex.1003, ¶221.

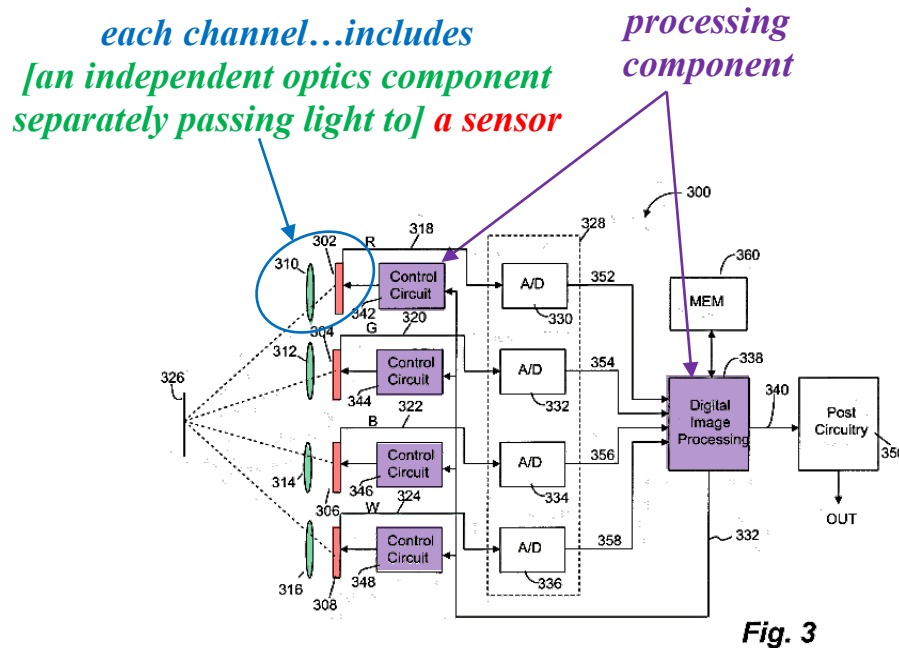
Thus, Yu discloses or at least renders obvious [9.1]. Ex.1003, ¶222.

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

Yu discloses or at least renders obvious [9.2.1]. Ex.1003, ¶¶223-225.

Consistent with Ground 2:[1.3], above, and as further illustrated in FIG. 3 below, Yu discloses *a processing component* (digital image processing unit 338 with

control circuits 342, 344, 346, and 348) coupled to *the plurality of channels* (e.g., to the respective sensor 302, 304, 306, or 308, thereof). Ex.1003, ¶224.



Ex.1005, FIG. 3, annotated; Ex.1003, ¶224.

Thus, Yu discloses [9.2.1]. Ex.1003, ¶225.

[9.2.2] wherein the processing component is configured to determine an integration time of each channel of the plurality of channels,

Yu-Miyazaki renders obvious [9.2.2]. Ex.1003, ¶¶226-228.

Consistent with Ground 2:[1.3], [8.0], and [9.1], Yu-Miyazaki renders obvious that *the processing component* (digital image processing circuitry 338, together with control circuits 342, 344, 346, and 348) *is configured to determine an integration time* (an exposure time of the sensor) *of each channel* (e.g., of the respective sensor thereof). Ex.1003, ¶227. Consistent with Ground 2:[8.0], the

integration time of each such sensor (and, accordingly, for the corresponding channel) is determined based on the incident light level for that sensor (and channel) as represented by a histogram. Ex.1005, 6:44-52; Ex.1003, ¶227.

Thus, Yu-Miyazaki renders obvious [9.2.2]. Ex.1003, ¶228.

[9.2.3] wherein the processing component is configured to combine data from the plurality of channels received to provide an image.

Yu-Miyazaki renders obvious [9.2.3]. Ex.1003, ¶¶229-232.

First, as discussed at Ground 2:[9.1] and [9.2.1], Yu discloses or at least renders obvious the plurality of channels, wherein each channel of the plurality of channels includes a sensor, and the processing component coupled to the plurality of channels. Ex.1003, ¶230.

Second, as discussed at Ground 2:[5.0], Yu-Miyazaki renders obvious that the processing component is further configured to combine data from the plurality of sensors received to provide an image. Ex.1003, ¶231.

Accordingly, Yu-Miyazaki renders obvious limitation [9.2.3], because in Yu-Miyazaki, the processing component is further configured to combine data from the plurality of channels received (from the plurality of sensors of the plurality of channels) to provide an image. Ex.1005, FIG. 5, 7:46-59; 10:54-58; 11:7-9; 11:39-41; Ex.1003, ¶232.

g. Claim 10

[10.0] The system of claim 9, wherein each sensor in the plurality of channels is configured to image the same field of view.

Yu-Miyazaki renders obvious [10.0] for the reasons presented above at Ground 2:[4.0]. Ex.1003, ¶233.

h. Claim 11

[11.0] The system of claim 9, wherein the integration time of at least one channel is relatively shorter than the integration time of at least one other channel.

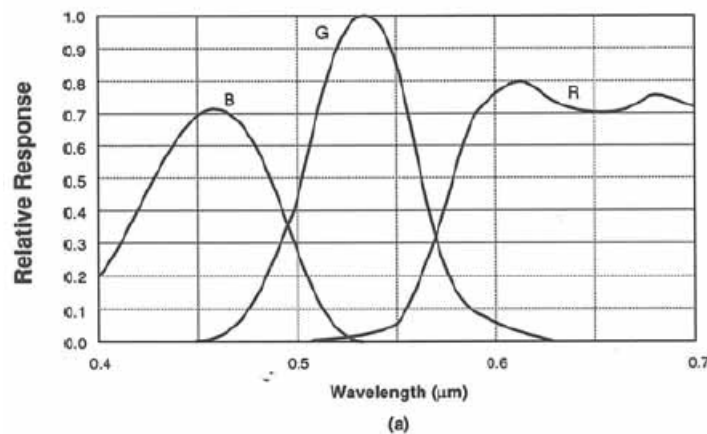
Yu-Miyazaki renders obvious [11.0]. Ex.1003, ¶¶234-241.

First, consistent with Ground 2:[1.3] and [8.0], in Yu-Miyazaki, *the integration time* (exposure time controlled using electronic shutter) of each channel (e.g., the sensor thereof) is independently and respectively controlled based on incident light level (by analyzing a histogram presenting the pixel intensity distribution associated with incident light level) received at each such channel's sensor. Ex.1005, 6:44-52; Ex.1003, ¶235.

Second, Yu describes, “[a]ccording to another embodiment in which the W sensor is not used, three images from three color sensors can compliment each other in the same way as described. This can be done as a result of three images from three independent sensors, **each being separately controlled with different exposure time** and other system parameters.” Ex.1005, 9:40-46. A POSITA would have understood that Yu’s description of controlling the channels with different exposure

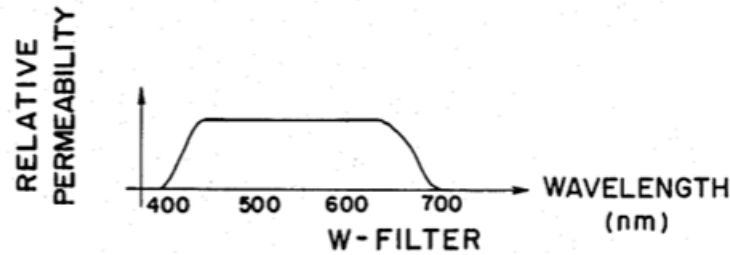
times similarly applies to Yu's FIG. 3 embodiment including four sensors, because the benefits of expanding the dynamic range by combining the captured images with different exposure times similarly applies Yu's FIG. 3 embodiment. Ex.1003, ¶236.

Moreover, differences in separately controlled exposure/integrations times directly follow from Yu's teaching of incident light levels (*see* discussion at Ground 2:[8.0]) coupled with a POSITA's understanding that different portions of the visible electromagnetic spectrum are incident on pixel sites of red ("R"), green ("G"), blue ("B") and white ("W") light sensors (illustrated in spectral responses curves "R," "G," and "B" of Ex.1035, Figure 3-43(a) below). Ex.1003, ¶237.



Ex.1035, FIG. 3-43(a)

Further, as shown in Nagano's Fig. 3a below, white sensor pixel sites would be expected to receive a higher level of incident light of than those of the R, G, and B sensors that each receive only a portion of the larger spectral range of the W sensor. Ex.1035, Fig. 3a; 3:59-65; Ex.1003, ¶238.

Fig. 3a**Ex.1038, FIG. 3**

Stated differently, the W channel will receive more light and thus have a shorter integration time than the R, G and B channels in Yu. *Id.* Moreover, because sensitivity of imaging sensors is dependent on wavelength, Yu's R, G and B channels will have different exposure/integrations times even for a spectrally balanced scene. Ex.1003, ¶239 (citing Ex.1009, 4 (“The number of electrons collected at each pixel is linearly dependent on light level and exposure time and **non-linearly dependent on wavelength**”)).

Accordingly, in Yu-Miyazaki, it would have been obvious to make the integration times of the four channels different, which renders obvious that *the integration time of at least one channel* (e.g., a shorter exposure time for a first channel) *is relatively shorter than the integration time of at least one other channel* (e.g., a longer exposure time for a second channel). Ex.1003, ¶240.

Thus, Yu-Miyazaki renders obvious [11.0]. Ex.1003, ¶241.

i. Claim 13

[13.0] The system of claim 9, wherein the processing component is configured to automatically control the integration time of each sensor.

Yu-Miyazaki renders obvious [13.0]. Ex.1003, ¶¶242-247.

First, as discussed at Ground 2:[1.3] and [8.0], in Yu-Miyazaki, *the processing component* (digital image processing circuitry 338, together with control circuits 342, 344, 346, and 348) *is configured to control the integration time* (exposure time/integration time/charge accumulation time controlled using electronic shutters of image sensors) *of each sensor* (image sensors 302, 304, 306 and 308). Ex.1003, ¶243.

Second, Yu describes generating “four control signals, each controlling the exposure time of one of said four image sensors by analyzing respectively said four digital images,” specifically, from histogram analysis of the images. Ex.1005, 12:15-23. Because Yu’s exposure time control signals are generated from histogram analysis without human intervention, Yu describes automatically control the exposure time of each sensor. Ex.1003, ¶244.

Third, Miyazaki describes that the processing component is configured to automatically control the integration time of each sensor, by providing the “*automatic exposure adjusting function*.” Ex.1006, 5:56-60 (“the system controller 38 has an *automatic exposure adjusting function*.”); Ex.1003, ¶245.

Accordingly, in Yu-Miyazaki, a POSITA would have been motivated to implement the automatic control of the integration time, as taught by Miyazaki, for the benefits of simplified process without relying upon user inputs and responsiveness to actual illumination intensity and spectral characteristics of a given scene. Ex.1003, ¶246.

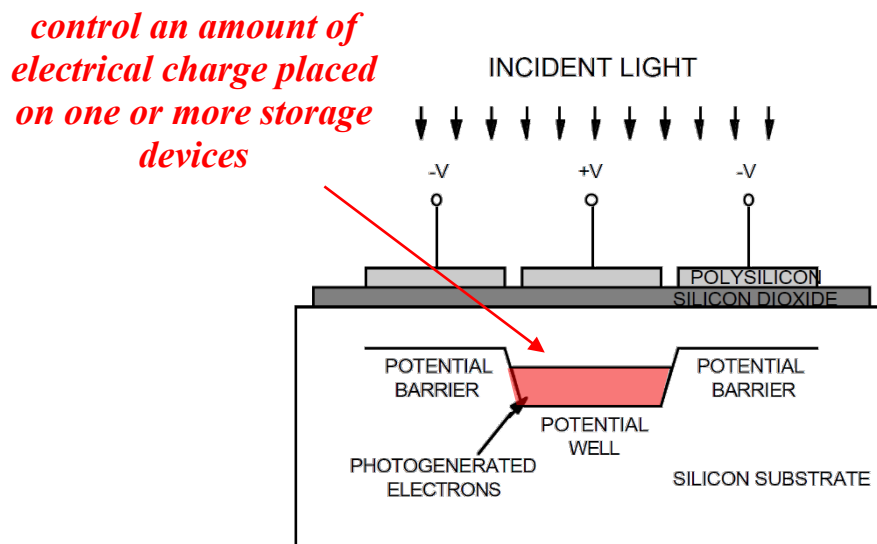
Thus, Yu-Miyazaki renders obvious [13.0]. Ex.1003, ¶247.

j. Claim 14

[14.0] The system of claim 9, wherein the integration time is used to control an amount of electrical charge placed on one or more storage devices associated with a sensor.

Yu-Miyazaki renders obvious [14.0]. Ex.1003, ¶¶248-250.

As discussed at Ground 2:[1.3], Miyazaki describes that “the [system] controller 38 feeds an electronic shutter control signal to the CCD driver 36 for **controlling the duration of charge storage** in the CCD image sensor 14.” Ex.1006, 9:11-14; *see also id.*, 4:20-35; Ex.1008, 2; Ex.1003, ¶249 (citing Ex.1012, 1-2; Ex.1023, 4, 11).



Ex.1022, 5, annotated; Ex.1003, ¶249.

Thus, Yu-Miyazaki renders obvious [14.0]. Ex.1003, ¶250.

IX. DISCRETIONARY DENIAL IS INAPPROPRIATE

A. No Basis For § 325(d) Denial

The Board should not exercise its discretion under 35 U.S.C. §325(d) to deny this Petition. None of the prior art in Petitioner's grounds were applied during prosecution of the '158 patent. *See* Ex.1002. Miyazaki and Matsushima were not mentioned during prosecution. *Id.* Yu was listed in an IDS submitted by Applicant on January 22, 2024, together with over 75 other references (Ex.1002, 145), and appeared in the Examiner's search history (Ex.1002, 105-120), but there is no evidence that the Examiner substantively considered Yu with respect to the

Challenged Claims. Moreover, the Examiner did not consider Yu in combination with Miyazaki as presented in Ground 2.⁴

Thus, the first prong of the *Advanced Bionics* analysis is not met, because neither “the same or substantially the same art” nor “the same or substantially the same arguments” were presented during prosecution. *Advanced Bionics, LLC v. Med-El Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 at 8 (Feb. 13, 2020) (precedential). The second prong is also not met, because the Examiner erred in overlooking Yu for the reasons presented above in Ground 2. *Advanced Bionics*, Paper 6 at 8-9, n.10.

B. No Basis for *Fintiv* Denial

The Board balances six factors in considering denial under §314. *Apple Inc.*

⁴ The '158 patent claims priority to five parent applications. Ex.1002, 168-169; Exs. 1030-1034. 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.1030, 1-2, 18, 21, 527. In the following four parent applications, Yu was cited along with many other references, but was never relied upon by the Office. Exs.1031-1034.

v. Fintiv, Inc., IPR2020-00019, Paper 11 (Mar. 20, 2020) (precedential). These factors strongly favor institution. The district court case is in its very early stages. Patent Owner filed its complaint on April 12, 2024 (Ex.1017) and trial is not scheduled to start until May 14, 2026. Ex.1018 (proposed scheduling order). Petitioner has worked diligently to prepare this Petition, which is being filed well within the one-year timeframe allowed by Congress.

1. No evidence regarding a stay

No motion to stay has been filed, so the Board should not infer the outcome of such a motion. *Sand Revolution II, LLC v. Continental Intermodal Group – Trucking LLC*, IPR2019-01393, Paper 24 at 7 (June 16, 2020) (informative). This factor is neutral.

2. Parallel proceeding trial date

This factor weighs against discretionary denial because the projected trial date—based on median time-to-trial statistics—is in January of 2027⁵, which is after the projected date for the Board to issue a Final Written Decision in May or June 2026. While trial is currently proposed⁶ for May 14, 2026 (Ex.1018, 4), the Board

⁵ The current average time-to-trial for the district court hearing the co-pending litigation is 32.7 months. *See* Ex.1019, 5.

⁶ The district court has not entered an order scheduling a trial date.

recognizes “that scheduled trial dates are unreliable and often change.” *See* Director’s Memorandum on Discretionary Denials (Ex.1020), 8. Moreover, Petitioner notes that “a court’s general ability to set a fast-paced schedule is not particularly relevant...where, like here, the forum itself has not historically resolved cases so quickly.” *In re Apple Inc.*, 979 F.3d 1332, 1344 (Fed. Cir. 2020). This factor heavily weighs against discretionary denial.

3. Investment in the parallel proceeding

The investment in the co-pending litigation has been minimal. A claim construction hearing has not yet occurred, fact discovery is not proposed to open until April 11, 2025, and expert discovery is not proposed to open until November 20, 2025. Ex.1018, 2-3; *see PEAG LLC v. Varta Microbattery GmbH*, IPR2020-01214, Paper 8 at 17 (Jan. 6, 2021). This lack of investment favors institution.

Moreover, Petitioner only learned which claims were being asserted in August 2024. *See* Ex.1015 (infringement contentions cover pleading). Since then, Petitioner has worked expeditiously to file this petition within four months. As of this filing, Patent Owner has not yet served its final infringement contentions. Under *Fintiv*, Petitioner’s prompt filing “weigh[s] against exercising the authority to deny institution.” *Fintiv*, Paper 11 at 11.

4. Overlapping issues with the parallel proceeding

The co-pending litigation is in its early stages. Petitioner served its

preliminary invalidity contentions on October 24, 2024. However, Petitioner will not be serving its final invalidity contentions until May 22, 2025, after the Board would issue an institution decision in this case. Ex.1018, 3. The extent of overlap is thus speculative at this point in time.

5. Petitioner is a defendant

Petitioner is a defendant in the co-pending litigation. That is true of most Petitioners in IPR proceedings, making this factor neutral. *See HP Inc. v. Slingshot Printing LLC*, IPR2020-01084, Paper 13 at 9 (Jan. 14, 2021).

6. Other circumstances

“[T]he PTAB will not deny institution of an IPR or PGR under *Fintiv* (i) when a petition presents compelling evidence of unpatentability.” Ex.1020, 9. Here, the petition—along with Mr. Guidash’s expert testimony—plainly shows that the ’158 patent claims no more than well-known subject matter. This compelling evidence of unpatentability renders the other *Fintiv* factors moot.

Because the *Fintiv* factors are either neutral or weigh against discretionary denial, institution should not be denied on discretionary factors.

C. No Basis for *General Plastic* Denial Under § 314(a).

The *General Plastic* factors weigh heavily in favor of institution. *Gen. Plastic*, IPR2016-01357, Paper 19, at 16 (PTAB Sept. 6, 2017) (precedential at § II.B.4.i). Toyota Motor Corp. filed IPR2022-00710 (“Toyota IPR”) in April 2022, and

American Honda Motor Co., Inc. filed IPR2022-01338 (“Honda IPR”) in July 2022, each challenging claims 1-20 of the ’158 patent.

Tesla does not have a “significant relationship” with the previous petitioners, and Tesla was sued over two years after the litigations involving Toyota and Honda were filed. “*General Plastic* factor one necessarily outweighs the other *General Plastic* factors.” *Videndum Prod. Sols. Inc v. Rotolight Ltd*, IPR2023-01218, Paper 12 (Director Vidal) (April 19, 2024).

Factors 3, 6, and 7 weigh against discretionary denial. This Petition does not use the same references as the Toyota and Honda IPRs and does not use Patent Owner’s preliminary response or the Board’s institution decision in the Toyota IPR as a roadmap.

X. CONCLUSION

The Challenged Claims are unpatentable.

Respectfully submitted,

Dated: November 26, 2024
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Jonathan R. Bowser
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XI. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8**A. Real Party-in-Interest**

Pursuant to 37 C.F.R. § 42.8(b)(1), Petitioner Tesla Inc. certifies that it is the real party-in-interest in this proceeding.

B. Related Matters

According to assignment records, the '158 patent is currently assigned to Intellectual Ventures II LLC. ("Patent Owner").

As of the filing date of this Petition, and to the best knowledge of Petitioner, the '158 patent is or has been involved in:

Case Caption	Number	Court	Filed	Status
<i>Intellectual Ventures I LLC et al. v. Toyota Motor Corp. et al.</i>	2-21-cv-00389	E.D. Tex.	10-19-2021	Terminated
<i>Intellectual Ventures I LLC et al. v. Honda Motor Company, Ltd. et al.</i>	2-21-cv-00390	E.D. Tex.	10-19-2021	Terminated
<i>Intellectual Ventures I LLC et al. v. General Motors Company et al.</i>	6-21-cv-01088	W.D. Tex.	10-19-2021	Terminated
<i>Intellectual Ventures I LLC et al. v. Honda Motor Company, Ltd. et al.</i>	3-22-cv-00761	N.D. Tex.	04-04-2022	Terminated
<i>Toyota Motor Corporation v. Intellectual Ventures II LLC</i>	IPR2022-00710	PTAB	04-11-2022	Terminated

<i>American Honda Motor Co., Inc. v. Intellectual Ventures II LLC (PTAB)</i>	IPR2022-01338	PTAB	07-27-2022	Terminated
<i>Intellectual Ventures I LLC et al. v. Volvo Car Corporation et al.</i>	6-23-cv-00429	W.D. Tex.	06-08-2023	Transferred
<i>Intellectual Ventures II LLC v. Tesla, Inc.</i>	1-24-cv-00390	W.D. Tex.	04-11-2024	Terminated
<i>Intellectual Ventures II LLC v. Tesla, Inc.</i>	6-24-cv-00188	W.D. Tex.	04-12-2024	Transferred
<i>Intellectual Ventures II LLC v. Tesla, Inc.</i>	1-24-cv-00884	W.D. Tex.	04-12-2024	Pending
<i>Intellectual Ventures I LLC et al. v. Volvo Car Corporation et al.</i>	2:24-cv-09298	D. NJ	09-19-2024	Pending

C. Lead and Back-up Counsel and Service Information

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Please address all correspondence to lead and back-up counsel. Petitioner consents to electronic service and asks Patent Owner to do the same.

XII. CERTIFICATE OF WORD COUNT

Under 37 C.F.R. § 42.24, the undersigned attorney for the Petitioner, declares that the argument section of this Petition (§§I-X) has 13,992 words, according to the word count tool in Microsoft Word™.

/Jonathan R. Bowser/
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

TESLA, INC.	§	Petition for <i>Inter Partes</i> Review
Petitioner	§	
	§	U.S. Patent No. 9,232,158
	§	

CERTIFICATE OF SERVICE

The undersigned certifies, under 37 C.F.R. §§ 42.105 and 42.6, that service was made on the Patent Owner as detailed below.

Date of service November 26, 2024

Manner of service Federal Express

Documents served Petition for *Inter Partes* Review, including Exhibit List; Exhibits 1001-1043; and Petitioner's Power of Attorney

Persons served Volpe Koenig
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