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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No. EV 708 398 928 US

INVENTOR(S)		
Given Name (first and middle (if any))	Family Name or Surname	Residence (City and either State or Foreign Country)
Richard Ian	Olsen	Irvine, California
Additional inventors are being named on the <u>ONE</u> separately numbered sheets attached hereto		
TITLE OF THE INVENTION (500 characters max):		
Simultaneous Multiple Field of View Digital Cameras		
Direct all correspondence to: CORRESPONDENCE ADDRESS		
☒ The address corresponding to Customer Number: 53186		
OR		
☐ Firm or Individual Name		
Address		
City	State	Zip
Country	Telephone	Fax
ENCLOSED APPLICATION PARTS (check all that apply)		
☐ Application Data Sheet. See 37 CFR 1.76		
☐ CD(s), Number of CDs _____		
☒ Specification Number of Pages <u>14</u>		
☐ Other (specify) _____		
☒ Drawing(s) Number of Sheets <u>5</u>		
Application Size Fee: If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).		
METHOD OF PAYMENT OF FILING FEES AND APPLICATION SIZE FEE FOR THIS PROVISIONAL APPLICATION FOR PATENT		
☒ Applicant claims small entity status. See 37 CFR 1.27.		TOTAL FEE AMOUNT (\$)
☐ A check or money order is enclosed to cover the filing fee and application size fee (if applicable).		100.00
☒ Payment by credit card. Form PTO-2038 is attached		
☒ The Director is hereby authorized to charge the filing fee and application size fee (if applicable) or credit any overpayment to Deposit Account Number: <u>503616</u> . A duplicative copy of this form is enclosed for fee processing.		
The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.		
☒ No.		
☐ Yes, the name of the U.S. Government agency and the Government contract number are: _____		

SIGNATURE R. Gregory

Date April 28, 2006

TYPED or PRINTED NAME Richard L. Gregory, Jr.

REGISTRATION NO. 42,607

TELEPHONE (408) 342-1900

(if appropriate)

Docket Number: NICO.P003P

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

This collection of information is required by 37 CFR 1.51. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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PROVISIONAL APPLICATION COVER SHEET
Additional Page

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First Named Inventor	Richard Ian Olsen	Docket Number	NICO.P003P
INVENTOR(S)/APPLICANT(S)			
Given Name (first and middle (if any))	Family or Surname	Residence (City and either State or Foreign Country)	
Darryl L.	Sato	Irvine, California	
Feng-Qing	Sun	Irvine, California	
James	Gates	Irvine, California	

Number 2 of 2

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Effective on 12/08/2004.
Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4818).**FEE TRANSMITTAL**
For FY 2005☒ Applicant claims small entity status. See 37 CFR 1.27**TOTAL AMOUNT OF PAYMENT** (\$) 100.00**Complete if Known**

Application Number	
Filing Date	April 28, 2006
First Named Inventor	Richard Ian Olsen
Examiner Name	
Art Unit	
Attorney Docket No.	NICO.P003P

METHOD OF PAYMENT (check all that apply)

- ☐ Check ☒ Credit Card ☐ Money Order ☐ None ☐ Other (please identify): _____
- ☒ Deposit Account Deposit Account Number: 503616 Deposit Account Name: Courtney Staniford & Gregory LLP
- For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)
- ☐ Charge fee(s) indicated below ☐ Charge fee(s) indicated below, except for the filing fee
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FEE CALCULATION**1. BASIC FILING, SEARCH, AND EXAMINATION FEES**

Application Type	FILING FEES		SEARCH FEES		EXAMINATION FEES		Fees Paid (\$)
	Fee (\$)	Small Entity Fee (\$)	Fee (\$)	Small Entity Fee (\$)	Fee (\$)	Small Entity Fee (\$)	
Utility	300	150	500	250	200	100	
Design	200	100	100	50	130	65	
Plant	200	100	300	150	160	80	
Reissue	300	150	500	250	600	300	
Provisional	200	100	0	0	0	0	100

2. EXCESS CLAIM FEES

Fee Description	Fee (\$)	Small Entity Fee (\$)
Each claim over 20 or, for Reissues, each claim over 20 and more than in the original patent	50	25
Each independent claim over 3 or, for Reissues, each independent claim more than in the original patent	200	100
Multiple dependent claims	360	180

Total Claims _____ **Extra Claims** _____ **Fee (\$)** _____ **Fee Paid (\$)** _____

_____ - 20 or HP = _____ x _____ = _____

HP = highest number of total claims paid for, if greater than 20

Indep. Claims _____ **Extra Claims** _____ **Fee (\$)** _____ **Fee Paid (\$)** _____

_____ - 3 or HP = _____ x _____ = _____

HP = highest number of independent claims paid for, if greater than 3

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

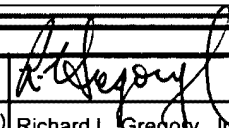
Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof	Fee (\$)	Fee Paid (\$)
_____	_____	_____ / 50 = _____ (round up to a whole number)	x _____	= _____

4. OTHER FEE(S)

Non-English Specification, \$130 fee (no small entity discount)

Other: _____

Fees Paid (\$)**SUBMITTED BY**

Signature		Registration No. (Attorney/Agent) 42,607	Telephone (408) 342-1900
Name (Print/Type)	Richard L. Gregory, Jr.	Date April 28, 2006	

This collection of information is required by 37 CFR 1.136. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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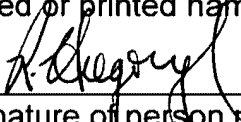
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Date of Deposit: April 28, 2006

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Richard L. Gregory, Jr.

(Typed or printed name of person mailing paper(s) or fee(s))


(Signature of person mailing paper or fee)

28 APR 2006
(Date signed)

Serial/Patent No.: Not yet assigned Filing/Issue Date: April 28, 2006

Title: Simultaneous Multiple Field of View Digital Cameras

Atty. Docket No.: NICO.P003P Date Mailed: April 28, 2006

The following has been received in the U.S. Patent & Trademark Office on the date stamped hereon:

- | | |
|---|--|
| ☐ Amendment/Response (pgs.) | ☐ Petition for Extension of Time (month(s)) |
| ☐ Preliminary Amendment (pgs.) | ☐ Information Disclosure Statement & PTO/SB/08A |
| ☐ Application - Utility (pgs.) | ☐ Issue Fee Transmittal |
| ☐ Application - Rule 1.53(b) Contin. (pgs.) | ☐ Submission of Formal Drawings |
| ☐ Application - Rule 1.53(b) Divis. (pgs.) | ☐ Notice of Appeal |
| ☐ Application - Rule 1.53(b) CIP (pgs.) | ☐ Appeal Brief (pgs. in triplicate) |
| ☐ Application - Rule 1.53(d) CPA (pgs.) | ☐ Reply Brief |
| ☐ Application - PCT (pgs.) | ☐ Response to Notice of Missing Parts |
| ☒ Application - Provisional (14 pgs.) | ☐ Utility Patent Application Transmittal |
| ☒ Drawings (<u>5</u> sheets) | ☒ Fee Transmittal and PTO-2038 Credit Card Payment |
| ☐ Declaration & POA (pgs.) | ☒ Itemized Postcard |
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| ☐ Power of Attorney | ☒ Express Mail No. <u>EV 708 398 928 US</u> |
| ☐ Nonpublication Request (35 USC 122(b)) | ☐ Check No. _____ Amt _____ |
| ☒ Other <u>Provisional Application For Patent Cover Sheet (2 pages)</u> | |

Simultaneous Multiple Field of View Digital Cameras

Inventors:
Richard Ian Olsen
Darryl L. Sato
Feng-Qing Sun
James Gates

RELATED APPLICATION

This application is a continuation in part application of United States Patent Application Number 11/212,803, filed August 25, 2005.

TECHNICAL FIELD

The following disclosure relates generally to optical devices and more particularly to digital imaging.

BACKGROUND

The recent technology transition from film to electronic media has spurred the rapid growth of the imaging industry. This growth includes new applications in still and video cameras, cell phones, other personal communications devices, surveillance equipment, automotive applications, computers, manufacturing and inspection devices, medical appliances, toys, plus a wide range of other and continuously expanding applications. The lower cost and reduced size of digital cameras, whether as stand-alone products or imbedded subsystems, is a primary driver for this growth and market expansion.

Most digital imaging applications are continuously in need of higher performance (image quality), more and/or better features, smaller size and/or lower cost. These market needs can often be in conflict as, for example, higher performance often requires larger size, improved features can require higher cost as well as a larger size, and conversely, reduced cost and/or size can come at a penalty in performance and/or features. As an example, consumers look for higher quality images from their cell phones, but are unwilling to accept the size or cost associated with putting stand-alone digital camera quality into their pocket sized phones.

One obstacle in the challenge to deliver higher image quality is the lens system of digital cameras. The ability to image with different fields of views (zoom in and out) is a highly desired feature. Zoom, as performed by the lens system, is known as “optical zoom”. This desirable “zoom lens” feature adds additional components, size and cost to a lens system. The zoom lens also requires significant power and time to operate. The time to move the optical elements in the zoom lens limits the ability to acquire multiple fields of view in rapid and/or simultaneous fashion.

Digital camera suppliers have one advantage over traditional film providers in the area of zoom capability. Through electronic processing, digital cameras can provide “electronic zoom” which provides the zoom capability by cropping the outer regions of an image and then electronically enlarging the center region to the original size of the image. In a manner similar to traditional enlargements, a degree of resolution is lost when performing this process. Further, since digital cameras capture discrete input to form a picture rather than the ubiquitous process of film, the lost resolution is more pronounced. As such, although “electronic zoom” is a desired feature, it is not a direct substitute for “optical zoom.”

Digital photography often requires imaging and subsequent display of different fields of views of the same or nearly the same scene. In some applications it is desirable to capture different fields of view of the same scene at the same time. This is not possible with optical zoom because of the time required to move the optical elements. Electronic zoom can display wide and narrow field of view but the displayed narrow field is often of inferior resolution. Foveal image sensors that use multiple pixels arranged both within and about a central fovea region of the chip can be used to acquire both a wide and narrow field of view. The pixels in the central fovea region have a smaller size than the pixels arranged in peripheral rings about the central region. The foveal image sensor has high resolution only in the narrow field of view. Multiple digital cameras with different fields of view can be used to acquire high resolution images simultaneously; however a multiple digital camera system is large and expensive. Thus there is a need for a high-performance solid-state digital camera that is capable of simultaneously acquiring imaging having high resolution using multiple fields of view.

INCORPORATION BY REFERENCE

Each patent, patent application, and/or publication mentioned in this specification is herein incorporated by reference in its entirety to the same extent as if each individual patent, patent application, and/or publication was specifically and individually indicated to be incorporated by reference.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram of a conventional digital camera.

Figure 2A shows the operation of conventional lens assembly in a retracted mode (also referred to as normal mode or a near focus setting).

Figure 2B shows the operation of conventional lens assembly in an optical zoom mode (sometimes referred to as a far focus setting).

Figure 3 shows a digital camera, under an embodiment.

Figure 4 is a digital camera system that includes multiple camera channels, under an embodiment.

Figure 5 is a flow diagram for simultaneous acquisition of multiple fields of view 500, under an embodiment.

DETAILED DESCRIPTION

A digital camera system and methods are described below that provide a digital camera in which multiple fields of view are acquired simultaneously. The digital camera system includes a digital camera having two or more image sensor camera channels. Each camera channel has an active area that includes multiple picture elements (pixels), and image capture uses the multiple camera channels. Each camera channel and associated optics of that camera channel has a predetermined field of view that can be different from other camera channels of the digital camera system. The digital camera system therefore makes possible the formation of multiple high resolution images in which different fields of view are acquired simultaneously. The digital camera system further includes methods for forming multiple images as described below.

The digital camera system of an embodiment uses a multiple optical system configuration in which the scene is imaged onto multiple image sensors located on the

same integrated circuit substrate. Each image sensor operates independently and, when combined with its own optics and electronics, forms a separate camera channel. Each image sensor is located beneath an optical assembly. The optical assembly, including mechanical mechanisms if desired, can be processed on the image sensor wafer, applied to the image wafer by a separate wafer transfer, transferred individually by pick and place method, or attached at die level. The optical focal length associated with each image sensor is chosen to provide a desired field of view. The electrical operation of each camera channel is independent of the other camera channels and multiple fields of view can be acquired simultaneously. The pixel size, array size and image sensor design can have approximately the same configuration in each camera channel or be configured so as to be optimized for each field of view. The imager electrical operation can be similar in each camera channel or configured so as to be optimized for each field of view (such as imager frame rate and integration time). The multiple camera channels operate independently, however embodiments provide for sharing of electrical and/or mechanical components in a host digital camera.

Visual imaging tasks may include search, detection, recognition, and tracking, which may not be easily handled by conventional imaging systems with single optics. Active vision systems are of interest in realizing autonomous systems. These systems range from commercial and industrial applications to surveillance and military applications. The commercial and industrial applications may involve robots, unmanned vehicles, self-navigating cars, automatic assembly and product inspection systems. The surveillance and military applications may involve iris and facial imaging, smart weapons and missile defense systems. The digital camera system of an embodiment improves performance of imaging systems and improves functions of search, detection recognition and track by providing simultaneous high resolution imaging in multiple fields of view with optimum electrical operation (such as independent frame rate and integration time control) in each field of view.

Figure 1 is a block diagram of a conventional digital camera 100. The digital camera 100 includes a lens assembly 110, a color filter array layer 112, an image sensor 116, and an electronic image storage media 120. The digital camera 100 also includes a power supply 124, a peripheral user interface (represented as a shutter button) 132, a

circuit board 136 (which supports and electrically interconnects the aforementioned components), a housing 140 (including housing portions 141, 142, 143, 144, 145 and 146) and a shutter assembly (not shown), which controls an aperture 150 and passage of light into the digital camera 100. A mechanical frame 164 is used to couple or connect the various components or parts of the lens assembly 110. The lens assembly 110 includes lenses 161, 162 and one or more electro-mechanical devices 163 to move the lenses 161, 162 along a center axis 165. The lenses 161, 162 may comprise multiple elements arranged together to form an integral optical component. Additional lenses may be included. The electro-mechanical device 163 of the lens assembly 110 and the mechanical frame 164 of the lens assembly 110 can include numerous components and/or complex assemblies.

The optional color filter array layer 112 includes an array of color filters arranged in a Bayer pattern (e.g., a 2x2 matrix of colors with alternating red and green in one row and alternating green and blue in the other row, although other colors may be used). The Bayer pattern (often used in color camera applications) is repeated throughout the color filter array.

The image sensor 116 includes a plurality of identical photo detectors (sometimes referred to as “picture elements” or “pixels”) arranged in a matrix. The number of photo detectors is usually in range of hundreds of thousands to millions. The pixel spacing is usually in the range of 2-5 μm for visible light. The lens assembly 110 spans the diagonal of the array.

Each of the color filters in the color filter array 112 is disposed above a respective one of the photo detectors in the image sensor 116, such that each photo detector in the image sensor receives a specific band of visible light (e.g., red, green or blue) and provides a signal indicative of the color intensity of the received visible light. Signal processing circuitry (not shown) receives signals from the photo detectors, processes the received signals, and outputs a color image.

The peripheral user interface 132, which includes the shutter button, may include one or more additional input devices (e.g., for settings, controls and/or input of other information). The user interface 132 can also include one or more output devices (e.g., a display for output of images or other information), and associated electronics.

Figure 2A shows the operation of conventional lens assembly 110 in a retracted mode (also referred to as normal mode or a near focus setting). The lens assembly 110 is shown focused on a distant object (represented as a lightning bolt) 180. A representation of the image sensor 116 is included for reference purposes. A field of view is defined between reference lines 182, 184. To achieve this field of view 182, 184, electro-mechanical devices 163 have positioned lenses 161 and 162 relatively close together. The lens assembly 110 passes the field of view through the lenses 161, 162 and onto the image sensor 116 as indicated by reference lines 186, 188. An image of the object (indicated at 190) is presented onto the image sensor 116 in the same ratio as the width of the actual image 180 relative to the actual field of view 182, 184.

Figure 2B shows the operation of conventional lens assembly 110 in an optical zoom mode (sometimes referred to as a far focus setting). In this mode, the electro-mechanical devices 163 of the lens assembly 110 re-position the lens 161, 162 so as to reduce the field of view 182, 184 over the same image area, thus making the object 180 appear closer (i.e., larger). One benefit of the lens assembly 110 is that the resolution with the lens assembly 110 in zoom mode is typically equal to the resolution with the lens assembly 110 in retracted mode. One drawback, however, is that the lens assembly 110 can be costly and complex. Moreover, providing a lens with zoom capability results in less light sensitivity and thus increases the F-stop of the lens, thereby making the lens less effective in low light conditions. The other disadvantage of optical zoom is that the two fields-of-view must be acquired sequentially. Further, since the lens must be moved forward and backwards with respect to the image sensor, additional time and power are required. This is an undesirable aspect of digital cameras as it creates long delays in capture response time as well as diminished battery capacity.

A narrow field of view can be displayed from a conventional digital camera without the use of optical zoom. Through electronic processing, digital cameras can provide “electronic zoom” which provides the zoom capability by cropping the outer regions of an image and then electronically enlarging the center region to the original size of the image. In a manner similar to traditional enlargements, a degree of resolution is lost when performing this process. Further, since digital cameras capture discrete input to form a picture rather than the ubiquitous process of film, the lost resolution is more

pronounced. As such, although “electronic zoom” is a desired feature, it is not a direct substitute for “optical zoom.”

Figure 3 shows a digital camera 200, under an embodiment. The digital camera 200 includes a digital camera subsystem 210, an electronic image storage media 220, a power supply 224, a peripheral user interface (represented as a shutter button) 232, a circuit board 236 that supports and/or electrically couples or interconnects the components, a housing 240 (including housing portions 241, 242, 243, 244, 245 and 246) and a shutter assembly (not shown), which controls an aperture 250 and passage of light into the digital camera 200. The digital camera subsystem (DCS) 210 includes one or more camera channels (e.g., four camera channels 260A-260D) and replaces and/or fulfills one, some or all of the roles fulfilled by the lens assembly 110, the color filter 112 and the image sensor 116 of the digital camera 100 described above. The four camera channels 260A-260D are configured through pixel array size and/or optical focal length to provide a desired field of view for that channel. The four camera channels 260A-260D can be operated simultaneously with independent electrical control of features such as integration time control and frame rate (in video applications) to name a few.

The peripheral user interface 232, which includes the shutter button, can include one or more additional input devices (e.g., for settings, controls and/or input of other information). The peripheral user interface 232 can also include one or more output devices, (e.g., a display for output of images or other information) and associated electronics. The electronic image storage media 220, power supply 224, peripheral user interface 232, circuit board 236, housing 240, shutter assembly (not shown), and aperture 250, may be, for example, similar to the electronic image storage media 120, power supply 124, peripheral user interface 132, circuit board 136, housing 140, shutter assembly (not shown), and aperture 150 of the digital camera 100 described above.

Figure 4 is a digital camera system 210 that includes multiple camera channels, under an embodiment. The digital camera system 210 of this example includes four camera channels 260A-260D but is not limited to four camera channels; alternative embodiments can have any number of camera channels. Each of the camera channels 260A-260D includes an optics component or portion and a sensor component or portion. For example, camera channel 260A includes an optics portion 290A and a sensor portion

292A. Camera channel B includes an optics portion 290B and a sensor portion 292B. Camera channel C includes an optics portion 290C and a sensor portion 292C. Camera channel D includes an optics portion 290D and a sensor portion 292D. The optics portions of the one or more camera channels are collectively referred to herein as an optics subsystem. The sensor portions of the one or more camera channels are collectively referred to herein as a sensor subsystem.

Each camera channel of the digital camera subsystem 210 of an embodiment provides a different FOV imaging capability relative to at least one other camera channel. For example, in one embodiment, one camera channel (e.g. camera channel 260A) is detects a wide field of view (e.g. $40^{\circ} \times 30^{\circ}$), one camera channel (e.g., camera channel 260B) detects a medium field of view (e.g. $20^{\circ} \times 15^{\circ}$), one camera channel (e.g., camera channel 260C) detects a narrow field of view (e.g. $12^{\circ} \times 9^{\circ}$), and one camera channel (e.g., camera channel 260D) detects light in a very narrow field on view (e.g. $5^{\circ} \times 5^{\circ}$). The digital camera subsystems of one or more alternative embodiments may configure one or more of the camera channels to have different fields of view than those described above. Still other alternative embodiments of the digital camera subsystems configure one or more of the camera channels to have a similar field of view relative to at least one other camera channel and a different field of view relative to at least one other camera channel.

In the digital camera subsystem 210, the optics portion of each camera channel can be configured similar to and/or different from the optics portion of at least one other camera channel. For example, embodiments of the digital camera subsystem 210 include optics portions that are configured approximately the same while having a different array size (area) between camera channels to provide a different field of view capability. The array area change can be accomplished by changing the number of pixels and/or pixel size. In addition to array area differences between the channels, parameters of the image sensor electrical operation (e.g., integration time, frame rate, etc.) can be configured differently in order to optimize system camera performance in the field of view of one or more specific camera channels.

In other embodiments of the digital camera subsystem 210, the optics portion of one or more camera channels is configured differently, in one or more respects (e.g.,

focal length, f-number, etc.), from the optics portion of one or more other camera channels. For example, in some embodiments, at least one characteristic (e.g., type of element(s), size, performance, etc.) of one or more of the optics portions is configured to the respective sensor portion and/or to achieve a desired result. For example, if a particular camera channel is dedicated to a particular color (or band of colors) or wavelength (or band of wavelengths) then the optics portion for that camera channel may be configured to transmit only that particular color (or band of colors) or wavelength (or band of wavelengths) to the sensor portion of the particular camera channel and/or to filter out one or more other colors or wavelengths.

Likewise, if the digital camera subsystem 210 includes more than one sensor portion, the sensor portion of each camera channel can be configured similar to and/or different from the sensor portion of at least one other camera channel. In some embodiments, the sensor portions of each camera channel are similarly configured. In some other embodiments, a configuration of one or more of sensor portions is different, in one or more respects, from one or more of the other sensor portions. For example, in some embodiments, one or more of the characteristics (e.g., type of element(s), size, performance, etc.) of one or more of the sensor portions is configured to the respective optics portion and/or to help achieve a desired result. For example, if a particular camera channel is dedicated to a particular color (or band of colors) or wavelength (or band of wavelengths) then the sensor portion for that camera channel may be configured to have a sensitivity that is higher to that particular color (or band of colors) or wavelength (or band of wavelengths) than other colors or wavelengths and/or to sense only that particular color (or band of colors) or wavelength (or band of wavelengths).

The digital camera system 210 of an embodiment includes a processor. The processor includes an image processor component or circuitry 270 (referred to herein as image processor 270) and a controller component or circuitry 300 (referred to herein as controller 300). The controller 300 is part of a positioning system 280. The processor 270 is coupled or connected to the one or more sensor portions (e.g. sensor portions 292A-292D) via one or more communication links, represented by a signal line 330.

The positioning system 280 includes the controller 300 and one or more positioners (e.g., positioners 310, 320). The controller 300 is coupled or connected to the

image processor 270 via one or more communication links, represented by a signal line 340. The controller 300 is coupled or connected to one or more of the positioners (e.g., positioners 310, 320) via one or more communication links (e.g. some number of electrical signal lines) represented by lines 350, 360.

The positioners (e.g., positioners 310, 320) are adapted to support and/or position each of the one or more optics portions (e.g., optics portions 290A-290D) of a camera channel above and/or in registration with the sensor portions (e.g., sensor portions 292A-292D) of the respective camera channels. In an example embodiment the positioner 310 supports and positions the one or more optics portions (e.g. optics portions 290A-290D) at least in part. The positioner 320 supports and positions the one or more sensor portions (e.g. sensor portions 292A-292D) at least in part. One or more of the positioners 310, 320 can also be configured to provide or help provide relative movement between one or more of the respective optics portions 290A-290D and one or more of the respective sensor portions 292A-292D

The operation of the digital camera subsystem 210 is described below. An optics portion of a first camera channel receives light from within a first field of view and transmits one or more portions of the received light to the corresponding sensor portion. The sensor portion of the first camera channel receives one or more portions of the light transmitted by the optics portion and outputs a signal representative of the received light. The output signal from the sensor portion is coupled to the image processor, which can generate an image or data based at least in part on information of the output signal.

An optics portion of a second camera channel receives light from within a second field of view and transmits one or more portions of the received light to the corresponding sensor portion. The sensor portion of the second camera channel receives one or more portions of the light transmitted by the optics portion and outputs a signal representative of the received light. The output signal from the sensor portion is coupled to the image processor, which can generate an image or data based at least in part on information of the output signal. Operations of any additional camera channels are similar to operations of the first and/or second camera channels described above.

The image processor is configured to generate a combined image or data based at least in part on the images from the first and second camera channels (and additional

camera channels when present), or to independently output camera channel data of each camera channel. The positioning system can control movement of the optics portion (or portions thereof) and/or the sensor portion (or portions thereof) of each camera channel to provide relative positioning with respect to one or operating modes of the digital camera system.

The digital camera system described above includes a multiple field of view digital camera, also referred to as a MFOV camera. The MFOV camera includes a first camera channel comprising an image sensor with multiple pixels and associated focal length optics. One or more of the pixels of the first camera channel have a first array size.

Figure 5 is a flow diagram for simultaneous acquisition of multiple fields of view 500, under an embodiment. The simultaneous acquisition of images having multiple fields of view 500 includes configuring 502 a first camera channel to have a first optical focal length. The acquisition 500 includes configuring 504 a second camera channel to have a second optical focal length that is different from the first optical focal length. An image is captured 506 by the first camera channel, and the image of the first camera channel has a first field of view. Approximately simultaneous with the image capture 506 by the first camera channel, the image is captured 508 by the second camera channel. The image captured by the second camera channel has a second field of view that is different from the first field of view. Optionally, additional camera channels capture the image with the first field of view, the second field of view, or a field of view different from the first and second field of view.

The MFOV camera comprises a second camera channel including an image sensor with multiple pixels of a second array size and associated focal length optics. One or more of the pixels of the second camera channel have a second array size.

The second camera channel of an embodiment provides a smaller field of view than the first camera channel.

The field of view of the second camera channel of an embodiment is reduced by approximately fifty percent (50%) relative to that of the first camera channel.

The MFOV camera of an embodiment includes a third camera channel comprising an image sensor with multiple pixels and associated optics. One or more of the pixels of the third camera channel have a third array size.

The third camera channel of an embodiment provides a smaller field of view relative to the second camera channel.

The field of view of the third camera channel of an embodiment is reduced by approximately fifty percent (50%) relative to that of the second camera channel.

Aspects of the digital camera system and methods described herein may be implemented as functionality programmed into any of a variety of circuitry, including programmable logic devices (PLDs), such as field programmable gate arrays (FPGAs), programmable array logic (PAL) devices, electrically programmable logic and memory devices and standard cell-based devices, as well as application specific integrated circuits (ASICs). Some other possibilities for implementing aspects of the self-timed interfaces include: microcontrollers with memory (such as electronically erasable programmable read only memory (EEPROM)), embedded microprocessors, firmware, software, etc. Furthermore, aspects of the self-timed interfaces may be embodied in microprocessors having software-based circuit emulation, discrete logic (sequential and combinatorial), custom devices, fuzzy (neural) logic, quantum devices, and hybrids of any of the above device types. Of course the underlying device technologies may be provided in a variety of component types, e.g., metal-oxide semiconductor field-effect transistor (MOSFET) technologies like complementary metal-oxide semiconductor (CMOS), bipolar technologies like emitter-coupled logic (ECL), polymer technologies (e.g., silicon-conjugated polymer and metal-conjugated polymer-metal structures), mixed analog and digital, etc.

It should be noted that the various circuits disclosed herein may be described using computer aided design tools and expressed (or represented), as data and/or instructions embodied in various computer-readable media, in terms of their behavioral, register transfer, logic component, transistor, layout geometries, and/or other characteristics. Formats of files and other objects in which such circuit expressions may be implemented include, but are not limited to, formats supporting behavioral languages such as C, Verilog, and HDL, formats supporting register level description languages

like RTL, and formats supporting geometry description languages such as GDSII, GDSIII, GDSIV, CIF, MEBES and any other suitable formats and languages. Computer-readable media in which such formatted data and/or instructions may be embodied include, but are not limited to, non-volatile storage media in various forms (e.g., optical, magnetic or semiconductor storage media) and carrier waves that may be used to transfer such formatted data and/or instructions through wireless, optical, or wired signaling media or any combination thereof. Examples of transfers of such formatted data and/or instructions by carrier waves include, but are not limited to, transfers (uploads, downloads, e-mail, etc.) over the Internet and/or other computer networks via one or more data transfer protocols (e.g., HTTP, FTP, SMTP, etc.). When received within a computer system via one or more computer-readable media, such data and/or instruction-based expressions of the above described components may be processed by a processing entity (e.g., one or more processors) within the computer system in conjunction with execution of one or more other computer programs.

Unless the context clearly requires otherwise, throughout the description and the claims, the words “comprise,” “comprising,” and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in a sense of “including, but not limited to.” Words using the singular or plural number also include the plural or singular number respectively. Additionally, the words “herein,” “hereunder,” “above,” “below,” and words of similar import refer to this application as a whole and not to any particular portions of this application. When the word “or” is used in reference to a list of two or more items, that word covers all of the following interpretations of the word: any of the items in the list, all of the items in the list and any combination of the items in the list.

The above description of illustrated embodiments of the digital camera system and methods is not intended to be exhaustive or to limit the digital camera system and methods to the precise form disclosed. While specific embodiments of, and examples for, the digital camera system and methods are described herein for illustrative purposes, various equivalent modifications are possible within the scope of the digital camera system and methods, as those skilled in the relevant art will recognize. The teachings of

the digital camera system and methods provided herein can be applied to other processing systems and methods, not only for the systems and methods described above.

The elements and acts of the various embodiments described above can be combined to provide further embodiments. These and other changes can be made to the digital camera system and methods in light of the above detailed description.

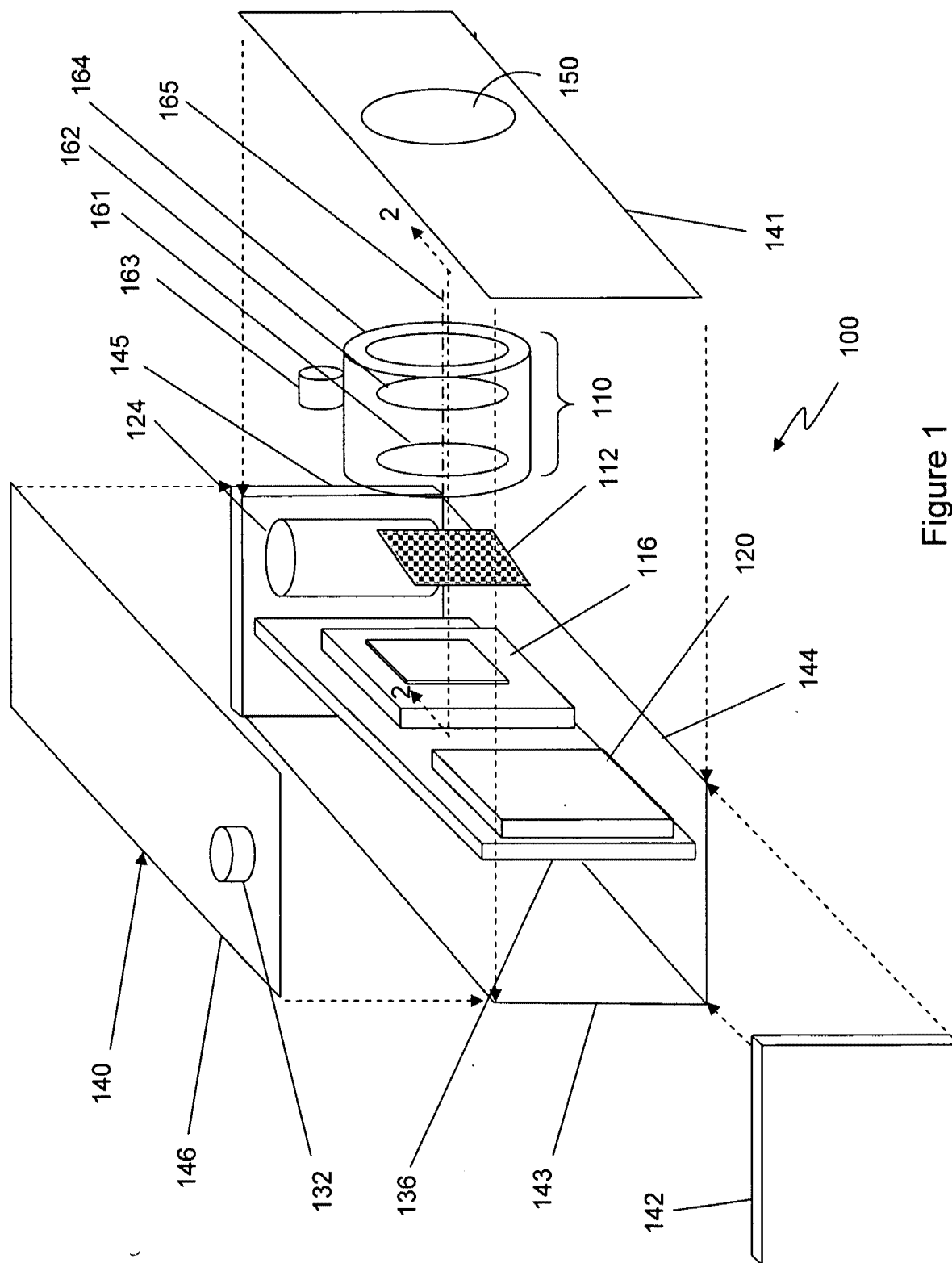


Figure 1
(Prior art)

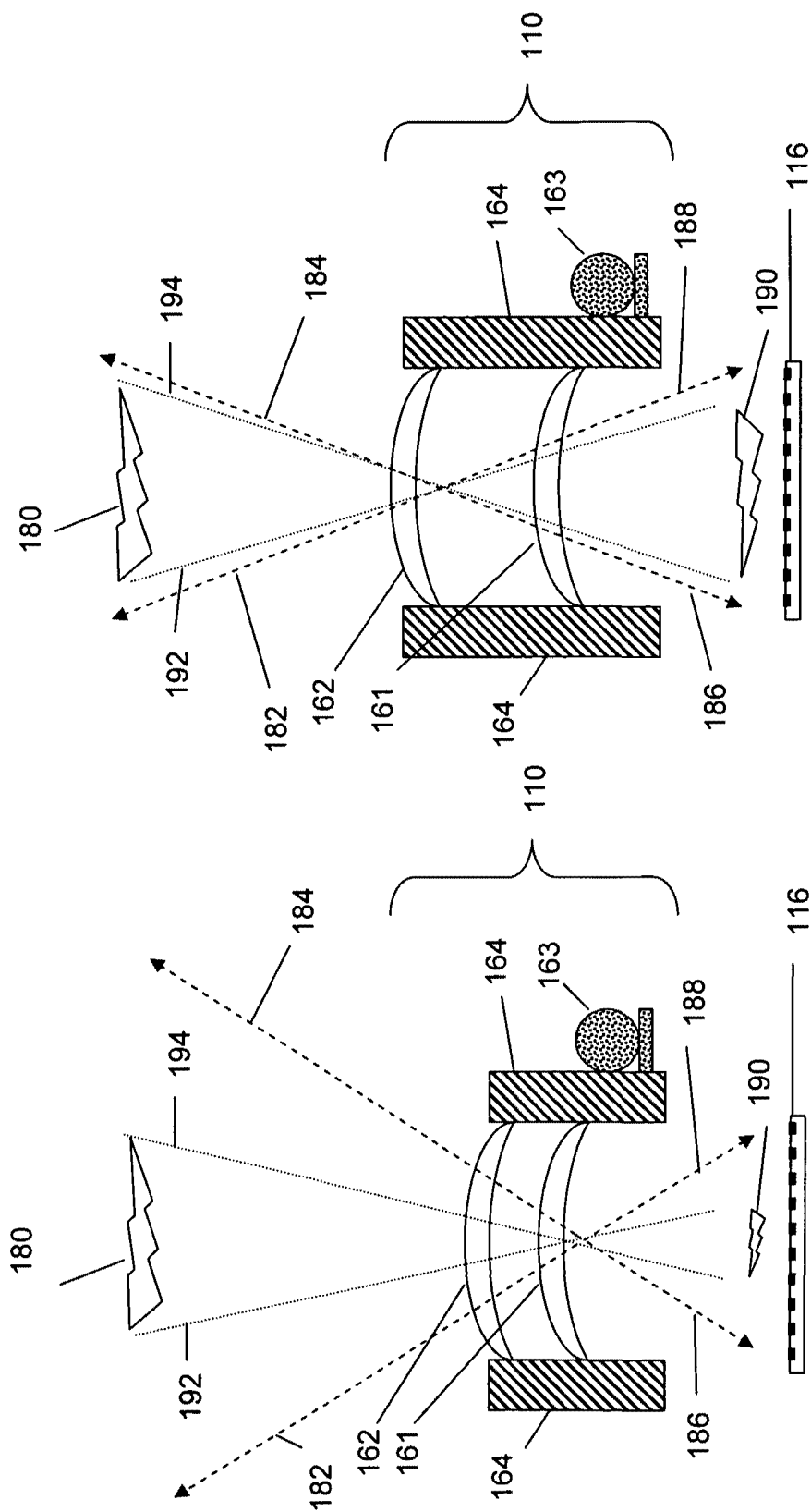
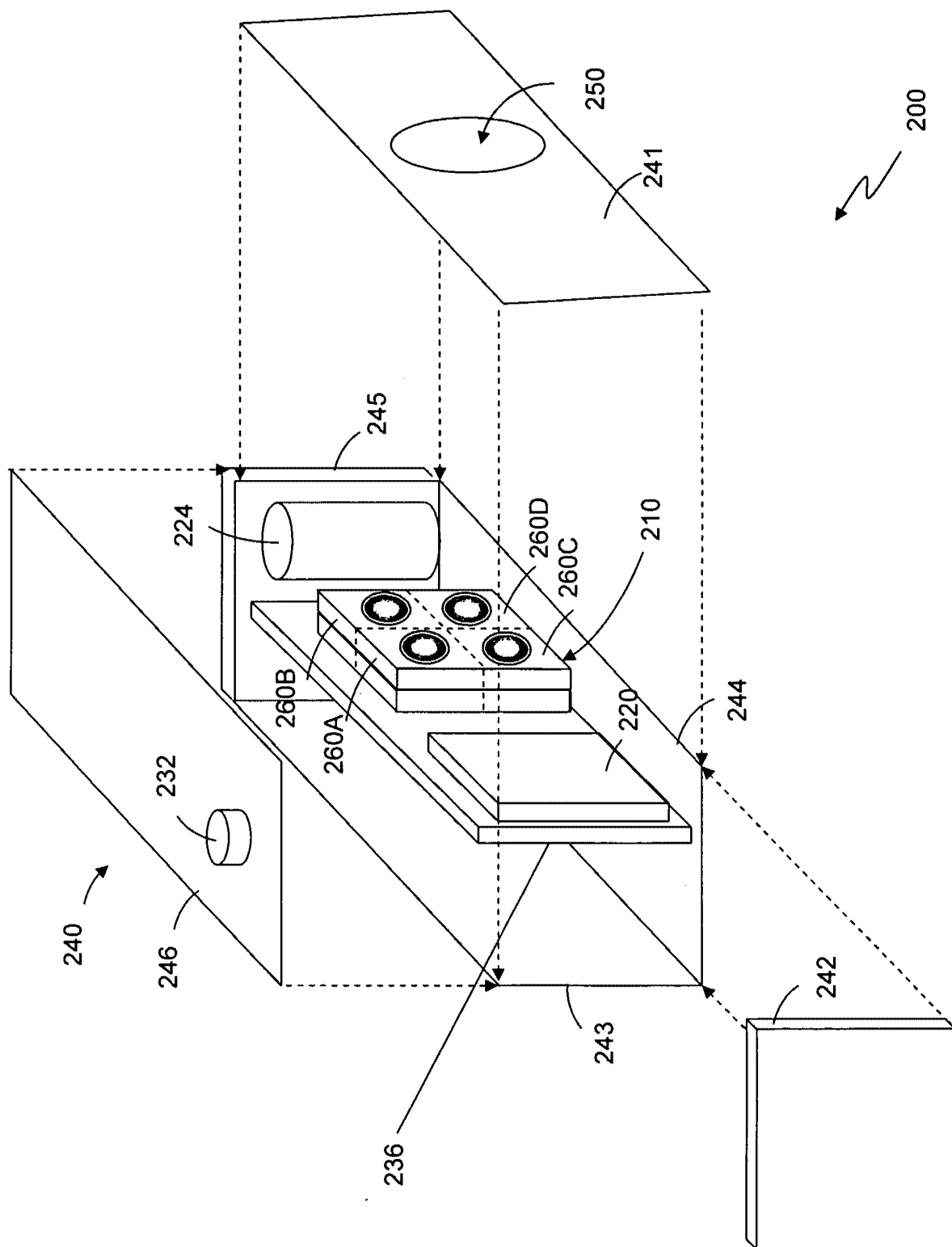


Figure 2B (Prior art)

Figure 2A (Prior art)



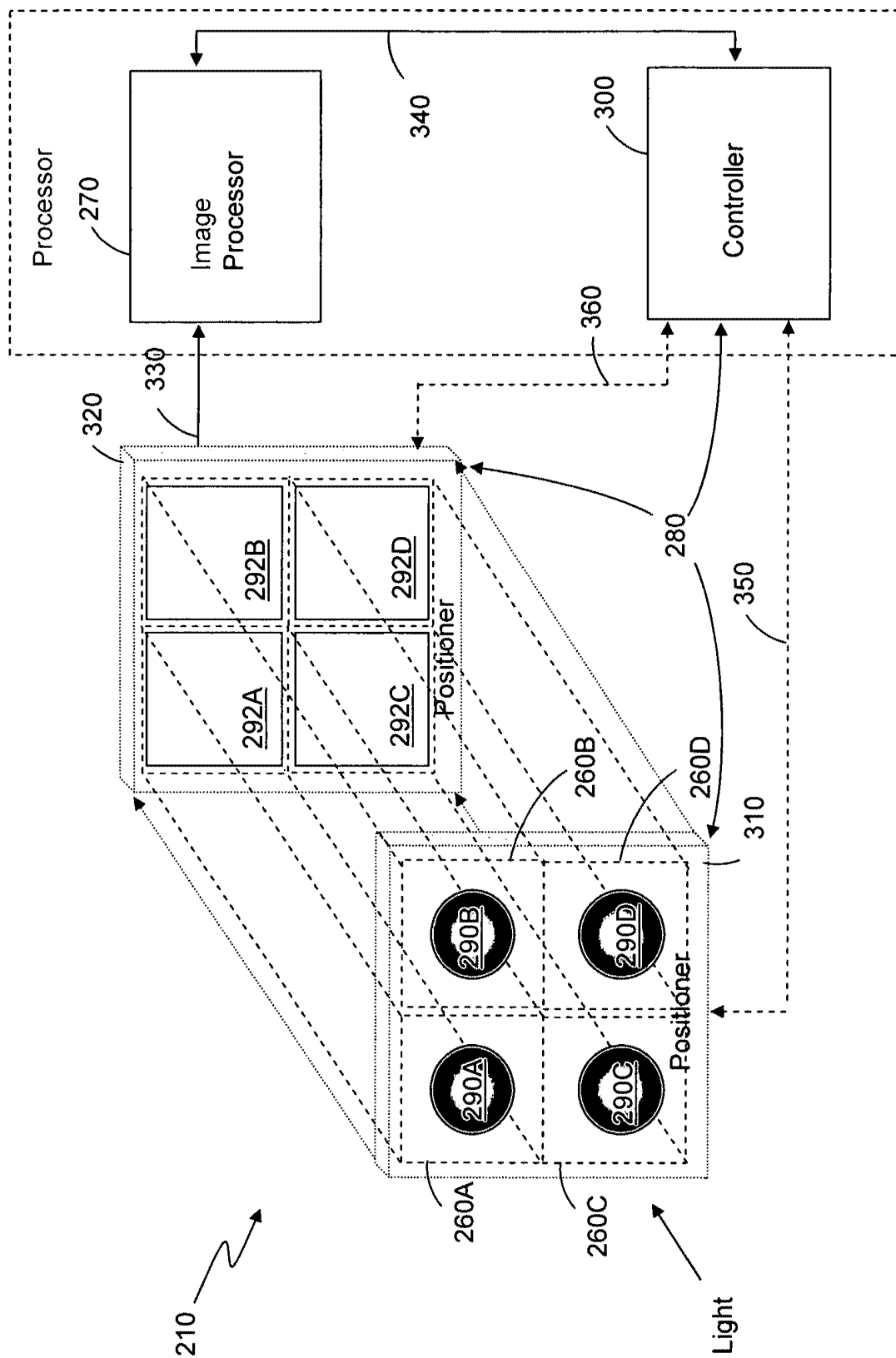
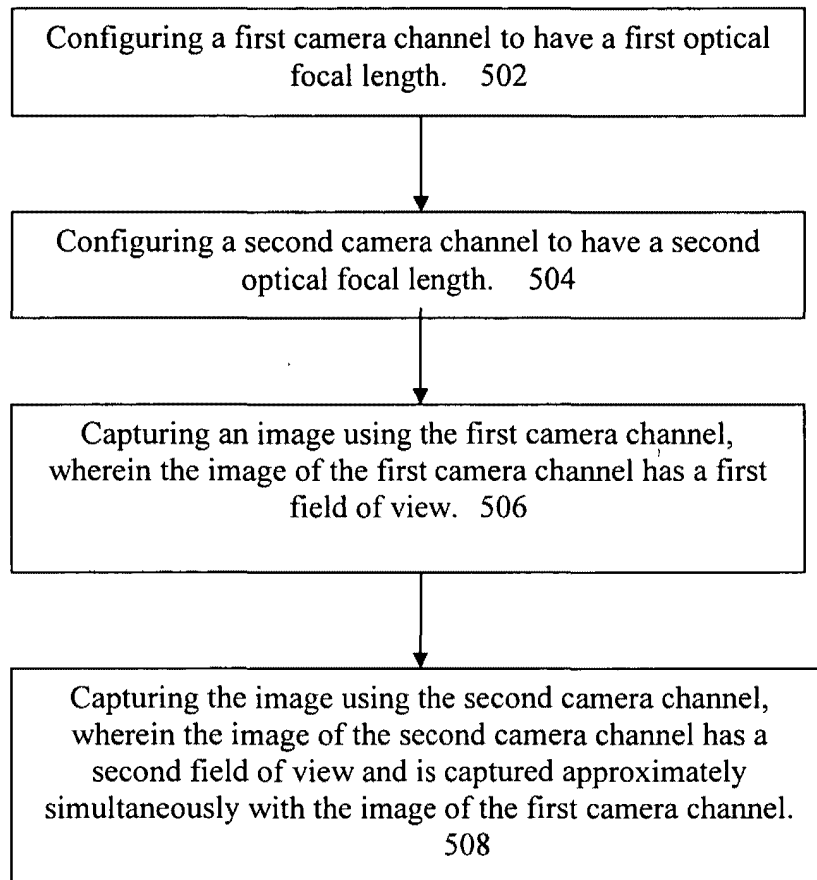


Figure 4

**Figure 5**